

Mathematics 6

Curriculum Guide 2015



Education and Early Childhood Development

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INTRODUCTION

Background

The curriculum guide communicates high expectations for students.

The Mathematics curriculum guides for Newfoundland and Labrador have been derived from *The Common Curriculum Framework for K-9 Mathematics: Western and Northern Canadian Protocol*, 2006. These guides incorporate the conceptual framework for Grades Kindergarten to Grade 9 Mathematics and the general outcomes, specific outcomes and achievement indicators established in the common curriculum framework. They also include suggestions for teaching and learning, suggested assessment strategies, and an identification of the associated resource match between the curriculum and authorized, as well as recommended, resource materials.

Mathematics 6 was originally implemented in 2010.

Beliefs About Students and Mathematics

Mathematical understanding is fostered when students build on their own experiences and prior knowledge.

Students are curious, active learners with individual interests, abilities and needs. They come to classrooms with varying knowledge, life experiences and backgrounds. A key component in developing mathematical literacy is making connections to these backgrounds and experiences.

Students learn by attaching meaning to what they do, and they need to construct their own meaning of mathematics. This meaning is best developed when learners encounter mathematical experiences that proceed from the simple to the complex and from the concrete to the abstract. Through the use of manipulatives and a variety of pedagogical approaches, teachers can address the diverse learning styles, cultural backgrounds and developmental stages of students, and enhance within them the formation of sound, transferable mathematical understandings. Students at all levels benefit from working with a variety of materials, tools and contexts when constructing meaning about new mathematical ideas. Meaningful student discussions provide essential links among concrete, pictorial and symbolic representations of mathematical concepts.

The learning environment should value and respect the diversity of students' experiences and ways of thinking, so that students feel comfortable taking intellectual risks, asking questions and posing conjectures. Students need to explore problem-solving situations in order to develop personal strategies and become mathematically literate. They must come to understand that it is acceptable to solve problems in a variety of ways and that a variety of solutions may be acceptable.

Affective Domain

To experience success, students must learn to set achievable goals and assess themselves as they work toward these goals.

A positive attitude is an important aspect of the affective domain and has a profound impact on learning. Environments that create a sense of belonging, encourage risk taking and provide opportunities for success help develop and maintain positive attitudes and self-confidence within students. Students with positive attitudes toward learning mathematics are likely to be motivated and prepared to learn, participate willingly in classroom activities, persist in challenging situations and engage in reflective practices.

Teachers, students and parents need to recognize the relationship between the affective and cognitive domains, and attempt to nurture those aspects of the affective domain that contribute to positive attitudes. To experience success, students must learn to set achievable goals and assess themselves as they work toward these goals.

Striving toward success and becoming autonomous and responsible learners are ongoing, reflective processes that involve revisiting, assessing and revising personal goals.

Goals For Students

Mathematics education must prepare students to use mathematics confidently to solve problems.

The main goals of mathematics education are to prepare students to:

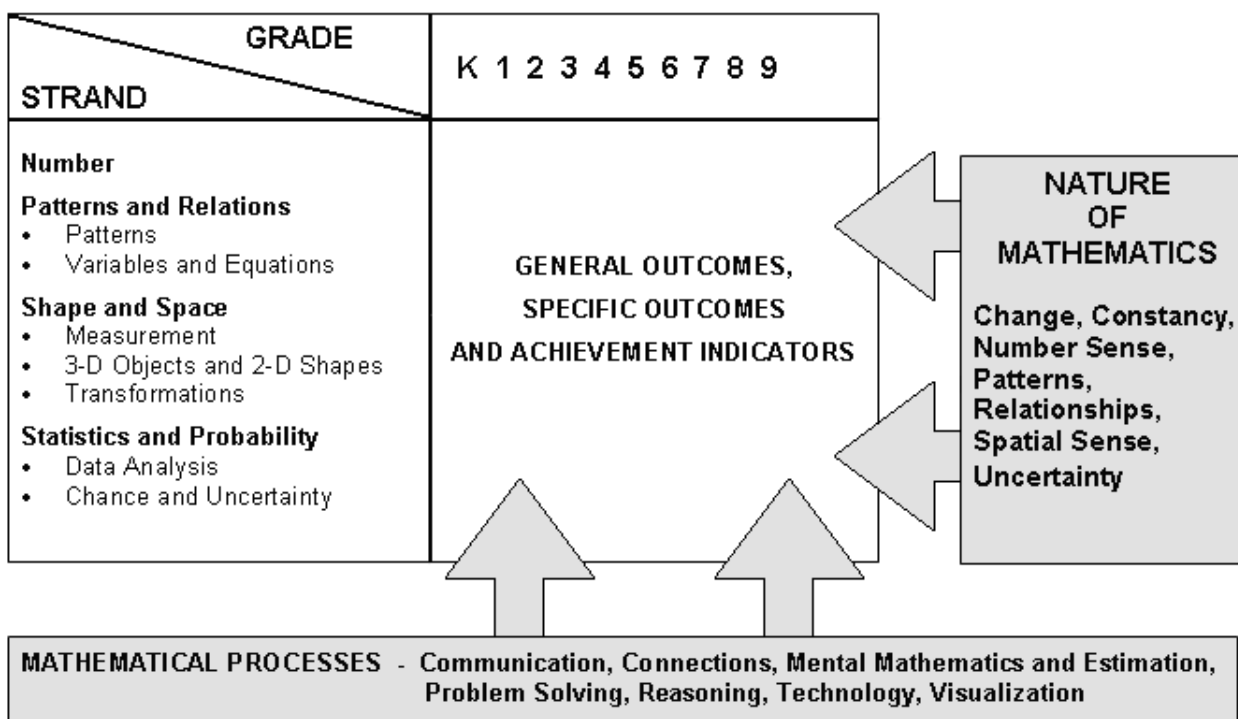
- use mathematics confidently to solve problems
- communicate and reason mathematically
- appreciate and value mathematics
- make connections between mathematics and its applications
- commit themselves to lifelong learning
- become mathematically literate adults, using mathematics to contribute to society.

Students who have met these goals will:

- gain understanding and appreciation of the contributions of mathematics as a science, philosophy and art
- exhibit a positive attitude toward mathematics
- engage and persevere in mathematical tasks and projects
- contribute to mathematical discussions
- take risks in performing mathematical tasks
- exhibit curiosity.

CONCEPTUAL FRAMEWORK FOR K - 9 MATHEMATICS

The chart below provides an overview of how mathematical processes and the nature of mathematics influence learning outcomes.



Mathematical Processes

- *Communication [C]*
- *Connections [CN]*
- *Mental Mathematics and Estimation [ME]*
- *Problem Solving [PS]*
- *Reasoning [R]*
- *Technology [T]*
- *Visualization [V]*

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and embrace lifelong learning in mathematics.

Students are expected to:

- communicate in order to learn and express their understanding
- connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- demonstrate fluency with mental mathematics and estimation
- develop and apply new mathematical knowledge through problem solving
- develop mathematical reasoning
- select and use technologies as tools for learning and for solving problems
- develop visualization skills to assist in processing information, making connections and solving problems.

This curriculum guide incorporates these seven interrelated mathematical processes that are intended to permeate teaching and learning.

Communication [C]

Students must be able to communicate mathematical ideas in a variety of ways and contexts.

Students need opportunities to read about, represent, view, write about, listen to and discuss mathematical ideas. These opportunities allow students to create links between their own language and ideas, and the formal language and symbols of mathematics.

Communication is important in clarifying, reinforcing and modifying ideas, attitudes and beliefs about mathematics. Students should be encouraged to use a variety of forms of communication while learning mathematics. Students also need to communicate their learning using mathematical terminology.

Communication helps students make connections among concrete, pictorial, symbolic, oral, written and mental representations of mathematical ideas.

Connections [CN]

Through connections, students begin to view mathematics as useful and relevant.

Contextualization and making connections to the experiences of learners are powerful processes in developing mathematical understanding. When mathematical ideas are connected to each other or to real-world phenomena, students begin to view mathematics as useful, relevant and integrated.

Learning mathematics within contexts and making connections relevant to learners can validate past experiences and increase student willingness to participate and be actively engaged.

The brain is constantly looking for and making connections. “Because the learner is constantly searching for connections on many levels, educators need to *orchestrate the experiences* from which learners extract understanding ... Brain research establishes and confirms that multiple complex and concrete experiences are essential for meaningful learning and teaching” (Caine and Caine, 1991, p.5).

Mental Mathematics and Estimation [ME]

Mental mathematics and estimation are fundamental components of number sense.

Mental mathematics is a combination of cognitive strategies that enhance flexible thinking and number sense. It is calculating mentally without the use of external memory aids.

Mental mathematics enables students to determine answers without paper and pencil. It improves computational fluency by developing efficiency, accuracy and flexibility.

“Even more important than performing computational procedures or using calculators is the greater facility that students need—more than ever before—with estimation and mental math” (National Council of Teachers of Mathematics, May 2005).

Students proficient with mental mathematics “... become liberated from calculator dependence, build confidence in doing mathematics, become more flexible thinkers and are more able to use multiple approaches to problem solving” (Rubenstein, 2001, p. 442).

Mental mathematics “... provides the cornerstone for all estimation processes, offering a variety of alternative algorithms and nonstandard techniques for finding answers” (Hope, 1988, p. v).

Estimation is used for determining approximate values or quantities or for determining the reasonableness of calculated values. It often uses benchmarks or referents. Students need to know when to estimate, how to estimate and what strategy to use.

Estimation assists individuals in making mathematical judgements and in developing useful, efficient strategies for dealing with situations in daily life.

Problem Solving [PS]

Learning through problem solving should be the focus of mathematics at all grade levels.

Learning through problem solving should be the focus of mathematics at all grade levels. When students encounter new situations and respond to questions of the type, “How would you know?” or “How could you ...?”, the problem-solving approach is being modelled. Students develop their own problem-solving strategies by listening to, discussing and trying different strategies.

A problem-solving activity requires students to determine a way to get from what is known to what is unknown. If students have already been given steps to solve the problem, it is not a problem, but practice. A true problem requires students to use prior learning in new ways and contexts. Problem solving requires and builds depth of conceptual understanding and student engagement.

Problem solving is a powerful teaching tool that fosters multiple, creative and innovative solutions. Creating an environment where students openly seek and engage in a variety of strategies for solving problems empowers students to explore alternatives and develops confident, cognitive mathematical risk takers.

Reasoning [R]

Mathematical reasoning helps students think logically and make sense of mathematics.

Mathematical reasoning helps students think logically and make sense of mathematics. Students need to develop confidence in their abilities to reason and justify their mathematical thinking. High-order questions challenge students to think and develop a sense of wonder about mathematics.

Mathematical experiences in and out of the classroom provide opportunities for students to develop their ability to reason. Students can explore and record results, analyze observations, make and test generalizations from patterns, and reach new conclusions by building upon what is already known or assumed to be true.

Reasoning skills allow students to use a logical process to analyze a problem, reach a conclusion and justify or defend that conclusion.

Technology [T]

Technology contributes to the learning of a wide range of mathematical outcomes and enables students to explore and create patterns, examine relationships, test conjectures and solve problems.

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Technology can be used to:

- explore and demonstrate mathematical relationships and patterns
- organize and display data
- extrapolate and interpolate
- assist with calculation procedures as part of solving problems
- decrease the time spent on computations when other mathematical learning is the focus
- reinforce the learning of basic facts
- develop personal procedures for mathematical operations
- create geometric patterns
- simulate situations
- develop number sense.

Technology contributes to a learning environment in which the growing curiosity of students can lead to rich mathematical discoveries at all grade levels.

Visualization [V]

Visualization is fostered through the use of concrete materials, technology and a variety of visual representations.

Visualization “involves thinking in pictures and images, and the ability to perceive, transform and recreate different aspects of the visual-spatial world” (Armstrong, 1993, p. 10). The use of visualization in the study of mathematics provides students with opportunities to understand mathematical concepts and make connections among them.

Visual images and visual reasoning are important components of number, spatial and measurement sense. Number visualization occurs when students create mental representations of numbers.

Being able to create, interpret and describe a visual representation is part of spatial sense and spatial reasoning. Spatial visualization and reasoning enable students to describe the relationships among and between 3-D objects and 2-D shapes.

Measurement visualization goes beyond the acquisition of specific measurement skills. Measurement sense includes the ability to determine when to measure, when to estimate and which estimation strategies to use (Shaw and Cliatt, 1989).

Nature of Mathematics

- *Change*
- *Constancy*
- *Number Sense*
- *Relationships*
- *Patterns*
- *Spatial Sense*
- *Uncertainty*

Mathematics is one way of trying to understand, interpret and describe our world. There are a number of components that define the nature of mathematics and these are woven throughout this curriculum guide. The components are change, constancy, number sense, patterns, relationships, spatial sense and uncertainty.

Change

Change is an integral part of mathematics and the learning of mathematics.

It is important for students to understand that mathematics is dynamic and not static. As a result, recognizing change is a key component in understanding and developing mathematics.

Within mathematics, students encounter conditions of change and are required to search for explanations of that change. To make predictions, students need to describe and quantify their observations, look for patterns, and describe those quantities that remain fixed and those that change. For example, the sequence 4, 6, 8, 10, 12, ... can be described as:

- the number of a specific colour of beads in each row of a beaded design
- skip counting by 2s, starting from 4
- an arithmetic sequence, with first term 4 and a common difference of 2
- a linear function with a discrete domain

(Steen, 1990, p. 184).

Constancy

Constancy is described by the terms stability, conservation, equilibrium, steady state and symmetry.

Different aspects of constancy are described by the terms stability, conservation, equilibrium, steady state and symmetry (AAAS-Benchmarks, 1993, p.270). Many important properties in mathematics and science relate to properties that do not change when outside conditions change. Examples of constancy include the following:

- The ratio of the circumference of a teepee to its diameter is the same regardless of the length of the teepee poles.
- The sum of the interior angles of any triangle is 180° .
- The theoretical probability of flipping a coin and getting heads is 0.5.

Some problems in mathematics require students to focus on properties that remain constant. The recognition of constancy enables students to solve problems involving constant rates of change, lines with constant slope, direct variation situations or the angle sums of polygons.

Number Sense

An intuition about number is the most important foundation of a numerate child.

Number sense, which can be thought of as intuition about numbers, is the most important foundation of numeracy (British Columbia Ministry of Education, 2000, p.146).

A true sense of number goes well beyond the skills of simply counting, memorizing facts and the situational rote use of algorithms. Mastery of number facts is expected to be attained by students as they develop their number sense. This mastery allows for facility with more complex computations but should not be attained at the expense of an understanding of number.

Number sense develops when students connect numbers to their own real-life experiences and when students use benchmarks and referents. This results in students who are computationally fluent and flexible with numbers and who have intuition about numbers. The evolving number sense typically comes as a by product of learning rather than through direct instruction. It can be developed by providing rich mathematical tasks that allow students to make connections to their own experiences and their previous learning.

Patterns

Mathematics is about recognizing, describing and working with numerical and non-numerical patterns.

Mathematics is about recognizing, describing and working with numerical and non-numerical patterns. Patterns exist in all strands of mathematics.

Working with patterns enables students to make connections within and beyond mathematics. These skills contribute to students' interaction with, and understanding of, their environment.

Patterns may be represented in concrete, visual or symbolic form. Students should develop fluency in moving from one representation to another.

Students must learn to recognize, extend, create and use mathematical patterns. Patterns allow students to make predictions and justify their reasoning when solving routine and non-routine problems.

Learning to work with patterns in the early grades helps students develop algebraic thinking, which is foundational for working with more abstract mathematics.

Relationships

Mathematics is used to describe and explain relationships.

Mathematics is one way to describe interconnectedness in a holistic worldview. Mathematics is used to describe and explain relationships. As part of the study of mathematics, students look for relationships among numbers, sets, shapes, objects and concepts. The search for possible relationships involves collecting and analyzing data and describing relationships visually, symbolically, orally or in written form.

Spatial Sense

Spatial sense offers a way to interpret and reflect on the physical environment.

Spatial sense involves visualization, mental imagery and spatial reasoning. These skills are central to the understanding of mathematics.

Spatial sense is developed through a variety of experiences and interactions within the environment. The development of spatial sense enables students to solve problems involving 3-D objects and 2-D shapes and to interpret and reflect on the physical environment and its 3-D or 2-D representations.

Some problems involve attaching numerals and appropriate units (measurement) to dimensions of shapes and objects. Spatial sense allows students to make predictions about the results of changing these dimensions; e.g., doubling the length of the side of a square increases the area by a factor of four. Ultimately, spatial sense enables students to communicate about shapes and objects and to create their own representations.

Uncertainty

Uncertainty is an inherent part of making predictions.

In mathematics, interpretations of data and the predictions made from data may lack certainty.

Events and experiments generate statistical data that can be used to make predictions. It is important to recognize that these predictions (interpolations and extrapolations) are based upon patterns that have a degree of uncertainty.

The quality of the interpretation is directly related to the quality of the data. An awareness of uncertainty allows students to assess the reliability of data and data interpretation.

Chance addresses the predictability of the occurrence of an outcome. As students develop their understanding of probability, the language of mathematics becomes more specific and describes the degree of uncertainty more accurately.

Essential Graduation Learnings

Essential graduation learnings are statements describing the knowledge, skills and attitudes expected of all students who graduate from high school. Essential graduation learnings are cross-curricular in nature and comprise different areas of learning: *aesthetic expression, citizenship, communication, personal development, problem solving, technological competence and spiritual and moral development.*

Aesthetic Expression

Graduates will be able to respond with critical awareness to various forms of the arts and be able to express themselves through the arts.

Citizenship

Graduates will be able to assess social, cultural, economic and environmental interdependence in a local and global context.

Communication

Graduates will be able to use the listening, viewing, speaking, reading and writing modes of language(s) and mathematical and scientific concepts and symbols to think, learn and communicate effectively.

Personal Development

Graduates will be able to continue to learn and to pursue an active, healthy lifestyle.

Problem Solving

Graduates will be able to use the strategies and processes needed to solve a wide variety of problems, including those requiring language and mathematical and scientific concepts.

Technological Competence

Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

Spiritual and Moral Development

Graduates will be able to demonstrate an understanding and appreciation for the place of belief systems in shaping the development of moral values and ethical conduct.

See *Foundations for the Atlantic Canada Mathematics Curriculum*, pages 4-6.

The mathematics curriculum is designed to make a significant contribution towards students' meeting each of the essential graduation learnings (EGLs), with the communication, problem-solving and technological competence EGLs relating particularly well to the mathematical processes.

Strands

- *Number*
- *Patterns and Relations*
- *Shape and Space*
- *Statistics and Probability*

The learning outcomes in the mathematics program are organized into four strands across the grades K–9. Some strands are subdivided into substrands. There is one general outcome per substrand across the grades K–9.

The strands and substrands, including the general outcome for each, follow.

Number

Number

- Develop number sense.

Patterns and Relations

Patterns

- Use patterns to describe the world and to solve problems.

Variables and Equations

- Represent algebraic expressions in multiple ways.

Shape and Space

Measurement

- Use direct and indirect measurement to solve problems.

3-D Objects and 2-D Shapes

- Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

Transformations

- Describe and analyze position and motion of objects and shapes.

Statistics and Probability

Data Analysis

- Collect, display and analyze data to solve problems.

Chance and Uncertainty

- Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.

Outcomes and Achievement Indicators

The curriculum is stated in terms of general outcomes, specific outcomes and achievement indicators (pages 19 - 148)

General Outcomes

General outcomes are overarching statements about what students are expected to learn in each course.

Specific Outcomes

Specific outcomes are statements that identify the specific skills, understanding and knowledge that students are required to attain by the end of a given grade.

In the specific outcomes, the word *including* indicates that any ensuing items must be addressed to fully meet the learning outcome. The phrase *such as* indicates that the ensuing items are provided for illustrative purposes or clarification, and are not requirements that must be addressed to fully meet the learning outcome.

Achievement Indicators

Achievement indicators are samples of how students may demonstrate their achievement of the goals of a specific outcome. The range of samples provided is meant to reflect the scope of the specific outcome. The list of indicators contained in this section is not intended to be exhaustive but rather to provide teachers with examples of evidence of understanding that may be used to determine whether or not students have achieved a given specific outcome. Teachers may use any number of these indicators or choose to use other indicators as evidence that the desired learning has been achieved.

Summary

The conceptual framework for K - Grade 9 Mathematics (p. 3) describes the nature of mathematics, mathematical processes and the mathematical concepts to be addressed. The components are not meant to stand alone. Activities that take place in the mathematics classroom should result from a problem-solving approach, be based on mathematical processes and lead students to an understanding of the nature of mathematics through specific knowledge, skills and attitudes among and between topics.

ASSESSMENT AND EVALUATION

Purposes of Assessment

What learning is assessed and evaluated, how it is assessed and evaluated, and how results are communicated send clear messages to students and others about what is really valued.

Assessment techniques are used to gather information for evaluation. Information gathered through assessment helps teachers determine students' strengths and needs in their achievement of mathematics and guides future instructional approaches.

Teachers are encouraged to be flexible in assessing the learning success of all students and to seek diverse ways in which students might demonstrate what they know and are able to do.

Evaluation involves the weighing of the assessment information against a standard in order to make an evaluation or judgment about student achievement.

Assessment has three interrelated purposes:

- assessment *for* learning to guide and inform instruction;
- assessment *as* learning to involve students in self-assessment and setting goals for their own learning; and
- assessment *of* learning to make judgements about student performance in relation to curriculum outcomes.

Assessment *for* Learning

Assessment *for* learning involves frequent, interactive assessments designed to make student understanding visible. This enables teachers to identify learning needs and adjust teaching accordingly. It is an ongoing process of teaching and learning.

Assessment *for* learning:

- requires the collection of data from a range of assessments as investigative tools to find out as much as possible about what students know
- provides descriptive, specific and instructive feedback to students and parents regarding the next stage of learning
- actively engages students in their own learning as they assess themselves and understand how to improve performance.

Assessment *as* Learning

Assessment *as* learning actively involves students' reflection on their learning and monitoring of their own progress. It focuses on the role of the student as the critical connector between assessment and learning, thereby developing and supporting metacognition in students.

Assessment *as* learning:

- supports students in critically analysing their learning related to learning outcomes
- prompts students to consider how they can continue to improve their learning
- enables students to use information gathered to make adaptations to their learning processes and to develop new understandings.

Assessment *of* Learning

Assessment *of* learning involves strategies to confirm what students know, demonstrate whether or not they have met curriculum outcomes, or to certify proficiency and make decisions about students' future learning needs. Assessment *of* learning occurs at the end of a learning experience that contributes directly to reported results.

Traditionally, teachers relied on this type of assessment to make judgments about student performance by measuring learning after the fact and then reporting it to others. Used in conjunction with the other assessment processes previously outlined, however, assessment *of* learning is strengthened.

Assessment *of* learning:

- provides opportunities to report evidence to date of student achievement in relation to learning outcomes, to parents/guardians and other stakeholders
- confirms what students know and can do
- occurs at the end of a learning experience using a variety of tools.

Because the consequences of assessment *of* learning are often far-reaching, teachers have the responsibility of reporting student learning accurately and fairly, based on evidence obtained from a variety of contexts and applications.

Assessment Strategies

Assessment techniques should match the style of learning and instruction employed. Several options are suggested in this curriculum guide from which teachers may choose, depending on the curriculum outcomes, the class and school/district policies.

Observation (formal or informal)

This technique provides a way of gathering information fairly quickly while a lesson is in progress. When used formally, the student(s) would be aware of the observation and the criteria being assessed. Informally, it could be a frequent, but brief, check on a given criterion. Observation may offer information about the participation level of a student for a given task, use of a concrete model or application of a given process. The results may be recorded in the form of checklists, rating scales or brief written notes. It is important to plan in order that specific criteria are identified, suitable recording forms are ready, and all students are observed within a reasonable period of time.

Performance

This curriculum encourages learning through active participation. Many of the curriculum outcomes promote skills and their applications. In order for students to appreciate the importance of skill development, it is important that assessment provide feedback on the various skills. These may be the correct manner in which to use a manipulative, the ability to interpret and follow instructions, or to research, organize and present information. Assessing performance is most often achieved through observing the process.

Paper and Pencil

These techniques can be formative or summative. Whether as part of learning, or a final statement, students should know the expectations for the exercise and how it will be assessed. Written assignments and tests can be used to assess knowledge, understanding and application of concepts. They are less successful at assessing processes and attitudes. The purpose of the assessment should determine what form of paper and pencil exercise is used.

Journal

Journals provide an opportunity for students to express thoughts and ideas in a reflective way. By recording feelings, perceptions of success, and responses to new concepts, a student may be helped to identify his or her most effective learning style. Knowing how to learn in an effective way is powerful information. Journal entries also give indicators of developing attitudes to mathematical concepts, processes and skills, and how these may be applied in the context of society. Self-assessment, through a journal, permits a student to consider strengths and weaknesses, attitudes, interests and new ideas. Developing patterns may help in career decisions and choices of further study.

Interview

This curriculum promotes understanding and applying mathematics concepts. Interviewing a student allows the teacher to confirm that learning has taken place beyond simple factual recall. Discussion allows a student to display an ability to use information and clarify understanding. Interviews may be a brief discussion between teacher and student or they may be more extensive. Such conferences allow students to be proactive in displaying understanding. It is helpful for students to know which criteria will be used to assess formal interviews. This assessment technique provides an opportunity to students whose verbal presentation skills are stronger than their written skills.

Presentation

The curriculum includes outcomes that require students to analyze and interpret information, to be able to work in teams, and to communicate information. These activities are best displayed and assessed through presentations. These can be given orally, in written/pictorial form, by project summary, or by using electronic systems such as video or computer software. Whatever the level of complexity, or format used, it is important to consider the curriculum outcomes as a guide to assessing the presentation. The outcomes indicate the process, concepts and context for which a presentation is made.

Portfolio

Portfolios offer another option for assessing student progress in meeting curriculum outcomes over a more extended period of time. This form of assessment allows the student to be central to the process. There are decisions about the portfolio, and its contents, which can be made by the student. What is placed in the portfolio, the criteria for selection, how the portfolio is used, how and where it is stored, and how it is evaluated are some of the questions to consider when planning to collect and display student work in this way. The portfolio should provide a long-term record of growth in learning and skills. This record of growth is important for individual reflection and self-assessment, but it is also important to share with others. For all students, it is exciting to review a portfolio and see the record of development over time.

INSTRUCTIONAL FOCUS

Planning for Instruction

Consider the following when planning for instruction:

- Integration of the mathematical processes within each strand is expected.
- By decreasing emphasis on rote calculation, drill and practice, and the size of numbers used in paper and pencil calculations, more time is available for concept development.
- Problem solving, reasoning and connections are vital to increasing mathematical fluency and must be integrated throughout the program.
- There is to be a balance among mental mathematics and estimation, paper and pencil exercises, and the use of technology, including calculators and computers. Concepts should be introduced using manipulatives and be developed concretely, pictorially and symbolically.
- Students bring a diversity of learning styles and cultural backgrounds to the classroom. They will be at varying developmental stages.

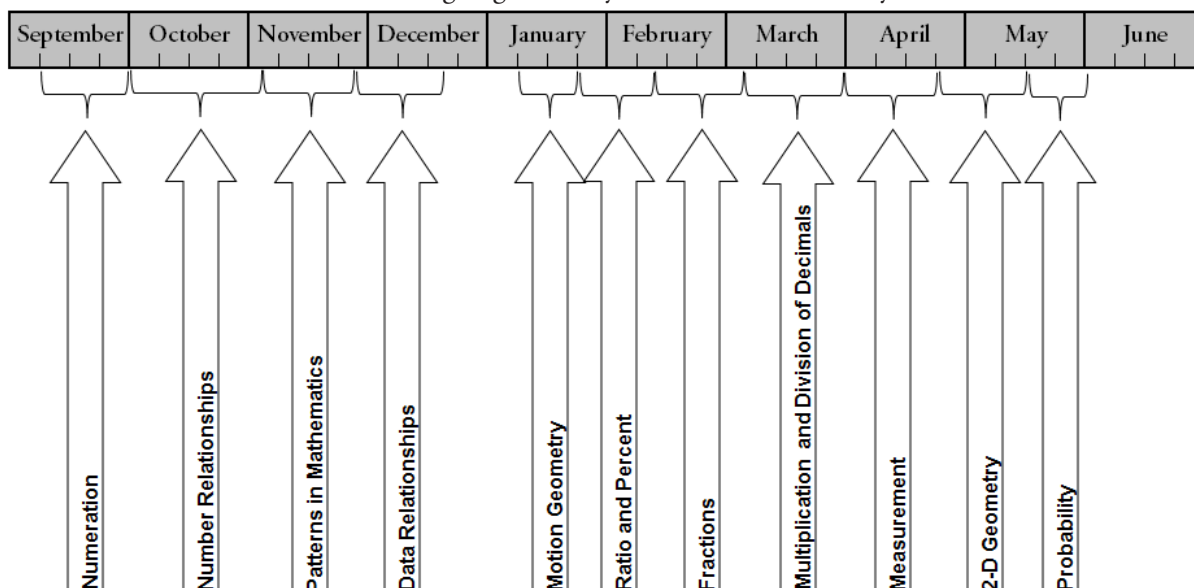
Teaching Sequence

The curriculum guide for Mathematics 6 is organized by units. This is only a suggested teaching order for the course. There are a number of combinations of sequences that would be appropriate.

Each two page spread lists the topic, general outcome, and specific outcome.

Instructional Time per Unit

The suggested number of weeks of instruction per unit is listed in the guide at the beginning of each unit. The number of suggested weeks includes time for completing assessment activities, reviewing and evaluating. The timelines at the beginning of each unit are provided to assist in planning. The use of this timeline is not mandatory. However, it is mandatory that all outcomes are taught during the school year, so a long term plan is advised. Teaching of the outcomes is ongoing, and may be revisited as necessary.



Resources

The authorized resource for Newfoundland and Labrador for students and teachers is *Math Focus 6* (Nelson). Column four of the curriculum guide references *Math Focus 6* for this reason.

Teachers may use any other resource, or combination of resources, to meet the required specific outcomes.

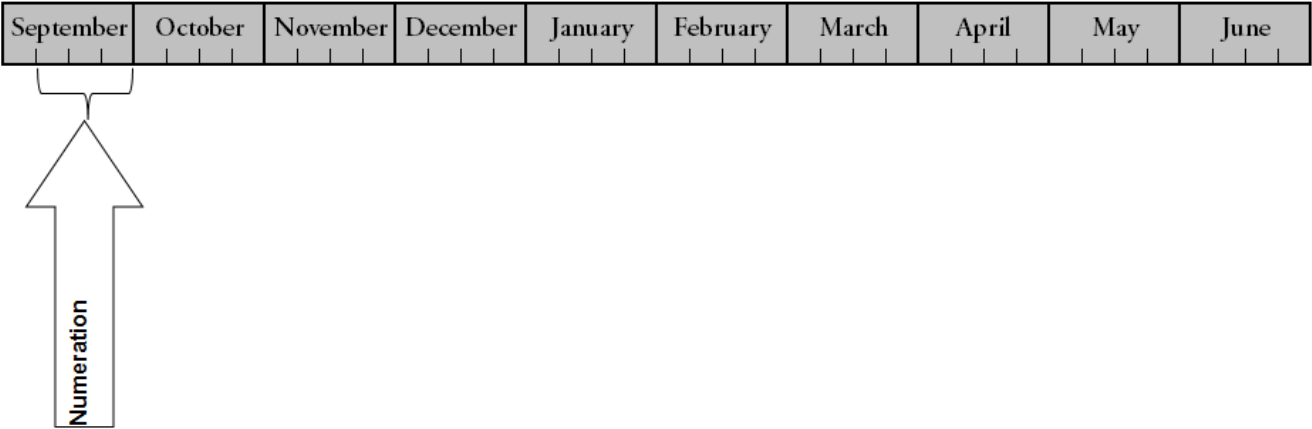
**GENERAL
AND SPECIFIC
OUTCOMES****GENERAL AND SPECIFIC OUTCOMES WITH ACHIEVEMENT INDICATORS** (pages 19-296)

This section presents general and specific outcomes with corresponding achievement indicators and is organized by unit. The list of indicators contained in this section is not intended to be exhaustive but rather to provide teachers with examples of evidence of understanding that may be used to determine whether or not students have achieved a given specific outcome. Teachers may use any number of these indicators or choose to use other indicators as evidence that the desired learning has been achieved. Achievement indicators should also help teachers form a clear picture of the intent and scope of each specific outcome.

Mathematics 6 is organized into eleven units: *Numeration, Number Relationships, Patterns in Mathematics, Data Relationships, Motion Geometry, Ratio and Percent, Fractions, Multiplication and Division of Decimals, Measurement, 2D Geometry* and *Probability*.

Numeration

Suggested Time: 3 Weeks

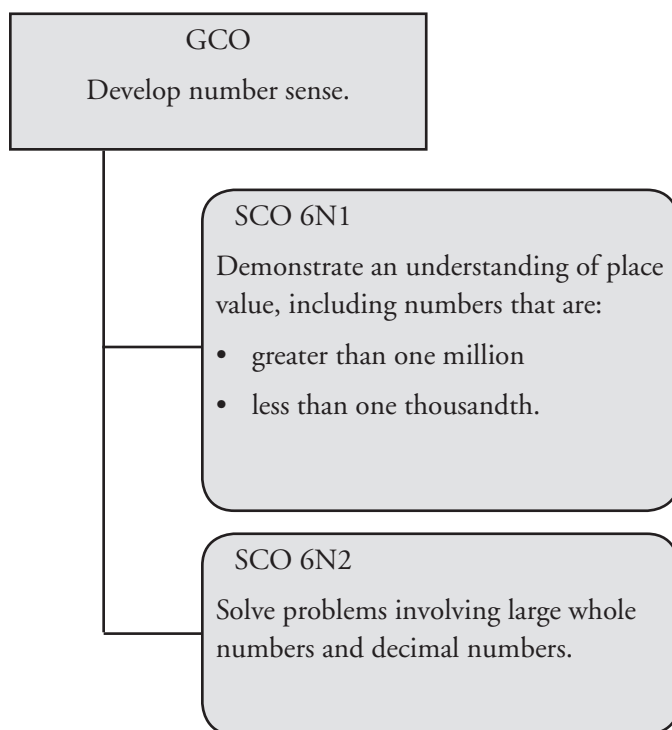


Unit Overview

Focus and Context

In Grade 5, students developed their understanding of whole numbers up to one million and of small numbers to one thousandth. In Grade 6, this will be extended to include whole numbers greater than one million and decimal numbers less than one thousandth. Students will explore contexts in which large or small numbers are used in real life and solve problems involving whole and decimal numbers. They will see large and small numbers in newspapers, on television, in stores and in texts. Students should be encouraged to relate the concepts that they learn in this unit to their everyday life and to raise these observations in class.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Number		
Specific Outcomes	Specific Outcomes	Specific Outcomes
5N1 Represent and describe whole numbers to 1 000 000. [C, CN, V, T] 5N8 Describe and represent decimals (tenths, hundredths, thousandths) concretely, pictorially and symbolically. [C, CN, R, V] 5N10 Compare and order decimals (to thousandths) by using: <ul style="list-style-type: none"> • benchmarks • place value • equivalent decimals [CN, R, V]	6N1 Demonstrate and understanding of place value, including numbers that are: <ul style="list-style-type: none"> • greater than one million • less than one thousandth. [C, CN, R, T]	

Mathematical Processes

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Daily Routine Opportunity



This curriculum guide contains suggestions for daily routines. They will be indicated with a graphic as seen above.

In Mathematics 5, students worked with basic multiplication facts to 9×9 . In the next unit, they will be exploring factors and multiples of whole number to 100. As part of a 5-10 minute daily routine, students could review their multiplication facts.

Place in a bag all multiplication facts to 81. Ask students to draw a grid, 3 blocks by 3 blocks, and record in each block a number representing any product up to 81. Multiplication facts are drawn from the bag and students. Students determine the product and cover that number if it is on their card. Play continues until one student covers three in a row.

21	48	36
18	30	12
35	64	72

Number

Specific Outcomes

Students will be expected to

6N1 Demonstrate an understanding of place value, including numbers that are:

- greater than one million
- less than one thousandth.

[C, CN, R, T]

Achievement Indicator:

6N1.1 Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

In Grade 5, students represented and described whole numbers up to one million and small numbers to one thousandth. They have written a given numeral in standard form, expanded form, and in words. They have also described the meaning of each digit in a given numeral. In Grade 6, this will be extended to develop place value concepts for numbers greater than one million and numbers less than one thousandth.

Students should explore the place value chart to discover how the pattern of hundreds, tens and ones within each period makes it possible to read and write large whole numbers:

Millions			Thousands			Ones		
Hundred Millions	Ten Millions	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones

Students should understand that:

- each position represents 10 times as much as the position to its right.
- each position represents $\frac{1}{10}$ as much as the position to its left.
- from right to left, each group of three digits is called a period.
- the three digits within each period are read as hundreds, tens and ones.

As a pre-assessment, teachers could begin by representing a number in the thousands using a place value chart.

Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones
4	5	2	1	3	7

Ask students to read this number (“four hundred fifty two thousand one hundred thirty seven”), write it in standard form (452 137) and in expanded form ($400\ 000 + 50\ 000 + 2\ 000 + 100 + 30 + 7$).

Students should extend this knowledge to read and write numbers greater than 1 000 000 by using an example such as 254 871 346.

Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
2	5	4	8	7	1	3	4	6

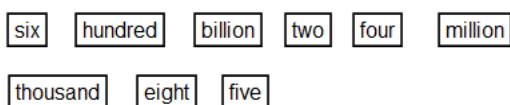
Ask students to read this number and write it in standard form.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Create cards with various number words on each as shown:



Ask students to rearrange the cards to create as many different numbers as they can. Ask them to record the numbers they create in standard form, expanded form, in a place value chart, and in words. Challenge students to create the greatest and the least number using all the cards.

(6N1.1)

- Ask students to use the number 619 723 766 to answer the following questions:
 - What does the 9 represent?
 - What does the 3 represent?
 - Choose a digit and show how it is ten times greater than the digit to its immediate right.

(6N1.1)

Interview

- Ask students to use the number 32 765 345 to answer the following:
 - How many millions are in the number? Justify.
 - How many thousands are in the number? Justify.
 - How many ten thousands are in the number? Justify.

(6N1.1)

Journal

- Ask students to respond to the following:
Joe said 3 450 000 is greater than 27 450 000 because three is greater than two. Is he correct? Explain using pictures, numbers and words.

(6N1.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Representing Numbers in the Millions

Teacher Resource (TR): pp. 13 – 17

Student Book (SB): pp. 36 – 39

Supplementary Resources

Making Math Meaningful to

Canadian Students K-8 – Marian Small

- Support for SCO 6N1 can be found on pp. 138 – 157

Teaching Student-Centered

Mathematics Grades 3-5 – John Van de Walle and LouAnn Lovin

- Support for SCO 6N1 can be found on pp. 47 – 51

Number

Specific Outcomes

Students will be expected to

6N1 Continued...

Achievement Indicator:

6N1.1 (Continued) Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

Students should realize that reading and writing numbers in the millions is similar to reading and writing numbers in the thousands. There is one extra period - the millions period:

Teachers may need to remind students that when they read large whole numbers they say the period name after each period **except** the ones period. Students may also need to be reminded that when writing a number that contains more than four digits a space must be used to indicate where one period ends and another begins.

As students continue to explore the place value system it is important that they work with examples which require 0 as a placeholder. Three million forty six thousand five hundred twenty one, for example, in standard form is 3 046 521. Recognizing the need to have three digits in the thousands period, where zero would indicate the absence of a hundred thousand in the number, should help students avoid the common error of writing the number as 3 46 521.

Students should understand the meaning of each digit in a numeral. This will allow them to more easily express the numeral in expanded form. Provide students with a number, such as 7 324 169, and ask:

- What does the 7 represent?
- What does the 4 represent?

To assess students understanding of the place value system, it is important to explore examples such as:

35 258 671 = _____ millions _____ ones _____ thousands _____ tens _____ hundred thousands _____ ten thousands _____ hundreds _____ ten millions.

Without a clear understanding of what each digit represents, students may incorrectly place the numbers 3, 5, 2, 5, 8, 6, 7, and 1 in the blanks.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Journal

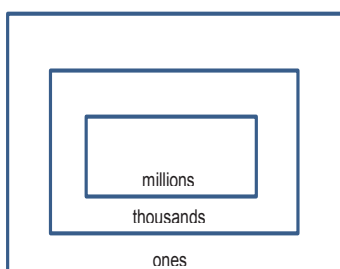
- Lori read the number twenty-three million sixty-five thousand one. She recorded it as 23 651. Ask students if she is correct. Ask them to use words, pictures, and/or numbers to explain their answers.

(6N1.1)

Performance

- Give students the following problem: We can use base-ten blocks to represent 1, 10, 100 and 1 000 using the unit, rod, flat and cube respectively. Ask: If we were to create new base-ten blocks to represent 10 000, 100 000, 1 000 000 and 10 000 000 what would they look like?
- Ask students to play Number Curling. Using painters tape, create different sized rectangles inside the other on the floor. Using different colored beanbags, assign a value for each colour. (E.g., red = 5, blue = 2 and green = 6).

(6N1.1)



Ask students to slide several beanbags into the squares. Using the value on each bean bag, ask them to record the number they created using the period in which the bean bags land. For example, a red and a green bean bag in the million square would equal 11 million, a red and blue in the thousand square would total 7 thousand, and a green in the ones square would equal 6 ones. Students would then take each period to create the number 11 700 006. They can continue play until they create several numbers. Ask students to compare them with their classmates to decide who has the greatest number.

(6N1.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Representing Numbers in the Millions

TR: pp. 13 – 17

SB: pp. 36 – 39

Number

Specific Outcomes

Students will be expected to

6N1 Continued...

Achievement Indicator:

6N1.1 (Continued) Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

Students should be able to express large numbers in expanded form (e.g., $12\,758\,246 = 10\,000\,000 + 2\,000\,000 + 700\,000 + 50\,000 + 8\,000 + 200 + 40 + 6$).

They should also understand that in the number 2 345 461, for example, five is in the thousands place, so it represents 5 000, but there are actually 345 thousands in this number.

Students should use the patterns they have observed in the place value chart to discover that one billion equals 1 000 millions.

Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
9	9	9	9	9	9	9	9	9

In Grades 4 and 5, students compared and ordered numbers. They should use these same strategies (i.e., number lines and place value), to compare and order a set of large whole numbers and explain the order by making reference to place value.



Teachers could display a seven-digit “Number of the Day” and ask students to choose one or more of the following ways to represent it:

- express it orally
- write it in words
- write it in standard form
- write it in expanded form
- represent it using base ten blocks or place value chart

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Observation

- Using several number lines, incorrectly place one or two numbers on each and ask students to work in small groups to explain why they are in the wrong places. They can share their responses with the group.

(6N1.1)

Performance

- Provide students with index cards folded in half with numbers written on each card. Distribute the number cards to a small group of students. Give students time to discuss within their group the value of the numbers on the cards. Ask students to place their numbers on a number line made of string. Teacher could choose to give students blank index cards that could be used to create end points and benchmarks for their groups' set of numbers. Give students time to reflect on their work looking at the placement of the numbers. Ask them to explain to the class their placement of the numbers.
- In groups, provide students with a deck of six to ten single digit number cards. It may be necessary to give each group a different deck of cards so that each group will have different results. Ask students to create the greatest and the least number possible using their number cards. Have each group present their numbers by writing them on the board and reading their numbers to the rest of the class. Once each group has presented have the class arrange all of the numbers from least to greatest and place each numeral on a number line.

(6N1.1)

(6N1.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Representing Numbers in the Millions

TR: pp. 13 – 17

SB: pp. 36 – 39

Number

Specific Outcomes

Students will be expected to

6N1 Continued...

Achievement Indicator:

6N1.2 Provide examples of where large and small numbers are used; e.g., media, science, medicine, technology.

Suggestions for Teaching and Learning

Providing examples of where large numbers are used will strengthen student understanding of these numbers. Some examples that could be discussed with students include:

- the age of the Earth (~ 4 540 000 000 years)
- the population of the world (~ 7 125 000 000 people)
- the distance from the Earth to the sun (149 000 000 km)
- lottery earnings (e.g., \$13 500 000)
- amount of money earned by a blockbuster film (e.g, Disney's Frozen earned ~ \$67 000 000 in its opening weekend)

Various texts (e.g., Social Studies, Science), media and technology could provide students real-life examples of large numbers and give them a context in which they can understand what these numbers mean.

Guinness World Records™ is a great resource for large whole numbers. Teachers could ask students to choose three world records involving numbers that have at least 7 digits. Students could write the numbers in words, standard form and expanded form and present their findings to the class.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Interview

- Ask students: When might 1 000 000 of something be a big amount?
When might 1 000 000 of something be a small amount?
(6N1.2)

Presentation

- Ask students to find examples of large numbers from newspapers, magazines, or the Internet. Ask them to cut the article with the large numbers in it and to share with the class. Ask them to compare the numbers, order them, and talk about the contexts in which they are used.
(6N1.2)

Performance

- The chart shows annual salaries for various athletes:

Sport	Annual Salary (\$)
Hockey	6 500 000.00
Baseball	twelve million
Basketball	18 000 000.00
Golf	one million two hundred thousand
Tennis	750 000.00

Ask students to arrange the salaries in order from least to greatest by sport. They should explain how they decided on the order. Students should place the numbers on a number line using their own benchmarks.

(6N1.1, 6N1.2)

Journal

- Ask students to research the population of the provinces in Canada. In a chart, list them in order from least to greatest. Ask them to compare populations of the provinces and write a journal entry on what they have found.
(6N1.1, 6N1.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Representing Numbers in the Millions

TR: pp. 13 – 17

SB: pp. 36 – 39

Lesson 2: Exploring Billions

TR: pp. 18 – 21

SB: p. 40

Curious Math:

Pandigital Numbers

TR: pp. 28 – 29

SB: p. 45

Math Game: What's in a Name?

TR: pp. 22 – 23

SB: p. 41

Suggested Resource

<http://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit1.html>

- Guinness Book of World Records

Number

Specific Outcomes

Students will be expected to

6N2 Solve problems involving large whole numbers and decimal numbers.

[ME, PS, T]

Achievement Indicators:

6N2.1 Identify which operation is necessary to solve a given problem, and solve it.

6N2.2 Estimate the solution to, and solve, a given problem.

6N2.3 Determine the reasonableness of an answer.

Suggestions for Teaching and Learning

Providing students with problem solving experiences involving large numbers will help develop their understanding of these numbers. Problem solving situations should be embedded in a meaningful context as often as possible. **The focus in this unit is on understanding a given problem, choosing the operation necessary to solve the problem and checking the reasonableness of their answers. Students should be permitted to use their calculators, when appropriate.**

As students work through problems they should be encouraged to communicate their thinking processes about the problem. Ask students questions such as:

- What information is given in the problem?
- What information do you need to determine in order to solve the problem?
- How can you determine this information?
- How did you determine your answer?
- Does your answer make sense?
- Is there another way to solve the problem?

Encourage students to use pictures, numbers and words to communicate their mathematical thinking.

Teachers could read the story *Betcha!* to students as a lead in to problem solving involving large numbers. This book reminds students that an estimate involves doing something with the given numbers: rounding, comparing, using referents/benchmarks, using compatible numbers, compensation, etc.

Discuss with students real-life situations that involve estimation:

- the number of hot dogs to buy for the school population for sports day
- how much money would be needed to buy a list of items at the store
- the amount of lumber needed to build a dog house.

Explain to students that they will be using the estimation strategies they developed in Grade 5 (i.e., rounding, compensation and compatible numbers) to estimate solutions to problems involving large numbers. Once they solve the problem, they should use their estimate to check the reasonableness of their answer.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Paper and Pencil

- The following chart shows the populations of five countries, ordered from greatest to least.

Country	Population
USA	305 106 000
Indonesia	228 278 928
Pakistan	164 310 000
Japan	127 690 000
Mexico	106 002 500

Ask students the following:

- The population of Russia is 141 862 011. If the population of Russia is added to the chart, between what two countries would it be listed? Explain how you know.
 - If we combined the population of Mexico and Japan, would it be more or less than the population of the USA?
 - Is there any one country that has about double the population as another? Explain.
 - If all the populations of the listed countries were combined, would there be more than or less than 1 billion people? How do you know? Students should show how they arrived at the answer. (6N2.1, 6N2.2, 6N2.3)
- Tell students John's class sold 104 magazine subscriptions and Jane's class sold 108. The profit on each subscription was \$11.00. One student estimated the total profit was \$230.00. Ask students if this estimate is reasonable. They should explain how they know. (6N2.1, 6N2.2, 6N2.3)

Performance

- Have students pick something that is difficult to count. Ask students to create their own *Betcha!* problem involving large numbers. Ask them to estimate the solution to the question, solve it, and check the reasonableness of their answer. (6N2.1, 6N2.2, 6N2.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Solving Problems That Involve Large Numbers

TR: pp. 24 – 27

SB: pp. 42 – 44

Lesson 5: Communicating about Large Numbers

TR: pp. 34 – 37

SB: pp. 50 – 51

Supplementary Resource

Betcha! - Stuart, Murphy

Number

Specific Outcomes

Students will be expected to

6N2 Continued...

Achievement Indicators:

6N2.1 (Continued) Identify which operation is necessary to solve a given problem, and solve it.

6N2.2 (Continued) Estimate the solution to, and solve, a given problem.

6N2.3 (Continued) Determine the reasonableness of an answer.

6N2.4 Determine whether the use of technology is appropriate to solve a given problem, and explain why.

6N2.5 Use technology when appropriate to solve a given problem.

Suggestions for Teaching and Learning

As students work through the problem solving process they will have to determine whether addition, subtraction, multiplication or division is necessary to solve the problem.

Ask students to solve the following question:

The Toronto Maple Leafs have 42 regular season games and sell out all their games each season. Their stadium has 18 800 seats.

- Will the Toronto Maple Leafs sell 1 000 000 tickets in a year?
- If not, how many games would it take to sell 1 000 000 tickets?

Some students may approach this problem by determining the number of tickets sold per year and comparing it to 1 000 000. Others may decide to determine how many games would be required to sell 1 000 000 tickets and compare this value to the number of regular season games the Toronto Maple Leafs play.

Open ended questions such as this provide students with the opportunity to communicate their reasoning and demonstrate their understanding of the problem.

While it is very important that students master basic facts and become comfortable using mental math strategies, calculator use can enhance student learning if it is used appropriately. Allowing students to use calculators within the problem solving context will allow them to focus on choosing the appropriate operation, to demonstrate their understanding of the given problem, and to assess the reasonableness of their answer. It will allow them to develop their problem solving skills without being consumed with computations necessary in arriving at the answer.

It is suggested that students use calculators to work with these large numbers for computational purposes when the focus is not on mental math. Take the opportunity to observe students as they use calculators when computing large numbers. Assess students' understanding as they communicate the reasonableness of the answer they found on the calculator.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Matching game – Prepare two sets of cards. One set of cards will have numbers written in standard form or in written form and the other set will have the same number written in decimal millions. Ask students to lay all cards face down. The first player turns over two cards. If they match, he/she keeps the cards. If they do not match, the two cards will be turned face down again. Play continues until all of the matches have been found. The player with the most cards at the end of the game wins.

(6N1.1, 6N2.2, 6N2.3)

Paper and Pencil

- Ask students to solve the following problem:
Mary's class sold tickets for a fundraiser. There were 22 students in Mary's class and each student sold 54 tickets. How many tickets were sold? If each ticket costs \$13.00, what was the total amount of money collected for the fundraiser?
- Tell students Amy sends approximately 150 text messages a day. Ask them to determine how many days it will take to send a total of 1 500 000 text messages.

(6N2.1, 6N2.2, 6N2.3)

(6N2.1, 6N2.2, 6N2.3)

Journal

- Tell students that Jim and Tom each rounded numbers to 2.4 million. Ask them if this means they both started with the same number. Ask them to explain their thinking using pictures, numbers and words.
- Ask students to write about a situation in which estimated numbers are used.

(6N1.1, 6N2.2)

(6N2.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Solving Problems That Involve Large Numbers

TR: pp. 24 – 27

SB: pp. 42 – 44

Lesson 5: Communicating about Large Numbers

TR: pp. 34 – 37

SB: pp. 50 – 51

Supplementary Resource

How Much is a Million? – David. M. Schwartz

Number

Specific Outcomes

Students will be expected to

6N1 Continued...

6N2 Continued...

Achievement Indicators:

6N2.4 (Continued) Determine whether the use of technology is appropriate to solve a given problem, and explain why.

6N2.5 (Continued) Use technology when appropriate to solve a given problem.

6N1.1 (Continued) Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

Teachers could use the book *How Much is a Million?* to generate problem solving questions. Teachers could ask students, for example, if they agree with the suggestion that it would take 23 days to count to one million. Begin by timing students counting to 100. Use this time to determine how long it would take to count to 1 000, then 100 000, then 1 000 000.

In keeping with the theme of the book, teachers could ask students if they were to take 1 000 000 unsharpened pencils and lay them down end to end, how far would they stretch? Would they reach from St. Anthony to St. Lawrence? Would they reach from British Columbia to Newfoundland and Labrador?

Students are required to rename large numbers using decimals. They may need to be reminded that the number to the left of the decimal represents the whole number and the digits to the right of the decimal names represents the part of the whole. In the number 52 378 364, for example, there are 52 millions and 378 thousands:

Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
	5	2	3	7	8	3	6	4

This number can be rounded to 52.4 million and would be read as 52 and four tenths of a million.

Students could generate large numbers from texts and/or media that are meaningful to them. Using these numbers, ask students to place the numbers in the place value chart and rename the numbers using decimals. Ask them to round the numbers to the nearest tenth of a million and hundredth of a million and show how they decided to rename the numbers.

If asked to round 33 311 389 to tenths of a million, for example, students should write 33.3 million. If asked to round to hundredths of million students should write 33.31 million.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Paper and Pencil

- Provide problems such as the following and ask students to solve them. Ask them to share with their classmates how they found their answer:
 - (i) Mr. Ron knows that approximately 162 000 000 used beverage containers were collected and recycled in Newfoundland and Labrador (NL) last year. The population of NL was approximately 525 000. How many beverage containers did each person return (assume that each person equally contributed)?
 - (ii) The school cafeteria sells 672 chocolate milk each day. The cost of a chocolate milk is \$1.75. If there are 190 school days in a year, ask students to determine the amount of money spent on milk in one school year. How can estimation help to determine the solution to the problem?
 - (iii) Jane is raising money for a local children's charity. She sold 620 candles at a cost of \$8.00 each and 774 tubs of cookie dough at a cost of \$12.00 each. How much money does she raise? How can estimation help to determine the solution to the problem?
 - (iv) Betty sends at least 50 text messages a day to her friends. Each text message has about 140 characters. Ask students to determine the number of days it would take Betty to text one and a half million characters. They should explain their thinking.
(6N2.1, 6N2.2, 6N2.3, 6N2.4, 6N2.5)

Performance

- Ask students to write five numbers between 5 000 000 and 6 000 000 and rename these numbers using decimal millions. They should also place the numbers on a number line.
(6N1.1, 6N2.2, 6N2.3)
- Ask students to find news articles that include large numbers written in different forms. They may use the Internet and search databases such as Statistics Canada. Ask them to rename the numbers in the article using decimal millions.
(6N1.1, 6N1.2, 6N1.3, 6N2.2)

Journal

- Ask students to make a list of 3-4 situations where they would use a calculator to solve a problem. Ask them to explain why they would use a calculator rather than pencil/paper to get the answer.
(6N2.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Solving Problems That Involve Large Numbers

TR: pp. 24 – 27

SB: pp. 42 – 44

Lesson 5: Communicating about Large Numbers

TR: pp. 34 – 37

SB: pp. 50 – 51

Lesson 4: Renaming Numbers

TR: pp. 30 – 33

SB: pp. 46 – 49

Number

Specific Outcomes

Students will be expected to

6N1 Continued...

Achievement Indicator:

6N1.1 (Continued) Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

There are some situations involving large numbers where it can be very difficult to be exact (e.g., population). If asked to find the population of Canada, students could use a search engine to see that in the 2008 census the population was 33 311 389 people. However, it is impossible to determine the population of the nation at any given time since it is continuously changing. Giving this population count, therefore, is only an estimate. When asked about the population of Canada, a reasonable estimate would be 33.3 million people.

It is important for students to understand that the place value system extends beyond thousandths and that they can use the patterns of the place value chart to assist them in reading and writing these decimal numbers.

Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths	Ten Thousandths	Hundred Thousandths	Millionths

Some students may find it challenging to read and write numbers less than one thousandth. Remind them that the decimal is read as a whole number and then the position of the last digit is named.

Students could begin by representing a given number, such as 0.000 2, on the place value chart.

Ones			$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10000}$
H	T	O	Tenths	Hundredths	Thousandths	Ten Thousandths
		0	0	0	0	2

They should recognize that the digit 2 is in the ten thousandths place, and is written and as two ten thousandths.

Students should be exposed to decimal numbers such as 2.003 8.

Ones			Tenths	Hundredths	Thousandths	Ten Thousandths
H	T	O				
		2	0	0	3	8

This number would be read and written two and thirty eight ten thousandths.

Students should also express decimal numbers in expanded form (e.g., $0.827 = 0.800 + 0.020 + 0.007$).

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Ask students to determine the five most populated countries in the world and record the population. Ask them to estimate the total population of these countries and, using a calculator, determine if the estimate is reasonable. They should explain why or why not.
(6N2.3, 6N2.4, 6N2.5)
- Ask students to research the distance of each planet from the sun. Record these distances in decimal millions. Using this information, ask students to create a problem for a classmate to solve.
(6N2.1, 6N2.2)

Paper and Pencil

- Ask students to use the following numbers to answer the questions below:
8.025 4 2.086 0.83 24.918
 - (i) In which number does 8 represent a value of 8 hundredths?
 - (ii) In which number does 2 represent a value of 2 tens?
 - (iii) In which number does 0 represent the value of 0 ones?
 (6N1.1)
- Ask students to write the number 23.087 6 in written form.
(6N1.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Renaming Numbers

TR: pp. 30 – 33

SB: pp. 46 – 49

Lesson 6: Representing Millionths

TR: pp. 42 – 45

SB: pp. 54 – 56

Lesson 7: Exploring Decimals to Millionths

TR: pp. 42 – 45

SB: p. 57

Note

Lesson 6 may be combined with Lesson 7.

The focus of lesson 6 and 7 in *Math Focus 6* is on decimals to millionths; however, the outcome states that students will demonstrate an understanding of place value to numbers less than one thousandths. Therefore it is important not to spend a great amount of time on numbers less than ten thousandths.

Number

Specific Outcomes

Students will be expected to

6N1 Continued...

Achievement Indicator:

6N1.1 (Continued) Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude.

Suggestions for Teaching and Learning

When comparing and ordering decimal numbers, students may use similar strategies as those used to compare large whole numbers. When comparing 454 125 374 to 45 875 361, for example, students may conclude that 454 125 374 is larger since there are more digits in the number. It is important that students understand that this strategy may not work for every example comparing decimal numbers. When asked which number is greater: 0.234 or 0.228 7, for example, students may respond that 0.228 7 is greater because it has more digits. Help students understand that 0.234 is greater because 0.23 is greater than 0.22. The use of a place value chart should help students make these connections:

Ones			Tenths	Hundredths	Thousandths	Ten Thousandths	Hundred Thousandths
H	T	O	.				
		0	.	0	2	3	4
		0	.	0	2	2	8
							7

Students can see that these two numbers have the same number in the hundredths position. Next, they should compare the numbers in the thousandths position. Since 3 is larger than 2, it follows that 0.234 is the larger number.

Some students may find it easier to compare decimal numbers that have the same number of decimal places. Teachers should demonstrate to students that when given a set of decimal numbers that do not have the same number of decimal places zeros can be placed at the end of the number without changing its value. Students should realize, for example, that one tenth is the same as 10 hundredths, or 100 thousandths or 1 000 ten thousandths. Writing these numbers on a place value chart should be helpful.

6N1.2 (Continued) Provide examples of where large and small numbers are used; e.g., media, science, medicine, technology.

It is important to provide students examples of where small numbers are used:

- the width of a strand of a human hair (0.000 008 m)
- concentration (parts per million)
- the diameter of the flu virus (0.000 000 008 m - 0.000 000 120 m)
- the amount of time required for sound to travel from one end of a soccer field to the other (0.005 3 min)

Brainstorm with students various places in their own lives where they see small numbers. Working in groups, ask students to collect examples of small numbers from newspapers, flyers, etc. Students should present their findings to the class.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Using a set of 24 decimal ten thousandths problem cards, have 12 cards with decimal ten thousandths written in words and 12 cards with the same numbers written in numbers.

Students can play the game “Go Fish” where players pick four cards each. They take turns asking the other if they have the card that matches one in their hand. For example, do you have a card that matches 2 and three hundred thousandths? If the other student has the card with the number 2.000 3 on it, they would give the card to the other player.

2.000 3	two and three ten thousandths
---------	-------------------------------

The game continues until all cards are gone. The player with the most cards at the end of the game wins.

(6N1.1, 6N2.2, 6N2.3)

- Ask students to play *Put Decimal Numbers in Order*.
(6N1.1)
- Provide students with a list of numbers in both written form and numeral form. Ask them to compare these numbers by placing them in a place value chart.

26.004 3

0.001 3

seventy ten thousandths

four and fourteen ten thousandths

(6N1.1, 6N2.2, 6N2.3)

- Ask students to roll a die five times. Using the numbers rolled, create a decimal number with a value between 1.000 1 and 6.666 6.

(6N1.1, 6N2.2, 6N2.3)

Journal

- Using number cards with digits 0-9 on them, ask students to create decimal ten thousandths numbers that are in a desired range. For example, using five different number cards create a number that can be found between 1.000 9 and 1.500 1. Ask students to write a journal entry explaining their thinking.

(6N1.1, 6N2.2, 6N2.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Representing Millionths

TR: pp. 42 – 45

SB: pp. 54 – 56

Lesson 7: Exploring Decimals to Millionths

TR: pp. 42 – 45

SB: p. 57

Lesson 8: Using Decimals

TR: pp. 49 – 52

SB: pp. 58 – 60

Curious Math:

Googols and Googolplexes

TR: pp. 53 – 54

SB: p. 61

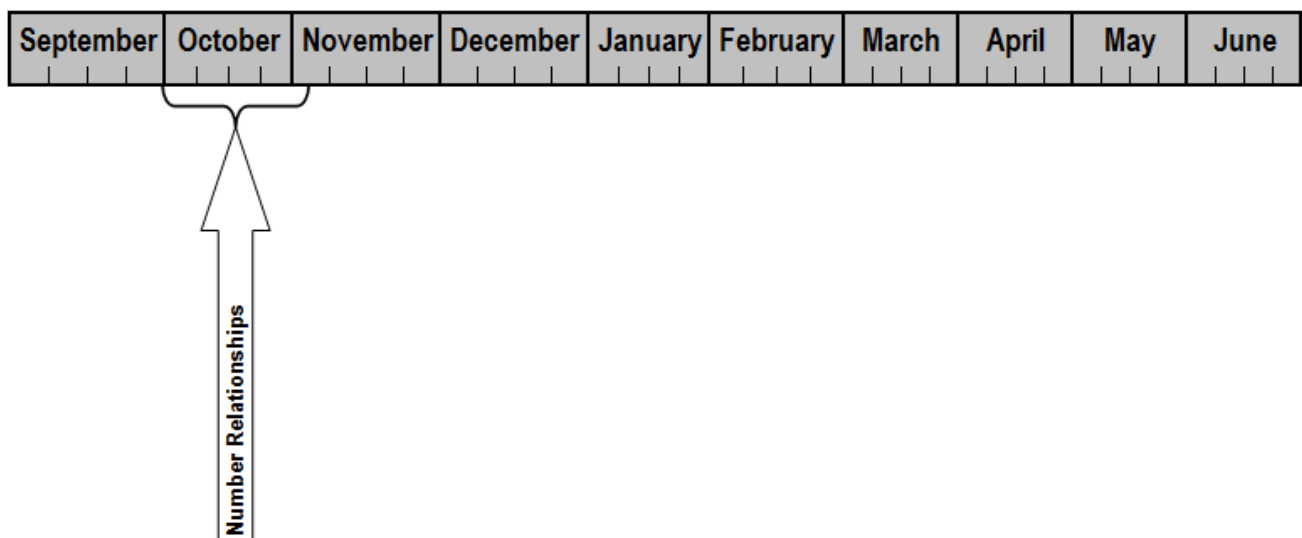
Supplementary Resource

<http://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit1.html>.

- Put Decimal Numbers in Order* Game

Number Relationships

Suggested Time: $4\frac{1}{2}$ Weeks



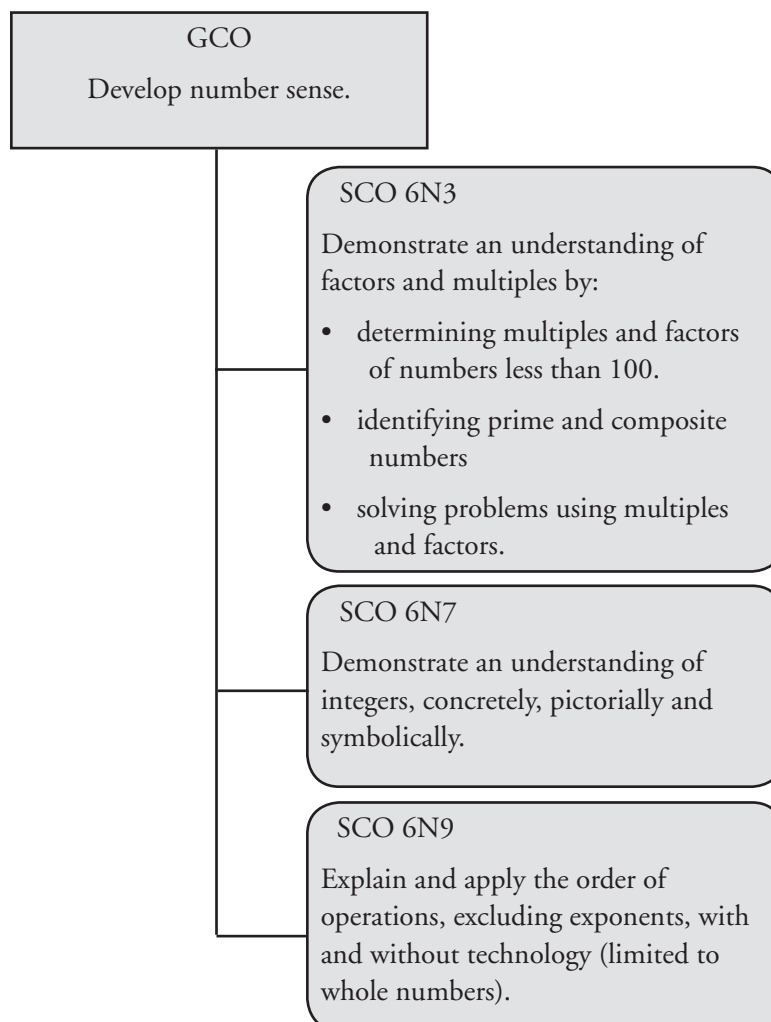
Unit Overview

Focus and Context

In Grade 5, students demonstrated an understanding of multiplication and division facts to 9×9 . In this unit they will continue to develop number sense through the study of multiples, factors, integers, and the order of operations. Students will use a variety of strategies to determine the multiples and factors of numbers less than 100, to identify prime and composite numbers, and to solve problems involving multiples and factors. Students should realize that a set of rules (the order of operations) are necessary when evaluating a mathematical expression to ensure that everyone arrives at the same answer. Students will apply the order of operations, **excluding** exponents.

Students should be encouraged to relate the concepts that they learn in this unit to their everyday life and to discuss these observations in class. To collect a prize, for example, an individual might be required to answer a skill testing question involving the order of operations.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Number		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5N3 Apply mental mathematics strategies and number properties, such as:</p> <ul style="list-style-type: none"> • skip counting from a known fact • using doubling or halving • using patterns in the 9s facts • using repeated doubling or halving to determine, with fluency, answers to basic multiplication facts to 9×9 and related division facts <p>[C, CN, ME, R, V]</p>	<p>6N3 Demonstrate an understanding of factors and multiples by:</p> <ul style="list-style-type: none"> • determining multiples and factors of numbers less than 100 • identifying prime and composite numbers • solving problems using multiples and factors <p>[CN, PS, R, V]</p> <p>6N7 Demonstrate an understanding of integers, concretely, pictorially and symbolically.</p> <p>[C, CN, R, V]</p> <p>6N9 Explain and apply the order of operations, excluding exponents, with and without technology (limited to whole numbers).</p> <p>[C, CN, ME, PS, T]</p>	<p>7N1 Determine and explain why a number is divisible by 2, 3, 4, 5, 6, 8, 9 or 10, and why a number cannot be divided by 0.</p> <p>[C, R]</p> <p>7N6 Demonstrate an understanding of addition and subtraction of integers, concretely, pictorially and symbolically.</p> <p>[C, CN, PS, R, V]</p>

Mathematical Processes

[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[ME]	Mental Mathematics and Estimation	[T]	Technology
		[V]	Visualization

Number

Specific Outcomes

Students will be expected to

6N3 Demonstrate an understanding of factors and multiples by:

- determining multiples and factors of numbers less than 100
- identifying prime and composite numbers
- solving problems using multiples and factors.

[CN, PS, R, V]

Achievement Indicator:

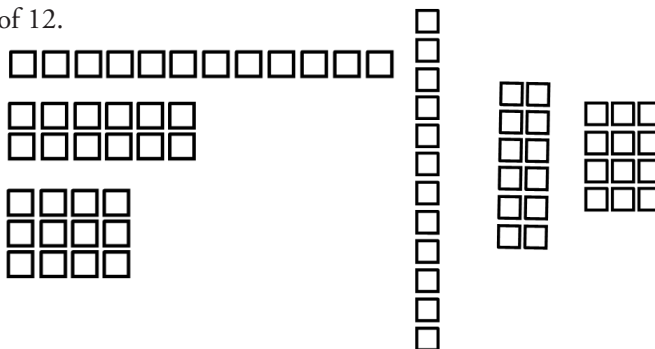
6N3.1 Determine all the whole number factors of a given number, using arrays.

Suggestions for Teaching and Learning

In Grade 5 students determined the results of basic multiplication facts to 9×9 . As a pre-assessment, teachers could begin with a review of these multiplication facts. While students are familiar with multiplication, this will be their first exposure to the term factor. In this unit, students will investigate a variety of strategies to determine multiples and factors of numbers less than 100.

Students should be introduced to the term **factor**. A factor is any one of the numbers you multiply. For $2 \times 6 = 12$, for example, 2 and 6 are factors. This term could be added to the class math word wall with students defining it in their own words, and providing examples to demonstrate their understanding.

Students should begin to explore the factors of a number by creating arrays using manipulatives, such as square tiles or snap cubes. Provide students with 12 tiles or snap cubes and ask them to form an array using these tiles. They should share their rectangle with the class. Students should recognize that there are six possible arrays: 1×12 (1 row of 12), 12×1 (12 rows of 1), 2×6 (2 rows of 6), 6×2 (6 rows of 2), 3×4 (3 rows of 4) and 4×3 (4 rows of 3). These numbers represent the factors of 12.



The factors of 12 are 1, 2, 3, 4, 6, 12.

Students should recognize that factors always occur in pairs. The factors of 12, for example, are 1 and 12, 2 and 6, and 3 and 4.

When using arrays, students sometimes forget to list 1 and the number itself as factors of a given number. Remind them that when given **any** number you can create an array of one row containing all of the tiles.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Provide each student with a number that has several factors, such as 12, 18, 24, 30 or 36. With counters and snap cubes ask students to build rectangles that have the given number of squares. For each arrangement, students should determine the factors and write a multiplication statement for the rectangle.
(6N3.1)
- Ask students to construct rectangles to show that 8 is a factor of 16 and 24.
(6N3.1)
- Factor Patterns - Provide each group with several numbers such as 3, 5, 8, 12, 16. Ask students to determine all the factors of each number using arrays. Have manipulatives available for student use. Have students draw each array on grid paper and record the multiplication sentence. Students should look for patterns in the factors. Ask students questions such as:
 - (i) Which numbers have the least number of factors? How do you know?
 - (ii) Which numbers have arrays that form a square?
 - (iii) Which numbers have a factor of 2?
 - (iv) What can you say about the factors for even numbers? Do even numbers always have 2 as a factor?
 - (v) What do you notice about the factors of odd numbers?

(6N3.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1:

Identifying Factors

TR: pp. 13 – 17

SB: pp. 70 – 73

Supplementary Resource

Making Math Meaningful to Canadian Students K-8 – Marian Small

- Support for SCO 6N3 can be found on pp.149 –151

Number

Specific Outcomes

Students will be expected to

6N3 Continued...

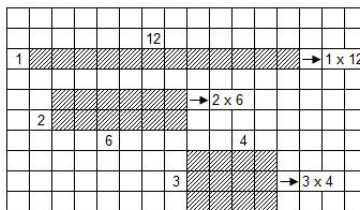
Achievement Indicator:

6N3.2 Identify the factors for a given number, and explain the strategy used; e.g., concrete or visual representations, repeated division by prime numbers, factor trees.

Suggestions for Teaching and Learning

Using manipulatives to create arrays is just one strategy students can use to determine the factors of a number. Teachers should expose students to additional strategies: using centimeter grid paper, using an organized list, and using factor rainbows.

Students could use one or two centimetre grid paper to create arrays or rectangles to identify the factors for a given number. The width and the length of these rectangles represent the factors of that number.



The factors of 12 are 1, 2, 3, 4, 6, and 12.

Students could create an organized list of the factors of a given number, using their multiplication and division facts.

Factors of 16		Factors of 32	
1	16	1	32
2	8	2	16
4	4	4	8
Factors of 16 are 1, 2, 4, 8, 16 (5 factors)		Factors of 32 are 1, 2, 4, 8, 16, 32 (6 factors)	

As the given number increases they may have difficulty identifying **all** of its factors. Ask students questions such as:

- What is the benefit of starting at the number one when listing factor pairs?
- How do you know if you have listed all of the factors?

Students should recognize that by starting at the number one and working their way up they are less likely to miss a factor. To ensure that they have listed **all** factors, students should identify whether there are any remaining factors between their last factor pair. The last factor pair listed for 32, for example, is 4 and 8. They should ask themselves whether there are any factors between 4 and 8. Since 5, 6, or 7 are not factors of 32 all factors have been listed.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Journal

- Give students the following journal prompt:
Find a number which has 4, 7, 28 and 12 as factors. Is there a smaller number which will meet these conditions? Explain.
(6N3.1, 6N3.2)
- Ask students to determine a number that has exactly 4 factors and another number that has exactly 5 factors.
(6N3.1, 6N3.2)

Performance

- Ask students to play Factor Flip.
(6N3.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1:

Identifying Factors

TR: pp. 13 – 17

SB: pp. 70 – 73

Supplementary Resource

<https://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit2.html>

- Factor Flip game

Number

Specific Outcomes

Students will be expected to

6N3 Continued...

Achievement Indicators:

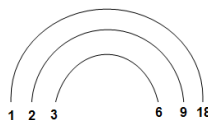
6N3.2 (Continued) Identify the factors for a given number, and explain the strategy used; e.g., concrete or visual representations, repeated division by prime numbers, factor trees.

6N3.3 Solve a given problem involving factors or multiples.

6N3.4 Identify multiples for a given number, and explain the strategy used to identify them.

Suggestions for Teaching and Learning

Factor rainbows are another visual representation that students can use to help factor numbers. In a factor rainbow, students use division facts to find all the factors of the number, starting at 1. When the factor pairs are connected, the curved lines create a rainbow shape.



The factors of 18 are: 1, 2, 3, 6, 9, 18.



Students could participate in “Factor Fitness” as a small group or whole class activity. Students identify the factors of a given number. For each factor given, the student provides a fitness challenge to complete. For the factors of 10, for example, students might suggest 1 push up, 2 sit ups, 5 high fives, and 10 jumping jacks.

Teachers should provide students with problem solving situations that involve factors. For example,

Kimberly bought boxes of yogurt tubes. Each box contains the same number of yogurt tubes. Kimberly had a total of 24 yogurt tubes. How many yogurt tubes could there be in each box?

Students should recognize that the possible number of yogurt tubes in each box is the factors of 24: 1, 2, 3, 4, 6, 8, 12, and 24. Engage in a discussion about which of these answers is likely? e.g., not likely that there would be one yogurt tube in a box.

Discuss with students that a multiple is the product of two whole number factors. For example, 10 is a multiple of 5 since $5 \times 2 = 10$; 10 is also a multiple of 2 since $2 \times 5 = 10$.

Students sometimes do not recognize that 0 can be a multiple of every number. Using the definition above, 0 is a multiple of 3 since $0 \times 3 = 0$. Patterns could also be used to explore this concept. The multiples of 5, for example, are 5 units apart (e.g., 5, 10, 15, 20, 25). If you decrease 5 by 5 you get 0. Therefore, 0 is a multiple of 5. (Small, 2008, p. 155).

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Journal

- John says the factors of 54 are 1, 2, 3, 18, 27, and 54. Is John correct? Explain.
(6N3.1, 6N3.2)
- Tell students you were trying to figure out the multiples of 8 and here is the list you came up with: 0, 8, 16, 23, 32 and 40. Ask if they agree and have them explain their thinking.
(6N3.2, 6N3.3)
- Ask students to choose a number from 2 – 10 and ask them to list at least 5 multiples of that number. Ask them to note any patterns they observe and discuss why these patterns occur.
(6N3.2, 6N3.3)
- Tell students: Jill has a sandwich which measures 10 cm by 10 cm. She wants to cut the sandwich into equal squares. What possible sizes could the squares be? How many squares of each size would be cut?
(6N3.1, 6N3.2, 6N3.3)

Paper and Pencil

- Present the following problem:
Craig and John each bought boxes of granola bars. Craig had 24 bars in total and John had 30 bars in total.
 - (i) What are the possible sizes of boxes for each student?
(i.e., 1 box of 24, 24 boxes of 1,...)
 - (ii) Craig and John bought boxes containing the same number of bars. How many bars are in each box? How many boxes did each person buy?
(6N3.1, 6N3.2, 6N3.3)
- Ask students to solve the following problem by using pictures, numbers, and words:
 - (i) Harry has 36 Halloween treats to share evenly among treat bags. How many bags could Harry fill?
(6N3.1, 6N3.2, 6N3.3)
 - (ii) Veronica has 56 square pieces of fabric for a quilt. She would like to arrange the pieces in 8 rows, with each row having 6 pieces. Will Veronica be able to create a quilt using all 56 pieces? Why or why not?
(6N3.1, 6N3.2, 6N3.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1:

Identifying Factors

TR: pp. 13 – 17

SB: pp. 70 – 73

Supplementary Resource

Making Math Meaningful to Canadian Students K-8 – Marian Small

- Support for SCO 6N3 can be found on pp.149 – 151

Number

Specific Outcomes

Students will be expected to

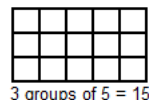
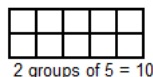
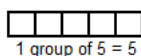
6N3 Continued...

Achievement Indicator:

6N3.4 (Continued) Identify multiples for a given number, and explain the strategy used to identify them.

Suggestions for Teaching and Learning

Students should use various manipulatives, such as snap cubes, counters, or buttons, to create equal groups of the given number to find its multiples. To find the multiples of 5, for example, they could create one group of 5, then two groups of five, three groups of five and so on. Remind students that 0 is a multiple of every number and must be included.



Therefore, the multiples of 5 are 0, 5, 10, 15, ...etc. Students should relate this back to multiplication: ($1 \times 5 = 5$, $2 \times 5 = 10$, $3 \times 5 = 15$...).

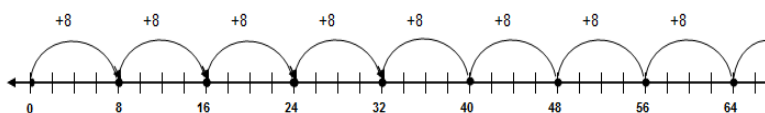
A hundred chart that includes 0 could also be used to identify the multiples for a given number. Students should start at 0 and then count on by the given number. When asked to find the multiples of 8, for example, students may shade 0, and shade every 8th number. The shaded numbers represent the multiples of 8.

Hundred chart illustrating multiples of 8

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29

Students could also use a number line to identify the multiples of a given number. They would start at 0 and skip count by the given number.

Number Line illustrating multiples of 8



Using an organized chart is another strategy to identify multiples of a given number.

Organized Chart Multiples of 8

Multiply by 8	0	1	2	3	4
Product	0	8	16	24	32

The multiples of 8 are: 0, 8, 16, 24, 32...

Students should select the strategy they wish to use in determining the multiples of numbers.

General Outcome: Develop Number Sense

Suggested Assessment Strategies


Performance

- Provide the following riddle:
I am thinking of a number. It is a multiple of 2 and also a multiple of 6. The sum of the digits is 9. What are some possibilities?
Challenge pairs of students to write similar riddles for one another and to record their answers.
(6N3.2, 6N3.3, 6N3.4)
- Post a chart such as the following:

Is a Multiple of 6	Is not a Multiple of 6

Provide each student with a number card (or Post-It Note). Students should place their number card in the appropriate column.

(6N3.2, 6N3.4)

-  Students could play Buzz, a whole class activity where a digit from 1 to 9 is selected to be the Buzz number. Since 0 is a multiple of every number the game will always begin with the first student saying Buzz. Students would continue to count forward but must say Buzz for any multiple of the chosen number. For example, if 4 was the Buzz number:

Buzz, 1, 2, 3, Buzz, 5, 6, 7, Buzz, 9, 10, 11, Buzz, ...

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2:

Identifying Multiples

TR: pp. 18 – 21

SB: pp. 74 – 77

Note

The Communication Tip on p. 75 of the text states that a list of multiples of a whole number begins with the whole number. Teachers should ensure that students recognize that 0 is a multiple of every number.

Number

Specific Outcomes

Students will be expected to

6N3 Continued...

Achievement Indicators:

6N3.3 (Continued) Solve a given problem involving factors or multiples.

6N3.5 Provide an example of a prime number, and explain why it is a prime number.

6N3.6 Provide an example of a composite number, and explain why it is a composite number.

Suggestions for Teaching and Learning

Students should be given opportunities to solve problems that involve multiples. Students may select the strategy they wish to use in determining multiples of numbers.

Students should solve problems such as the following:

Chef Sally must fill an order of 72 hot dogs. Weiners are sold in packages of 12. Hot dog buns are sold in packages of 8. Chef Sally does not want any weiners or hot dog buns left over. How many packages of weiners and how many packages of hot dog buns should she purchase?

Students should recognize that this question involves determining the multiples of 8 and 12:

8, 16, 24, 32, 40, 48, 56, 64, 72

12, 24, 36, 48, 60, 72

They should also work with more open ended questions such as the following:

Peter has a collection of spiders and ants. Spiders have 8 legs and ants have 6 legs. In his collection, the number of spider legs equal the number of ant legs. How many spiders and ants could Peter have?

8, 16, 24, 32, 40, 48, 56, 64, 72, 80, ...

6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72, ...

Ask students to share their solutions and to communicate their reasoning. Some may identify 24 as a common multiple and conclude the collection must have 3 spiders and 4 ants. Encourage them to explore other possibilities.

Earlier in this unit students identified the factors of a given number. Students will use this knowledge to develop an understanding of prime and composite numbers.

Provide students with a set of prime and composite numbers (e.g., 3, 6, 7, 13, 16). Ask them to determine the factors of each number using a strategy of their choice. They should then organize their numbers into two groups: numbers that have exactly 2 factors, and numbers that have more than two factors.

Discuss with students that a prime number is a whole number that has exactly two different factors - one and itself. Composite numbers are whole numbers that have more than two different factors (other than one and the number itself).

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Paper and Pencil

- Present students with the following questions:
 - (i) The cafeteria is having a promotion. Every second student receives free milk and every sixth student receives a slice of pizza. If 60 students are served at the cafeteria that day, which students received free milk? A slice of pizza? Both?
(6N3.2, 6N3.3, 6N3.4)
 - (ii) Micheal and his sister, Rebecca, both play soccer. They are on different teams and both have a tournament this weekend. Michael and Rebecca's parents are trying to determine if they will play each other during the tournament. Michael plays every third game and Rebecca plays every second game. If there are 12 games in the tournament, is it possible for Michael and Rebecca to play against each other? If so, how many times will they play against each other? Explain your answer using pictures, numbers and words.
 - (iii) Joe bought some \$10 computer games. Damian bought some \$15 computer games. They each spent less than \$200, but they both spent the same amount. How much could they have spent? What is the largest amount of money they could have spent?
(6N3.2, 6N3.3, 6N3.4)

Journal

- Olivia was in a class of 24 people. Her teacher told the class to line up and that every second student would receive a pencil and every sixth student would receive a smelly sticker. If Olivia wanted both a pencil and a smelly sticker, ask students which position in the line Olivia should be in.
(6N3.2, 6N3.3, 6N3.4)
- Ask students: Is it possible for an even number, other than 2, to be prime? Explain.
(6N3.5, 6N3.6)
- Ask the student how he/she can determine, without factoring, that certain large numbers such as 17 932 and 19 875 are not prime.
(6N3.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2:

Identifying Multiples

TR: pp. 18 – 21

SB: pp. 74 – 77

Curious Math:

String Art

TR: pp. 22 – 23

SB: p. 77

Number

Specific Outcomes

Students will be expected to

6N3 Continued...

Achievement Indicators:

6N3.5 (Continued) Provide an example of a prime number, and explain why it is a prime number.

6N3.6 (Continued) Provide an example of a composite number, and explain why it is a composite number.

6N3.7 Sort a given set of numbers as prime and composite.

Suggestions for Teaching and Learning

Students may notice that all prime numbers, with the exception of the number 2, end with a 1, 3, 7, or 9. Teachers should emphasize that this does not mean that **every** number that ends with one of these digits is prime. Students sometimes mistakenly identify odd composites for prime numbers. To strengthen student understanding of prime and composite numbers it is important that they are exposed to numbers such as 39 and 51.

Another misconception students may have is that a number is prime if each digit of the number is prime. For example, students may think that 27 is prime since 2 and 7 are prime numbers. It is important that they work with numbers such as 27 and 25 to strengthen their understanding of prime and composite numbers.

In assessing student understanding of prime and composite numbers teachers could ask questions such as the following:

- Why are all even numbers greater than 2 composite?
- Why are all multiples of 5 greater than 5 composite?
- Are all odd numbers prime?

After developing the concepts of prime and composite numbers, students should be able to sort a given set of numbers as prime and composite using the strategies they developed earlier in this unit.

Teachers could provide each student with a number card (variety of prime and composite numbers). Designate each corner of the classroom with one of the following categories: even composite, even prime, odd composite, odd prime. Students should determine which category their number is in and stand in the designated corner of the classroom. Within their corner groups, students should discuss why they made the decision they did.

Alternatively, students could be given a deck of number cards and asked to sort the numbers as prime and composite.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Colouring Factors- Students work in groups of two for this activity. Each group needs a game board (1-50 of a hundred chart) and a different colored marker for each player. The game begins with Player One choosing a number on the game board and colouring it. Player Two then has to identify and colour all the factors of that number that are not already coloured. Players would then switch roles. Player Two would colour a number on the game board and Player One would have to identify and colour all the factors. Players would continue to switch roles until every number on the game board is coloured. Each player would determine the sum of the numbers they have coloured and the player with the most points wins. Once the game is completed, ask students to cut out each number and sort them into prime numbers and composite numbers.

(6N3.2, 6N3.5, 6N3.6, 6N3.7)

- Ask students to use coloured tiles or grid paper to determine whether the numbers 7, 10, and 18 are prime or composite numbers. They should explain their thinking.

(6N3.5, 6N3.6)

- Ask students to design a “Missing in Action” poster for either a prime or composite number. They should:
 - create a clever name for their chosen number (e.g. Captain Composite).
 - state the factors of the chosen number and explain the strategy they used in determining the factors.
 - classify the number as prime or composite with an explanation.
 - provide a fun fact about their number (e.g. Captain Composite is afraid of spiders).

(6N3.5, 6N3.6, 6N3.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3:

Prime and Composite Numbers

TR: pp. 24 – 28

SB: pp. 78 – 80

Math Game:

Colouring Factors

TR: pp. 29 – 30

SB: p. 81

Supplementary Resource:

Making Math Meaningful to

Canadian Students K-8 – Marian Small

- Support for SCO 6N3 can be found on pp.154 – 155

Number

Specific Outcomes

Students will be expected to

6N3 Continued...

Achievement Indicators:

6N3.8 Explain why 0 and 1 are neither prime nor composite.

6N3.2 (Continued) Identify the factors for a given number, and explain the strategy used; e.g., concrete or visual representations, repeated division by prime numbers, factor trees.

Suggestions for Teaching and Learning

It is important that students understand that the number 1 is neither prime nor composite. It does not fit the definition of a prime or composite number. To be prime, the number must have two different factors, one and itself. The number 1, only has one factor. It is not composite either because it does not have more than 2 factors.

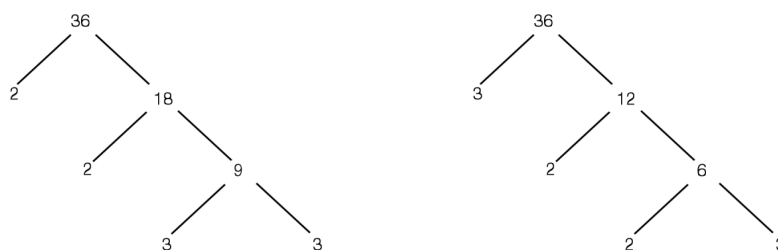
Students should also understand that 0 is neither prime nor composite. 0 cannot be a prime number because it can be expressed in many ways (0×1 does equal 0, but 0 multiplied by any number equals 0).

0 is not a composite number because it cannot be written as a product of 2 factors, neither of which is itself.

Earlier in the unit students were required to identify the factors of a given number and have developed an understanding of prime and composite numbers. They will apply this knowledge to determine the prime factors of a number.

Students should be exposed to a variety of strategies when asked to identify the prime factors of a given number. Some students may decide to list all the factors of the given number and then identify which of these numbers are prime. The factors of 36 are 1, 2, 3, 4, 6, 9, 12, 36, for example. The only prime factors of 36 are 2 and 3.

Another strategy students should use to determine the prime factors of a number is prime factorization. Students begin by selecting any factor pair for the given number. They should continue to factor any composite number until only prime numbers remain. For example,



From the factor tree, the prime factors are 2 and 3.

It is important that students realize the prime factors of a given number will be the same regardless of which factor pair they use to begin their factor tree. In both instances the prime factors of 36, for example are 2 and 3.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Ask students to participate in a Prime and Composite Matching Game. Provide students with two stacks of cards. The first stack of cards are number cards. The second stack of cards are labeled prime, composite, or neither. Students shuffle each deck of cards and lay them on the desk face down. The first student would flip over one card from each deck. If the number card matches the description card the student gets a point and the cards are removed from the deck. If the cards do not match they are returned to the bottom of the deck. For example, 2 and prime would score a point whereas 6 and prime would not. Students should take turns flipping cards. The first student to score 10 points wins the game.
(6N3.2, 6N3.5, 6N3.6)
- Ask students to create their own factor tree for a given number using tree branches, pipecleaners, straws, etc.
(6N3.2, 6N3.5, 6N3.6)

Journal

- Give students 6 – 8 numbers and ask them to sort them as either prime or composite numbers. Ask students to justify their reasoning.
(6N3.5, 6N3.6, 6N3.7)
- Ask students to respond to the following:
There are 84 students in four grades and they are arranged into teams with the same number on each team. How many teams are there and how many students might there be on each team? How many possible solutions can you find to this problem? How would this problem change if there were 89 students instead of 84?
(6N3.2, 6N3.3, 6N3.5, 6N3.6)

Paper and Pencil

- Ask students to determine the prime factors of 56 and 32 by constructing a factor tree. Is it possible to draw another factor tree for each number? Explain.
(6N3.2)
- Ask students to name a composite number for which you can draw only one factor tree. Ask students how many factor trees they can draw for the number 13 and explain their reasoning.
(6N3.2, 6N3.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3:

Prime and Composite Numbers

TR: pp. 24 – 28

SB: pp. 78 – 80

Number

Specific Outcomes

Students will be expected to

6N3 Continued...

Achievement Indicators:

6N3.2 (Continued) Identify the factors for a given number, and explain the strategy used; e.g., concrete or visual representations, repeated division by prime numbers, factor trees.

6N3.3 (Continued) Solve a given problem involving factors or multiples.

Suggestions for Teaching and Learning

Students may also use repeated division of prime numbers to determine the prime factors of a given number. To determine the prime factors of 36, for example, students would begin by dividing 36 by the lowest prime number, in this case 2.

$$\begin{array}{r} 18 \\ 2 \overline{)36} \end{array}$$

Students would continue to divide by 2 until it is no longer a factor:

$$\begin{array}{r} 9 \\ 2 \overline{)18} \end{array}$$

Students would continue to divide by prime numbers until the quotient is 1:

$$\begin{array}{r} 3 \\ 3 \overline{)9} \end{array}$$

$$\begin{array}{r} 1 \\ 3 \overline{)3} \end{array}$$

Students should conclude that the prime factors of 36 are 2 and 3.

Students should solve a variety of problems involving prime and composite numbers.

Consider the following example:

You are planning a birthday party and you are trying to decide upon seating arrangements for your 28 guests (including you). There must be the same number of people at each table.

- (i) Assuming that there is an unlimited supply of tables of various sizes, how could you arrange your guests?
- (ii) While reviewing the guest list, you realize that you forgot to invite your classmate John. This brings your total to 29 guests. How could you arrange your guests now?

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Paper and Pencil

- Tell students that a number has exactly 4 prime factors. Ask them to determine what this number could be. Explain. (6N3.2, 6N3.5)

Performance

- Students could play 97 Prime. In small groups students take turns rolling a die. The goal is to move a counter (or other marker) to 97. Students can only move ahead when they roll a number which allows them to move to a prime number. The first student to 97 wins. (6N3.2, 6N3.5, 6N3.6)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4:

Identifying Factors by Dividing

TR: pp. 31 – 34

SB: pp. 82 – 84

Lesson 5:

Creating Composite Numbers

TR: pp. 35 – 38

SB: p. 85

This lesson does not require a lot of time.

Lesson 6:

Solving Problems Using an Organized List

TR: pp. 31 – 34

SB: pp. 88 – 89

Suggested Resource

<https://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit2.html>

- Game Board for 97 Prime

Number

Specific Outcomes

Students will be expected to

6N7 Demonstrate an understanding of integers, concretely, pictorially and symbolically.

[C, CN, R, V]

Achievement Indicator:

6N7.1 Extend a given number line by adding numbers less than zero, and explain the pattern on each side of zero.

Suggestions for Teaching and Learning

This will be students' first exposure to negative numbers. Integers include three groups of numbers: counting numbers, the opposites of counting numbers and the number 0.

Students are familiar with integers from their understanding of temperature. Using this context provides a connection to their everyday lives which will strengthen their understanding of integers. Teachers could introduce negative numbers by bringing in a thermometer and asking questions such as:

- What is the temperature today?
- What would be the temperature on the hottest day of summer in Newfoundland and Labrador? coldest day of winter?

Students are expected to represent a given integer using integer tiles. Teachers should model the use of the tiles and ask students to write the integer represented by the tiles. To represent -4 , for example, four red tiles would be used. To represent $+2$, two yellow tiles would be used. In keeping with the theme of temperature, teachers could ask students to represent temperatures such as -4°C , $+3^{\circ}\text{C}$, or 18°C using integer tiles. Explain to students that when there is no $+$ or $-$ sign in front of the number it is assumed to be $+$.

Using the correct mathematical terminology is important in developing student understanding of integers. While in the context of temperatures, society uses 'minus', integers should be described as being 'negative.' This will avoid confusing the sign of the integer with the operation of subtraction.

A number line is a useful tool in helping students understand the relationship between negative and positive integers. Students have worked with number lines in previous grades and will now extend a given number line to the left to represent negative integers. Tape a number line on the floor using cash register tape, painters tape or string. The center of the number line should be labelled 0.

Ask students questions such as the following:

- Where would 1 be located on the number line? 2?
- Where would -1 be located on the number line? -2 ?
- How far away from 0 is $+1$? How far away from 0 is -1 ? What do you notice about these distances?

Students should recognize that integers such as $+1$ and -1 are opposite integers. They are the same distance from 0 but are on opposite sides of 0. Students should realize that positive integers are located to the right of 0 and negative integers are to the left of 0. It is important that they recognize that 0 is neither positive nor negative.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Performance

- Students could play *Representation Match*. (6N7)
- A number is 12 units away from its opposite on a number line. Ask students what the number could be and how they know. (6N7.1)

Paper and Pencil

- Provide students with incomplete number lines and ask them to fill in the missing numbers. (6N7.1)

Journal

- Ask students to explain, in writing, why -4 and $+4$ are closer to each other than -6 and $+6$. (6N7.1)
- Ask students to explain, in writing, why an integer is never an odd number of jumps away from its opposite on a number line. (6N7.1)

Resources/Notes

Authorized Resource

Math Focus 6
Lesson 7:
Representing Integers
TR: pp. 47 – 50
SB: pp. 90 – 92

Note

Demonstrating an understanding of integers concretely is not covered in the textbook. It is essential that students learn how to represent integers using integer tiles. This work is important in grade 7 where students will develop an understanding of zero pairs and explore operations involving integers.

Suggested Resource

<https://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit2.html>

- Representation Match

In this online game students are required to match an integer to its counter representation.

Number

Specific Outcomes

Students will be expected to

6N7 Continued...

Achievement Indicators:

6N7.2 Describe contexts in which integers are used; e.g., on a thermometer.

6N7.3 Place given integers on a number line, and explain how integers are ordered.

6N7.4 Order given integers in ascending or descending order.

Suggestions for Teaching and Learning

Teachers should encourage students to discuss situations in their everyday lives where integers are used. Students' daily experiences with integers might include:

- on a thermometer - temperatures above/below 0 degrees
- in an elevator - floors above/below ground level
- golf scores - above/below par
- elevation - above/below sea level
- money - being in debt/having money
- hockey - a player's plus/minus statistic

Teachers could provide an example of an integer, such as -34, and ask students to describe a situation that could be represented by this number. Teachers could also ask students to represent a given situation with an integer. Owing a friend \$15, for example, can be represented by -15.

When placing integers on a number line, ask students questions such as:

- Is the integer positive or negative?
- Is this integer located to the left or right of 0?
- How many units from 0 is the integer?

Remind students that negative integers are located to the left of 0 and positive integers are located to the right of 0. The magnitude of the given integer determines how many units from 0 the integer is. Students should recognize that positive integers are larger than negative integers.

After placing a given set of integers on a number line students could order them in ascending or descending order. If ordering integers in ascending order students would list the integers from left to right. If ordering integers in descending order students would list the integers from right to left.

Teachers could provide students with a list of integers, such as -5, 3, 6, -1, 2, 4, -3 and have them place them on a number line. Students should explain their reasoning and then order the set of integers in both ascending and descending order.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Journal

- Ask students to describe a situation in which they have encountered something that could be represented with a negative number.
(6N7.2)

Performance

- Ask students to design a game in which positive and negative points may be awarded. Ask students to play and keep track of their score.
(6N7.1, 6N7.3, 6N7.4)
- Ask students if there is a negative number that is greater than a positive number. Ask them to use a number line to explain their thinking.
(6N7.1, 6N7.3)
- Provide students with a blank number line. Give them positive and negative integers to place on the line with them choosing their end points and benchmarks.
(6N7.1, 6N7.3)
- Students may wish to research pro golf players databases where they compile data on scores. Explain that golf scores are reported in positive and negative numbers, where positive numbers show how many shots above par was needed to sink the ball. A negative number would be how many shots under par was needed to sink the ball. On a hole that was par 5, for example, it is suggested that it would take 5 shots to sink the ball. If a player took 3 shots, he/she would score -2 for that hole. If it took him 6 shots to sink the ball, his score would be +1. Ask students to rank players according to their scores.
(6N7.1, 6N7.2, 6N7.3, 6N7.4)
- Create a number line on the board and incorrectly place a negative number on the positive side of the number line. Ask students to decide if this number line is correct and ask them to justify their thinking.
(6N7.1, 6N7.3)
- Joe and John are standing on a number line. Joe is 6 spaces away from John. Joe is standing on a negative number and John is on a positive number. Ask students to determine some possible numbers Joe and John may be standing on. Ask them to explain the strategies used to solve this problem.
(6N7.1, 6N7.3)
- Ask students to research cities in North America that are below sea level, at about sea level and some that are above sea level. Using a chart, ask them to list these cities from lowest elevation to highest.
(6N7.2, 6N7.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 7:

Representing Integers

TR: pp. 47 – 50

SB: pp. 90 – 92

Number

Specific Outcomes

Students will be expected to

6N7 Continued...

Achievement Indicator:

6N7.5 Compare two integers; represent their relationship using the symbols $<$, $>$ and $=$; and verify the relationship, using a number line.

Suggestions for Teaching and Learning

To compare two integers students should think about the placement of each integer on a number line. When using a number line to compare two integers, remind them that the number to the left is always less than the number to the right **or** the number to the right is always greater than the number to the left. Consider the following question:

Which integer is larger: -8 or -5 ?

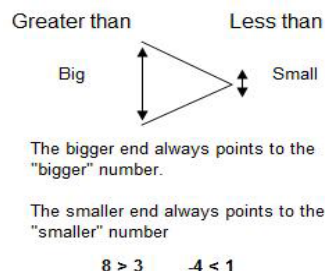
Using a number line, teachers could have one student stand on -5 and another student stand on -8 . Classmates should recognize that the person standing on -8 is further away from 0. Therefore, -8 is less than -5 , or -5 is greater than -8 . This can be written as $-5 > -8$ or $-8 < -5$.

When comparing integers, a common error occurs when students simply look at the magnitude of the integer and do not take into account its sign. Some students may reason that -8 is larger than -5 or $+1$ since 8 is larger than 5 and 1. Remind them that the integer that is furthest to the right is always larger. Students should consult their number lines to verify that their answer is correct.

After comparing two integers using number lines, students may begin to visualize the number line mentally and use reasoning to compare two integers. In comparing -5 and 8, for example, students may quickly conclude that 8 is greater than -5 since a positive integer is always larger than a negative integer. In a similar manner, students may conclude that -4 is greater than -10 since it is closer to 0.

Students sometimes have difficulty with the less than and greater than symbols, $<$ and $>$. One strategy to help students use the symbols correctly is to relate the symbols to the end of an arrow. An arrow usually points to something. In this case it must point to the smaller number.

Another strategy to help students use the symbols involves getting students to look at the symbol as a sideways “V”. Tell students there are two sides to the symbol, a big side and a small side.



General Outcome: Develop Number Sense

Suggested Assessment Strategies

Journal

- Ask students to choose two negative integers. Ask them to compare these numbers by describing a context in which they could be used, such as temperature. They should use this context to compare the integers using the less than/greater than symbols.

(6N7.2, 6N7.5)

- Ask students how many negative integers are greater than -7. Ask them to explain how they know.

(6N7.1, 6N7.3, 6N7.5)

Performance

- Create number cards where there are both positive and negative numbers. Play Integer War where students would pick a card and then compare each. The player with the greatest value would keep the cards. Play continues until all cards are used. The player with the most cards wins.

(6N7.5)

Paper and Pencil

- Ask students to represent the relationship between the following numbers by using $<$, $>$, or $=$:

(i) $6 \underline{\hspace{1cm}} -7$

(ii) $5 \underline{\hspace{1cm}} +5$

(iii) $-4 \underline{\hspace{1cm}} +1$

(6N7.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 8:

Comparing and Ordering Integers

TR: pp. 53 – 57

SB: pp. 94 – 97

Curious Math:

Countdown Clock

TR: pp. 51 – 52

SB: p. 93

Suggested Resource

Resource Link: <https://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit2.html>

- A variety of online games to support 6N7:

Who Am I?

Students ask a series of less than/greater than questions to identify a secret integer.

Diamond Drop

Students grab falling integers and use them to create comparison statements.

Number

Specific Outcomes

Students will be expected to

6N9 Explain and apply the order of operations, excluding exponents, with and without technology (limited to whole numbers).

[C, CN, ME, PS, T]

Achievement Indicator:

6N9.1 Explain, using examples, why there is a need to have a standardized order of operations.

Suggestions for Teaching and Learning

In previous grades, students have added, subtracted, multiplied and divided whole numbers. They will extend this knowledge to evaluate mathematical expressions involving more than one operation (limited to whole numbers). Students will apply the order of operations **excluding** exponents with and without technology.

To emphasise the importance of the order of operations students could be asked to evaluate an expression such as the following:

$$10 + 5 \times 3 - 2$$

Invite students to share their answers with the class and communicate the steps they followed in arriving at the answer. From the discussion, students should recognize that when evaluating an expression involving more than one operation the answer depends upon which operation you perform first.

Provide students with the correct answer of 23. Students should identify which strategy resulted in the correct answer. They should recognize that, in this example, performing the multiplication first and then the addition and subtraction from left to right will result in the correct answer. They should understand that the order of operations ensures that everyone arrives at the same answer. When evaluating an expression that involves more than one operation students must:

- perform the operations inside the brackets first
- next, perform division and multiplication from left to right.
- finally, perform addition and subtraction from left to right.

Teachers could pose a contextual problem to also highlight why there is a need to have a standardized order of operations. Consider the following problem:

Mac bought a scarf which cost \$4.00 and 6 pairs of socks that costs \$7.00 per pair.

Ask students to write an expression to represent the amount of money that Mac spent.

Students may write $4 + 6 \times 7$ or $6 \times 7 + 4$.

General Outcome: Develop Number Sense

Suggested Assessment Strategies*Paper and Pencil*

- Mrs. Smith bought 2 boxes of bars for her three children. Each box of bars has 6 bars in it. Ask students to determine how many bars each child receives. Ask students to write an expression to show the order of operations used to solve the problem.

(6N9.1)

Resources/Notes**Authorized Resource***Math Focus 6*

Lesson 9: Order of Operations

TR: pp. 58 – 61

SB: pp. 98 – 100

Number

Specific Outcomes

Students will be expected to

6N9 Continued...

Achievement Indicators:

6N9.1 (Continued) Explain, using examples, why there is a need to have a standardized order of operations.

6N9.2 Apply the order of operations to solve multistep problems with and without technology; e.g., a computer, a calculator.

Suggestions for Teaching and Learning

In order to determine the correct answer students would have to multiply the $6 \times \$7.00 = \42.00 . This represents the amount of money Mac spend on socks. Then he bought a scarf. The amount of money for the scarf (\$4.00) must be added to the \$42.00. Students should recognize that if they performed the addition first, $4 + 6 = 10$, and then the multiplication, they would get \$70.00. Considering the context of the problem, it would not make sense to add the 4 and 6 (cost of scarf + number of pairs of sock).

Students should be given opportunities to apply the order of operations to a variety of problems. Students should be asked to evaluate expressions such as the following:

- $12 + 6 \div 3$
- $5 \times (10 + 2)$
- $24 \div 3 - 6 \times 2$
- $4 \times 9 + (3 - 1) \div 2$
- $8 - (4 + 32 \div 2) \div 10$

When working with large numbers, the use of a calculator is appropriate. Students should be aware that some calculators will not automatically apply the order of operations to evaluate expressions. They will need guidance and practice in using their calculators to solve problems involving the order of operations.

General Outcome: Develop Number Sense

Suggested Assessment Strategies

Paper and Pencil

- Ask students to place a set of brackets into this expression to explore how many different solutions are possible.

$$10 + 2 \times 8 - 6 \div 2$$

(6N9.1, 6N9.2)

- Ask students to evaluate the following:

(i) $5 \times 3 - 1$

(ii) $6 + 20 \div 4$

(iii) $(7 + 3) \div 2$

(iv) $8 \times (7 - 2) \div 4 + 6$

(6N9.1, 6N9.2)

- Molly was doing her math homework when all of a sudden her pet mouse came along and began chewing her paper. When she looked, she noticed all the operation symbols were missing. Ask students to help Molly put these symbols and numbers back to make the statements true. Brackets should be included where necessary.

$$12 \ ? \ 8 \ ? \ 3 \ ? \ 2 = 26$$

$$8 \ ? \ 6 \ ? \ 4 \ ? \ 2 = 10$$

(6N9.1, 6N9.2)

- Loretta bought 8 bags of green grapes. Each bag costs \$3.00. She has a coupon that will give her \$5.00 off her purchase. Create an expression that represents the amount of money that she will pay for her grapes. Evaluate the expression to determine the amount of money Loretta spent.

(6N9.1, 6N9.2)

Performance

- Ask students to locate several skill testing questions that have been used in contests. Ask students to answer the question and compare the answers when following the order of operations and the answers when you do not follow them. Discuss the importance, in terms of the contest, of following these rules.

(6N9.1, 6N9.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 9: Order of Operations

TR: pp. 58 – 61

SB: pp. 98 – 100

Math Game:

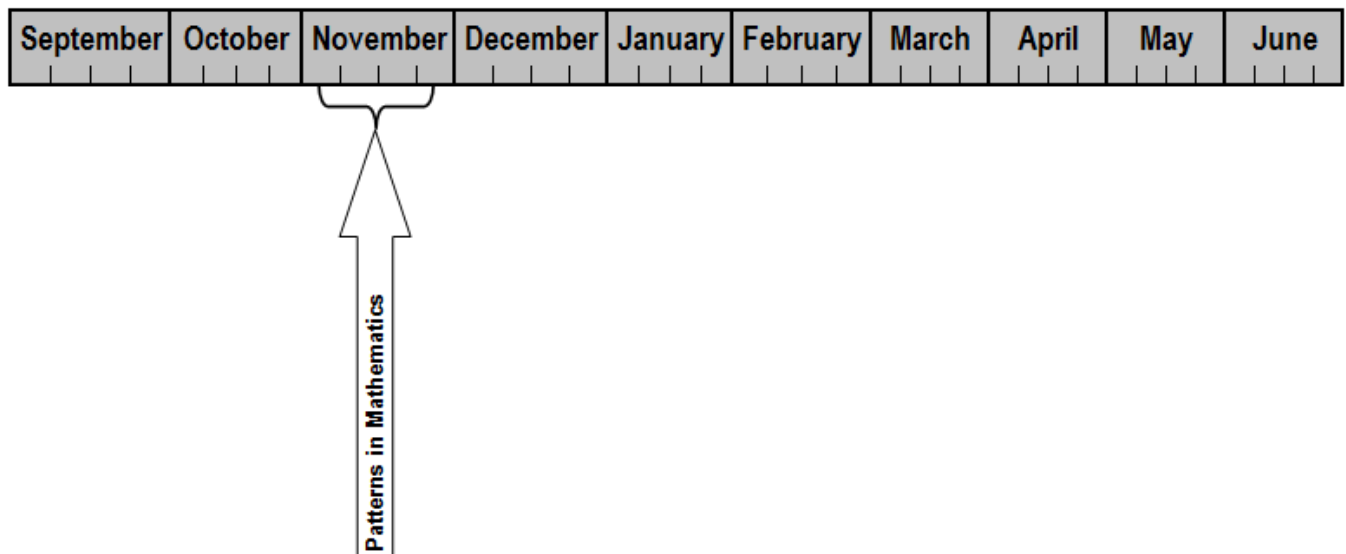
Four in a Row

TR: pp. 62 – 63

SB: p. 101

Patterns in Mathematics

Suggested Time: 3 Weeks



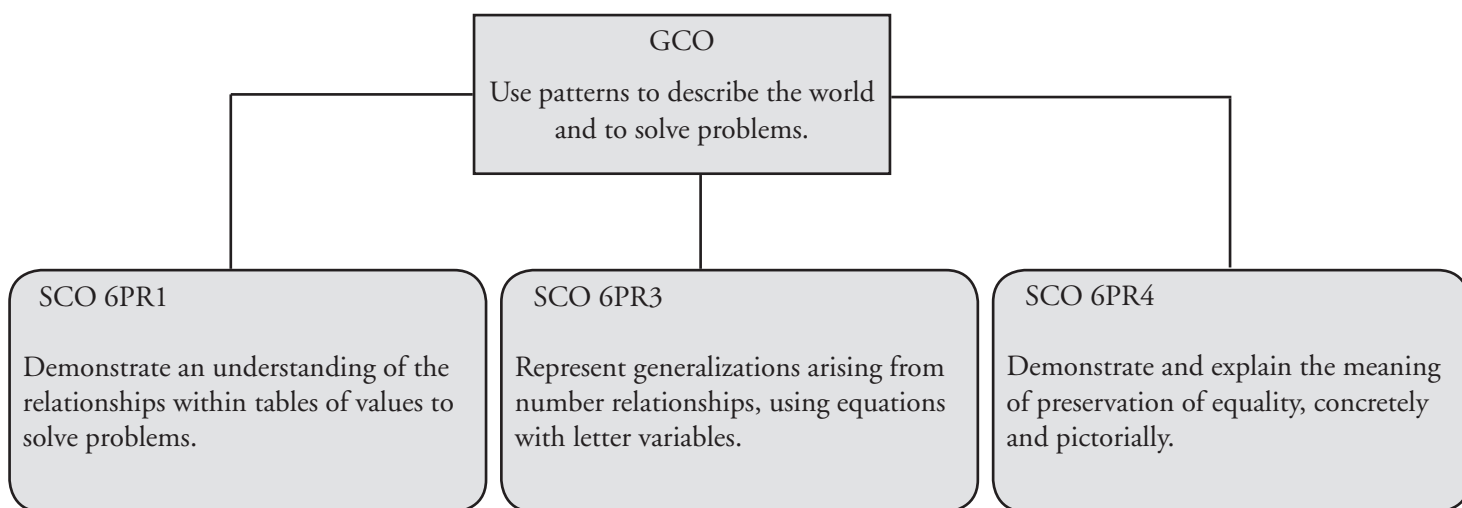
Unit Overview

Focus and Context

Grade 6 students will build upon previous knowledge of patterns and relations as they explore various patterns, identify pattern rules, and translate between concrete and pictorial representations of patterns in charts and tables. Students will explore patterns within the columns of a given table of values as well as the relationship **between** columns. They will represent these patterns using mathematical expressions. Through their understanding of representing patterns concretely, extending patterns, finding missing values and creating algebraic expressions, students will use their knowledge of patterns to solve problems. A solid foundation in analyzing and understanding patterns is fundamental to student success and progress throughout intermediate and high school algebra.

Students will also explore the preservation of equality within algebraic equations. Concrete models, such as a balance scale, will be used to demonstrate preservation of equality and identify equivalent equations. Solving such equations will be addressed in Grade 7.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Patterns and Relations		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5PR1 Determine the pattern rule to make predictions about subsequent elements. [C, CN, PS, R, V]</p> <p>5PR2 Solve problems involving single-variable, one-step equations with whole number coefficients and whole number solutions. [C, CN, PS, R]</p>	<p>6PR1 Demonstrate an understanding of the relationships within tables of values to solve problems. [C, CN, PS, R]</p> <p>6PR3 Represent generalizations arising from number relationships, using equations with letter variables. [C, CN, PS, R, V]</p> <p>6PR4 Demonstrate and explain the meaning of preservation of equality, concretely and pictorially. [C, CN, PS, R, V]</p>	<p>7PR1 Demonstrate an understanding of oral and written patterns and their equivalent linear relations. [C, CN, R]</p> <p>7PR3 Demonstrate an understanding of preservation of equality by:</p> <ul style="list-style-type: none"> • modelling preservation of equality, concretely, pictorially and symbolically • applying preservation of equality to solve equations <p>[C, CN, PS, R, V]</p> <p>7PR4 Explain the difference between an expression and an equation. [C, CN]</p> <p>7PR5 Evaluate an expression, given the value of the variable(s). [CN, R]</p> <p>7PR6 Model and solve, concretely, pictorially and symbolically, problems that can be represented by one-step linear equations of the form $x + a = b$, where a and b are integers. [CN, PS, R, V]</p> <p>7PR7 Model and solve, concretely, pictorially and symbolically, problems that can be represented by linear equations of the form:</p> <ul style="list-style-type: none"> • $ax + b = c$ • $ax - b = c$ • $ax = b$ • $\frac{x}{a}, a \neq 0$ <p>where a, b and c are whole numbers. [CN, PS, R, V]</p>

Mathematical Processes

[C] Communication
[CN] Connections
[ME] Mental Mathematics and Estimation

[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR1 Demonstrate an understanding of the relationships within tables of values to solve problems.

[C, CN, PS, R]

Achievement Indicators:

6PR1.1 Create a concrete or pictorial representation of the relationship shown in a table of values.

6PR1.2 Describe the pattern within each column of a given table of values.

6PR1.3 State, using mathematical language, the relationship in a given table of values.

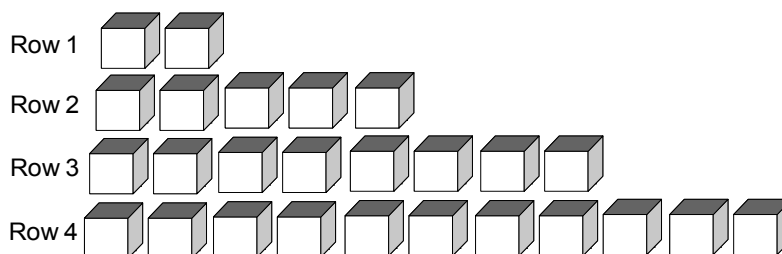
6PR1.4 Predict the value of an unknown term, using the relationship in a table of values, and verify the prediction.

Suggestions for Teaching and Learning

In Grades 4 and 5 students completed tables of values given simple expressions involving one operation. In Grade 5 students have determined pattern rules to make predictions about subsequent elements. More specifically, they have extended patterns, described given patterns, and have written mathematical expressions to represent a given pattern. In Grade 6, they will build upon this knowledge to explore more complex patterns that involve multiple operations.

Students represented table of values using concrete materials in Grade 5. Provide them with a table of values, such as the one below, and ask them to create a concrete and pictorial representation of the relationship shown in the table.

Row number	1	2	3	4
Number of Blocks	2	5	8	11



Students described pattern rules in Grade 5. Remind them that a pattern rule is a description of how the pattern starts and how it continues (the amount of increase or decrease). Given a table of values, students should describe the pattern within each column, using appropriate mathematical language. When describing patterns within a column of a given table of values, students sometimes overlook the starting value of the pattern. In the table above, students may describe the number of rows as “going up by 1” and the number of blocks as “going up by 3”. Both of these descriptions have omitted the starting value. Students should ensure they include the number the pattern begins with. The appropriate description of each would be: “Rows start at 1 and **increase** by 1 each time. Blocks starts at 2 and **increase** by 3 each time”.

Based on the observed pattern in a given table of values, students should be able to predict the value of an unknown term. They should be able to determine the number of blocks in row 7, for example. Encourage students to extend the table of values to answer this question – row 5 would have 14 blocks, row 6 would have 17 blocks and row 7 would have 20 blocks.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Performance

- Provide the following table of values. Ask students to use the green triangles from the set of pattern blocks to represent what the worm would look like on day 3, 4 and 5.

Age/Days	Number of Triangles
1	4
2	6
3	8
4	10
5	12

E.g., This is a one-day-old worm:



(6PR1.1)

- A train has 8 wheels and pulls cars each having 4 wheels. The table of values below shows the number of wheels on a train with different numbers of cars being pulled. Ask students to draw or make a model of the train with each number of cars being pulled.

Number of cars	Number of wheels
0	8
1	12
2	16
3	20
4	24

(6PR1.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Identifying Number Patterns

Teacher Resource (TR):

pp. 13 – 17

Student Book (SB): pp. 4 – 7

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR1 Continued...

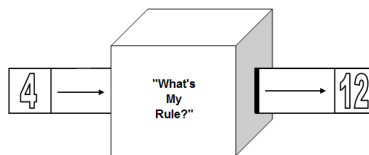
Achievement Indicators:

6PR1.5 Formulate a rule to describe the relationship between two columns of numbers in a table of values.

Suggestions for Teaching and Learning

Students may suggest a guess and check to develop pattern rules between two columns of numbers in a table of values. In the beginning stages this is an appropriate strategy. Teachers should begin with a simple relationship involving multiplication, for example, before moving on to more complicated pattern rules.

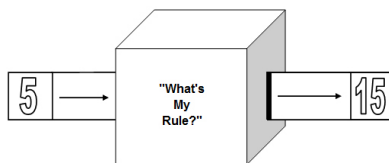
Teachers could begin by exploring input/output machines. Prepare sentence strips with numbers on both ends as shown below. Insert the sentence strip so students can see input and output numbers. Challenge students to come up with several different operations or combinations of operations that could be used to get the output from the initial input. Consider the following example:



Ask students “What rule could have been used to get an output of 12 from an input of 4”?

Students may reply “We multiplied by 3”, “We added 8”, “We doubled the input and added 4”, etc.

Record all suggestions and then present another input/output situation based on the same pattern rule. For example, 5 for the input and 15 for the output.



Ask students, “Which rule from the first input/output situation could also be used to describe an input of 5 and an output of 15”?

Students should realize that adding 8 will not work. Multiplying by 3, however, does result in the desired output. They should conclude that the pattern rule must be “multiply the input by 3.” Present another input/output pair to allow students to verify that this is the correct rule.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Journal

- Ask students to identify the pattern within each column of the given table:

Hour	Snowfall (cm)
1	7
2	12
3	17
4	22
5	27

What will be the snowfall after 7 hours?

(6PR1.2, 6PR1.3, 6PR1.4)

Performance

- “What’s My Rule” - Provide a student with an operation card such as $+2$, $\times 3$, or -1 . They should not share their card with anyone. A second student should suggest an input number between 1 and 10. The student with the operation card will perform the operation mentally on this input value and report the result to the class. The class should record the result in a table of values. Ask the class to identify what operation was performed on the input. Repeat the process using the same operation but a new input to verify the class’s answer. This activity could be extended to include pattern rules that involve more than one operation.

(6PR1.2, 6PR1.3, 6PR1.4, 6PR1.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Identifying Number Patterns

TR: pp. 13 – 17

SB: pp. 4 – 7

Lesson 2: Describing Relationships in Tables

TR: pp. 18 – 22

SB: pp. 8 – 11

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR1 Continued...

Achievement Indicators:

6PR1.5 (Continued) Formulate a rule to describe the relationship between two columns of numbers in a table of values.

6PR1.4 (Continued) Predict the value of an unknown term, using the relationship in a table of values, and verify the prediction.

Suggestions for Teaching and Learning

Students should build connections between the amount of increase or decrease and the pattern rule. This will help them more efficiently determine the rule to describe the relationships between two columns of numbers in a table of values. Provide students with a question such as the following:

Emily is saving her money for a new doll. The table of values below shows the amount of money she has at the end of each month.

Month	Amount of Money (\$)
1	10
2	15
3	20
4	25

If the doll costs \$100, will she have enough money saved by the end of the year (assuming month 1 is January)?

While some students might suggest extending the table of values to determine the amount of money she would have at the end of the year, this method can be very time consuming. Ask students if there is a way they can determine the amount of money Emily has if they know the month number. They should recognize that the amount of money increases by \$5.00 each month. This suggests that the month number is multiplied by 5. If they apply this pattern rule, however, it does not result in the correct amounts of money (the values are \$5.00 less than what Emily actually has).

To compensate for this difference, students should realize that they would have to add \$5.00 to each number. This would result in the pattern rule “multiply the month number by 5 and add 5.”

Students should also formulate the rule to describe decreasing patterns. Consider the following example:

Carlos received \$200.00 for his birthday. The table of values below shows the amount of money Carlos has remaining at the end of each week:

Week	Amount of Money (\$)
0	200
1	175
2	150
3	125

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Performance

- Provide students with statues made of a single column of cubes (see diagram below). A painter has been hired to paint all the faces of the cube that are visible. Students should first build the model using multilink cubes or blocks. Then they should create a table of values to record the number of faces that need to be painted for towers 1, 2, 3, 4 and 5. Ask students to determine the number of faces that would have to be painted for a tower containing 10 blocks? 20 blocks?



(6PR1.2, 6PR1.3, 6PR1.4, 6PR1.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Describing Relationships in Tables

TR: pp. 18 – 22

SB: pp. 8 – 11

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR1 Continued...

Achievement Indicators:

6PR1.5 (Continued) Formulate a rule to describe the relationship between two columns of numbers in a table of values.

6PR1.4 (Continued) Predict the value of an unknown term, using the relationship in a table of values, and verify the prediction.

6PR1.6 Generate values in one column of a table of values, given values in the other column and a pattern rule.

Suggestions for Teaching and Learning

- How much money did Carlos spend each week?
- Write a rule to determine how much money Carlos has after any number of weeks.

In this case, students should recognize that Carlos began with \$200. This amount decreasing by \$25.00 for each week that passes. The pattern rule is “multiply the number of weeks by 25 and subtract it from 200.”

Students sometimes have difficulty determining a rule to describe the relationship between two columns in a table of values. They should be given many opportunities to develop these pattern rules. Through classroom activities students should recognize that the amount of increase or decrease in the output values is the number by which the input is being multiplied. For an increasing table, when the product of this amount of change and a given input is not equal to its corresponding output, they must then determine the amount of increase or decrease required to arrive at that output. For a decreasing table, students must subtract this from the starting value.

It is important to note that using the difference in the outputs to determine a pattern rule in this manner will only work if the inputs are consecutive numbers. (e.g. 1, 2, 3, 4, 5...). Therefore, when asking students to determine pattern rules be sure to use consecutive input numbers.

Given a pattern rule, students should be able to generate the corresponding table of values. Consider the following examples:

- The pattern rule for the cost of Judy’s cell phone is multiply the number of internet visits by \$2.00 and add \$10.00.

Number of Internet Visits	Cost per Month
1	12
2	
3	
4	
5	

- The pattern rule for the number of blocks in a given diagram is 40 subtract the diagram number multiplied by 2.

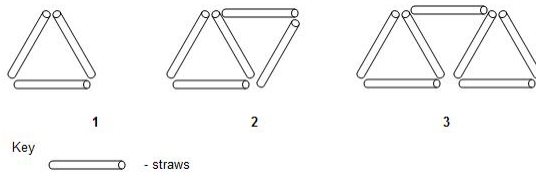
Diagram Number	Number of Blocks
1	38
2	
3	
4	
5	

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Performance

- Ask students to create a table of values to represent the pattern below.



- Write a pattern rule to describe the change within each column.
- Predict the number of straws for diagram 10.

(6PR1.4, 6PR1.5)

Paper and Pencil

- Ask students to determine a pattern rule to describe the relationship between the output and input values in the following table:

Input	Output
1	5
2	9
3	13
4	17

Ask them to predict the output if the input is 7.

(6PR1.4, 6PR1.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Describing Relationships in Tables

TR: pp. 18 – 22

SB: pp. 8 – 11

Lesson 3: Using Expressions to Create Tables

TR: pp. 23 – 27

SB: pp. 12 – 15

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR1 Continued...

Achievement Indicators:

6PR1.7 Create a table of values to record and reveal a pattern to solve a given problem.

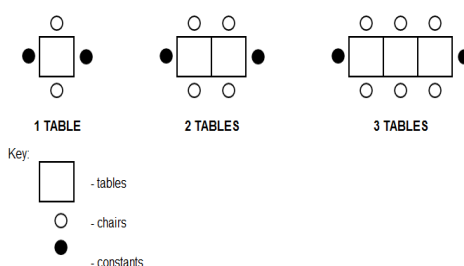
6PR1.5 (Continued) Formulate a rule to describe the relationship between two columns of numbers in a table of values.

6PR1.4 (Continued) Predict the value of an unknown term, using the relationship in a table of values, and verify the prediction.

Suggestions for Teaching and Learning

When presented with a problem students should be able to create a table of values and use it to identify the patterns that exist. They should use these patterns to solve a given problem. Consider the following example:

Four students can be seated around a square table, with one chair on each side. Tables could be added as shown in the diagram below:



Ask students how many chairs would be needed if there were 20 tables.

Students could model this situation using manipulatives such as linking cubes and counters (or real tables and chairs if available). Pattern blocks or interactive whiteboard graphics could also be used to create the model. Alternatively, students could represent this situation pictorially.

Students should generate the table of values that shows the relationship between the number of tables and the number of chairs:

Number of Tables	Number of Chairs
1	4
2	6
3	8
4	10
6	12

Ask students questions such as:

- What is the pattern rule for the number of tables?
- What is the pattern rule for the number of chairs?
- What is the pattern rule that describes the relationship between the number of chairs and the number of tables?
- How many chairs will be needed if there are 20 tables?

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Journal

- Present the following scenario to the class:

Ted is having a pot-luck dinner. He has prepared 4 dishes of food for the dinner and told all his invited guests to bring two dishes each.

The number of dishes at the party depends on the number of guests that come.

- Write a pattern rule in words that could be used to determine the number of dishes that will be at the dinner for any number of guests that might attend.

- Use this pattern rule to complete the table of values below.

Number of Guests	Number of Dishes
0	
1	
2	
3	
4	

(6PR1.5, 6PR1.6, 6PR1.8)

Paper and Pencil

- Present the following situation:

Sheila works in a computer repair shop. She gets paid \$75 a day plus \$5 for every computer she fixes.

- Create a table of values to display the total amount of money Sheila could make in a day for any number of computers she might fix.
- Write a pattern rule for the total amount of money Sheila could make in a day for any number of computers she might fix.
- Use your pattern rule to determine how much money Sheila would make if she fixed 12 computers in one day.

(6PR1.4, 6PR1.7, 6PR1.8)

- Tell students that the average person's hair grows 3 cm in one month. Ask students to create a table that would help them determine how much Dan's hair would have grown after 6 months.

(6PR1.4, 6PR1.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Describing Relationships in Tables

TR: pp. 18 – 22

SB: pp. 8 – 11

Lesson 3: Using Expressions to Create Tables

TR: pp. 23 – 27

SB: pp. 12 – 15

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR1 Continued...

Achievement Indicators:

6PR1.8 Identify missing elements in a given table of values.

6PR1.9 Identify errors in a given table of values.

Suggestions for Teaching and Learning

Students have used a given pattern rule to complete the right column of a table of values. They will now be expected to find missing elements in either column of an incomplete table using a given pattern rule. Inverse operations could be used to identify missing elements in a table of values. Consider the following example where the pattern rule is multiply the input by 3.

Input	Output
2	
4	
	18
	24
10	

Students will complete the first two missing values by simply applying the pattern rule, multiply the input by 3. To find the third and fourth missing values they will have to work backwards (or use the inverse operation). To determine the third missing value, for example, students should ask themselves “What number multiplied by 3 would equal 18?”

Students should analyze a given table of values, identify the errors in it, and communicate their reasoning for questions such as:

Sam has a weekly paper route. He gets paid \$30 a week. The following table of values shows his earnings over a 5 week period. Identify the errors in this table.

Weeks	Earnings (\$)
1	30
2	60
3	90
4	100
5	130

As they think about the pattern rule, the increase in earnings should be \$30. The pattern rule is multiply the number of weeks by 30. Testing the pattern rule will help them identify the errors in Sam’s earnings.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Paper and Pencil

- Ask students to solve the problem:
 - Jill works in a store for a wage of \$9 per hour. Help Jill complete the following table to show her total earnings after each hour worked in a day. Some values were omitted on each side of the table. Find the missing values:

Hours Worked	Total Earnings
2	
	36
6	
	72

Ask students to explain how they derived each omitted value using the pattern rule.

- Jill wants to buy two pairs of jeans that cost \$46.00 each. How many hours does she need to work in order to buy the jeans?

(6PR1.8)

- Teachers could create tables containing an error in the right column and ask students to identify the value that does not fit the pattern. Ask students to explain why the value in question is incorrect.

(6PR1.8)

Journal

- Ask students to find the missing values in the table below, based on the patterns observed.

Number of people	Number of sandwiches
3	6
6	
	18
12	24
15	
	36

- How many sandwiches would each person get?
- How many sandwiches would be needed if 60 people attended the picnic?
- How many could attend if 90 sandwiches were provided?

(6PR1.9)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Using Expressions to Create Tables

TR: pp. 23 – 27

SB: pp. 12 – 15

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR3 Represent generalizations arising from number relationships, using equations with letter variables.

[C, CN, PS, R, V]

Achievement Indicators:

6PR3.1 Describe the relationship in a given table, using a mathematical expression.

6PR3.2 Represent a pattern rule, using a simple mathematical expression such as $4d$ or $2n + 1$.

Suggestions for Teaching and Learning

In Grade 5, students represented simple patterns using mathematical expressions such as $r + 1$, $p - 6$. In Grade 6, students represent more complex patterns involving multiplication and addition or subtraction. They have already described pattern rules in words throughout this unit. They will now translate their pattern rule into a mathematical expression. While students will not be expected to explain the difference between an equation and an expression until Grade 7, it is important that correct language is being used. An equation is a mathematical statement where two expressions are equal. An expression is a mathematical phrase made up of numbers and/or variables connected by operations.

Teachers could begin by revisiting previous activities from this unit. Ask students to write the mathematical expressions for the pattern rules that were written in words. Start with an example that involves only one operation:

- When Mary visits her grandparents she likes to go to the beach to collect beach rocks. She collected 12 on the first visit. Ask students to use the table below to determine how many beach rocks Mary would have collected after 4 visits. Then ask them to determine the mathematical expression that represents the relationship between the number of rocks collected and the number of visits. Using this expression, students should determine how many rocks Mary would have collected after 8 visits to her grandparents. How many visits would it take to collect 120 rocks?

Visits	Number of Rocks Collected
1	12
2	24
3	36
4	

Teachers could ask students questions such as:

- How would the table of values and the expression change if the number of rocks started with 12 and increased by 10 each visit?
- How would the table of values and the expression change if the number of rocks started with 20 and increased by 12 each visit?
- How would the table of values and the expression change if the number of rocks started with 6 and increased by 8 each time?

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Journal

- Ask students to use words to describe the pattern rule for each expression:
 - $p - 3$
 - $3 - p$

Explain how the position of the variable changes the meaning of the expression in each case.

Would this also apply to the following expressions?

 - $p + 3$
 - $3 + p$

(6PR3)

Performance

- Ask students to match each of the following situations with the correct expression:

• Harry is twice as old as Noel	$4n + 2$
• Susan has a bag of candy and gave away four	$2n$
• Margot has four packages of hockey cards and two individual cards	$n + 2$
• Harry is two years older than Noel	$4 - n$
• Susan has four dolls and gives some away	$n - 4$
- Teachers could create a deck of cards containing pattern rules in words and their corresponding expressions:
 - Double a number
 - Five more than a number
 - Three less than a number
 - A number less than ten
 - Six more than twice a number
 - One less than triple a number

Students should match each pattern rule with the correct expression.

(6PR3.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Using Expressions to Create Tables

TR: pp. 23 – 27

SB: pp. 12 – 15

Lesson 6: Solving Problems Using Patterns

TR: pp. 42 – 45

SB: pp. 24 – 26

Supplementary Resource

Making Math Meaningful to Canadian Students K-8 – Marian Small

- Support for SCO 6PR3 can be found on pp. 582 – 588

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR3 Continued...

Achievement Indicators:

6PR3.1 (Continued) Describe the relationship in a given table, using a mathematical expression.

6PR3.2 (Continued) Represent a pattern rule, using a simple mathematical expression such as $4d$ or $2n + 1$.

Suggestions for Teaching and Learning

Students should also write mathematical expressions to describe relationships involving more than one operation.

- The table shown represents the cost of renting an arena for a birthday party.

Number of children	Total cost (\$)
0	\$250
1	\$260
2	\$270
3	\$280
4	\$290

Ask students to determine the pattern rule that describes the relationship between the total cost and the number of children attending the party. Students should recognize the pattern rule is “multiply the number of children by 10 and then add 250.”

To translate the pattern rule into a mathematical expression students must decide on a variable to represent the number of children.

Encourage students to define their variable. The number of children, for example, could be represented by the variable n . Students should use their pattern rule in words to describe the relationship using a mathematical expression: $10n + 250$.

Students should be able to interpret a mathematical expression in terms of the pattern rule. When comparing two mathematical expressions such as $2n + 3$ and $n + 3$ they should recognize that while both involve adding three they do not represent the same pattern rule. The expression $2n + 3$ involves an increase of 2, while $n + 3$ only involves an increase of 1. In a similar manner, $4n + 2$ and $4n + 3$ do not represent the same pattern rule even though both involve an increase of 4 each time.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Performance

- Four Corners- Provide students with a question, such as the following:
The school is taking a group of students bowling. It costs \$50 to rent the bowling alley plus an additional \$3 per student for their shoe rentals. Write an expression to represent the total cost for any number of students.

(A) $50n + 3$

(B) $3n + 50$

(C) $50n - 3$

(D) $3n - 50$

Place one answer in each of the four corners of the classroom. Students should go to the corner which they think is the correct answer. They should justify their choice.

(6PR3.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Using Expressions to Create Tables

TR: pp. 23 – 27

SB: pp. 12 – 15

Lesson 6: Solving Problems Using Patterns

TR: pp. 42 – 45

SB: pp. 24 – 26

Lesson 4: Comparing Expressions

TR: pp. 28 – 31

SB: p. 16

Curious Math:

Clock Number Patterns

TR: pp. 32 – 33

SB: p. 17

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR3 Continued...

Achievement Indicators:

6PR3.1 (Continued) Describe the relationship in a given table, using a mathematical expression.

6PR3.2 (Continued) Represent a pattern rule, using a simple mathematical expression such as $4d$ or $2n + 1$.

Suggestions for Teaching and Learning

Teachers should present students with a variety of pattern rules and ask them to represent each pattern rule using a mathematical expression. Consider the following:

- The cost to join minor hockey is \$120.00 per player. Each player must pay an additional fee of \$5.00 for each practice.

The expression $5p + 120$ represents this pattern rule, where ' p ' represents any number of practices. Students should use this expression to generate a table of values showing total costs for various possible numbers of practices.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Paper and Pencil

- Give students the following situation: You are going to play paintball with your friends. It costs \$20 for admission and an additional \$5 for every round of balls. This relationship can be represented by the expression $5b + 20$. Use this pattern rule to complete the table of values below.

Number of Rounds	Total Cost
1	25
2	
3	
4	
5	

(6PR3)

- Gloria is going to a community celebration. Admission is \$5 and each activity costs \$2. Ask students to:
 - Use words to describe how to find the total amount of money Gloria will spend for any number of activities that she may participate in.
 - Write an expression to represent the above situation.
 - Use your expression to create a table of values showing how much Gloria will spend if she takes part in 0 to 5 activities.

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Using Expressions to Create Tables

TR: pp. 23 – 27

SB: pp. 12 – 15

Lesson 6: Solving Problems Using Patterns

TR: pp. 42 – 45

SB: pp. 24 – 26

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to

6PR4 Demonstrate and explain the meaning of preservation of equality, concretely and pictorially.

[C, CN, PS, R, V]

Achievement Indicators:

6PR4.1 Model the preservation of equality for addition, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

6PR4.2 Model the preservation of equality for subtraction, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

6PR4.3 Model the preservation of equality for multiplication, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

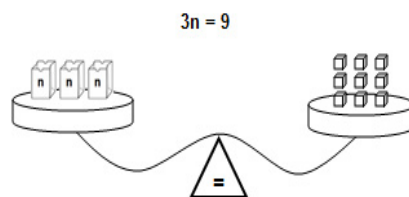
6PR4.4 Model the preservation of equality for division, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

Suggestions for Teaching and Learning

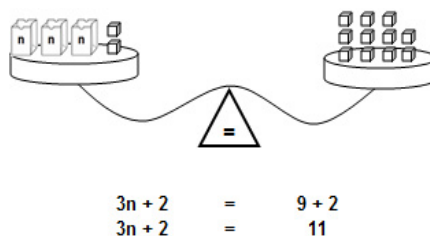
In Grade 5, students solved problems involving single-variable, one-step equations with whole number coefficients and whole number solutions. The focus in Grade 6 is demonstrating an understanding of preservation of equality. In order for equations to be equivalent, both sides of the equation must be changed in the same way. In other words, the same operations must be performed on each side of the equation. $3n + 1 = 7$ and $3n = 6$ are equivalent equations, for example, since 1 is subtracted from each side in the first equation, resulting in the second equation. This is the preservation of equality.

Students should use manipulatives such as balance scales, linking cubes, counters, and bags to model the preservation of equality. When modelling equations, using the pan balance, bags can be used to represent variables (unknown amounts) and multi-link cubes or blocks used to represent numbers.

Teachers should model a simple equation on a pan balance such as $3n = 9$.



Ask students to add 2 to one side and observe what happens. Ask students how they can make the scale balanced again (maintain equality). Students should add 2 to the other side of the scale. Repeat this process for other constants. Students should observe that as long as they add the same amount to each side equality is preserved.



Since students added 2 units to both sides, $3n = 9$ and $3n + 2 = 11$ are equivalent equations.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Performance

- Ask students to draw or model (using a two pan-balance or number line) each set of equations below. Determine if each pair of equations are equivalent or not. Explain how you know.

- $n + 2 = 6$ and $n + 3 = 7$
- $2m + 1 = 9$ and $2m + 2 = 8$
- $5p + 3 = 18$ and $4p + 3 = 18$
- $4y = 20$ and $8y = 40$
- $3k = 12$ and $9k = 24$

(6PR4.1)

- Provide cards with the following equations:

$$\begin{array}{cccc}
 2s = 4 & 3 + 2s = 6 & 1 + s = 5 & 18 = 8s + 2 \\
 3 + 2s = 5 & 6s + 3 = 27 & s = 6 & 9 = 4s + 1 \\
 s + 30 = 36 & 6 + 4s = 10 & 2s + 1 = 5 & 3s = 18 \\
 6s + 1 = 25 & 7 + 2s = 10 & 4 + 4s = 20 & s + 24 = 30
 \end{array}$$

Lay out the equation cards (face up) so students can see what is on the cards. Match the equation card with its corresponding equivalent equation. When all equation cards are matched, choose one equation and create a word problem. Ask students to switch word problems and solve one belonging to a classmate.

(6PR4.5)

Journal

- Ask students if $2n + 2 = 6$ and $2n + 4 = 6$ are equivalent equations. Explain why or why not. Use a model to represent each equation.

(6PR4.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Equivalent Equations

TR: pp. 34 – 41

SB: pp. 20 – 23

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to
6PR4 Continued...

Achievement Indicators:

6PR4.1 (Continued) Model the preservation of equality for addition, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

6PR4.2 (Continued) Model the preservation of equality for subtraction, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

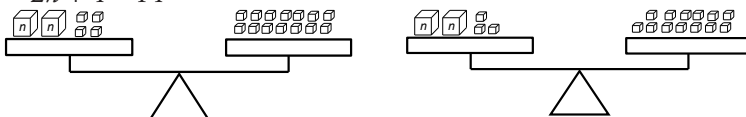
6PR4.3 (Continued) Model the preservation of equality for multiplication, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

6PR4.4 (Continued) Model the preservation of equality for division, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process.

Suggestions for Teaching and Learning

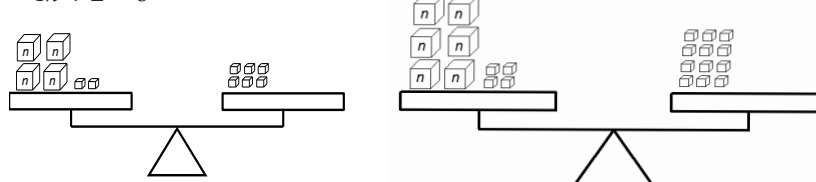
Students should also model the preservation of equality for subtraction, multiplication and division. Consider the following examples:

- $2n + 4 = 14$



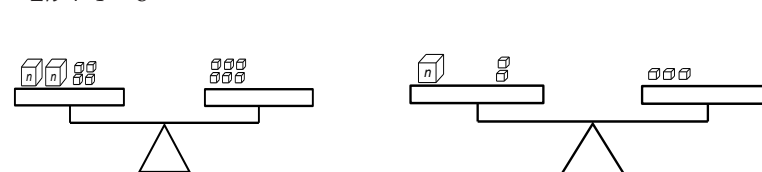
$2n + 3 = 13$ is an equivalent equation since the same amount (1 unit) was subtracted from both sides.

- $4n + 2 = 6$



$8n + 4 = 12$ is an equivalent equation since both sides of the scale were doubled.

- $2n + 4 = 6$



$n + 2 = 3$ is an equivalent equation since both sides of the scale were halved.

Once students have had experience creating equivalent equations using concrete materials, they could model the preservation of equality using an online interactive balance scale.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Performance

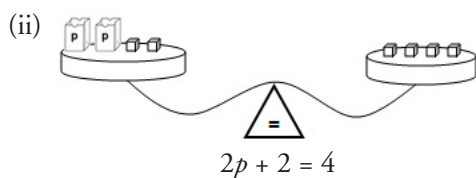
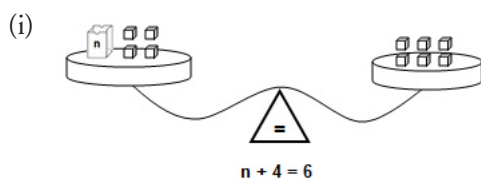
- Ask students to draw or model another equation that is equivalent to the first equation shown below. Explain why the model you created is equivalent to the original.



Are there other ways of showing equivalent equations using different operations? Explain.

(6PR4.1, 6PR4.2, 6PR4.3, 6PR4.4)

- Draw or model another equation that is equivalent to each equation shown below using multiplication. Explain why the model you drew/made is equivalent to the original.



(6PR4.3)

- Ask students to write an equation to represent the following situations:
 - Bethany is 3 years older than Toby. Toby is 21 years old. Write and model an equation to represent the problem. Write an equivalent equation to represent the problem that preserves equality.
 - There are 11 muffins on a tray. There were 24 at the start. Some have been eaten. How many muffins are missing from the tray? Write and model an equation to represent the problem. Write an equivalent equation to represent the problem that preserves equality.

(6PR4.1, 6PR4.2, 6PR4.3, 6PR4.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Equivalent Equations

TR: pp. 34 – 41

SB: pp. 20 – 23

Suggested Resource

<https://k12pl.nl.ca/curr/k-6/math/grade-6/links/unit3.html>

- The Interactive Whiteboard activity provides an opportunity for teachers and students to model equivalent equations by using a balance scale.

Patterns and Relations (Patterns)

Specific Outcomes

Students will be expected to
6PR4 Continued...

Achievement Indicator:

6PR4.5 Write equivalent forms of a given equation by applying the preservation of equality and verify using concrete materials, e.g., $3b = 12$ is same as $3b + 5 = 12 + 5$ or $2r = 7$ is the same as $3(2r) = 3(7)$.

Suggestions for Teaching and Learning

Provide students with an equation such as $4n + 2 = 6$ and ask them to write three equivalent equations by applying the preservation of equality and verify using the balance scale. Solving these equations will be addressed in Grade 7. The focus here is on demonstrating an understanding that when you add, subtract, multiply, or divide **any** value to both sides of the equation it remains balanced. Solving an equation does not guarantee this understanding:

$$4n + 2 = 6$$

$$4n + 2 - 2 = 6 - 2$$

$$4n = 4$$

$$n = 1$$

$$4n + 2 = 6$$

$$4n + 2 + 5 = 6 + 5$$

$$4n + 7 = 11$$

To determine preservation of equality between two equations students should determine whether:

- an equal amount has been added or subtracted to both sides.
- each side was multiplied or divided by the same amount.

Remind students that for multiplication and division **all terms** must be multiplied or divided by the same number. Consider $2n + 3 = 7$ and $4n + 3 = 7$, for example. These equations would not be equivalent since only the $2n$ was multiplied by 2.

General Outcome: Use Patterns to Describe the World and to Solve Problems.

Suggested Assessment Strategies

Journal

- Give students the following prompt:

The distance from Irishtown to Pouch Cove is 720 km. A bus left Pouch Cove at 8:00 am travelling west at an average speed of 90 km/hr. A car leaves Irishtown at 9:00 am travelling east at an average speed of 120 km. At what time will the bus and the car meet each other?

Sample solution: In order to solve this problem, students should create a table of values for each vehicle and compare these to solve the problem:

The bus and car will meet at 12:00 noon.

Bus	
Hour h	Distance (km) $90h$
8:00 AM	0
9:00 AM	90
10:00 AM	180
11:00 AM	270
12 noon	360

Car	
Hour h	Distance (km) $120h$
9:00 AM	0
10:00 AM	120
11:00 AM	240
12 noon	360
1:00 PM	480

(6PR1.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Equivalent Equations

TR: pp. 34 – 41

SB: pp. 20 – 23

Math Game:

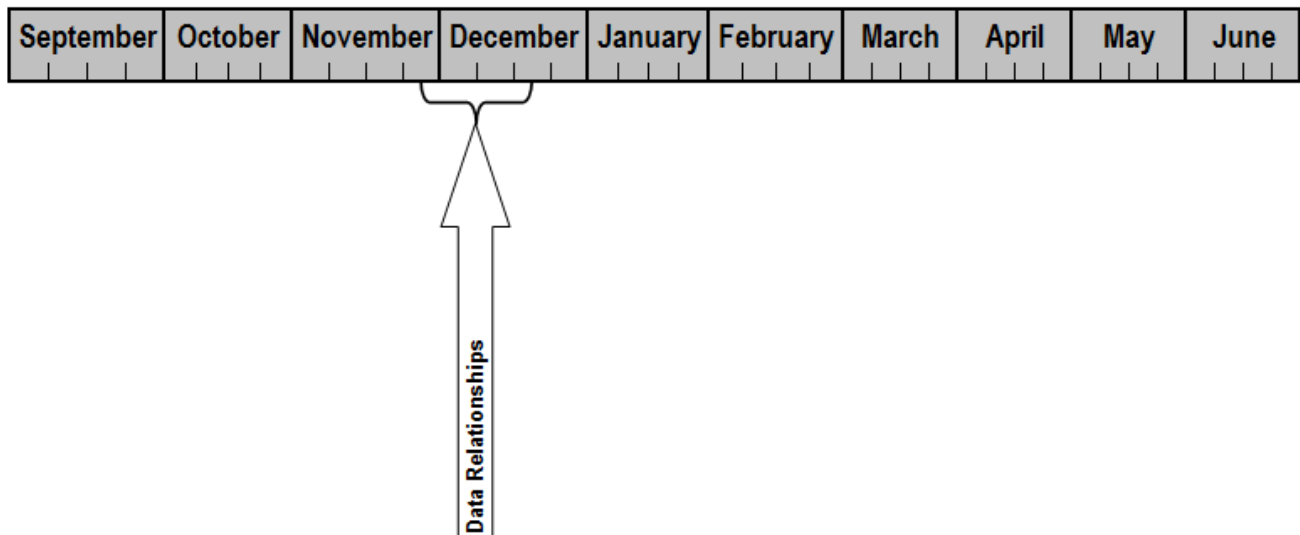
Rolling Equations

TR: pp. 46 – 47

SB: p. 27

Data Relationships

Suggested Time: 3 Weeks

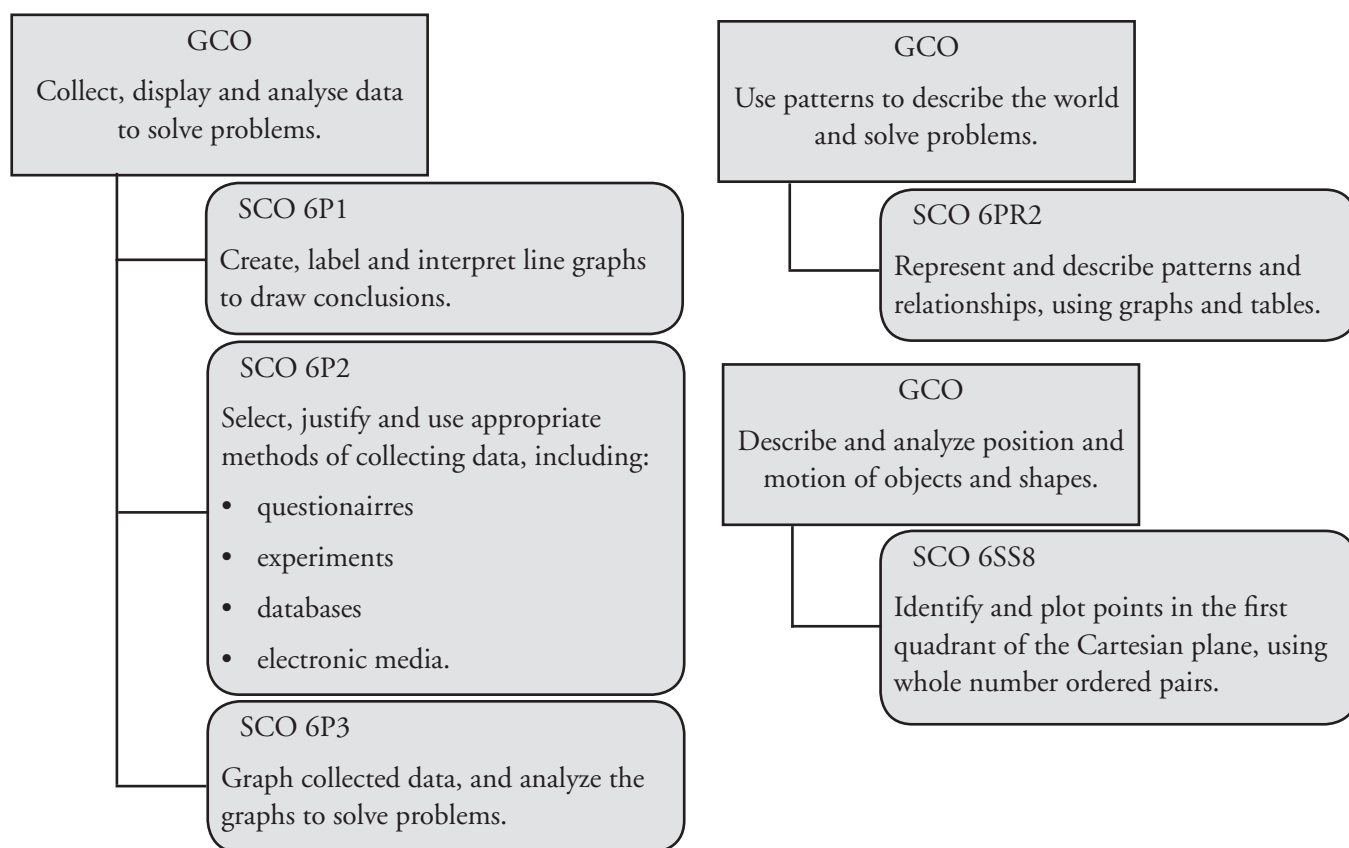


Unit Overview

Focus and Context

Graphing is a way to present data, concisely, and visually. In Grade 6, the focus will be mainly on line graphs and interpreting data to see relationships. In preparation for constructing line graphs and using them to interpret data, students will learn to plot ordered pairs in the first quadrant of the Cartesian plane. They will explore various data collection methods to answer questions that are meaningful to them and will learn to display their data using appropriate graphs. Data collection methods covered in this unit include questionnaires, experiments, databases, and electronic media. Students will also analyze and interpret graphs to solve problems. Teachers may find opportunities in other subject areas, such as Science and Social Studies, for students to collect, organize and display data to solve problems. Being equipped with these skills will allow students to make intelligent and informed decisions when presented with data or when they have a question they would like answered.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Statistics and Probability (Data Analysis)		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5SP1 Differentiate between first-hand and second-hand data. [C, R, T, V]</p> <p>5SP2 Construct and interpret double bar graphs to draw conclusions. [C, PS, R, T, V]</p>	<p>6SP1 Create, label and interpret line graphs to draw conclusions. [C, CN, PS, R, V]</p> <p>6SP2 Select, justify and use appropriate methods of collecting data, including:</p> <ul style="list-style-type: none"> questionnaires experiments databases electronic media <p>[C, CN, PS, R]</p> <p>6SP3 Graph collected data, and analyse the graph to solve problems. [C, CN, PS, R, T, V]</p>	<p>7SP1 Demonstrate an understanding of central tendency and range by:</p> <ul style="list-style-type: none"> determining the measures of central tendency (mean, median, mode) and range. determining the most appropriate measure of central tendency to report findings. <p>[C, PS, R, T]</p> <p>7SP2 Determine the effect on the mean, median and mode when an outlier is included in the data set. [C, CN, PS, R]</p> <p>7SP3 Construct, label and interpret circle graphs to solve problems. [C, CN, PS, R, T, V]</p>
Strand: Patterns and Relations (Patterns)		
	<p>6PR2 Represent and describe patterns and relationships, using graphs and tables. [C, CN, ME, PS, R, V]</p>	<p>7PR1 Demonstrate an understanding of oral and written patterns and their equivalent linear relations. [C, CN, R]</p> <p>7PR2 Create a table of values from a linear relation, graph the table of values, and analyze the graph to draw conclusions and solve problems. [C, CN, PS, R, V]</p>
Strand: Shape and Space (Transformations)		
	<p>6SS8 Identify and plot points in the first quadrant of the Cartesian plane, using whole number ordered pairs. [C, CN, V]</p>	<p>7SS4 Identify and plot points in the four quadrants of a Cartesian plane, using integral ordered pairs. [C, CN, V]</p>

Mathematical Processes

[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[ME]	Mental Mathematics	[T]	Technology

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS8 Identify and plot points in the first quadrant of a Cartesian plane, using whole number ordered pairs.

[C, CN, V]

Achievement Indicator:

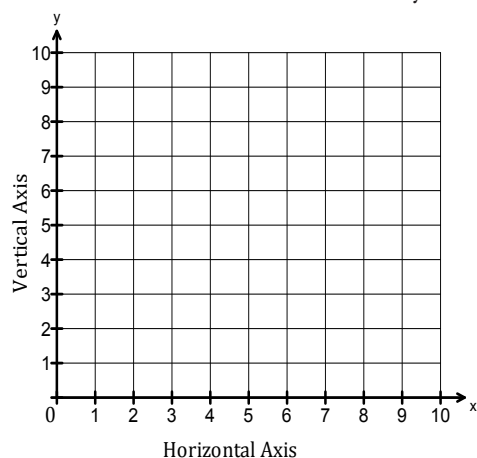
6SS8.1 Label the axes of the first quadrant of a Cartesian plane, and identify the origin.

Suggestions for Teaching and Learning

This will be students' first exposure to the Cartesian plane. It is important that they develop a strong understanding of plotting ordered pairs as this is a prerequisite for creating line graphs later in the unit and in Mathematics 7, students will build on this knowledge to identify and plot points in the four quadrants of the Cartesian plane.

Teachers could begin this unit by discussing with students where they see grids (e.g., GPS Systems, shipping lanes, mapping, etc.). Making these connections will strengthen student understanding of these concepts.

Teachers should display a coordinate grid and through guided instruction, label the axes and identify the origin:



Students should recognize that the coordinate grid is created when two lines, one horizontal and one vertical, meet at a right angle. The horizontal line is referred to as the x -axis and the vertical line is referred to as the y -axis. These two lines (axes) intersect at a point called the origin (0, 0) and is denoted by the letter O. Another name for the coordinate grid is the Cartesian plane, named after the mathematician Rene Descartes, who developed it. Highlight the location of the numbers on a coordinate grid- aligned with the grid lines. A common error students make when labelling the axes is putting the number in the middle of the blocks (in between grid lines). This may cause them to have difficulty when plotting ordered pairs.

General Outcome: Describe and analyze position and the motion of objects and shapes.

Suggested Assessment Strategies*Paper and Pencil*

- Provide students with an unlabeled coordinate grid. Ask them to label the y-axis using a blue marker, the x-axis using a red marker, and the origin using a yellow marker.

(6SS8.1)

Resources/Notes**Authorized Resource***Math Focus 6*

Lesson 4: Plotting Points on a Grid

TR: pp. 28 – 32

SB: pp. 120 – 123

Note*Math Focus 6* suggests an alternate sequence of lessons for this unit.

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS8 Continued...

Achievement Indicators:

6SS8.2 Plot a point in the first quadrant of a Cartesian plane, given its ordered pair.

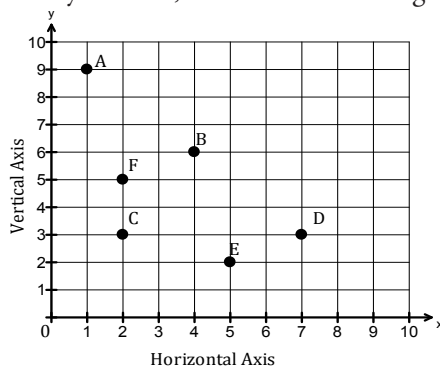
6SS8.3 Match points in the first quadrant of a Cartesian plane with their corresponding ordered pair.

Suggestions for Teaching and Learning

Teachers should introduce an ordered pair to students as a pair of numbers that describes the position of a point on a Cartesian plane. When describing an ordered pair the numbers are always written in the same order (x, y) . The first number represents the horizontal distance from the origin (i.e., how far right you move when plotting a point) and the second number in the ordered pair represents the vertical distance from the origin (i.e., how far up you move when plotting a point).

Teachers could create a coordinate grid on the classroom floor using masking or painters tape. Provide each student with an ordered pair card and ask them to plot their point by moving to the correct location on the coordinate grid. Students should be encouraged to stand at the origin, move horizontally across the x -axis then vertically to locate the position of their ordered pair.

Explain to students that sometimes an ordered pair is identified with a capital letter on the coordinate grid. Students should be able to match points on a coordinate grid with their corresponding ordered pair. Teachers could provide students with a large coordinate grid with points already labelled, such as the following:



Give them the corresponding ordered pairs cards and ask them to place their card next to (or stand next to) the correct point.

In assessing student understanding of ordered pairs be sure to include examples such as $(1, 4)$ and $(4, 1)$. A common error occurs when students interchange the x and y coordinate (i.e., view the ordered pair as (y, x)). To plot the point $(1, 4)$, for example, students may incorrectly move up 1 and to the right 4.

General Outcome: Describe and analyze position and the motion of objects and shapes.

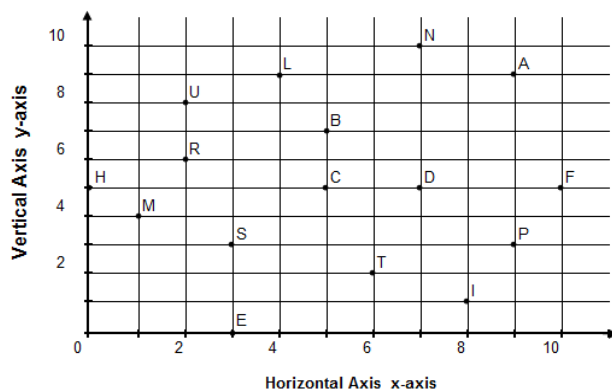
Suggested Assessment Strategies

Journal

- Ask students to explain, using pictures, numbers, and words how ordered pairs are used to describe and locate points on a grid. (6SS8.2)

Performance

- Twister - Using masking tape, create a coordinate grid on the floor. Create a deck of cards containing ordered pairs from the first quadrant. Prepare a spinner with four equal sections: either right hand, left hand, right leg or left leg. The first player selects an ordered pair (replacing it when you are done for the next player) and spins the spinner to determine which body part must be used to identify the point. Students take turns 'plotting' ordered pairs. If a student falls or moves from his coordinate point, the other team wins a point. (6SS8.2)
- Give students a blank coordinate grid. Ask them to randomly place 10 points anywhere on the grid. Call out random ordered pairs. If students have that point on their grid, they mark an X through it. The first student to have all of their points marked with an X wins. (6SS8.3)
- Give students a grid that has points already labelled with letters as shown below. Ask students to find the letter on the grid represented by each ordered pair. Record the letters, in order, to figure out the message.
(1, 4) (9, 9) (6, 2) (0, 5) (8, 1) (3, 3) (10, 5) (2, 8) (7, 10)



(6SS8.3)

Paper and Pencil

- Ask students to plot several points along the x -axis and the y -axis such as (2, 0), (4, 0), (7, 0) and (0, 1), (0, 3), (0, 7). Ask them to make a statement about an ordered pair having 0 for the x coordinate. They should also make a statement about ordered pairs that have 0 for the y coordinate.

(6SS8.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Plotting Points on a Grid

TR: pp. 28 – 32

SB: pp. 120 – 123

Math Game:

Wei-Chi

TR: pp. 43 – 44

SB: p. 131

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS8 Continued...

Achievement Indicators:

6SS8.4 Plot points in the first quadrant of a Cartesian plane with intervals of 1, 2, 5 or 10 on its axes, given whole number ordered pairs.

6SS8.5 Draw shapes or designs, given ordered pairs, in the first quadrant of a Cartesian plane.

Suggestions for Teaching and Learning

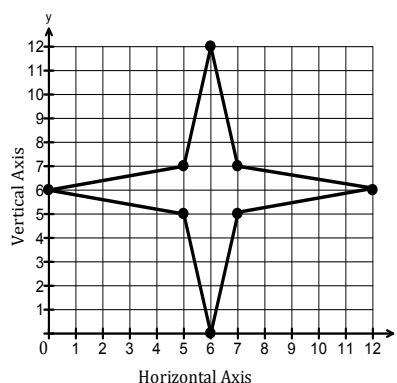
When the numbers in an ordered pair are large, students must use an interval other than 1 on the coordinate grid. The interval used is also referred to as the scale. To generate a discussion around this idea ask students how they would plot the point (50, 100).

Students should recognize that it is unreasonable to sketch a coordinate grid using an interval of 1 to plot (50, 100). Students may suggest a scale of 10 for this particular example. When asked to plot ordered pairs, encourage students to look at the magnitude of the numbers involved before choosing a scale. Ask students questions such as:

- What scale would you use to plot (16, 20)? (4, 7)?
- What interval would you use to plot (25, 15)? (70, 120)?
- Why would a scale of 1 not be best to plot (40, 60)?

Provide students with various points and ask them to plot the points on a coordinate grid by selecting an appropriate scale.

Teachers should provide students with a set of ordered pairs that, when plotted on a coordinate grid reveal a design, shape or letter. Ask them to plot (6, 12), (5, 7), (0, 6), (5, 5), (6, 0), (7, 5), (12, 6), (7, 7), for example. They should connect the points in the order in which they were plotted, returning to the first point to complete the design.



General Outcome: Describe and analyze position and the motion of objects and shapes.

Suggested Assessment Strategies*Presentation*

- Give students a coordinate grid to plot the points listed below and join them in order. The last point should be joined to the first point. Ask students to describe the figure they have drawn to the class.

A(2,2), B(5,3), C(8,2), D(7,5), E(9,8), F(6,7),
G(5,10), H(4,7), I(1,8), J(3,5)

(6SS8.5)

Resources/Notes**Authorized Resource**

Math Focus 6

Lesson 4: Plotting Points on a Grid

TR: pp. 28 – 32

SB: pp. 120 – 123

Shape and Space (Transformations)

Specific Outcomes

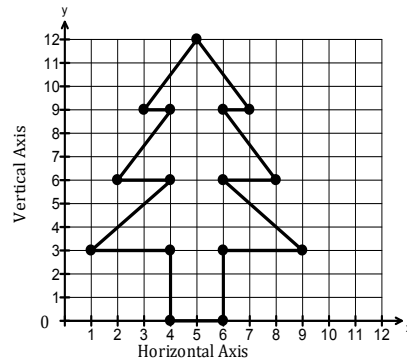
Students will be expected to
6SS8 Continued...

Achievement Indicators:

6SS8.6 Draw shapes or designs in the first quadrant of a Cartesian plane, and identify the points used to produce them.

Suggestions for Teaching and Learning

Teachers should also provide students with a shape or design such as the following and ask them to identify the points that were used to produce it:



Students should create their own shape, letter, or design on a coordinate grid and identify the ordered pairs required to create their design. They could give the ordered pairs to a classmate and ask them to discover their design by plotting the ordered pairs on a blank grid. Final products could be displayed on a classroom bulletin board.

General Outcome: Describe and analyze position and the motion of objects and shapes.

Suggested Assessment Strategies*Paper and Pencil*

- Draw a partial shape or design and ask students to complete the figure and identify the ordered pairs required to do so. (6SS8.6)

Resources/Notes**Authorized Resource***Math Focus 6*

Lesson 4: Plotting Points on a Grid

TR: pp. 28 – 32

SB: pp. 120 – 123

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

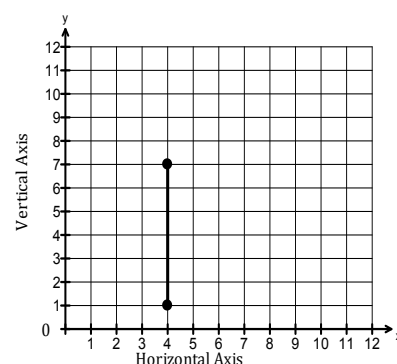
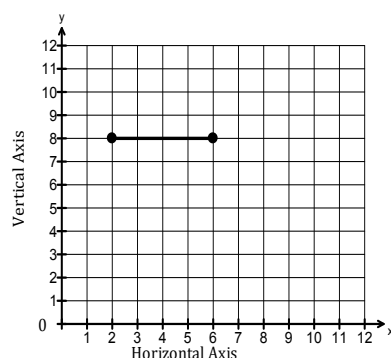
6SS8 Continued...

Achievement Indicator:

6SS8.7 Determine the distance between points along horizontal and vertical lines in the first quadrant of a Cartesian plane.

Suggestions for Teaching and Learning

Provide students with a variety of grids showing horizontal and vertical lines, such as the ones shown below and ask them how they would determine the distance between the points on each line:



One strategy that students may use in determining the distance between points along horizontal and vertical lines is to count the number of units using the given scale. When the graph is not provided students may choose to plot the given points first.

A common error occurs when students include the starting point. If asked to determine the vertical distance between the points (6, 2) and (6, 8), for example, students might count on: 2, 3, 4, 5, 6, 7, 8 and state the answer is 7. Encourage them to look at the values in the ordered pairs and think of movement along a number line. The y -coordinate increased from 2 to 8, which is 6 units.

Students may recognize that to determine the horizontal distance between two points you subtract the x coordinates and to determine the vertical distance between two points subtract the y coordinates. In the previous example they may simply subtract 2 from 8, resulting in 6.

General Outcome: Describe and analyze position and the motion of objects and shapes.

Suggested Assessment Strategies

Performance

- Give students a coordinate grid with axes labelled from 0 to 10. Ask students to plot each pair of points on the grid, join the points with a line segment and find the length of each line segment.
 - (i) (4,2) and (7,2)
 - (ii) (5,7) and (10,7)

(6SS8.7)
- Ask students to create a horizontal and vertical line by joining points on a coordinate grid. They should switch grids with another student and determine the distance between the points on each line.

(6SS8.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Plotting Points on a Grid

TR: pp. 28 – 32

SB: pp. 120 – 123

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SP1 Create, label and interpret line graphs to draw conclusions.

[C, CN, PS, R, V]

6PR2 Represent and describe patterns and relationships, using graphs and tables.

[C, CN, ME, PS, R, V]

Achievement Indicator:

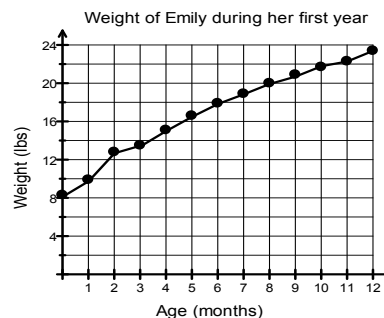
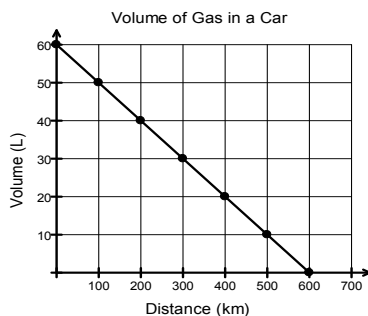
6SP1.1 Determine the common attributes (title, axes and intervals) of line graphs by comparing a given set of line graphs.

6SP1.2 Determine whether a given set of data can be represented by a line graph (continuous data) or a series of points (discrete data), and explain why.

Suggestions for Teaching and Learning

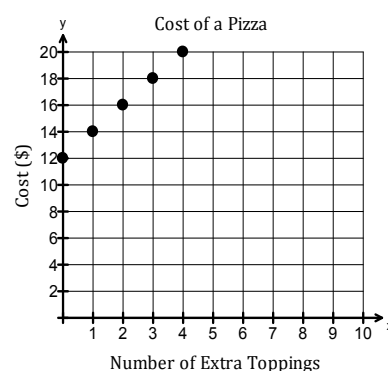
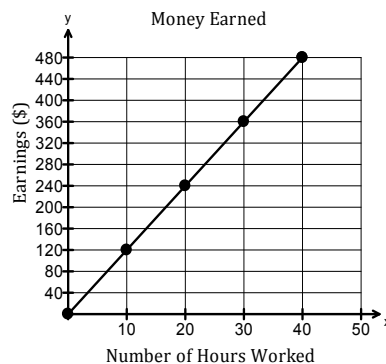
In Grade 5, students determined the pattern rule to make predictions about subsequent elements and represented patterns using tables. In this unit this will be extended to represent patterns and relationships using a graph. In previous grades students constructed and interpreted bar graphs, double bar graphs and pictographs. Students will now expand their graphing knowledge to include line graphs. Line graphs are used to show trends in data. The points are plotted to show relationships between two variables and the points are joined with a line to make it easier to see trends.

Provide students with a set of line graphs such as the following:



Ask students what the line graphs have in common. They should recognize that line graphs have common characteristics: a title, axes, and intervals. Each axis is labelled to identify the type of information displayed in the graph, with appropriate units.

Present students with two graphs, one representing discrete data and one representing continuous data:



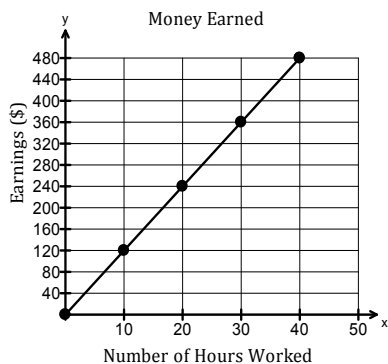
Ask students why they think the points are joined on the first graph but are not joined on the second graph.

General Outcome: Describe and analyze position and the motion of objects and shapes.

Suggested Assessment Strategies

Performance

- Present students with a graph, such as the one shown below, and ask them to identify the title, axes, and scale:



(6SP1.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Interpreting Line Graphs

TR: pp. 36 – 40

SB: pp. 126 – 129

Supplementary Resource:

Teaching Student-Centered Mathematics Grade 3 - 5 - Van de Walle, John and Lovin, LouAnn (2006)

- Support for SCO 6SP1 and SPR2 can be found on pp. 334 – 335

Making Math Meaningful to Canadian Students K-8 - Marian Small Small, Marin

- Support for SCO 6SP1 can be found on pp. 487-- 488

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP1 Continued...

Achievement Indicator:

6SP1.2 (Continued) Determine whether a given set of data can be represented by a line graph (continuous data) or a series of points (discrete data), and explain why.

6SP1.3 Create a line graph from a given table of values or a given set of data.

6SP1.4 Interpret a given line graph to draw conclusions.

Suggestions for Teaching and Learning

Continuous data can include any value between data points. If a given set of data is continuous, the points on the graph should be joined. The line can be used to predict values between two given points or to predict values beyond the given set of data. When the data between given points has no meaning the data is discrete. If a given set of data is discrete the points are not joined. Consider the points (1,3) and (2,6), for example, plotted on a coordinate grid. If these ordered pairs represented the distance travelled over time they would be joined, since distance could include values between 3 and 6 and time could include values between 1 and 2, such as 1.5. However, if the graph was displaying costs for the number of DVDs rented, the points should not be joined since it is not possible to rent 1.5 DVDs. Students are not expected to know these terms. However, they should be able to determine whether or not they should join the points on a graph.

- Examples of discrete data – the number of DVDs sold each day for one month, the number of cans recycled each month for year, the number of text messages you receive each day for a week, the number of siblings a person has.
- Examples of continuous data – the distance you travel throughout a race, the temperature of your hometown over a 24 hour period, your height as you get older, the percentage of battery life remaining on your iPad throughout the day.

Students should create a line graph from a given table of values or a given set of data. They should ensure that the graph has a title, appropriate intervals, and that each axis is clearly labelled to identify the type of information displayed in the graph, with appropriate units. Consider the following example:

Sandra is buying movie tickets for her classmates. The table below shows the relationship between the number of tickets and the cost.

Number of Tickets	0	1	2	3	4	5
Cost (\$)	0	10	20	30	40	50

Ask students to graph the table of values and answer questions such as the following:

- Should you join the points on the graph? Explain.
- What is the trend between the number of tickets purchased and cost?
- How can you use the graph to determine the cost of 6 students attending?
- How many tickets can Sandra buy if she only has \$45?

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Interview

- Give students several examples of data. They should determine whether the data would be represented by a line graph or a series of points (i.e., Is the data discrete or continuous?). Examples of data:
 - (i) the number of cans and bottles each class recycles each month
 - (ii) population trends of our province over the last 20 years
 - (iii) the number of students who are absent in school for each day of the month
 - (iv) how much time you spend on homework each night for the month of March

(6SP1.2)

Paper and Pencil

- Provide students with a set of data and ask them to graph it, clearly identifying the attributes used. The scale, the title and the intervals may be different among students. Ask students to explain their selections.

(6SP1.1, 6PR1.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Interpreting Line Graphs

TR: pp. 36 – 40

SB: pp. 126 – 129

Patterns and Relations (Patterns)

Suggested Outcomes

Students will be expected to

6SP1 Continued...

6PR2 Continued...

Achievement Indicators:

6PR2.1 Create a table of values from a given pattern or a given graph.

6PR2.2 Translate a pattern to a table of values, and graph the table of values (limited to linear graphs with discrete elements).

6SP1.4 (Continued) Interpret a given line graph to draw conclusions.

6PR2.3 Describe, using everyday language, orally or in writing, the relationship shown on a graph.

Suggestions for Teaching and Learning

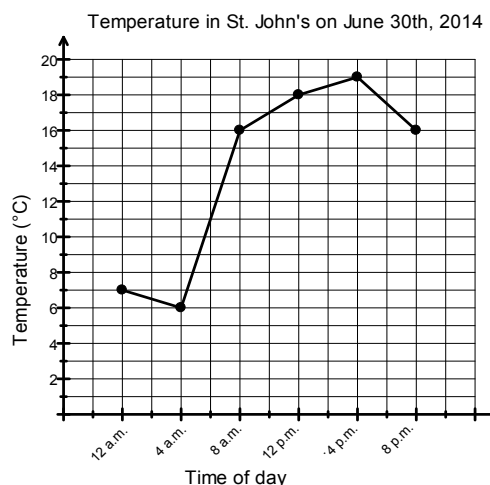
Given a pattern or a graph, students should create the corresponding table of values.

Provide students with a variety of patterns, such as the following:



They should create a table of values from the given pattern and use the table of values to construct the corresponding graph. As they construct the graph, remind them to consider whether or not it should be a line graph or a series of points.

Students should describe the relationship shown on graph and interpret the graph to answer questions. They could work in pairs to analyze graphs – answering questions about the information the graph displays and whether they can use the graph to make predictions. Consider the following example:



Ask students questions such as the following:

- What was the highest temperature?
- What was the lowest temperature?
- How much warmer was it at 2:00 p.m. than at 10:00 a.m.?
- What interval is used?

General Outcome: Use Patterns to Describe the World and to Solve Problems

Suggested Assessment Strategies

Paper and Pencil

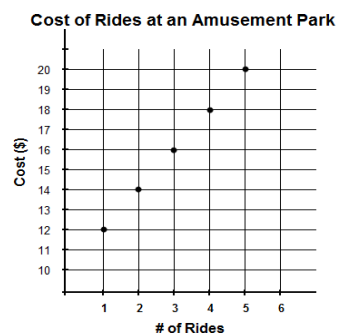
- Give students a table of values and ask them to graph it. They will need to label each axes in the same way as the table is labelled. Then give them a graph and ask them to create a table of values. Some simple data that could be used are (a) time and distance information and (b) growing patterns with multi-link cubes.
(6SP1.3, 6PR2.1)

Performance

- Ask students to investigate the relationship between the number of tricycles and the number of wheels. They should discover that as the tricycles increase in number, the wheels will increase by 3. Ask them to create a table of values from this pattern and graph it.
(6PR2.1, 6PR2.2)

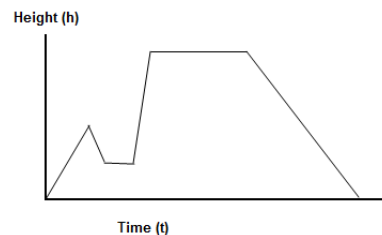
Performance

- Provide groups of students with a graph, such as the one shown below. Ask them to interpret the graph and make three statements about the information it reveals. Based on their statements, students should create three questions about the graph. Groups should then switch graphs and answer the created questions.



(6SP1.4, SPR2.3)

- Ask students to describe the graph below that shows Marc's hike (Small, 2008). Students should be encouraged to share their storied with the class.



(6SP1.4, 6SP2.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Constructing Line Graphs

TR: pp. 45 – 49

SB: pp. 132 – 135

Curious Math:

A Graph is Worth a Thousand Words

TR pp. 41 – 42

SB: p. 130

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP3 Graph collected data, and analyze the graph to solve problems.

[C, CN, PS, R, T]

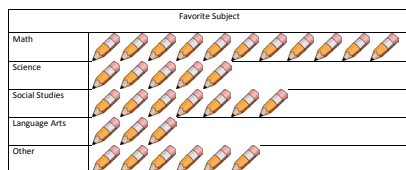
Achievement Indicator:

6SP3.1 Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

Suggestions for Teaching and Learning

In previous grades students constructed and interpreted bar graphs, double bar graphs, and pictographs. Earlier in this unit, they have been introduced to line graphs. Teachers should review with students how to construct these graphs and when to use them. These skills are important when students move into the data collection methods where they will have to collect a set of data and choose an appropriate graph to display their results. Students will also have to analyze graphs to solve a problem.

Teachers could provide students with a set of various graphs to initiate a discussion around choosing an appropriate graph to display a set of data:



General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Performance

- Ask students to work in groups. On separate sheets of chart paper, write the names of types of graphs: bar graph, double bar graph, line graph, and pictograph. Ask them to create two columns on each sheet: Column A - Advantages and Column B - Disadvantages. After they complete the chart, you may wish to ask them to share the results with the class. Extend this activity by adding the kinds of questions that could be used for each type of graph. A bar graph, for example, is best used to graph comparisons, while a double bar graph can be used to compare the same information, which contains two distinct parts (e.g., male and female, cats and dogs, etc.).

(6SP3.1)

Resources/Notes

Note

6SP3 can be found throughout the unit. At this stage, teachers should review the types of graphs students have studied and when to use each type. This will strengthen their ability to determine an appropriate graph later in the unit.

Supplementary Resource

Making Math Meaningful to Canadian Students K-8 - Marian Small

- Support for SCO 6SP3 can be found on pp. 471 – 513

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to
6SP3 Continued...

Achievement Indicator:

6SP3.1 (Continued) Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

Suggestions for Teaching and Learning

The following table may be useful in selecting an appropriate graph to display collected data:

Type of Graph	Uses	Example
Pictograph	To compare data that can be easily counted and represented using symbols	Favorite movie genre of your classmates
Bar graph	To compare data grouped in categories	Favorite restaurant of your classmates
Double Bar graph	To comparing two sets of data grouped in categories	Favorite video game of Grade 5 students. Favorite video game of Grade 6 students.
Line Graph	To show change; to compare measurement	Temperature throughout the day

Provide students with questions and sets of data. Ask them to decide which type of graph they would use to display the collected data, justifying their choice. Consider the following examples:

- How fast does a cup of hot chocolate cool down after it has been poured?
- What is the favourite season of Grade 6 boys and girls?
- What was the highest temperature in (insert hometown) today?
- A store manager keeps track of video game sales for one month.

Week	Video Games Sold
1	16
2	28
3	45
4	62

- Janelle surveyed students in her school to determine their favourite ice cream flavour.

Flavor	Chocolate	Vanilla	Strawberry	Mint Chocolate Chip	Bubblegum	Other
Number of Students	4	2	6	4	10	1

Teachers could ask students to search magazines, newspapers or the Internet to locate two different types of graphs. Students could explain what data is represented in the graph and why they think the graph was chosen to display the collected data. Students could present their examples to the class and display their graphs on a classroom bulletin board.

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Presentation

- Ask students to create a graph that compares two sets of data, such as the number of pizza slices ordered by Grade 5 and Grade 6 students or the number of books that students in Grade 5 and Grade 6 read over a 4 week period. They should present their findings to the class. (6SP3.1)
- Graph One* - Students should select one of the following situations and graph the collected data:

Average Monthly Precipitation in Newfoundland and Labrador:		
January 9cm	February 10cm	March 13cm
April 20cm	May 22cm	June 16cm
July 6cm	August 8cm	September 5cm
October 7cm	November 5cm	December 9cm

Number correct on a Math Test:		
Anthony 60	Anna 80	Hannah 95
Hunter 100	Matthew 80	Ashley 70
David 65	Amanda 75	Sarah 90

Students should justify their choice of graph.

(6SP3.1)

Journal

- Ask students to write about how they decide which type of graph best displays a set of data. Students should use specific examples in their explanations. (6SP3.1)

Resources/Notes

Note

6SP3 can be found throughout the unit. At this stage, teachers should review the types of graphs students have studied and when to use each type. This will strengthen their ability to determine an appropriate graph later in the unit.

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP2 Select, justify and use appropriate methods of collecting data, including:

- questionnaires
- experiments
- databases
- electronic media.

[C, CN, PS, R, T]

6SP3 Continued ...

Achievement Indicators:

6SP2.1 Design and administer a questionnaire for collecting data to answer a given question, and record the results.

6SP3.1 (Continued) Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

6SP3.2 Solve a given problem by graphing data and interpreting the resulting graph.

Suggestions for Teaching and Learning

In previous grades students collected and organized first and second hand data. In this unit they will explore various methods of collecting data: questionnaires, experiments, databases, and electronic media.

Students should be given opportunities to collect, display and analyze data in a variety of ways. After students have explored the various methods of data collection, they should discuss which method is most appropriate for a given question.

Teachers could activate prior knowledge by asking students to share methods of data collection they might use to answer a given question. Students may suggest observations, experiments, surveys, interviews, polls, past records, searching the Internet, using databases and electronic media. Ask them to describe situations where they would use each suggested method to collect data.

Questionnaires should be carefully constructed to ensure that the data collected will answer the chosen question. The wording of each question should be clear. The question should not influence the participants' decision. There should be an option for each person completing the questionnaire.

Teachers should present various questions to students and have them decide whether or not the question is a good question and explain their reasoning. Students should make improvements to those questions that are not good questions. Consider the following examples:

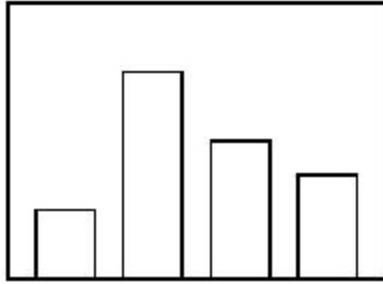
Do you study a lot for Math?		Which is your favorite NHL team?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Toronto Maple Leafs	<input type="checkbox"/> Montreal Canadiens
		<input type="checkbox"/> Boston Bruins	<input type="checkbox"/> Detroit Red Wings
What is your favorite Winter activity?			
<input type="checkbox"/> building a snowman	<input type="checkbox"/> snowboarding	<input type="checkbox"/> ice skating	
<input type="checkbox"/> sledding	<input type="checkbox"/> skiing	<input type="checkbox"/> other (please specify): _____	

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Performance

- Provide an untitled and unlabeled graph and ask students to suggest different sets of data that might realistically be represented by the graph.



E.g.,

- It might represent the number of students with each hair colour – red, brown, black and blonde (using a scale of 2).
- The number of books read by 4 family members over the summer.

(6SP3.1)

- Ask students to create a question that they would like to use for a survey. Students should create and administer a questionnaire to answer their question. They should display the results using an appropriate graph and present their findings to the class.

(6SP2.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Creating a
Questionnaire

TR: pp. 13 – 17

SB: pp. 112 – 114

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP2 Continued...

6SP3 Continued...

Achievement Indicators:

6SP2.1 (Continued) Design and administer a questionnaire for collecting data to answer a given question, and record the results.

6SP3.1 (Continued) Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

6SP3.2 (Continued) Solve a given problem by graphing data and interpreting the resulting graph.

Suggestions for Teaching and Learning

Brainstorm with students topics of interest. They should select a topic and write a related question which they would like answered. They should then design a questionnaire, carry out the survey, and record the results.

Survey questions for questionnaires may be multiple choice questions, Yes/No questions, or ratings:

Do you own a cell phone?

☐ Yes

☐ No

How often do you play video games?

☐ never

☐ a few times a month

☐ a few times a week

☐ almost every night

☐ every night

Please rate your satisfaction with our store:

Strongly
Disagree

Disagree

Undecided

Agree

Strongly
Agree

The cashier was friendly.

☐

☐

☐

☐

☐

Once students have created their questionnaires they should construct a tally chart based on their question(s). This will help them analyze their results once the survey is complete. Suppose, for example, that a student wanted to determine the favourite fruit of their classmates. They may use the following question:

Which is your favorite fruit?

☐ apples

☐ oranges

☐ grapes

☐ strawberries

☐ bananas

☐ other (please specify): _____

Based on the given question, students might construct the following tally chart, leaving rows at the bottom for other fruits that might be reported when analyzing their results:

Favorite Fruit Survey	
Fruit	Tally
apple	
orange	
grapes	
strawberries	
banana	

After tallying the results, students should display their data using an appropriate graph, and answer their initial question. Students should be encouraged to present their questionnaires and their results to their classmates.

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Journal

- Present the following situation to students:
Carmen designed and handed out 100 questionnaires to students in her school. She asked this question:
What job would you like to have?
- Doctor/Dentist - Teacher - Lawyer
- Sports Manager - Coach
50 questionnaires were returned. Here are the results:

	Boys	Girls
Doctor/Dentist	/// ///	/// /
Teacher	//	/// /// /
Lawyer	/// /// ///	/// //
Sports Manager, etc	///	/

Carmen reached the conclusion that most students will become doctors or dentists. Do you agree with her conclusions? Explain.
(6SP2.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Creating a Questionnaire

TR: pp. 13 – 17

SB: pp. 112 – 114

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP2 Continued...

6SP3 Continued...

Achievement Indicators:

6SP2.2 Explain when it is appropriate to use a database as a source of data.

6SP2.3 Gather data for a given question by using electronic media, including selecting data from databases.

6SP3.1 (Continued) Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

6SP3.2 (Continued) Solve a given problem by graphing data and interpreting the resulting graph.

Suggestions for Teaching and Learning

Teachers could begin work with databases by asking students how would they determine the number of medals won by Canada in the Vancouver 2010 Olympic Games. Students would likely respond by saying they would use a search engine, such as Google. Discuss with students that a database is an organized set of a large amount of information, often stored on a computer (e.g., Statistics Canada, Environment Canada, a telephone book, a dictionary). Databases are used when the data needed has already been collected. Students should realize that the type of database they will use depends on the question they want answered (e.g., they would use Statistics Canada to determine how the number of smokers have changed over the past five years; they would use an NHL database to determine the leading scorer in the 1997 playoff season). Students should be given the opportunity to visit various databases so that they understand how the information is organized and how it can be accessed to obtain data.

Students should be able to use electronic media (television, radio, the Internet) to gather data for a given question. Ask students to select one of the following questions (or create their own) and use a database to answer their questions.

- What were the top 5 songs in Canada in 2005?
- What are the telephone numbers of five restaurants in (insert your hometown/area)?
- How has the population of Newfoundland and Labrador changed over the past 10 years?
- How do Canadian students travel to school?
- Who are the top three shooters in the NBA?
- How have the high and low temperatures in Newfoundland and Labrador changed over the past 10 years?
- How do Canadian students communicate with their friends?

Students should print the data they used and display their data in a graph (where appropriate). Encourage students to present their findings to the class.

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Presentation

- Ask students to choose one of the following questions to answer by using an appropriate database.
 - (i) How much has the moose population in Newfoundland and Labrador increased over the past 25 years?
 - (ii) What are some of the genres of Newfoundland musicians?
 They should search online to collect data and share their results with the class.
- (6SP2.3)

Performance

- Ask students to create a graph that shows the growth of the Canadian population over a period of 20 years. Discuss the various databases that could be accessed to find the information.

(6SP2.3, 6SP3.1, 6SP1.2, 6SP1.3)
- Ask students how they would determine the temperature changes for the month of January for their town or city, or the nearest centre to them, or a city they would like to visit. Have students collect this information and construct a graph to display the collected data.

(6SP2.3, 6SP3.1, 6SP1.2, 6SP1.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Using Databases

TR: pp. 18 – 21

SB: pp. 112 – 114

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP2 Continued...

6SP3 Continued...

Achievement Indicators:

6SP2.4 Answer a given question by performing an experiment, recording the results and drawing a conclusion.

6SP3.1 (Continued) Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

6SP3.2 (Continued) Solve a given problem by graphing data and interpreting the resulting graph.

Suggestions for Teaching and Learning

Students should be familiar with conducting Science experiments. They should recognize that an experiment is a situation or test that is set up to answer a question. Experiments are often used to test something that can be observed. They are often used to determine if one factor affects another or to identify which product is best.

Brainstorm questions that can be answered by performing an experiment. Sample questions include:

- Which sum is more likely when you roll a dice?
- What is the most frequent number of stripes on a sunflower seed?
- How many drops of water can fit on top of a coin before it overflows?
- How does exercise affect pulse rate?
- Which paper towel absorbs the most water?
- When clasping your hands which thumb is on top?

Students should select one question to explore further. As a class, design an experiment that could be conducted to gather the required data. Students should record their results using an appropriate graph and communicate their conclusion based on their results.

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Performance

- Working in pairs, ask each student to roll a die 25 times. Record how many times each number occurs and then combine the individual's results with those of her/his partner. Students should analyze their results and state their conclusions.

(6SP2.4)

- Give students a list of questions that could be answered by performing experiments (or allow them to create a question of interest to them). Ask them to select a question and conduct an experiment to answer their question. Some possibilities are:

- If you rolled a pair of dice 10 times, how many times would a double number show up?
- If you used a spinner that is colour coded and spun it 20 times, how many times would you land on a particular colour?
- If you flipped a coin 50 times, how many times would TAILS show up?

(6SP2.4)

- Ask students to answer the following question by carrying out the experiment:

What is the relationship between the 'drop height' and the 'bounce height' of a ball? Make a prediction first before you do the experiment. Conduct trials to gather the data and to answer the question. Create a graph of the results and answer the questions: What can you say about the relationship between drop height and bounce? Was your prediction correct? Explain.

(Make sure that the ball is simply released and let the ball bounce on a hard surface. Try heights other than the ones that are in your experiment to confirm the results).

(6SP2.4, 6SP3.1, SP3.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Performing an Experiment

TR: pp. 22 – 27

SB: pp. 116 – 119

Statistics and Probability (Data Analysis)

Specific Outcomes

Students will be expected to

6SP2 Continued...

6SP3 Continued...

Achievement Indicators:

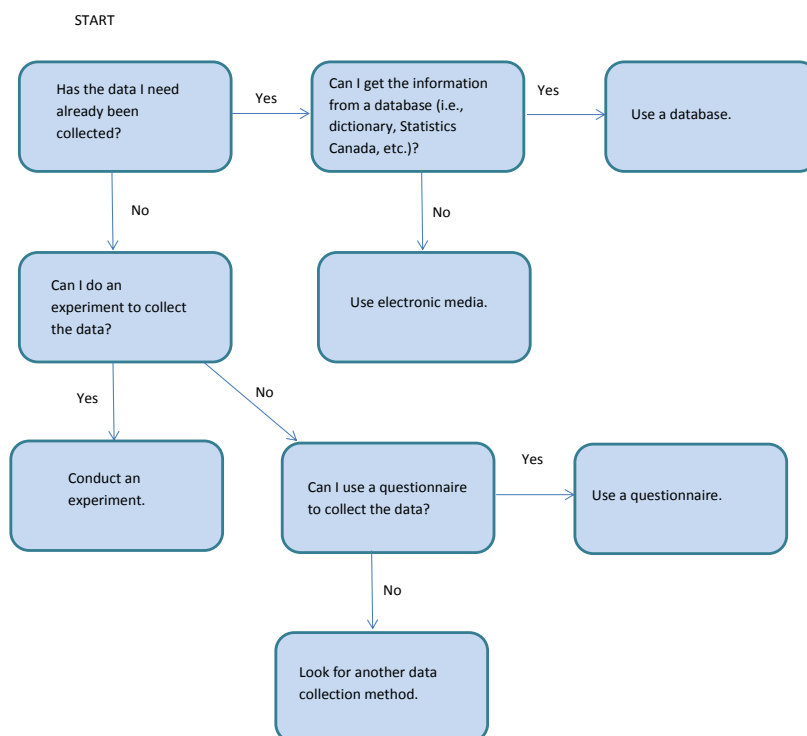
6SP2.5 Select a method for collecting data to answer a given question, and justify the choice.

6SP3.1 (Continued) Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.

6SP3.2 (Continued) Solve a given problem by graphing data and interpreting the resulting graph.

Suggestions for Teaching and Learning

Once students have explored all data collection techniques they should be able to select a method to answer a given question. In deciding the method for collecting data some students might find the following flow chart useful:



Consider using children's literature, such as *Math Curse* by Jon Scieszka and Lane Smith. In this story, a girl takes us through her day where everything she encounters becomes a math problem. After reading the book out loud call students attention to Mrs. Fibonacci's birthday chart. Ask students questions such as:

- What month has the most birthdays? What month has the fewest birthdays? Which months have an equal number of birthdays?
- How do you think Mrs. Fibonacci collected this data? Is there another way she could have collected it?
- Why do you think Mrs. Fibonacci chose to display her graph in a bar graph?

Students should work together to construct their class birthday chart to display in their classroom.

General Outcome: Collect, Display and Analyze Data to Solve Problems

Suggested Assessment Strategies

Journal

- Ask students to write one question for which a questionnaire would be the best choice to find the answer to the question. Write one question for which an experiment would be conducted to find the answers to the question.

(6SP2.5)

- Ask students to write about:
 - what they have learned about the different methods of data collection.
 - which method for gathering information they find the easiest and explain why.
 - what sample / data source they would use to determine the amount of milk an average Grade 6 student would drink.
 - where they might go to find out the number of school-aged children in their province.

(6SP2.5)

Performance

- Ask students to answer the following question: How long does it take to run 5m, 10m, 15m, 20m, 25m and 30m? Student could collect this data in Physical Education class and display their data using an appropriate graph. Ask students to make three statements about the information displayed in their graph.

(6SP1.3, 6SP2.4, 6SP2.5, 6SP3.1)

- Ask students to collect data to answer the question: How many hours does each person in their family sleep each night for a week? At the end of the week, ask students to present their findings to the class in a graph. Ask students to create three questions for classmates to answer by looking at the graph. Students may want to share their results with other classes in order to talk about the importance of sleep (cross curricular – also meets Health outcomes). Extension: Students may survey other classes to determine whether they get the recommended amount of sleep.

(6SP2.5, 6SP3.1, 6SP3.2, 6PR2.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 7: Communicating about Data

TR: pp. 50 – 54

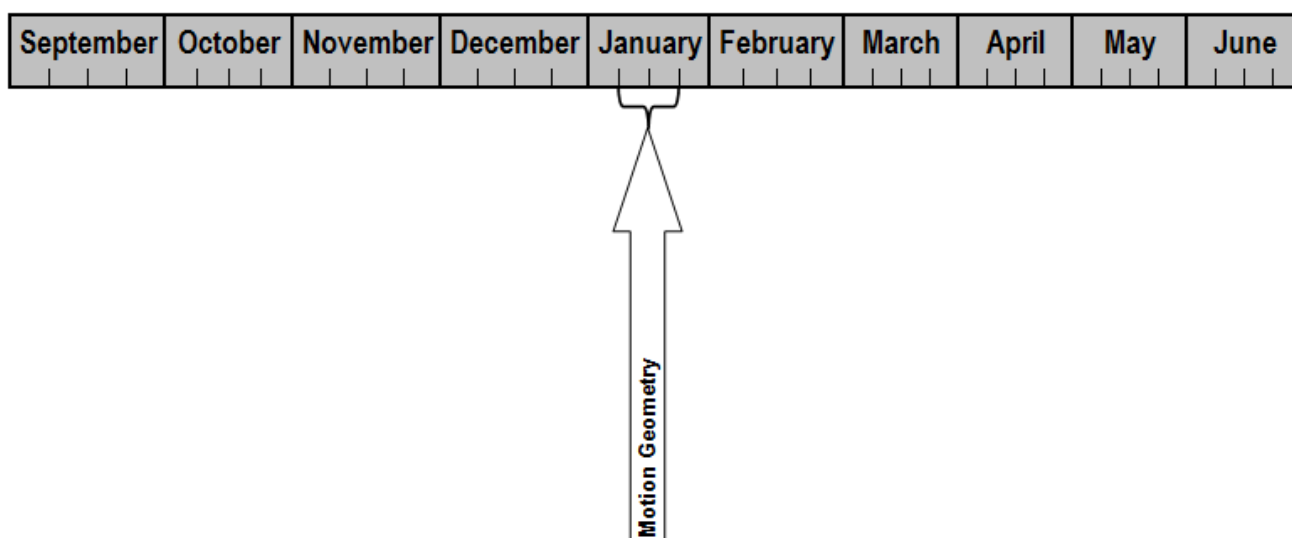
SB: pp. 136 – 138

Supplementary Resource

Math Curse - Jon Scieszka and Lane Smith

Motion Geometry

Suggested Time: 2 Weeks



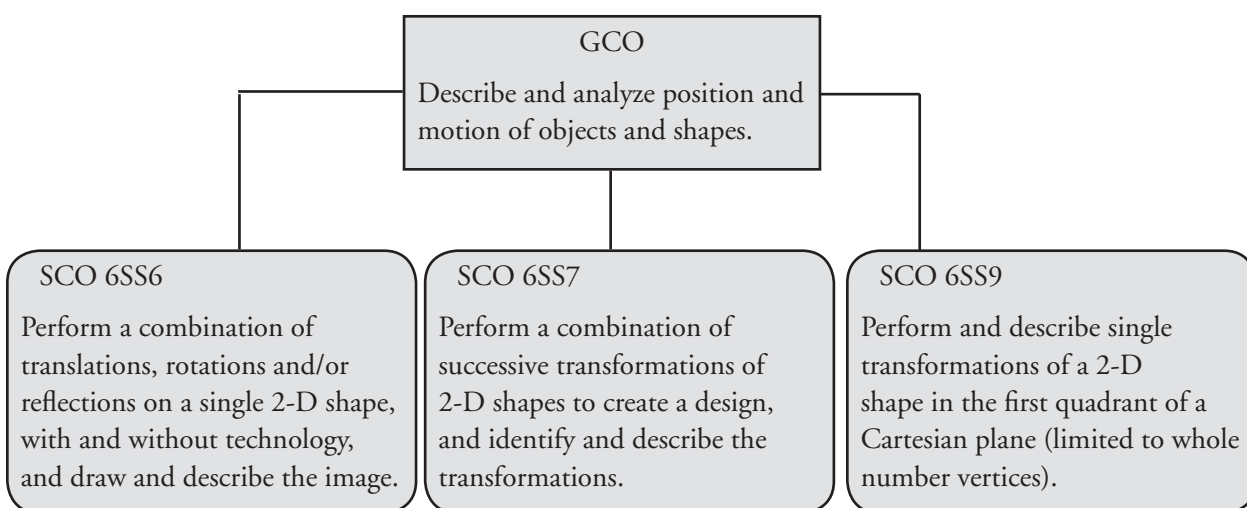
Unit Overview

Focus and Context

Transformational geometry was introduced in Grade 5, where students identified and described a single transformation, including translations, rotations and reflections of 2-D shapes. In Grade 6, students will continue their work with single transformations in the first quadrant of the Cartesian plane. They will extend their knowledge of motion geometry to perform a combination of transformations (with and without technology) and then draw and describe the image. Using transformations students will create a design and describe the transformations that resulted in its construction. Using manipulatives such as pattern blocks, Miras™, and grid paper along with various technologies such as interactive whiteboards and interactive websites will help students visualize various transformations and will help strengthen their understanding of these concepts.

An understanding of the arrangements of objects is important as we see various transformations in everyday life: quilting, opening a door, driving, rearranging furniture, and in various sports. Developing spatial sense will help develop an appreciation for art, nature and architecture. Describing and predicting location will help develop spatial sense which is also an important component of engineering, design, and carpentry.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Shape and Space (Transformations)		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5SS7 Perform a single transformation (translation, rotation or reflection) of a 2-D shape, and draw the image. [C, CN, T, V]</p> <p>5SS8 Identify and describe a single transformation, including a translation, rotation and reflection of 2-D shapes. [C, T, V]</p>	<p>6SS6 Perform a combination of translations, rotations and/or reflections on a single 2-D shape, with and without technology, and draw and describe the image. [C, CN, PS, T, V]</p> <p>6SS7 Perform a combination of successive transformations of 2-D shapes to create a design, and identify and describe the transformations. [C, CN, T, V]</p> <p>6SS9 Perform and describe single transformations of a 2-D shape in the first quadrant of a Cartesian plane (limited to whole number vertices). [C, CN, PS, T, V]</p>	<p>7SS5 Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices). [C, CN, PS, T, V]</p>

Mathematical Processes

[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[ME]	Mental Mathematics and Estimation	[T]	Technology
		[V]	Visualization

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS9 Perform and describe single transformations of a 2-D shape in the first quadrant of a Cartesian plane (limited to whole number vertices).

[C, CN, PS, T, V]

Achievement Indicator:

6SS9.1 Identify the coordinates of the vertices of a given 2-D shape (limited to the first quadrant of a Cartesian plane).

6SS9.2 Perform a transformation on a given 2-D shape, and identify the coordinates of the vertices of the image (limited to the first quadrant).

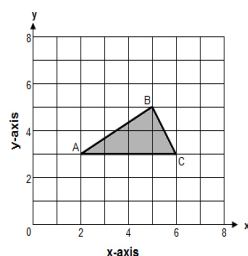
6SS9.3 Describe the positional change of the vertices of a given 2-D shape to the corresponding vertices of its image as a result of a transformation (limited to the first quadrant).

Suggestions for Teaching and Learning

In Grade 5, students described and performed single translations, reflections and rotations. In Grade 6, students will continue their study of transformations by combining their knowledge of ordered pairs and the coordinate grid with their previous knowledge of transformations. Students will begin by identifying the coordinates of the vertices of a 2-D shape in the first quadrant of a Cartesian plane. They will then perform and describe various transformations on the shape and will create a design by applying transformations.

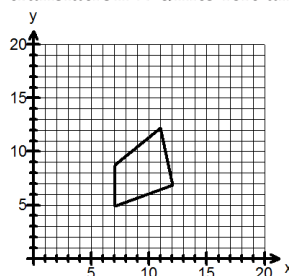
Students may find it helpful when performing transformations to use manipulatives such as pattern blocks, tracing paper, a small piece of overhead plastic and dry-erase marker or a traced and cut out image of the shape. They should explore the effect of various transformations on a variety of 2-D shapes. Using shapes such as rhombi or parallelograms will allow students to easily identify the effect of the applied transformation. When using symmetrical shapes to apply transformations, encourage students to highlight or mark one of the vertices so they can readily describe the changes that have occurred.

Provide students with a variety of 2-D shapes on coordinate grids and ask them to identify the coordinates of the vertices of each shape:



This is a continuation of work with Cartesian plan in the Data Relationships unit.

Students begin their study of transformations by exploring translations. A translation occurs when an object is shifted to the left or right and/or up or down. Begin by providing students with a 2-D shape on a coordinate grid, such as the one shown below. Ask students how they would perform the translation 2 units left and 1 unit up.



General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Provide students with two decks of cards. The first set should have a variety of 2-D shapes on coordinate grids. The second set should have the corresponding ordered pairs. Students should match the 2-D shape with the correct ordered pairs.

(6SS9.1)

Observation

- Students could participate in a Draw the Shape activity. In groups of two, one student should draw a 2-D shape on a coordinate grid (hiding it from their partner). They should then describe the shape and its position to their partner who must draw the shape using the description provided.

(6SS9.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Translating Shapes

TR: pp. 13 – 17

SB: pp. 148 – 150

Supplementary Resource

*Making Math Meaningful to**Canadian Students K-8* – Marian Small

- Support for SCO 6SS9 can be found on pp.342 – 350

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS9 Continued...

Achievement Indicators:

6SS9.2 (Continued) Perform a transformation on a given 2-D shape, and identify the coordinates of the vertices of the image (limited to the first quadrant).

6SS9.3 (Continued) Describe the positional change of the vertices of a given 2-D shape to the corresponding vertices of its image as a result of a transformation (limited to the first quadrant).

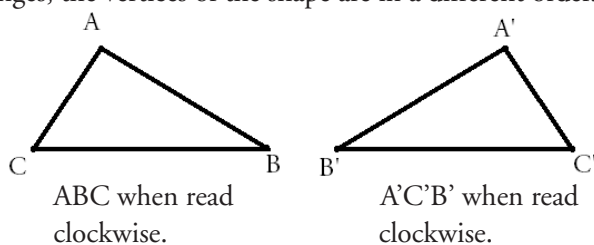
Suggestions for Teaching and Learning

They should recall from Grade 5 that this involves each vertex shifting 2 units right and 1 unit down. Remind them that this translation can be expressed as (2R, 1D). When labelling the vertices of a transformed shape prime notation should be used.

Ask students questions such as the following:

- Has the size or shape changed as a result of the translation?
- What are the coordinates of the vertices of the image?
- How have the coordinates of each vertex changed as a result of the translation?
- Has the orientation of the object changed as a result of the translation?

Students may need to be reminded that when the orientation of a shape changes, the vertices of the shape are in a different order.



Students should recognize that for a translation:

- the shape and its image is congruent.
- the shape and the image have the same orientation.
- the coordinates of the original shape increases or decreases in the same way:

If the translation is to the left, the x coordinate will decrease.

If the translation is to the right, the x coordinate will increase.

If the translation is down, the y coordinate will decrease.

If the translation is up, the y coordinate will increase.

Given a 2-D shape students should be able to identify the transformations that have occurred. Encourage them to focus on one vertex to determine the translation that has occurred.

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Provide a 2-D shape on grid paper and ask students to translate the shape according to specific instructions. E.g., 4 units left and 1 unit down. Ask students to identify the vertices of the image.
(6SS9.1, 6SS9.2)
- Provide students with a Cartesian plane. Ask them to draw a three sided figure on the plane. Tell them to choose another coordinate in the plane that the image is not already on. Tell them this new point is now a vertex of the translated image. Ask them to show and explain how they would know what the other coordinates of their translated image would be just by knowing one of the vertices. Ask students to describe the positional change of the vertices after the translation.
(6SS9.2, 6SS9.3)

Journal

- Ask students to describe how the translation rule can help them identify the positional change of the vertices.
(6SS9.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Translating Shapes

TR: pp. 13 – 17

SB: pp. 148 – 150

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to
6SS9 Continued...

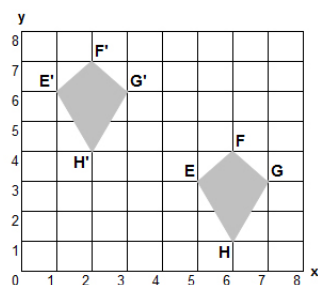
Achievement Indicators:

6SS9.2 (Continued) Perform a transformation on a given 2-D shape, and identify the coordinates of the vertices of the image (limited to the first quadrant).

6SS9.3 (Continued) Describe the positional change of the vertices of a given 2-D shape to the corresponding vertices of its image as a result of a transformation (limited to the first quadrant).

Suggestions for Teaching and Learning

Use a translation such as:



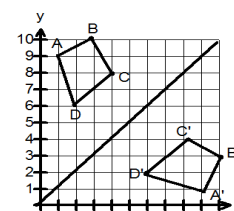
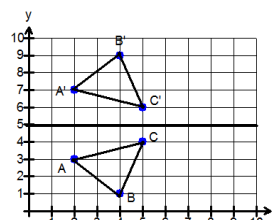
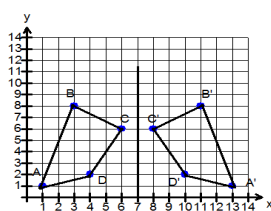
Ask:

- What translation has occurred?
- How has the x-coordinate of each ordered pair changed?
- How has the y-coordinate of each ordered pair changed?
- Has the orientation of the object changed? Explain.



Students should participate in *Tile Slide*. Use masking or painters tape create a coordinate grid on the floor of the classroom. Assign an ordered pair to each student. They should stand on their ordered pair and then translate themselves using a variety of translation rules suggested by the teacher.

Students will continue their study of transformations by performing a reflection on a 2-D shape in the first quadrant of the coordinate grid. This is a natural extension of the work they completed in Grade 5. Some students may benefit from the use of a Mira™ or pattern blocks as they work with reflections of 2-D shapes. Students should reflect a shape over horizontal, vertical, and an oblique (slanted) lines of reflection. Provide students with a 2-D shape on a coordinate grid and ask them to reflect the image over the given reflection line.



General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Teachers could create a coordinate grid on the classroom floor using masking or painters tape (floor tiles can be used as the grid if available). Students should create a 2-D shape by standing on the ordered pairs that represent the vertices of the shape. To create the sides of the figure have the first student hold the end of a ball of yarn and toss it to the next student and so on, until the shape is complete. Provide students with a translation. They should discuss the effect of the translation on each vertex to determine their new position. Students should verify their new ordered pair by physically performing the translation. Alternatively, a new group of students could form the image.

(6SS9.2, 6SS9.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Translating Shapes

TR: pp. 13 – 17

SB: pp. 148 – 150

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS9 Continued...

Achievement Indicators:

6SS9.2 (Continued) Perform a transformation on a given 2-D shape, and identify the coordinates of the vertices of the image (limited to the first quadrant).

6SS9.3 (Continued) Describe the positional change of the vertices of a given 2-D shape to the corresponding vertices of its image as a result of a transformation (limited to the first quadrant).

Suggestions for Teaching and Learning

Ask students questions such as the following:

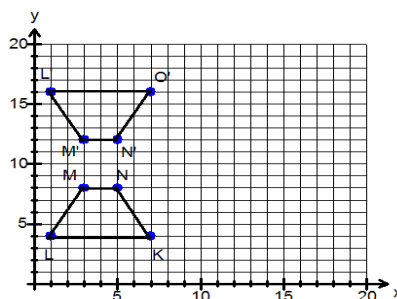
- Has the size or shape changed as a result of the reflection?
- What are the coordinates of the vertices of the image?
- How have the coordinates of each vertex changed as a result of the reflection?
- Has the orientation of the object changed as a result of the reflection?
- What would happen to the coordinates of point C if it were on the line of reflection?

Students should recognize that for a reflection:

- the shape and its image is congruent.
- the shape and the image have different orientations.
- the shape and the image is the same distance from the line of reflection.
- if the line of reflection is vertical the x -coordinate of each ordered pair changes and the y -coordinate remains the same.
- if the line of reflection is horizontal the x -coordinate of each ordered pair remains the same and the y -coordinate changes.
- if the line of reflection is an oblique line (slanted) both the x and y coordinate of each ordered pair changes.
- if a vertex (or other ordered pair) is on the line of reflection, the ordered pair will not change.

It is important that students be able to identify that a reflection has occurred by analyzing the given shape and its image. Students should answer questions such as the following:

Harry said that the image shown is a translation because the original shape moved up. Jackie said the image is a reflection over a horizontal line because the shape and the image have different orientations. Who is correct? Explain.

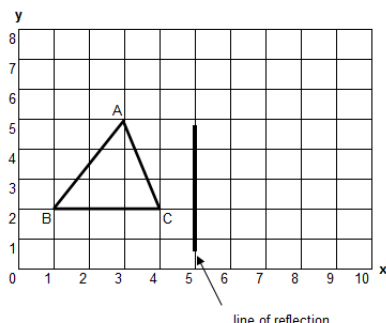


General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Paper and Pencil

- Ask students to reflect $\triangle ABC$ using the given line of reflection. Ask them to describe the orientation of the reflected image and justify why it is correct.

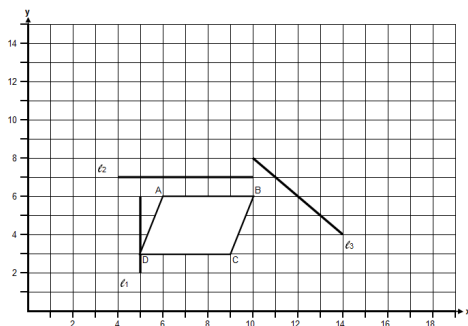


(6SS9.2, 6SS9.3)

- Tell students that $\triangle ABC$ with coordinates $A(1,5)$, $B(0,2)$ and $C(4,0)$ is reflected. The resulting image has vertices $(6, 2)$, $(4, 6)$ and $(1, 5)$. Ask students to determine where the line of reflection is located and to write the coordinates of two different points on the line of reflection.

(6SS9.3)

- Parallelogram Reflection - Students can work in pairs. Provide them with a similar copy of a coordinate grid and a table for recording vertices.



Ask students to do the following:

- Reflect Parallelogram ABCD using each reflection line and draw the image each time.
- Label the vertices of each image and record them in the table
- Describe the distance of the image from the line of reflection.
- Describe the orientation.
- Examine the table and describe any changes in the vertices when comparing the original shape to each image.

(6SS.9.1, 6SS9.2, 6SS9.3)

Shape	Image		
	Vertical Reflection	Horizontal Reflection	Diagonal Reflection
A (,)	A' (,)	A' (,)	A' (,)
B (,)	B' (,)	B' (,)	B' (,)
C (,)	C' (,)	C' (,)	C' (,)
D (,)	D' (,)	D' (,)	D' (,)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Reflecting Shapes

TR: pp. 18 – 21

SB: p. 151

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS9 Continued...

Achievement Indicators:

6SS9.2 (Continued) Perform a transformation on a given 2-D shape, and identify the coordinates of the vertices of the image (limited to the first quadrant).

6SS9.3 (Continued) Describe the positional change of the vertices of a given 2-D shape to the corresponding vertices of its image as a result of a transformation (limited to the first quadrant).

Suggestions for Teaching and Learning

The next transformation students will explore is rotation. When students describe a rotation, their description should include:

- the amount of rotation (90° , 180° , 270° turn $\frac{1}{4}$ turn, $\frac{1}{2}$ turn and $\frac{3}{4}$ turn)
- the direction of turn (clockwise or counterclockwise)
- the center of rotation.

To activate prior knowledge, ask students to stand and turn their bodies to illustrate a half turn (180°) and then a quarter turn (90°).

In Grade 5, students only rotated shapes about a vertex of the given shape. **In Grade 6, students will rotate images about a centre of rotation on a vertex, outside the shape and within the shape.**

Some students will have difficulty visualizing rotations. The use of Geoboards and tracing paper will assist students as they explore rotations. Students will need time to develop their understanding of this transformation.

Provide students with tracing paper (or blank overhead transparencies) and a given 2-D shape on grid paper. Ask students to trace the shape on the paper and place a dot on the point of rotation. They should draw an upward arrow at the point of rotation to help them identify when the required rotation is complete. Students should then place the tip of a pencil on the point of rotation and turn the tracing paper the indicated direction and amount for the given rotation to see the position of the rotated image. Students can then transfer the traced shape on the grid.

Students should recognize the following about a rotation:

- the shape and its resulting image are congruent
- the orientation of the shape and its image are the same.
- the shape and the image is the same distance from the center of rotation.
- both the x-coordinate and the y-coordinate may change.

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Paper and Pencil

- Provide students with coordinate grid paper and colored pencils.
On the grid paper ask students to draw trapezoid ABCD with vertices A(2, 4), B(9, 4), C(9, 8) and D(4, 8).

Ask students to draw the image of the trapezoid each time and color it as indicated.

- Rotate trapezoid ABCD $\frac{1}{4}$ (90°) turn clockwise about C(9, 8) and color the image blue.
- Rotate trapezoid ABCD $\frac{1}{2}$ (180°) turn about a point at (11, 9) and color the image red.
- Rotate trapezoid ABCD $\frac{3}{4}$ (270°) turn counter clockwise about a point at (10, 4) and color the image yellow.

Ask students to write the coordinates of the vertices of each rotated image. Ask them to describe if the centre of rotation has an effect on the location of the image.

(6SS9.1, 6SS9.2, 6SS9.3)

- Provide students with a variety of completed single transformations. Ask them to identify the type of transformation and explain how they know. Ask them to describe a transformation required to produce the image by discussing the positional change of the vertices.

(6SS9.3)

Performance

- Ask students to create a Pac-Man Maze (individual or in small groups). Using square dot paper student student should create a maze that Pac-Man must navigate through by applying various transformations. Students should identify the transformations required to navigate through the maze.

(6SS9.2)

- *Spin Toppers* - Ask students to find a space within the classroom and complete various rotations announced by the teacher (90° cw, for example).

(6SS9.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Rotating Shapes

TR: pp. 22 – 26

SB: pp. 152 – 155

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS6 Perform a combination of translations, rotations and/or reflections on a single 2-D shape, with and without technology, and draw and describe the image.

[C, CN, PS, T, V]

Achievement Indicators:

6SS6.1 Model a given set of successive translations, successive rotations or successive reflections of a 2-D shape.

6SS6.2 Draw and describe a 2-D shape and its image, given a combination of transformations.

Suggestions for Teaching and Learning

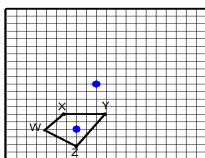
Performing a combination of translations, rotations, and/or reflections on a single 2-D shape is a new concept for Grade 6 students.

After working with each of the three transformations, combining transformations should be a natural progression for students. They will begin by exploring combinations of the same type: all translations, all reflections, or all rotations before moving into combinations of different types of transformations.

Encourage students to try to visualize the result of the combination of transformations. They should determine the location of the image from the first transformation and then use this image to perform the second transformation. When students are drawing combined transformations encourage them to appropriately label their images. When transforming $\triangle ABC$, for example, its image after the first transformation should be labelled $\triangle A'B'C'$. The second image should be labelled $\triangle A''B''C''$, and so on.

When modelling transformations emphasize which image is being transformed. **Students must recognize that when performing multiple transformations the second transformation is performed on the first image, not on the original shape.** Encourage students to use pattern blocks and/or geoboards to model a given set of transformations such as a translation (1R, 2U) followed by (3R, 5D).

Provide students with various 2-D shapes and ask them to perform successive transformations. Consider the following example:



Ask students to rotate the shape 90° clockwise around the point inside the 2-D shape. Then ask them to rotate the image 180° around the second center of rotation (the one outside the shape). Ask questions such as:

- Is there a single transformation that would take you from the given shape to the image.
- Does the order in which the rotations are performed make a difference to your final image?

Through exploration, students should discover that they should perform the transformations in order. The order in which they are performed may affect the location of the final image.

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Working in groups of three, ask one student to create a triangle on a geoboard. The second student should perform a given transformation to locate the image. Then the last student should perform a second transformation. Students could repeat this activity using other shapes and/or other transformations of the same kind. (6SS6.1)
- Ask students to create a triangle, then locate the image of $\triangle ABC$ after a reflection in line 1 followed by a reflection in line 2 and indicate the coordinates of the final image. Students should choose the lines of reflections used. Ask them what single transformation of $\triangle ABC$ would have the same result. (6SS6.1, 6SS6.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Combining Transformations of the Same Kind
 TR: pp. 31 – 35
 SB: pp. 158 – 161

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS6 Continued...

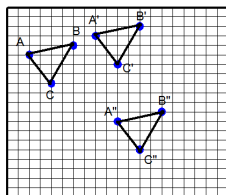
Achievement Indicators:

6SS6.3 Describe the transformations performed on a 2-D shape to produce a given image.

6SS6.4 Demonstrate that a 2-D shape and its transformation image are congruent.

Suggestions for Teaching and Learning

After modelling and describing successive transformations, students should be asked to describe the transformations that were performed on a 2-D shape to produce it. Students should be encouraged to use appropriate language in their descriptions, beginning with the type of transformation that has occurred. For rotations they should also indicate the amount of rotation, the direction, and the center of rotation. For translations, students should indicate the number of units and the direction of motion. For reflections, students should indicate the line of reflection (e.g., horizontal). Use an example such as:



Ask students questions such as the following:

- What type of transformations moved the triangle to its final image?
- Could the final image could have been obtained by a single transformation? Explain.

Demonstrate congruency to students using pattern blocks. Choose one (or more) pattern blocks, such as the triangle. Ask students to perform a combination of 2 transformations. Students should observe that the size and shape of the pattern block has not changed. The shape and its image are congruent.

Students could use tracing paper to check congruency by tracing the image and overlaying it on the initial shape. Students will see that the size and shape is maintained. If not, this is an indication that there is an error in their creation of the image or they have performed the transformation incorrectly.

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Journal

- Present students with two congruent shapes on grid paper (the first and the third shapes after two transformations were performed.) Ask students to write in their journals:
 - (i) What two transformations do you predict were performed?
Explain your reasoning.
 - (ii) Draw the second image
 - (iii) Could this have been done more than one way?
 - (iv) Could this have been done by a single transformation?

(6SS6.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Combining
Transformations of the Same Kind

TR: pp. 31 – 35

SB: pp. 158 – 161

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS6 Continued...

Achievement Indicators:

6SS6.5 Model a given combination of two different types of transformations of a 2-D shape.

6SS6.2 (Continued) Draw and describe a 2-D shape and its image, given a combination of transformations.

6SS6.6 Model a given set of successive transformations (translations, rotations and/or reflections) of a 2-D shape.

Suggestions for Teaching and Learning

Students should now model a given transformation of two different types of transformations. Some students may find this more difficult than two transformations of the same type. The continued use of pattern blocks, geoboards, tracing and grid paper is recommended.

Using an overhead projector or interactive white board, display a 2-D shape. Ask a student to suggest a single transformation to perform. Another student should perform this transformation on the overhead/interactive white board. Invite another student to suggest a different type of transformation for the resulting image. Once combinations of two different transformations have been used, invite students to brainstorm other transformations that could have been used to get the original shape to its final image.

Repeat this activity using two different types transformations.

Students should draw and describe a 2-D shape when given a combination of two different transformations. They should work with:

- a reflection followed by a translation (and vice versa)
- a translation followed by a rotation (and vice versa)
- a reflection followed by a rotation (and vice versa)

Remind students when performing a combination of transformations to focus on one transformation at a time where each new transformation is applied to the previous image.

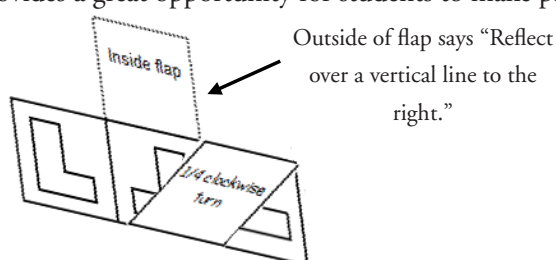
Students should also model successive transformations involving all three transformations. Ask them to create a 2-D shape using their geoboards (or pattern blocks and grid paper). They should perform set of transformations such as: a translation 2 units up and 1 unit to the left, a reflection over a vertical line, and a rotation of 180° .

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Provide students with a sheet legal paper and ask them to fold and cut it according to the diagram below. They should place one figure in the first (lower left-hand) box of the strip. Students must perform a transformation and write on the flap a description of the movement performed. They should continue performing successive transformations until all blocks have been filled. This activity shows students the orientation of each image, not the position in reference to the shape undergoing the transformation. Students can exchange strips and predict the shape they will see before they raise each flap. It provides a great opportunity for students to make predictions.



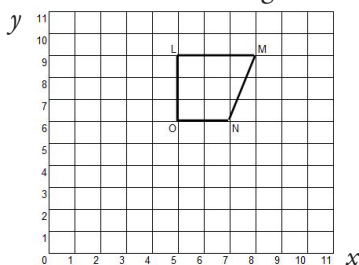
Source: Navigating Through Geometry (Grades 3 – 5)
(6SS6.5, 6SS6.2, 6SS6.3, 6SS6.6, 6SS6.7)

- Provide each student with a coordinate grid and three pattern blocks of the same type. Ask them to place one block on the grid so that one of its vertices is at (4, 3). Ask them to place a second block so that it would be the image of the first block under a vertical translation of 10 units up. Then ask them to place the third block so that it is the image of the second block under a reflection in the vertical line through the point (11, 10). Ask them to compare the first and third blocks.

(6SS6.5)

Paper and Pencil

- Provide students with a coordinate grid and figure as shown:



Ask students to translate the figure 1 square left and 5 squares down. Rotate the translated image $\frac{1}{4}$ turn counter clockwise about (4, 1). Write the coordinates of the final image. What do you notice about this final image?

(6SS6.2, 6SS6.3, 6SS6.6, 6SS6.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Combining Transformations of Different Kinds

TR: pp. 36 – 40

SB: pp. 162 – 165

Lesson 6: Communicating About Transformations

TR: pp. 45 – 48

SB: pp. 168 – 169

Note

Lessons 5 and 6 may be combined.

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS6 Continued...

Achievement Indicators:

6SS6.2 (Continued) Draw and describe a 2-D shape and its image, given a combination of transformations.

6SS6.7 Perform and record one or more transformations of a 2-D shape that will result in a given image.

Suggestions for Teaching and Learning

Given any 2-D shape and a combination of translations, rotations, and/or reflections, students should be able to draw and describe the image. Students could participate in a transformation scavenger hunt. Teachers could give students a grid with a map of the school on it and a 2-D shape. Students must perform the first transformation, which will identify the location of the next clue (based on the image). After the first transformation the image might land on the library, for example. They would then go to the library where the next transformation would be waiting. The first group to determine the final location wins.

Given a 2-D shape and an image students should be able to perform and record the transformation(s) that occurred. Note that when the intermediate step is not shown there could be more than one correct description for the transformations that occurred.

Provide each student with a coordinate grid and pattern blocks. They should carry out two transformations of their choice on the grid and leave only the first and third blocks in place. Encourage them to exchange grids with a partner and predict the two transformations that took place.

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Provide students with the Chinese characters for either “Family” or “Snow”. Students should choose an original position for their character and then apply a combination of transformations, drawing and describing each transformation

Example:



Alternatively, students could choose their own word and research the Chinese symbol for it. Encourage the use of technology to complete the transformations.

(6SS6.5, 6SS6.2, 6SS6.6)

- In small groups, students should create a line dance using their knowledge of transformations. Criteria could be as follows:
 - Each movement should be represented on grid paper.
 - Students must include a line dance key using appropriate mathematical language in their descriptions.
 - The line dance must include at least 3 transformations in any order.
 - Students should choose appropriate music for their line dance.
 - Students should present their line dance to the class.

(6SS6, 6SS9)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Combining Transformations of Different Kinds

TR: pp. 36 – 40

SB: pp. 162 – 165

Lesson 6: Communicating About Transformations

TR: pp. 45 – 48

SB: pp. 168 – 169

Note

Lessons 5 and 6 may be combined.

Curious Math:

Single Transformations or Multiple Transformations

TR: pp. 41 – 42

SB: p. 166

Math Game:

Capturing Squares

TR: pp. 43 – 44

SB: p. 167

Shape and Space (Transformations)

Specific Outcomes

Students will be expected to

6SS7 Perform a combination of successive transformations of 2-D shapes to create a design, and identify and describe the transformations.

[C, CN, T, V]

Achievement Indicators:

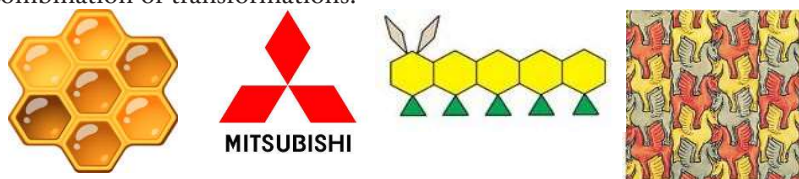
6SS7.1 Analyze a given design created by transforming one or more 2-D shapes, and identify the original shape(s) and the transformations used to create the design.

6SS7.2 Create a design using one or more 2-D shapes, and describe the transformations used.

Suggestions for Teaching and Learning

Students will now use their knowledge of transformations to analyze and create a design. Their design should require a combination of transformations. Students should be able to identify and describe the transformations that were used in the design.

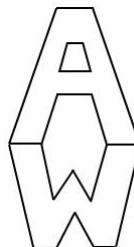
Display a variety of designs and logos that were created by using a combination of transformations:



Ask students to identify which transformations could have been used to create each design. M.C. Escher, an artist, is well known for his work with tessellations. Many of his pieces are created by using transformations.

Students should create their own design using a combination of transformations. The use of pattern blocks could help students with their design. They may choose to create their own tessellations or their own logo. Encourage creativity in their designs.

Students could create a design using their own initials. Ask them to draw their initials in a block letter symbol. They should perform a combination of at least two different transformations on their symbol to create their design.



Students should present their designs to the class and discuss the transformations that occurred. Alternatively, students could exchange their design with a classmate and ask their partner to describe which combinations of transformations were used in the design.

General Outcome: Describe and Analyze Position and Motion of Objects and Shapes.

Suggested Assessment Strategies

Performance

- Ask students to create a design using 3-5 pattern blocks (there must be at least 3 different shapes). Using a sheet of grid paper they will move their design from the top-left corner of the page to the bottom-right corner. The design should be in its original orientation when finally in the bottom right corner. Each move must be a reflection, a rotation or a translation. Encourage students to use more rotations and reflections than translations. Students should note how many moves were needed and draw each move on a piece of paper (or use additional blocks) to show what their design looks like. Extension: Students can complete the task again in fewer moves and describe the strategies used.

(6SS7.1, 6SS7.2)

- Ask students to create a tessellation design using a combination of one type of transformation.

(6SS7.2)

Presentation

- Ask students to choose from preselected company logos or symbols that illustrate different combinations of transformations. (e.g., the recycling symbol, Pepsi symbol). Ask them to present the logo/symbol to the class explaining the transformations that have taken place.

(6SS7.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Communicating About Transformations

TR: pp. 45 – 48

SB: pp. 168 – 169

Supplementary Resource

Teaching Student-Centered

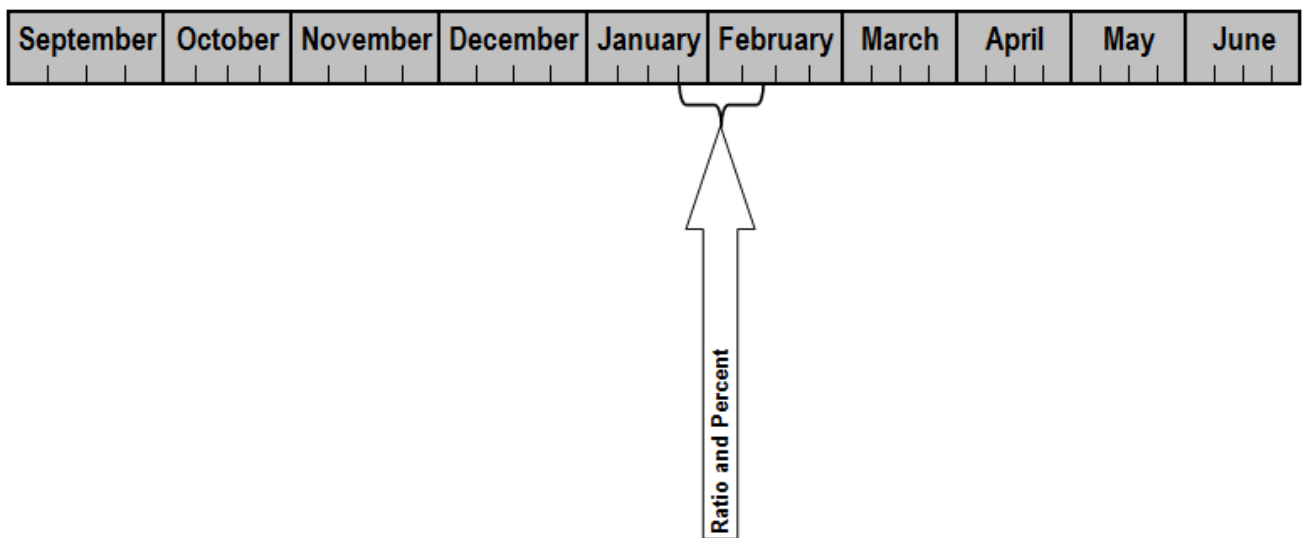
Mathematics Grades 3-5 – John

Van de Walle and LouAnn Lovin

- Support for SCO 6SS7 can be found on p. 233 and pp. 237 – 239

Ratio and Percent

Suggested Time: $2\frac{1}{2}$ Weeks



Unit Overview

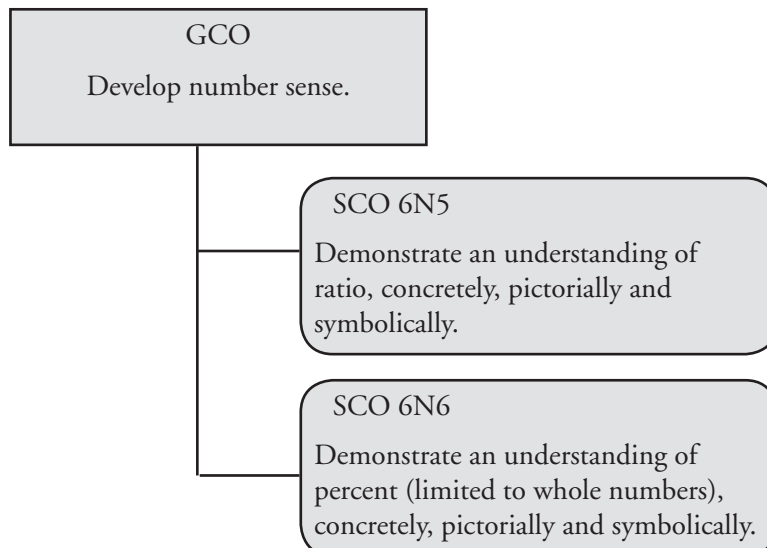
Focus and Context

Students encounter fractions, decimals, percentages and ratios in many everyday situations: a retail store is offering 20% off, a pizza must be shared with friends, sporting statistics are displayed on a website or television. Being able to make sense of these concepts is necessary to be informed citizens and consumers to work in today's society. As students make the necessary connections between decimals, fractions, ratios and percentages, it enhances their knowledge of and flexibility in thinking about numbers.

In the beginning of this unit, students will learn that a ratio is a comparison of any two quantities that have the same unit. A part-to-part ratio compares part of a set with another part of the set while a part-to-whole ratio compares part of a set to the entire set. They should understand the relationship between these ratios. Students will also explore equivalent ratios.

In the second part of this unit, students will explore percent as a special ratio that compares to 100. They will strengthen their understanding of the relationship between fractions, percents, ratios, and decimals and solve a variety of problems involving these concepts.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Number		
Specific Outcomes	Specific Outcomes	Specific Outcomes
Not addressed	<p>6N5 Demonstrate an understanding of ratio, concretely, pictorially and symbolically. [C, CN, PS, R, V]</p> <p>6N6 Demonstrate an understanding of percent (limited to whole numbers), concretely, pictorially and symbolically. [C, CN, PS, R, V]</p>	<p>7N3 Solve problems involving percents from 1% to 100%. [C, CN, PS, R, T]</p>

Mathematical Processes

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Number

Specific Outcomes

Students will be expected to

6N5 Demonstrate an understanding of ratio, concretely, pictorially and symbolically.

[C, CN, PS, R, V]

Achievement Indicators:

6N5.1 Write a ratio from a given concrete or pictorial representation.

6N5.2 Express a given ratio in multiple forms, such as 3:5, or 3 to 5.

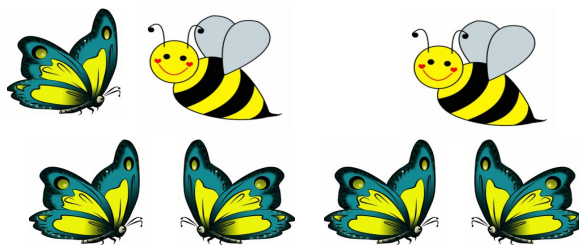
Suggestions for Teaching and Learning

This is students first exposure to ratios and percents. As students progress through this unit it is necessary to show them how ratios and percents can also be represented by decimals and fractions. Connecting these four concepts is essential in the development of students' number sense.

In Grade 5, students explored the connections between fractions and decimals. This work will help them to now connect this with ratios and percents. By the end of this unit, students should be able to fluently move between naming a number as a fraction, ratio, percent and decimal. When given a number such as 0.50, for example, students should see this as 50%, $\frac{5}{10}$, 5:10 but also see it as one half.

Teachers could begin this unit by reviewing fraction concepts, which would be beneficial in beginning work on ratios and percentages. Ask students to represent examples of different fractions in a variety of ways.

Teachers could begin exploration of ratios by displaying a set of objects such as the following:



Ask students to compare the number of butterflies to bumblebees. Students should respond with 5 to 2.

Ask them to compare the number of butterflies to the number of insects. They should respond with 5 to 7.

Introduce students to ratios as a comparison of any two quantities that have the same unit. The ratio of butterflies to the number of insects above, for example, can be written as 5:2, or 5 to 2. Students should be able to express a given ratio in multiple forms. Encourage the use of appropriate language. The ratio 3:2, for example, should be read as "3 to 2" or "3 __ for every 2 __."

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to determine body ratios such as wrist size: ankle size, wrist size: neck size, hand width: hand length, arm span: body height. Ask students to compare their results with others and express the ratios in multiple forms.

(6N5.1, 6N5.2)

Paper and Pencil

- Ask students to find and record the ratio of odd numbers to even numbers in their home phone number.

(6N5.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Ratios

TR: pp. 13 – 17

SB: pp. 178 – 181

Number

Specific Outcomes

Students will be expected to

6N5 Continued...

Achievement Indicators:

6N5.1 (Continued) Write a ratio from a given concrete or pictorial representation.

6N5.2 (Continued) Express a given ratio in multiple forms, such as 3:5, or 3 to 5.

6N5.3 Explain the part/whole and part/part ratios of a set; e.g., for a group of 3 girls and 5 boys, explain the ratios 3:5, 3:8 and 5:8.

Suggestions for Teaching and Learning

Teachers could provide small groups of students with a mini-box of Fruit Loops™, a package of Skittles™, or a set of Legos™ and have them sort their items according to colour. They should determine the following ratios (depending on colour selection):

- yellow to green
- red to orange
- purple to total
- blue to total
- a ratio of their choice

Students should express these ratios in multiple forms.

It is important for students to understand the difference between a part-to-part ratio and part-to-whole ratio. Discuss with students that a part-to-part ratio compares part of a set with another part of the set. Referring back to the insect example, the ratio 5:2, for example, compares the number of butterflies to the number of bumblebees. A part-to-whole ratio compares part of a set with the entire set. The ratio 5:7 compares the number of butterflies to the number of insects.

To illustrate the difference between part-to-part and part-to-whole ratios of the set, ask students to select a piece of fruit from a basket and as a class write the following ratios:

- apples to oranges
- oranges to bananas
- bananas to total pieces of fruit

Students should identify which of the ratios are part-to-part and which of the ratios are part-to-whole.

Since fractions represent a part of a whole or a set, part-to-whole ratios can be written as a fraction. Students are not expected, however, to express part-to-part ratios as part-to-whole fractions until Grade 8.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- Provide students with a set of animals, such as the one below. Ask them to write/read ratio comparisons (including part-to-part and part-to-whole ratios) and to identify those that can be expressed as fractions.

4 cats, 3 goldfish, 2 hamsters

(6N5.3)

- Pose the following question: Why might you describe the data set below as 4:1? As 1:4? As 1:5? As 4:5? Are there other ratios that you can use to describe the boys and girls?

B B B B G

B= boy G=girl

(6N5.1, 6N5.3)

Performance

- Ask students to write their full name indicating the ratio of vowels to consonants, vowels to all letters, consonants to vowels and consonants to all letters. They should identify each ratio as part-to-part or part-to-whole.

(6N5.3)

- Give students a handful of two or three different coloured snap cubes. Ask them to describe all possible ratios that exist using these cubes.

(6N5.1, 6N5.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Ratios

TR: pp. 13 – 17

SB: pp. 178 – 181

Number

Specific Outcomes

Students will be expected to

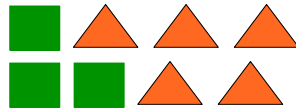
6N5 Continued...

Achievement Indicators:

6N5.4 Provide a concrete or pictorial representation for a given ratio.

Suggestions for Teaching and Learning

Given any part-to-part or part-to-whole ratio, students should be able to provide a concrete or pictorial representation using manipulatives such as snap cubes, pattern blocks, buttons or candy. If asked to provide a concrete representation of the ratio 3:5 as a part-to-part ratio, for example, students could display the following pattern blocks:



Teachers could identify the type of ratio as part-to-part or part-to-whole or it could be left to students to decide which ratio type to use. After creating their representations, encourage students to communicate how they decided on their representation.

Students could create a poster by displaying a ratio found in the classroom. They should write the ratio in multiple forms and provide a pictorial representation to illustrate their ratio. Completed posters could be displayed in the classroom. Students could select one of the following ratios:

- boys:girls
- teacher:pupils
- desks:students
- tables:students
- pencils:students

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to select 20 tiles of four different colours so that pairs of colours show the following ratios: 4 to 3, 2:1.
(6N5.1)
- Ask students to model a variety of ratios, such as 2:3 and 4:10.
(6N5.1)
- *Ratio Match* - Provide students with a set of cards (half should contain ratios, while the other half should display a pictorial representation of the ratio). Students should match the ratio card with the correct pictorial representation.
(6N5.1, 6N5.2)
- Ask students to model two situations which could each be described by the ratio 3:4. Specify that the situations must involve a different total number of items.
(6N5.1, 6N5.5)
- Tell students that John's family has a mother, father, 2 daughters and John. The part-to-part ratio of male to female is 2:3. The part-to-whole ratio (males:whole family) is 2:5. Ask students to represent these ratios using counters.
(6N5.1, 6N5.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Ratios

TR: pp. 13 – 17

SB: pp. 178 – 181

Number

Specific Outcomes

Students will be expected to

6N5 Continued...

Achievement Indicator:

6N5.5 Identify and describe ratios from real-life contexts, and record them symbolically.

Suggestions for Teaching and Learning

Through exploration and making meaningful connections, ratios can be related to everyday situations. Brainstorm with students where they have encountered ratios in their everyday lives:

- Ratios are used to mix frozen orange juice. Three cups of water must be added for every can (i.e., the ratio of water to concentrate to make orange juice is 3:1 or “3 to 1”).
- Maps also illustrate ratios. A scale of 1:100 on a map, for example, means that 1 cm on the map represents an actual distance of 100 km. Students should see the necessity of this scale, or ratio - it is impossible to show the actual size and/or distances on a map.
- Ratios are used in cooking. To make pancakes, for example, the ratio of pancake mix to water is 4:3. That is, for every 4 cups of pancake mix 3 cups of water must be added.
- Mixing gas and oil for chainsaws, snowblowers and snowmobiles. The gas:oil ratio for some machines is 50:1. This means that for every 50 L of gas there would be 1 L of oil needed.

Consider using children’s literature, such as *Math Curse* by Jon Scieszka and Lane Smith. In this story, students follow a girl through her daily routine. Everything she encounters becomes a math problem. After reading the book out loud call students attention to the shirts that her Uncle Zeno sent. Ask students to write ratios such as the following:

- white shirts to blue shirts
- plaid shirts to striped shirts
- blue shirts to total shirts

Students should identify each ratio as part-to-part or part-to-whole and represent each ratio pictorially.



Throughout this unit students should get daily practice using ratios. Ask students to create a book over the course of the unit, where each page represents a different ratio. Ask them to represent their ratio pictorially and symbolically. Later in the unit, students could add to each page by expressing each ratio as a fraction, decimal, and percent.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Journal

- Ask students whether or not they believe that the ratio of the population of any city in Canada to the total population of Canada could be 1:2. Students should explain their responses.

(6N5.4)

Performance

- Ask students to use snap cubes to show the ratio 5:6. Then ask them to use more cubes to create an equivalent ratio.
- Ask students to model two situations which could each be described by the ratio 3:4. Each situation must involve a different total number of items.

(6N5.6)

(6N5.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Ratios

TR: pp. 13 – 17

SB: pp. 178 – 181

Supplementary Resource

Math Curse - Jon Cieszka

Number

Specific Outcomes

Students will be expected to

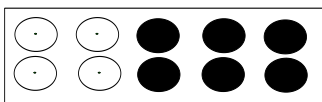
6N5 Continued...

Achievement Indicators:

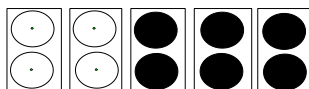
6N5.6 Demonstrate an understanding of equivalent ratios.

Suggestions for Teaching and Learning

In Grade 5, students created sets of equivalent fractions using pattern blocks and other manipulatives. They will extend this knowledge to create equivalent ratios. Teachers should make the connection between equivalent fractions and equivalent ratios. In the diagram below, for example, $\frac{4}{10}$ of the counters are white. This can be represented by the ratio 4:10.



Students should recognize that the above diagram also represents the fraction $\frac{2}{5}$ and the ratio 2:5.

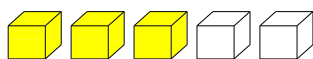


The ratios 2:5 and 4:10 are equivalent. If 2 of every 5 counters are white, then 4 of every 10 would also be white.

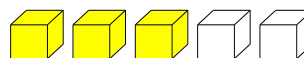
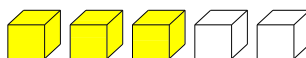
Present the following problem to students:

- Rebecca is preparing cookies for a bake sale. Her recipe calls for 3 cups of Rice Krispies for every 2 cups of marshmallows. Suppose she uses 6 cups of Rice Krispies to make her cookies. How many cups of marshmallows will she use?

Students should recognize that the ratio of Rice Krispies to marshmallows is 3:2. Students could use yellow snap cubes to represent Rice Krispies and white cubes to represent marshmallows:



For every 3 cups of Rice Krispies Rebecca will need 2 cups of marshmallows. She needs 3 more cups of Rice Krispies. Replicating the original model, creates an equivalent ratio:



Students should recognize that 6 cups of Rice Krispies will require 4 cups of marshmallows. The ratio of Rice Krispies to marshmallows is 6:4. Replicating the concrete or pictorial model of the ratio creates additional equivalent ratios. Teachers could make the connection to multiplication. Multiplication charts could help students in creating equivalent ratios.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to use counters to display a ratio of 3:5. Ask them to show an equivalent ratio and justify their answers. (6N5.1, 6N5.6)
- Provide students with a problem such as:
 - (i) Donald's punch recipe calls for 3 L of ginger ale, 1 L of strawberry juice and 2 L of orange juice. Suppose Donald uses 9 L of ginger ale, how much strawberry juice and orange juice should he use? Justify your answer. (6N5.6)
 - (ii) The Easter Bunny left 6 Hershey Kisses and some Jujubes. The ratio of kisses to Jujubes was 3:2. Altogether, how many Hershey Kisses and Jujubes did the Easter Bunny leave? Explain your answer pictorially, symbolically and concretely. (6N5.6)

Presentation

- Ask students to draw a picture of them and their families at the park. Ask students to write a part-to-part ratio and a part-to-whole ratio to describe their picture (e.g., Number of arms to legs and number of children to people) and allow time for them to share their pictures and ratios with the class. Next, ask students to switch pictures. Give each student a strip of paper and ask them to write a word problem involving equivalent ratios to go with their classmate's picture. Display the pictures and word problems around the classroom. Allow students time to solve all the problems by having students do a gallery walk in pairs. (6N5.2, 6N5.6)

Paper and Pencil

- Present the following diagram to students:

x x x o
 x x x o
 x x x o

Ask students to write equivalent ratios demonstrated through this diagram and to explain their thinking.

(6N5.2, 6N5.6)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Equivalent Ratios

TR: pp. 18 – 22

SB: pp. 182 – 185

Number

Specific Outcomes

Students will be expected to

6N5 Continued...

Achievement Indicators:

6N5.6 (Continued) Demonstrate an understanding of equivalent ratios.

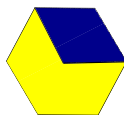
Suggestions for Teaching and Learning

Another strategy to create equivalent ratios is using tables and patterns:

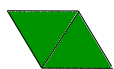
Cups of Rice Krispies	3	6	9
Cups of Marshmallows	2	4	6

Rebecca needs 6 cups of Rice Krispies in all. This is 2 groups of 3 cups of Rice Krispies. To maintain balance, she will need 2 groups of 2 cups of marshmallows- a total of 4 cups of marshmallows. Students can create equivalent ratios by using number sense. They can multiply each term in the ratio by the same number.

Students could also use pattern blocks to explore equivalent ratios. They should recognize that when the yellow hexagon is one whole, one blue rhombus represents $1:3$ or $\frac{1}{3}$ of the hexagon.



To create an equivalent ratio, students could use the green triangles to match the same area as one blue rhombus.



They should observe that it takes 2 green triangles to create a blue rhombus, therefore the ratio of triangles to the whole is $2:6$. Visually, students see that $1:3$ is equivalent to $2:6$. Students could explore other equivalent ratios using the pattern blocks.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Resources/Notes

Performance

- For each of the following ratios, ask students to find an equivalent ratio in which one of the terms is 20.

4:6 10:30 3:5 4:5

(6N5.6)

- Ask students to list:
 - five ratios that are equivalent to 1:2
 - three ratios that are equivalent to 8:6.

(6N5.6)

- Ask students to work in pairs or small groups to discuss all possible ratios, including equivalent ratios, that could be represented by the following situation:

During a student council election, Sue received 36 votes and Sam received 9 votes.

(6N5.6)

Interview

- Ask students to explain how a multiplication chart can be used to generate equivalent ratios. (6N5.6)
- Ask students: Why do you get an equivalent ratio by multiplying both terms of a ratio by 3? (6N5.6)

Journal

- Tell students that in a class of 30 students, there are 20 girls. Ask them to explain why the ratio of boys to girls is 1:2. (6N5.6)
- Ask students to create a picture representing various groups of items and write two equivalent ratios that can be found in the picture. Ask them to explain their thinking. (6N5.2, 6N5.6)

Paper and Pencil

- Ask students to solve the following problem:
In a large bag of marbles, the ratio of blue marbles to the total number of marbles is 4:10. Predict the number of blue marbles if the total number of marbles was 100. (6N5.6)

Authorized Resource

Math Focus 6

Lesson 2: Equivalent Ratios

TR: pp. 18 – 22

SB: pp. 182 – 185

Number

Specific Outcomes

Students will be expected to

6N5 Continued...

Achievement Indicator:

6N5.7 Solve a given problem involving ratio.

Suggestions for Teaching and Learning

Students should be exposed to a variety of problems that involve ratio. There are many applications of ratios to students' lives such as cooking, scale diagrams and maps. Teachers could choose one or more of the following to provide students with opportunities to solve problems involving ratios:

- In small groups, students should analyze various maps. They should identify the scale used on the map and then use it to determine the distances between various cities or countries, for example.
- Provide students with a recipe for cookies. In small groups students should modify the list of ingredients using ratios to make enough cookies for their entire school.
- Provide students with a floor plan for a particular room in a house. Using the scale provided students should determine the dimensions of the room.
- A model car has a scale of 1:30. Ask students to determine the dimensions of the actual size of the car. Using their understanding of scales and ratios they should determine the height of the actual car door if the model car has a door that is 4 cm in height.
- During practice, the ratio of volleyballs to players is 1:2. If there are 12 players at practice, how many volleyballs are there?

Consider using children's literature, such as *Bat Jamboree*, to assess student understanding of ratios. 55 bats have practiced for the bat jamboree all spring and do not disappoint. From singing, to dancing, to playing instruments, the show has it all. The grand finale occurs when the bats create a pyramid. After reading the story with the class, call students attention to the "Great Bat Pyramid" (teachers could display this picture on their interactive whiteboards. Ask students questions such as:

- What is the ratio of bats with hats to the total number of bats?
- What is the ratio of bats with instruments to bats with hats? Write an equivalent ratio for this.
- What is the ratio of bats wearing ties to bats wearing hats?

Students could create their own visual and develop ratio questions. Encourage them to share their visuals and questions with the class or in small groups.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to use 20 tiles of four different colours to show pairs of colours that show the following ratios:
 - 4 to 3
 - 2:1
 - $\frac{1}{3}$

(6N5.6, 6N5.7, 6N6.7)
- Ask students to create their own scale diagram. Ask them to let every one block of one centimetre-grid paper represent two meters of real, outdoor playground space. To visualize this scale, use string or chalk to mark off a two-meters-by-two-meters space on the floor. Use small cubes or blocks to build a scale model of a playground structure on your paper. Trace and draw on the paper a top-view plan of the structure. How could you represent yourself on your playground?

(6N5.6, 6N5.7, 6N6.7)
- Provide students with a problem such as: 758 people were surveyed to determine their favourite laundry detergent. 248 individuals responded that they used Brighto detergent. Working in pairs, ask students to write a ratio involving the number of people who use Brighto. Encourage students to share their ratios with their classmates and explain their reasoning.

(6N5.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Ratios

TR: pp. 13 – 17

SB: pp. 178 – 181

Lesson 2: Equivalent Ratios

TR: pp. 18 – 22

SB: pp. 182 – 185

Lesson 5: Exploring Scale
Diagrams

TR: pp. 38 – 41

SB: p. 195

Note

Scale diagrams is ONE example of solving a given problem involving percents and ratios. You should explore a variety of problems involving these concepts.

Supplementary Resource

Bat Jamboree - Kathi Appelt

Number

Specific Outcomes

Students will be expected to

6N6 Demonstrate an understanding of percent (limited to whole numbers), concretely, pictorially and symbolically.

[C, CN, PS, R, V]

Achievement Indicators:

6N6.1 Explain that “percent” means “out of 100.”

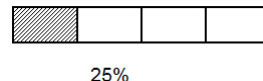
6N6.2 Explain that percent is a ratio out of 100.

Suggestions for Teaching and Learning

This is students’ first exposure to percents.

At this point in time, students are not expected to determine percentages by converting a fraction to a percent and will not be dealing with percentages greater than 100. Students should recognize:

- situations in which percent is commonly used
- diagrams that represent various percentages
- the relationship between percents, decimals and fractions (e.g., $48\% = 0.48 = \frac{48}{100}$)
- that percent is a ratio or a comparison of the percent value to 100 and can be written as $__ : 100$ and $\frac{__}{100}$
- that finding a percentage is the same as finding an equivalent ratio out of 100



Percent is a special ratio that compares to 100. It is a part-to-whole ratio that compares a number to a whole divided into 100 equal parts. Percent means “out of 100.” Students should recall that when they receive their test scores, they are often reported as a percent. If they scored 87% on a test, it means 87 out of 100 ($\frac{87}{100}$). As connections are made to fractions, 100% can be seen as a whole where anything less than that whole is a part or percent. Students should also recognize $\frac{87}{100}$ as 0.87. Focus on mathematical language, using 87 hundredths, or 87 out of 100 to help students make these connections.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies*Performance*

- Ask students to use the Internet, a geography book, or other print resource to locate the flags of various countries. You will notice that many flags are created with a number of colours or combinations of those colours. Ask students to choose three different countries to reflect on the design of their flags. What percentage of a flag is a particular colour? What fraction? What would this look like as a ratio to the whole flag? Sort and graph flags that represent halves, thirds, and fourths.

(6N6.1)

Resources/Notes**Authorized Resource***Math Focus 6*

Lesson 3: Percents

TR: pp. 23 – 27

SB: pp. 186 – 189

Number

Specific Outcomes

Students will be expected to

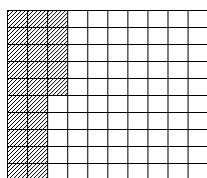
6N6 Continued...

Achievement Indicators:

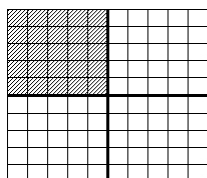
6N6.3 Use concrete materials and pictorial representations to illustrate a given percent.

Suggestions for Teaching and Learning

Demonstrate to students how to use a hundredths grid to represent percents. Explain to students that the hundredths grid represents 1 whole. To represent and model 25%, for example, students should recognize that 25% means 25 out of 100. It should make sense that to represent this on a hundredths grid they would shade 25 blocks out of 100, $\frac{25}{100}$.



$\frac{25}{100}, 25 : 100$
25%
0.25



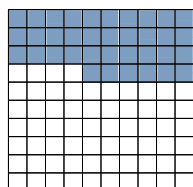
25 % shaded

The use of concrete materials or pictures should help students see the connection among fractions, decimals and percents. 25 blocks out of 100 is equivalent to $\frac{1}{4}$, 25:100 or 1:4, 0.25 or 25%.

Provide students with a blank hundredths grid and ask them to use four different colors to shade in the grid. Ask them, for example, to shade 30 blocks red, 20 blocks blue, 45 black and 5 yellow. They should describe each color using a fraction, decimal, percent and a part to whole ratio. This activity will help strength students connections among the various representations.

6N6.4 Record the percent displayed in a given concrete or pictorial representation.

Students should record the percent displayed in given concrete and pictorial representations:



Encourage them to use other concrete representations to facilitate their understanding. Share with students the book *Piece = Part = Portion: Fractions = Decimals = Percents* by Scott Gifford. The images provided demonstrate examples of percents of objects, as well as equivalences of fractions, decimals and percents.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to shade hundredths grids to show a percentage such as 20%, 60%, and 25%. Ask what percent is left unshaded. What are other ways of representing the unshaded part?

(6N6.3)

- Ask students to place the following on a number line. Then choose one number and justify their thinking.

0.40 76% $\frac{2}{10}$ 95%

(6N6.3)

Journal

- Ask students to draw a picture to show why a decimal can be represented as a percent.

(6N6.1, 6N6.3)

- Ask students to choose a fraction and a percent that are not equivalent. Ask them to use pictures, numbers and words to explain which is greater.

(6N6.1, 6N6.3)

- Ask students to compare 20% and 0.02 on a hundredth grid. Which is greater? Explain your answer.

(6N6.3)

- Ask students: What percent of a metre stick is 37 cm? How do you know?

(6N6.4)

Paper and Pencil

- Ask students to name percents that indicate:
 - almost all of something
 - very little of something
 - a little less than half of something (ask students to explain their thinking)

(6N6.4)

- Ask students to estimate the percentage of red that is shown on the Canadian flag. Justify your thinking.

(6N6.4)

Portfolio

- Ask students to create a pencil crayon quilt made of patches of various colours. They can describe the approximate or exact percentages, ratios or fractions of each colour within the patch and then estimate the percent of the total quilt that is each colour.

(6N6.2, 6N6.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Percents

TR: pp. 23 – 27

SB: pp. 186 – 189

Supplementary Resource

Piece = Part = Portion: Fractions = Decimals = Percents – Scott Gifford

Number

Specific Outcomes

Students will be expected to

6N6 Continued

Achievement Indicators:

6N6.5 Identify and describe percents from real-life contexts, and record them symbolically.

6N6.6 Express a given percent as a fraction and a decimal.

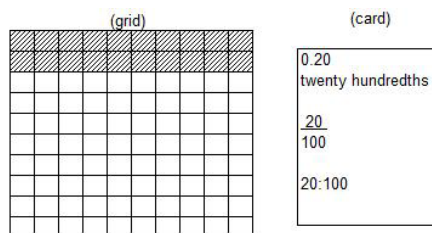
Suggestions for Teaching and Learning

Brainstorm with students where they would encounter percents in real-life. Students may suggest the following:

- test scores
- a sale (20% off, for example)
- many retail and car dealership employees get paid commission (e.g., 3% on their sales)
- tax paid when you make a purchase
- interest rates at a bank
- on food labels (% of your daily intake)
- election results/surveys

Provide students with a variety of flyers, magazines, books, newspapers, etc., that display percents. They should identify the percents that are used and communicate what these percents represent in the given context. Encourage students to communicate their findings with the class.

Students should be able to move between the various representations of a percent. Throughout the unit they have been making connections between percents, fractions, decimals and ratios. The use of a hundredths grid will help reinforce these relationships. Provide students with a hundredths grid and ask them to represent 20%, for example. They should also create a corresponding card that illustrates the percent shaded on the grid using a decimal, fraction, ratio and in words.



The use of appropriate mathematical language should also help students move from one representation to another.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to create a collage showing how percents are used in daily life.

(6N6.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Percents as Fractions or Decimals

TR: pp. 32 – 35

SB: p. 192 – 193

Math Game:

Ratio Match

6N5

TR: pp. 36 – 37

SB: p. 194

Number

Specific Outcomes

Students will be expected to

6N6 Continued...

Achievement Indicators:

6N6.7 Solve a given problem involving percents.

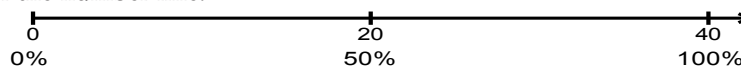
Suggestions for Teaching and Learning

Students should use their knowledge of percents, decimals, fractions, and ratios to solve a variety of problems involving percents. They should be encouraged to estimate their solution when appropriate. Using models such as base ten blocks, counters and number lines will help students determine given percentages.

When using number lines, students should consider the following:

- 50% is equivalent to $\frac{1}{2}$. To identify 50% of a number simply take half of the number (divide by 2).
- 25% is equivalent to $\frac{25}{100} = \frac{1}{4}$. To identify 25% of a number divide the number by 4. Alternatively, students should recognize that 25% is halfway between 0% and 50%. To determine 25% they could identify the number halfway between 0% and 50% of the given number.
- 75% is equivalent to $\frac{75}{100} = \frac{3}{4}$. Students could use the result of 25% of the given number and add it three times to determine 75%. Alternatively, students should recognize that 75% is halfway between 50% of the given number and 100% of the given number.
- If students know 10% of the given number they can determine 20% by adding 10% of the number to itself (or doubling 10%), 30% by adding 10% of the number three times (tripling 10%) and so on. In the same manner, if students know 10% of the given number they should determine 5% since 5% is half of 10%.

Teachers should model the use of number lines to solve percentage problems. To determine 50% of 40, for example, being by sketching a number line where 40 represents 100% or a whole. Next, establish a benchmark of 50%. Many students would recognize that 50% is equivalent to $\frac{1}{2}$. Since $\frac{1}{2}$ of 40 is 20, 20 would be placed in the middle of the number line.



To determine 25% of 40, students should recognize that 25% is equivalent to $\frac{25}{100} = \frac{1}{4}$. They could divide 40 by 4 to determine 25% of 40 is 10. It follows that $75\% = \frac{75}{100} = \frac{3}{4}$ of 40 would be 30.

Alternatively, students should recognize that 25% is exactly between 0% and 50% of a number. They could take half of 20 to get 10. They could recognize that 75% is exactly halfway between 50% and 100%. Halfway between 20 and 40 would give them 30. Students should identify each of these benchmarks on their number line and then use them to estimate and calculate any other percentages.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- In a set of tangrams, a large triangle is 25% of the whole set. Ask students: What percentage of the set is the square? Parallelogram? Small triangle? Medium triangle?
(6N6.7)
- Changing to newer, more energy-efficient light bulbs can save up to 70 percent on your electric bill. If a person's electric bill was \$30 before changing his bulbs, what would the bill be with the newer bulbs? Talk to your family about your electric bill. How much could you save? Or how much are you already saving? Make a list of additional ways your family could both conserve energy and save money.
(6N6.7)

Paper and Pencil

- Ask students to solve the following problems:
 - (i) Sandra bought a pizza for her slumber party. Jaime and Maria ate 25% of it. Louisa and Abby ate one-third of what was left. Chantel and Sammie ate 50% of what was left. Manuela ate two slices. Sandra was left with two slices. How many slices were in the pizza? How many slices did each of the girls eat? Explain your thinking using pictures, numbers, and words.
 - (ii) Approximately 50% of all people in Canada over 18 years old vote when it is time to elect a new prime minister. If 50% of your class voted, how many people would that be? Determine the number of voters if 50% in your grade, in your school, and in your community voted? Was this percentage easy or difficult to work with and why? What would happen if the percentage was 75%? Would you use the same strategy or a different strategy to find your answer?
 - (iii) Ask students to assign a percentage value to each letter in the word **HEART**. Assign the values so that the sum of the letters equals one hundred percent. All the letters can have the same value or each letter can have a different value. Show four different ways you can do this.
(6N6.7)

Interview

- Ask students to explain how they know that the ratio of 1:5 represents 20%.
(6N6.7)
- The ratio of boys to girls in Sarah's class is 7:13. Sarah says there are at least 50% girls in her class. Is she correct? Explain.
(6N6.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Percents as Fractions or Decimals

TR: pp. 32 – 35

SB: pp. 192 – 193

Lesson 6: Solving Percent Problems

TR: pp. 42 – 45

SB: pp. 196 – 198

Lesson 7: Communicating about Ratios and Percents

TR: pp. 48 – 51

SB: pp. 200 – 201

Curious Math:

Interesting Percents

TR: pp. 46 – 47

SB: p. 199

Number

Specific Outcomes

Students will be expected to

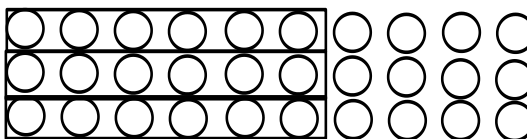
6N6 Continued...

Achievement Indicator:

6N6.7 (Continued) Solve a given problem involving percents.

Suggestions for Teaching and Learning

Students could also use base-ten blocks or linking cubes to find given percentages. When asked to find 60% of 30, for example, students could count out 30 blocks. They should recognize that 60% is the same as $\frac{60}{100}$ or $\frac{6}{10}$ (6 out of every 10). They can use this relationship to break 30 into groups of 10.



60% of 30 would be 6 blocks out of every 10. It follows that 3 groups of 6 blocks would be 18. Therefore, 60% of 30 is 18.

Students should be exposed to a variety of problems involving percent. Consider some of the following:

- Shawn wanted to buy his sister a birthday gift that costs \$60.00. He would like to have 50% saved by the end of June. How much money would he have saved by June?
- The school has raised \$800.00 to buy new sports equipment. 50% of the money will be spent on volleyball equipment. 30% will be spent on basketball equipment. The remaining money will be used to purchase new scooters. How much money was spent on each item?
- Darryl got 16 out of 20 on a Math test. John got 75%. Whose mark was higher? Explain using pictures, numbers and words.
- The ratio of girls to boys in the school choir is 3:1. What percent of the choir are girls? If there are 40 children in choir, how many of them are boys?

When solving problems involving percents, students should communicate their reasoning using pictures, numbers, and words (using appropriate mathematical language).

Using the book *The Toothpaste Millionaire*, by Jean Merrill, ask students to review page 27 where Mr. Conti caught Rufus passing a note to Kate which read “If there are $2\frac{1}{2}$ billion tubes of toothpaste sold in the U.S. in one year, and 1 out of 10 people switched to a new brand, how many tubes of the new brand would they be buying?” Invite students to explore this problem using ratios and percentages to find out the number of people that would switch to a new brand of toothpaste in one year. Ask them to discuss the different ways they used ratios and percentages to come up with a solution. Compare this with the answer the book gives.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- If the Montreal Canadians won 75% of their hockey games this season, and their season consists of 60 games, what is the ratio of their games won? Lost? Justify your answers. (6N6.7)
- There are 50 students in a choir with 32% boys. How many girls are in the choir? Is it possible to use a hundredths grid to solve the problem? (6N6.7)
- Tell students Emma is making a quilt. She has 60 patches. Help Emma create a quilt with the following colours:

- 25% red
- 0.10 green
- 3:10 yellow
- The rest is blue

Ask students to draw a picture to show their thinking and explain how they were able to determine how many of each colour Emma will need to complete her quilt.

(6N6.7)

Performance

- Tell students they have been hired by a graphic design company to design a new logo for the company. They tell you the logo can be any shape and have the following criteria:
 - less than one third of the logo is blue
 - about 60% red
 - the rest yellow

Ask students to design the logo and write a description telling the company how you were able to come up with the percentages of each colour. You may need to represent each portion (colour) of the logo in decimal and fractional form, just in case they may want to make sure you have met the criteria.

(6N6.7)

- Ask students to use the Internet or print resources to determine the following:
 - What percent of the Earth is water?
 - What percent of the rainforests are in danger?
 - What percent of animals are endangered?

(6N6.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Solving Percent Problems

TR: pp. 42 – 45

SB: pp. 196 – 198

Lesson 7: Communicating about Ratios and Percents

TR: pp. 48 – 51

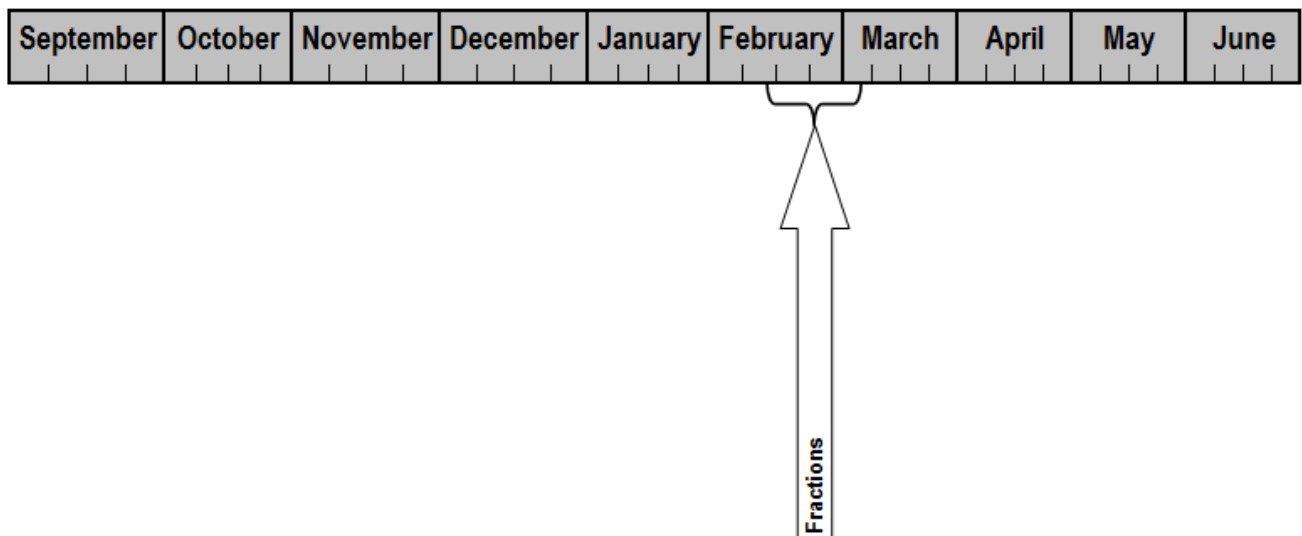
SB: pp. 200 – 201

Supplementary Resource

The Toothpaste Millionaire – Jean Merrill

Fractions

Suggested Time: 3 Weeks

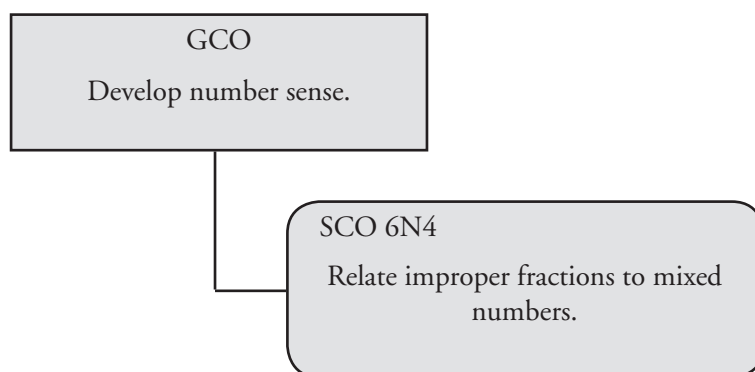


Unit Overview

Focus and Context

Fractions are a part of everyday life: cooking, measuring, building and understanding quantities are just a few examples of where people encounter fractions. In Grade 6, students extend their knowledge of fractions by developing an understanding of fractions that are greater than one. They will explore how these improper fractions can be expressed as mixed numbers. Students will have many opportunities to develop these concepts as they model, draw, name and write about mixed numbers and improper fractions while solving meaningful problems. The use of manipulatives will enable students to visualize the connections between improper fractions and mixed numbers. The study of improper fractions and mixed numbers should build on students' prior knowledge of whole number and proportional concepts and skills and their encounters with decimals, proper fractions, ratios and percents in previous work and in their everyday life. Students will be engaged in problem solving situations where they will have to compare improper fractions and mixed numbers. As they work through various situations, students will continue to develop their problem solving strategies as they learn how to effectively use models, pictures and logical reasoning to solve problems.

Outcome Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Number		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5N7 Demonstrate an understanding of fractions by using concrete, pictorial and symbolic representations to:</p> <ul style="list-style-type: none"> • create sets of equivalent fractions • compare fractions with like and unlike denominators. [C, CN, PS, R, V] <p>5N9 Relate decimals to fractions and fractions to decimals (to thousandths). [CN, R, V]</p>	<p>6N4 Relate improper fractions to mixed numbers. [CN, ME, R, V]</p>	<p>7N5 Demonstrate an understanding of adding and subtracting positive fractions and mixed numbers, with like and unlike denominators, concretely, pictorially and symbolically (limited to positive sums and differences). [C, CN, ME, PS, R, V]</p>

Mathematical Processes

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Number

Specific Outcomes

Students will be expected to

6N4 Relate improper fractions to mixed numbers.

[CN, ME, R, V]

Achievement Indicator:

6N4.1 Demonstrate, using models, that a given improper fraction represents a number greater than 1.

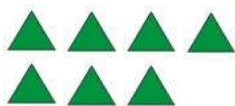
Suggestions for Teaching and Learning

In Grade 5, students developed an understanding of equivalent fractions and compared fractions with like and unlike denominators, where the numerator was less than the denominator. In Grade 6, students will extend this knowledge by exploring fractions that are greater than 1 and relate this to mixed numbers. They will use various models and pictures such as pattern blocks, fraction pieces, fraction strips, snap cubes, and number lines.

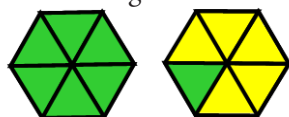
Remind students that the number of parts in a whole varies from situation to situation. They must recognize that the denominator names how many parts in a whole and the numerator names how many parts in all. Demonstrate these ideas to students by using pattern blocks. Use the yellow hexagon to represent one whole, for example, and then change the whole to be two (side by side) yellow hexagons. This should help students understand that:

- When using one hexagon as a whole, the red trapezoid is $\frac{1}{2}$, the blue rhombus is $\frac{1}{3}$ and the green triangle is $\frac{1}{6}$.
- When two yellow hexagons becomes one whole, the red trapezoid, then becomes $\frac{1}{4}$, the blue rhombus becomes $\frac{1}{6}$, and the green triangle becomes $\frac{1}{12}$.

Students have an understanding of fractional parts, or equal shares which they refer to as thirds, fourths, fifths, tenths, etc. Teachers should emphasize that these fractional parts can be counted in the same way as any other set of objects. Fractions greater than one whole can be understood this way. Using pattern blocks, for example, if one hexagon represents a whole, then one triangle represents $\frac{1}{6}$. Present a set of triangle pattern blocks and ask them how many sixths it represents:



Students should respond with $\frac{7}{6}$. Ask if the collection is more or less than 1. Some students would immediately recognize that this would represent a number greater than 1 since only 6 triangles are needed to form a whole (a hexagon). For students who do not readily make this connection, ask them to group the triangles to see if there are enough to cover a hexagon:



Visually, students can see that the given fraction, $\frac{7}{6}$, represents a number greater than 1.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Tell students Billy went to the store. While he was there he noticed a sign saying bars were on sale. “4 for \$1.00. Billy thought this was a great deal and bought 4 bars. Billy wanted to share the bars among his two friends. Show how Billy can share this equally among him and his two friends.

(6N4.1, 6N4.2)

- Ask students to model $\frac{7}{4}$ to show that it is greater than one whole. Ask students to model an improper fraction. Ask them to explain how they know it is an improper fraction.

(6N4.1, 6N4.2)

- Ask students to use pattern blocks to model the improper fraction $\frac{10}{3}$ as many ways as they can.

(6N4.1)

Interview

- Tell students you modelled the improper fraction $\frac{9}{6}$ using pattern blocks. Ask them to determine which pattern block was used to model $\frac{9}{6}$ and explain how they know.

(6N4.1)

Journal

- Ask students to represent the following improper fractions using rectangles:

(i) $\frac{5}{4}$

(ii) $\frac{3}{2}$

They should explain their thinking.

(6N4.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Modelling Fractions

TR: pp. 13 – 17

SB: pp. 210 – 211

Lesson 2: Fractions Greater Than 1

TR: pp. 18 – 22

SB: pp. 212 – 215

Supplementary Resource

Teaching Student-Centered

Mathematics Grades 3-5 – John

Van de Walle and LouAnn Lovin

- Support for SCO 6N4 can be found on pp. 131-150

Number

Specific Outcomes

Students will be expected to

6N4 Continued...

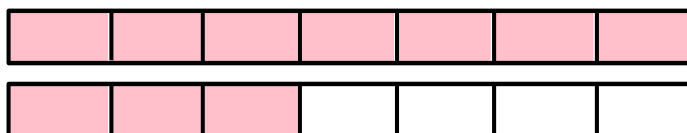
Achievement Indicator:

6N4.1 (Continued) Demonstrate, using models, that a given improper fraction represents a number greater than 1.

Suggestions for Teaching and Learning

Teachers should use a variety of models to demonstrate that a given improper fraction is greater than 1. Using pattern blocks and fraction strips, for example, allow students to see how the same fraction can be modelled in two different ways.

Fraction strips can also be used to show that a given improper fraction is greater than 1. Consider $\frac{10}{7}$, for example:



From previous work with fractions strips, students should recognize the given fraction is more than 1.

Making meaningful connections to students' lives will help them understand the concepts they are learning. While talking about improper fractions, and even mixed numbers later in the unit, money could be used. A dime, for example, can be seen as $\frac{1}{10}$ of a dollar where 10 dimes make one whole dollar. If you ask students to model $\frac{15}{10}$, students could use 15 dimes. In this case, they should readily make the connection that this is a number greater than one, since they know 15 dimes is \$1.50 (more than one whole). Using this context, ask students to represent $\frac{5}{4}$. Most students are comfortable working with money and would model the given fraction using 5 quarters. They should conclude that this fraction is more than 1 since they know if they had 5 quarters they would have \$1.25.

Other everyday objects, such as egg cartons, lego blocks, and chocolate bars, could also be used to develop improper fractions as being larger than one.

It is important that students develop a strong conceptual understanding of improper fractions. They should understand that an improper fraction represents more than one whole and that its numerator is greater than its denominator. To create this conceptual understanding students should be given the opportunity to engage in many hands on activities that require them to model improper fractions.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Tell students there are 12 eggs in a carton. Ask them if they had 17 eggs, would $1\frac{1}{2}$ cartons be enough to hold the eggs?
(6N4.1, 6N4.2)
- Using snap cubes, show students a model of a whole. (E.g., 5 same coloured snap cubes would equal one whole) Ask students to explore different ways to create an improper fraction between 1 and 2 using this whole.
(6N4.1)
- Ask students to work with a partner to create and model improper fractions. Provide students with a six-sided die. Students A should roll the die and record the result as the numerator. Student B should roll the die and record the result as the denominator. They should then model their fraction and decide if it is improper, explaining their reasoning.
(6N4.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Modelling Fractions

TR: pp. 13 – 17

SB: pp. 210 – 211

Lesson 2: Fractions Greater Than 1

TR: pp. 18 – 22

SB: pp. 212 – 215

Number

Specific Outcomes

Students will be expected to

6N4 Continued...

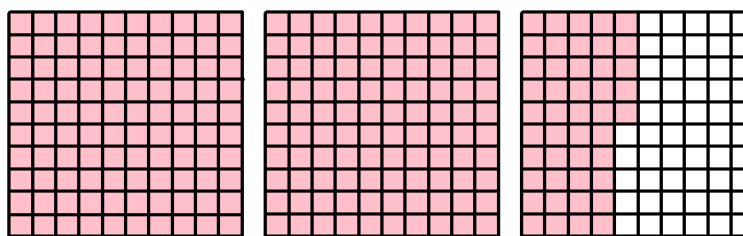
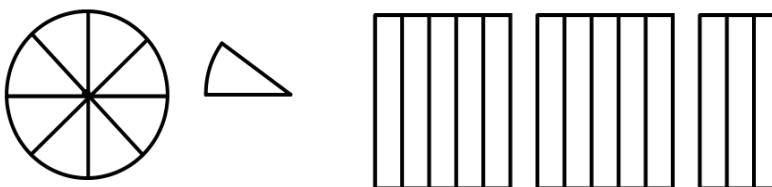
Achievement Indicator:

6N4.2 Translate a given improper fraction between concrete, pictorial and symbolic forms.

Suggestions for Teaching and Learning

Students should be able to translate a given improper fraction between various representations: concrete, pictorial and symbolic. Consider the following:

- Provide students with a variety of concrete and pictorial representations of improper fractions and ask students to describe each as an improper fraction:



- Provide students with a set of improper fractions, such as $\frac{5}{3}$, $\frac{9}{2}$, $\frac{13}{4}$ and ask them to model concretely and sketch the pictorial representation of each fraction.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to explore the different possibilities of creating an improper fraction with two hexagons being one whole. Challenge them by limiting the number of blocks they can use. For example, if two hexagons equals one whole, ask students to find various ways to represent an improper fraction with 7 blocks. Ask them to record their answers in a chart. Make this a class challenge where students can find as many representations as possible, receiving one point for each representation found and 5 points for each representation that is unique among the students. The winner would be the student with the most points.
(6N4.2)
- Provide index cards and ask students to create cards that name an improper fraction and that represent the improper fractions. E.g., students can draw five rhombi to represent $\frac{5}{3}$ when one hexagon is a whole and then create the corresponding card with the symbolic form of $\frac{5}{3}$. Students can then combine their completed cards and play a matching game whereby they have to match the picture with the number.
(6N4.2)
- Ask students to use any type of manipulative available to model an improper fraction. Ask students to pass this model to their shoulder partner where their partner will determine if the model represents an improper fraction. Ask each partner to explain how they know it is or is not an improper fraction and use a picture and the symbolic form to explain.
(6N4.1, 6N4.2)
- Using the numbers 2, 5, 7, 8, ask students to create as many improper fractions as they can. Ask them to choose one improper fraction and represent it using a model, picture and in symbolic form.
(6N4.1, 6N4.2)

Journal

- Write the following on the board “All improper fractions must be greater than one whole”. Ask students to agree or disagree with this statement using models and pictures. Ask them to justify their thinking about the statement.
(6N4.1, 6N4.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Modelling Fractions

TR: pp. 13 – 17

SB: pp. 210 – 211

Lesson 2: Fractions Greater Than 1

TR: pp. 18 – 22

SB: pp. 212 – 215

Number

Specific Outcomes

Students will be expected to

6N4 Continued...

Achievement Indicator:

6N4.3 Express improper fractions as mixed numbers.

Suggestions for Teaching and Learning

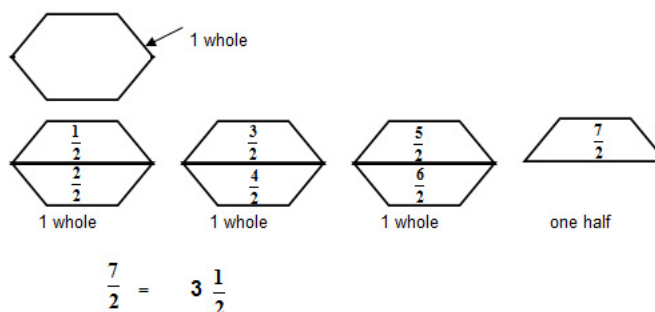
After working with improper fractions, students are formally introduced to mixed numbers. Teachers could present a visual such as the one below to introduce mixed numbers:



Ask students how many halves of pizza there are in the picture. Ask them if there is another way to describe the number of pizzas shown. Students may respond with 1 and a half pizzas. Explain to students that $1\frac{1}{2}$ is called a mixed number. A mixed number is a number that has a whole number part and a proper fraction part (1 and $\frac{1}{2}$).

Students should understand that improper fractions and mixed numbers both represent numbers greater than one whole. They also need to recognize that every improper fraction can be converted to a mixed number and every mixed number can be converted to an improper fraction.

The continued use of manipulatives will help students express improper fractions as mixed numbers. Ask students to model $\frac{7}{2}$, for example, using pattern blocks, where one yellow hexagon equals one whole. They should use 7 trapezoids. Next they should determine how many wholes they could create. As they build this model they will see that they have created 3 whole hexagons with one piece or one half of another hexagon left over. Ask students to record the result as a mixed number.



General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Interview

- Ask students to express the improper fraction $\frac{7}{4}$ as a mixed number and state what this improper fraction could represent.
(6N4.1, 6N4.2, 6N4.3)

Performance

- Ask students to think of a mixed number that is a little less than $\frac{9}{4}$. Ask them to show how they know their number is less than $\frac{9}{4}$.
(6N4.1, 6N4.3, 6N4.6)
- Ask students to make a model to represent $\frac{15}{6}$. Ask them to explain how this number can be expressed as a mixed number using models, picture and numbers.
(6N4.3, 6N4.4)
- Ask students the following: If Daniel ate 9 half donuts, how do you know he ate between 4 and 5 full donuts? Use models, pictures and numbers to show your thinking.
(6N4.3, 6N4.2, 6N4.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Representing Improper Fractions as Mixed Numbers

TR: pp. 23 – 27

SB: pp. 216 – 218

Lesson 4: Exploring Improper Fractions and Mixed Numbers

TR: pp. 28 – 31

SB: p. 219

Note

The lesson activity calls for the use of coloured rods. If these are not available, colored snap cubes can be used instead.

Lesson 7: Solving Problems Using Logical Reasoning

TR: pp. 48 – 50

SB: pp. 226 – 228

Note

Teachers may choose to integrate Lesson 7 throughout the unit.

Number

Specific Outcomes

Students will be expected to

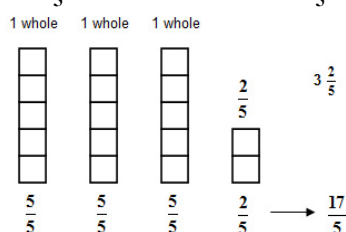
6N4 Continued...

Achievement Indicator:

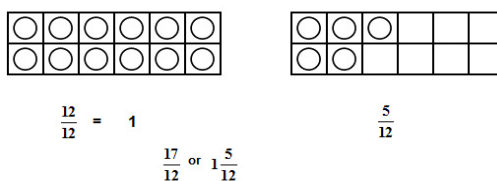
6N4.3 (Continued) Express improper fractions as mixed numbers.

Suggestions for Teaching and Learning

Provide students with snap cubes. Ask students to represent an improper fraction such as $\frac{17}{5}$. They should understand from previous work that $\frac{17}{5}$ means there are 5 in a whole with 17 parts in all. They should then go on to create towers of 5 snap cubes where they will see that they can create 3 complete towers with 2 cubes left over. This can be used then to help them see that $\frac{17}{5}$ is the same as 3 and $\frac{2}{5}$.



The figure below illustrates another way to show that an improper fraction can be expressed as a mixed number, where both name the same quantity. In this example, it can be seen that there is one full egg carton, or $\frac{12}{12}$ eggs and a part of another carton, namely $\frac{5}{12}$. The resulting mixed number then, would be $1\frac{5}{12}$ or the equivalent improper fraction that would name the amount of the set would be $\frac{17}{12}$.



General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Tell students that a cookie recipe calls for $\frac{4}{3}$ cups of flour. Mr. Bob is not sure what this means. Ask students to help Mr. Bob by explaining to him what $\frac{4}{3}$ means and tell him how much flour he needs using a mixed number.
(6N4.3)
- Ask students to model and then draw a picture to show that $\frac{5}{2} = 2\frac{1}{2}$.
(6N4.3, 6N4.5, 6N4.2, 6N4.4)

Journal

- Ask students to explain a situation when it would be a good idea to express an improper fraction as a mixed number.
(6N4.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Representing Improper Fractions as Mixed Numbers

TR: pp. 23 – 27

SB: pp. 216 – 218

Lesson 4: Exploring Improper Fractions and Mixed Numbers

TR: pp. 28 – 31

SB: p. 219

Note

The lesson activity calls for the use of colored rods. If these are not available, colored snap cubes can be used instead.

Number

Specific Outcomes

Students will be expected to

6N4 Continued...

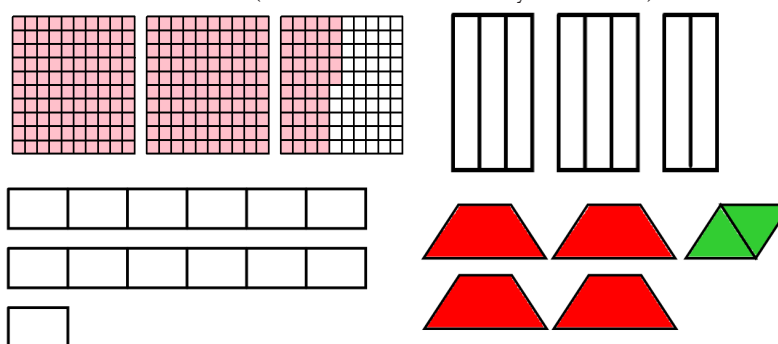
Achievement Indicator:

6N4.4 Translate a given mixed number between concrete, pictorial and symbolic forms.

Suggestions for Teaching and Learning

Students should translate a given mixed number between various representations: concrete, pictorial and symbolic. Consider the following:

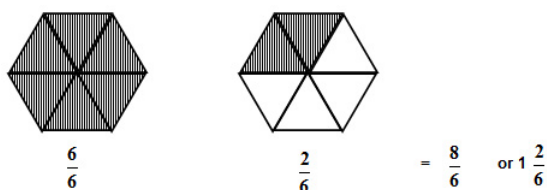
- Provide students with a variety of concrete and pictorial representations of mixed numbers and ask students to describe each as a mixed number (teachers should identify the whole):



- Provide students with a set of mixed numbers such as $3\frac{2}{6}$, $5\frac{3}{4}$, $2\frac{1}{3}$ and ask them to represent each concretely and pictorially.

When modelling a given mixed number, encourage students to discuss their choice of manipulatives. Remind them that the denominator suggests the number of parts in a whole. Their choice of manipulative should reflect this value.

To help students see the relevance of translating their models of improper fractions to pictures and then to a symbolic form ask students to show that $\frac{8}{6}$ is less than $1\frac{1}{2}$. To do this ask students to use pattern blocks to build $\frac{8}{6}$ and then draw this on paper as a part of their written response to the question. Students could then go on to show how their picture of the pattern blocks show that $\frac{8}{6}$ is less than $1\frac{1}{2}$.



General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Invite students to make a plan to teach their parents about improper fractions and mixed numbers. Ask students to use models, pictures, numbers and words to show their parents how to express a mixed number as an improper fraction.

(6N4.3, 6N4.5)

- Improper Fraction War - Using a deck of cards containing numerals 1-9, ask students to work in small groups. Shuffle the cards and deal four cards to each player. Students can use any two of the four cards in their hand to create the greatest possible improper fraction. In turn, each player will reveal their improper fraction determining who has the greatest number. Students may have to convert these improper fractions to mixed numbers to help them compare the numbers. The player with the greatest improper fraction will score one point. The first player with five points wins.

(6N4.3, 6N4.4)

- Ask students to create their own riddles about improper fractions and mixed numbers. They should exchange riddles with a classmate and solve them.

E.g., I am an improper fraction.

My denominator is 2.

My numerator is the number of days in one week.

What number am I?

(6N4.3, 6N4.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Exploring Improper Fractions and Mixed Numbers

TR: pp. 28 – 31

SB: p. 219

Lesson 5: Representing Mixed Numbers as Improper Fractions

TR: pp. 36 – 40

SB: pp. 222 – 225

Number

Specific Outcomes

Students will be expected to

6N4 Continued...

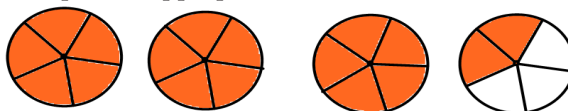
Achievement Indicator:

6N4.5 Express mixed numbers as improper fractions.

Suggestions for Teaching and Learning

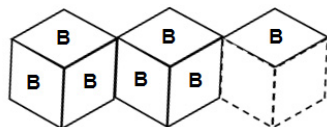
Students will now strengthen their understanding of the relationship between mixed numbers and improper fractions by expressing mixed numbers as improper fractions. They should understand that the two representations are equivalent.

Students should model a mixed number, such as $3\frac{2}{5}$ using manipulatives and express the concrete or pictorial representation as an improper fraction. They should recognize that there are 5 parts to a whole in this example. An appropriate model would be:



Students could count the number of one fifths. Alternatively, they may recognize $\frac{5}{5} + \frac{5}{5} + \frac{5}{5} + \frac{2}{5} = \frac{17}{5}$.

Pattern blocks could also be used to develop the relationship between mixed numbers and their corresponding improper fractions. Students should use blue rhombi, for example, to represent $2\frac{1}{3}$.



Once again they could count the number of one thirds or recognize $\frac{3}{3} + \frac{3}{3} + \frac{1}{3} = \frac{7}{3}$.

Encourage students to demonstrate their understanding of the relationships between improper fractions and mixed numbers by modeling, using words and numbers.

Through working with these numbers, some students may discover the relationship in multiplying the denominator with the whole number and adding the numerator to get the improper fraction, but it is not the recommended way to introduce or teach the topic. "There is absolutely no reason ever to provide a rule about multiplying the whole number by the bottom number and adding the top number. Nor should students need a rule about dividing the bottom number into the top to convert fractions to mixed numbers." (Van de Walle, 2006, p. 141).

Providing students with ample opportunities to explore these concepts through the use of hands on activities, using models and pictures will help students develop an understanding, but in their own words and in their own way.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- Tell students that it takes four 250 mL cups to fill a 1 L bottle. If they had ten 250 mL cups, how many 1 L bottles would they fill? Represent this answer as a mixed number and an improper fraction. (6N4.3, 6N4.5)

Performance

- Ask students to choose one mixed number and one improper fraction. Ask them to write these numbers on separate pieces of paper. Next, ask them to create a model for each number and draw a picture to represent each. Students should switch papers and models with a partner and ask their partner to express the improper fraction as a mixed number and express the mixed number as an improper fraction. Finally, partners model these new numbers using a different type of manipulative and draw their representation of the numbers and show the number in symbolic form. (6N4.2, 6N4.4)
- Ask students to determine a possible value for $\frac{13}{\square}$ if $\frac{13}{\square}$ is an improper fraction having a value between 2 and 3. Ask students if there is more than one answer and explain how they know. (6N4.3, 6N4.5, 6N4.6)
- Tell students it takes $\frac{1}{3}$ of an hour to bake one batch of cookies. If they had five batches of cookies to bake, how long would it take. Ask them to represent their answer using a mixed number and an improper fraction. (6N4.3, 6N4.5)
- Mixed Number War - Using a deck of cards containing numerals 1-9, ask students to work in small groups. Shuffle the cards and deal three cards to each player. Students use the cards to create the greatest possible mixed number. In turn, each player will reveal their mixed number. The player with the greatest mixed number will score one point. The first player with five points wins. (6N4.5)
- Place a mixed number/improper fraction on a student's back. Instruct the class to question the student about the number to determine what it is. Limit the number of questions the student can ask. This could also be done as a class activity where all students have improper fractions/mixed numbers on their backs and they have to go around the class asking questions to get clues about what their number is. (6N4.3, 6N4.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Representing Mixed Numbers as Improper Fractions

TR: pp. 36 – 40

SB: pp. 222 – 225

Lesson 7: Solving Problems Using Logical Reasoning

TR: pp. 48 – 50

SB: pp. 226 – 228

Number

Specific Outcomes

Students will be expected to

6N4 Continued

Achievement Indicator:

6N4.5 (Continued) Express mixed numbers as improper fractions.

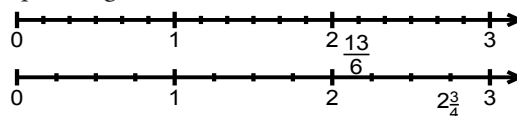
6N4.6 Place a given set of fractions, including mixed numbers and improper fractions, on a number line, and explain strategies used to determine position.

Suggestions for Teaching and Learning

Using the book *Funny and Fabulous Fraction Stories*, ask students to read the section on Improper Fractions and Mixed Numbers found on page 22. Set up this activity as a reader's theatre where small groups of students take on the roles of the various characters. Extend the scenes, whereby, the callers of the radio station need further clarification about the nature of converting mixed numbers to improper fractions. Students can rewrite the script to do this (It is not necessary to do the second scene with Joe and Al as this section deals with simplifying the fractions which is not a requirement for Grade 6). Once Joe and the caller are established, give the remaining students the role of the Math Experts in which Joe calls upon to help out the callers Betty and Pauline. In the scenes Betty and Pauline call Joe Trella, the Fraction Fella, to get advice on a problem they have involving converting mixed number and improper fractions. The Math Experts should come up with a plan to help Betty and Pauline complete this task. Encourage students to use a variety of strategies to help Betty and Pauline. Alternatively, Joe could explain how to express a mixed number as an improper fraction.

Students should develop strategies to compare improper fractions and mixed numbers. In Grade 5, students worked with comparing proper fractions with like and unlike denominators. This will help them compare mixed numbers and allow them to extend their personal strategies to compare improper fractions.

Students should place a given set of fractions (improper fractions and mixed numbers) on a number line using benchmarks. To compare $2\frac{3}{4}$ and $\frac{13}{6}$, for example, students could construct two number lines of equal length:



Students should recognize that $2\frac{3}{4}$ is further to the right on the number line and is, therefore, greater than $\frac{13}{6}$.

Alternatively, students could change the mixed number to an improper fraction and then convert both fractions such that they have the same denominator and place them on a number line.

$2\frac{3}{4}$ is equivalent to $\frac{11}{4}$. Writing each fraction with a denominator of 12 gives $\frac{33}{12}$ and $\frac{26}{12}$. Since both fractions have the same denominator students can compare numerators to conclude that $2\frac{3}{4}$ must be larger.

General Outcome: Develop Number Sense.

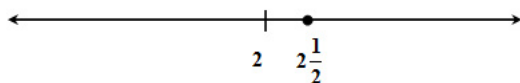
Suggested Assessment Strategies

Performance

- Tell students that you have 18 quarters in a coin collection. How many dollars would this be? Can you model the amount as an improper fraction? Mixed number? Which one would be easier to understand how much money you have altogether?
(6N4.3, 6N4.5)
- Give students an equivalent improper fraction and a mixed number (e.g., $\frac{12}{5}$ and $2\frac{2}{5}$). Ask them to represent these two numbers concretely, pictorially and symbolically to show they are equivalent.
(6N4.4, 6N4.5)
- Ask students to choose two improper fractions or two mixed numbers, order them and compare them. Ask them to explain to a friend how they know they have ordered their numbers correctly.
(6N4.1, 6N4.3, 6N4.5, 6N4.6)

Interview

- Ask students to respond to the following:
Mario and Sydney are great hockey players. To prepare for the season, Mario practiced $3\frac{4}{7}$ weeks. Sydney practiced $\frac{25}{7}$ weeks. Who practiced more? Explain your thinking using pictures, numbers and words.
(6N4.3, 6N4.5)
- Ask students to write two improper fractions and two mixed numbers that are between 4 and 5. Ask them to explain their thinking.
(6N4.3, 6N4.5)
- On the number line below, place the following: $\frac{3}{2}$, $3\frac{1}{2}$, $\frac{5}{4}$, $\frac{15}{4}$, $1\frac{2}{5}$.



Students should explain the placement of each number.

- Ask students how they would **immediately** know that $2\frac{2}{5}$ is greater than $1\frac{7}{8}$?
(6N4.6)

Paper and Pencil

- Pose the following to students: You just baked one dozen brownies. Seven of your friends just arrived and you want to share the brownies equally among all of you. Show how you would do this and write the amount you all get using a mixed number and an improper fraction.
(6N4.3, 6N4.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Representing Mixed Numbers as Improper Fractions

TR: pp. 36 – 40

SB: pp. 222 – 225

Lesson 7: Solving Problems Using Logical Reasoning

TR: pp. 48 – 50

SB: pp. 226 – 228

Supplementary Resource

Funny and Fabulous Fraction Stories – Dan Greenberg

Number

Specific Outcomes

Students will be expected to

6N4 Continued...

Achievement Indicator:

6N4.6 (Continued) Place a given set of fractions, including mixed numbers and improper fractions, on a number line, and explain strategies used to determine position.

Suggestions for Teaching and Learning

When comparing improper fractions, some students may express the improper fraction as a mixed number where they would compare the whole number first and then look at the proper fraction if needed.

For example, when comparing $\frac{6}{4}$ and $\frac{9}{5}$, students could express both as a mixed number, namely $1\frac{2}{4}$ and $1\frac{4}{5}$. In this example, they should recognize that they are both 1 whole with the first having an extra $\frac{2}{4}$ or $\frac{1}{2}$ and the second having an extra $\frac{4}{5}$. Students should conclude that $\frac{9}{5}$ is greater than $\frac{6}{4}$ because $\frac{4}{5}$ is greater than $\frac{1}{2}$.

Teachers could create a number line across the classroom using string. Mark various points for 0, 1, 2, 3, and 4. Provide students with an index card with either a mixed number or an improper fraction. Students should clip the index cards in the appropriate position on the number line, communicating their reasoning. Once all cards have been placed, ask students whether the positioning of each number is correct and have them order the fractions from least to greatest or greatest to least. Students should also create their own fraction index cards to add to the number line. Teachers could ask students to create a card that meets specific conditions, such as a number between 1 and 2.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to choose a mixed number and tell them to keep it a secret from their classmates. Set up centers around the room where students could model their number in one center, draw it in another and then represent it using an improper fraction in yet another center. After everyone has had an opportunity to represent their number in the three centers, bring the class together. Ask them to match all the models to the corresponding pictures and numbers.

(6N4.2, 6N4.5)

- Tell students there are 24 cans of soft drink in one case. 60 cans of drink are needed for the volleyball tournament. How could knowing about mixed numbers and improper fractions help you determine the number of cases of drinks that are needed for the tournament? (Remind students that a part of a case of drink can be bought)

(6N4.1, 6N4.3)

- Ask students to place the following improper fractions and mixed numbers on a number line. Which are between 2 and 3? Explain.

$$\frac{7}{3}, 2\frac{1}{5}, 3\frac{1}{2}, \frac{7}{4}$$

(6N4.6)

Paper and Pencil

- Ask students to answer the following questions:
 - Bill said he ate $1\frac{1}{3}$ bags of popcorn. Ed said he ate $\frac{4}{3}$ bags of popcorn. Assuming each bag of popcorn is the same size, is it possible for Bill to have eaten more popcorn than Ed? Explain your thinking with pictures, numbers and words.
(6N4.3, 6N4.5, 6N4.6)
 - 4 friends were at a party. Joe said he ate $\frac{5}{3}$ of pizza while Amy said she ate $\frac{5}{4}$ of pizza. Larry said that Amy ate more pizza than Joe. Is Larry correct? Explain your thinking.
(6N4.1, 6N4.6)
 - Two athletes were competing in a biathlon. One athlete one finished the race in $\frac{7}{6}$ hours and the other athlete finished in $\frac{12}{10}$ hours. Determine who won the race.
(6N4.6)
 - Determine which number is greater: $\frac{26}{5}$ or $4\frac{3}{4}$. Explain using pictures, numbers and words.
(6N4.6)
 - Why would someone think that $\frac{5}{4}$ is greater than $\frac{3}{2}$? Use pictures, numbers and words to explain.
(6N4.1, 6N4.3, 6N4.5, 6N4.6)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Comparing Fractions and Mixed Numbers

TR: pp. 41 – 45

SB: pp. 226 – 228

Lesson 7: Solving Problems Using Logical Reasoning

TR: pp. 48 – 50

SB: pp. 226 – 228

Math Game:
Spinner Fractions

TR: pp. 46 – 47

SB: p. 229

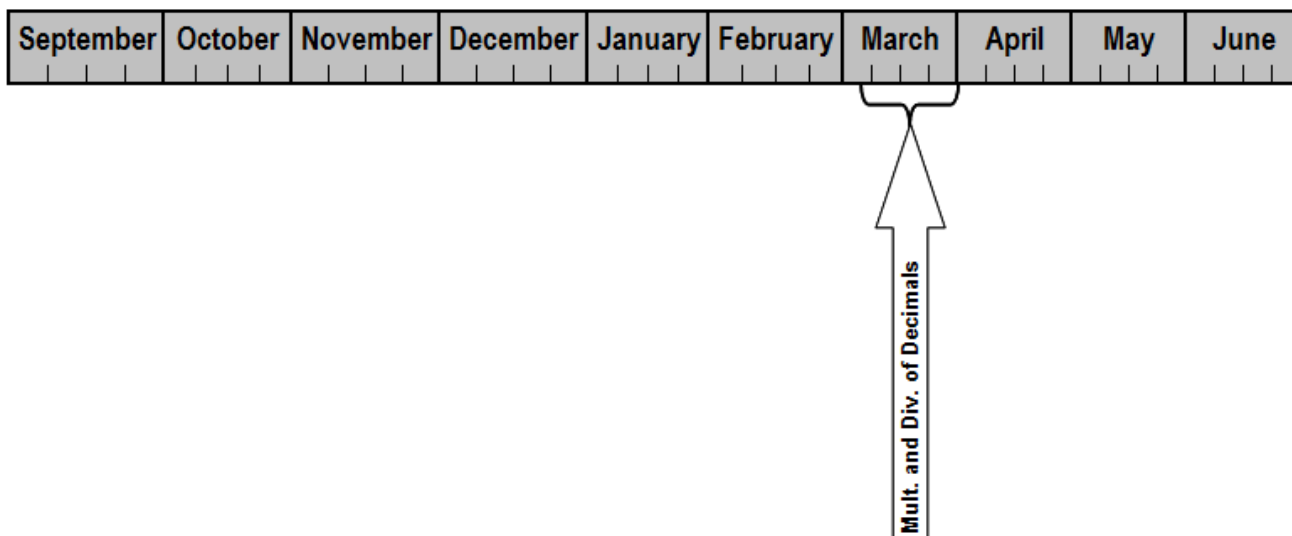
Curious Math:
Growing Shapes

TR: pp. 51 – 52

SB: p. 229

Multiplication and Division of Decimals

Suggested Time: $3\frac{1}{2}$ Weeks



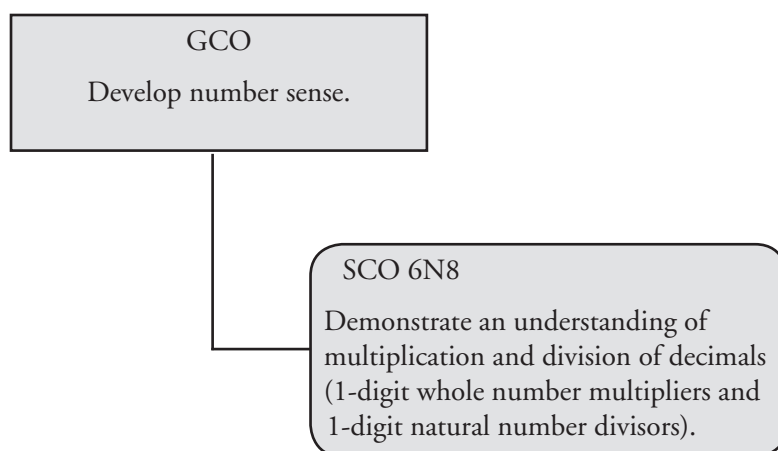
Unit Overview

Focus and Context

The ability to solve problems involving multiplication and division of decimal numbers is essential in everyday life. Connecting this to measurement and money, for example, will help students see the relevance of this content to their own lives.

In this unit, students will use their understanding of multiplication and division of whole numbers as well as their estimation skills to develop strategies for the multiplication and division of decimals (1-digit whole number multipliers and 1-digit natural number divisors). Students will use various concrete and pictorial representations, such as base-ten blocks and decimal squares, to develop their understanding of the multiplication and division of decimals before moving into a more symbolic approach. As students develop the practice of estimating the product and quotient before computing, it enables them to strengthen their number sense. It will allow them to determine the reasonableness of their answer as well as aid them in the placement of the decimal point in the product or quotient. Encourage students to communicate their reasoning and share the strategies they use in solving a problem. Provide opportunities for them to create their own problems involving the multiplication and division of decimals to strengthen their understanding of these concepts.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Number		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5N5 Demonstrate, with and without concrete materials, an understanding of multiplication (2 digit by 2 digit) to solve problems. [C, CN, PS, V]</p> <p>5N6 Demonstrate, with and without concrete material, an understanding of division (3-digit by 1-digit), and interpret remainders to solve problems. [C, CN, ME, PS, R, V]</p>	<p>6N8 Demonstrate an understanding of multiplication and division of decimals (1-digit whole number multipliers and 1-digit natural number divisors). [C, CN, ME, PS, R, V]</p>	<p>7N2 Demonstrate an understanding of the addition, subtraction, multiplication and division of decimals to solve problems (for more than 1-digit divisors or 2-digit multipliers, the use of technology is expected). [ME, PS, T]</p>

Mathematical Processes

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Number

Specific Outcomes

Students will be expected to

6N8 Demonstrate an understanding of multiplication and division of decimals (1-digit whole number multipliers and 1-digit natural number divisors).

[C, CN, ME, PS, R, V]

Achievement Indicator:

6N8.1 Predict products and quotients of decimals, using estimation strategies.

Suggestions for Teaching and Learning

In Grade 5, students used a variety of strategies to solve problems involving the multiplication and division of whole numbers (base ten blocks, pictorial representations, distributive property, repeated subtraction, etc.) They also predicted the products and quotients of whole numbers and sums and differences of decimals by using the following strategies:

- **front-end estimation** – keeping the first digit of the number and changing all the other digits to zero.
- **compatible numbers** – using friendly or nice numbers that can be easily calculated mentally.
- **rounding** – a number is rounded up or down to the nearest whole, tenth, etc.
- **compensation** - adjusting a computational estimate to make it closer to the calculated answer.

A review of multiplication, division and estimation strategies would benefit students as they begin this unit since they will use these same strategies when solving problems involving the products and quotients of decimals. Although students have represented decimals using base ten blocks and decimal squares, it may be necessary to review this concept again. **It is important that students recognize that when representing decimals one whole can be represented using different base-ten blocks.**

Students should begin their study of the multiplication of decimals by predicting the products of decimals using estimation strategies. Pose the following problem to students:

The farmer fills a jug with 3.7 litres of milk. If he fills 4 jugs, about how many litres of milk does he have?

Students should reason that 3.7 is close to 4 and $4 \times 4 = 16$.

Any estimation strategy is acceptable when predicting products. When estimating the product of 2.629 and 4, for example, students may suggest the following:

- front-end estimation - $2.000 \times 4 = 8$
- compatible numbers - $2.5 \times 4 = 10$ or $3 \times 4 = 12$
- rounding - $3 \times 4 = 12$
- compensation - 2.629×4 . Think $2 \times 4 = 8$,
0.629 is about $0.5 \times 4 = 2$, thus $8 + 2 = 10$.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Journal

- Provide students with a set of multiplication expressions involving decimals multiplied by a single digit whole number, such as 4.16×3 . Ask them to choose one or two expressions and estimate the product. Students should explain how they estimated each product. (6N8.1)
- Ask students if the product $\$21.57 \times 5$ would be greater or less than one hundred? Students should explain how they know. (6N8.1)
- Tell students Jack wanted to pay his 3 friends \$10.15 each for helping him paint his shed. Ask students to estimate the total amount of money that Jack will have to pay to his friends. (6N8.1)

Portfolio

- Tell students that a person's hair grows an average of 0.83 cm a month. Students should predict how long a child's hair would grow in 9 months if they never had a haircut and explain their estimation strategy. (6N8.1)
- Two students rounded a decimal number to 3. Does this mean their numbers were the same? Explain, using examples. (6N8.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Estimating Products

TR: pp. 12 – 15

SB: pp. 292 – 295

Supplementary Resource

Teaching Student-Centered Mathematics Grade 3 - 5 – John Van de Walle LouAnn Lovin

- Support for SCO 6N8 can be found on pp. 116 - 117

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicator:

6N8.1 (Continued) Predict products and quotients of decimals, using estimation strategies.

Suggestions for Teaching and Learning

Students should be able to classify their estimate as being lower or higher than the actual product. To estimate the product of 2.629 and 4, for example, they could use rounding to get, $3 \times 4 = 12$. Students should recognize that their prediction is an overestimate since 3 is more than 2.629. The actual product will be less than 12.

Students should also use benchmarks to approximate a given product. When considering 1.62×5 , for example, students should recognize that 1.62 is between 1 and 2. Since $1 \times 5 = 5$ and 2×5 equals 10, it should make sense that the product 1.62×5 will be between 5 and 10.

Thinking critically about estimates is important for solving problems such as the following:

If 2.2 metres of string is required to wrap a parcel and there are 3 parcels to wrap, how much string would be required?

Many students would conclude $2 \times 3 = 6$ metres. While this is a close estimate, they should realize that they would not have enough string to wrap all of the parcels. Estimating also allows to check the reasonableness of their calculated solution.

Students could use compatible numbers to predict the products of small decimals. When asked to estimate the product of 0.41 and 8, for example, students should recognize that 0.41 is close to 0.5, 5 tenths. 5 tenths multiplied by 8 is 40 tenths (4.0).



Teachers could provide students with a multiplication sentence or a problem solving context and ask students to predict the product using estimation strategies. They should share their result with the class.

General Outcome: Develop Number Sense.**Suggested Assessment Strategies***Paper and Pencil*

- Ask students to predict the product for various multiplication expressions, such as 5.6×2 . Students should explain their strategy.
(6N8.1)
- Pose the following to students: If one school basketball jersey costs \$18.49, about how much would it cost to buy 9 jerseys? Show how you got your answer pictorially and explain your thinking.
(6N8.1)

Resources/Notes**Authorized Resource***Math Focus 6*

Lesson 1: Estimating Products

TR: pp. 12 – 15

SB: pp. 292 – 295

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicators:

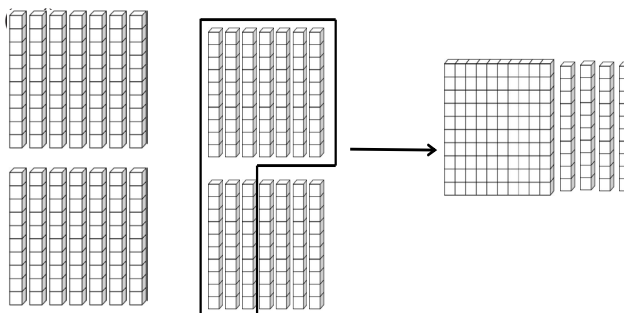
6N8.2 Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9.

6N8.3 Place the decimal point in a product, using estimation; e.g., for $15.205 \text{ m} \times 4$, think $15 \text{ m} \times 4$, so the product is greater than 60 m.

Suggestions for Teaching and Learning

Students should solve problems involving the multiplication of decimals. They should continue to use their estimation strategies to determine the reasonableness of their answers, and with some strategies, to determine the placement of the decimal point.

Students should begin to solve problems involving multiplication of decimals using manipulatives such as base ten blocks and decimal squares. When asked to determine the product 2×0.7 , for example, students should represent 0.7 using seven rods, where one flat is equal to one whole. They should make 2 groups of 7 rods. Students should recognize there is a total of 14 rods. Knowing there are 10 rods in a flat, students should understand that 14 rods equals one whole and 4 tenths



Another strategy that could be used to multiply decimals by a one digit multiplier is decimal squares. To determine the product 5×0.27 , for example, ask students to represent 0.27. Ask them how they can use this representation to determine 5×0.27 . Students should recognize that the product can be represented by shading 27 squares 5 times, as shown below:

X	X	O	O	O	X	X	X	O	O
X	X	O	O	O	X	X	X	O	O
X	X	O	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O
X	X	X	O	O	X	X	X	O	O

O	X	X	X						
O	X	X	X						
O	X	X	X						
O	X	X	X						
O	X	X	X						
O	X	X							
O	X	X							
O	X	X							
X	X	X							
X	X	X							

$$5 \times 0.27 = 1.35$$

There are a total of 135 blocks shaded. Students should recognize the product as 1.35.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Performance

- Ask students to solve a multiplication problem, such as $4 \times \$1.36$, pictorially. Students should create a story problem based on the multiplication sentence and exchange the problem with a classmate to solve.

(6N8.2, 6N8.3)

- Ask students to use base-ten blocks or decimal squares to determine the following products:

(i) 4.8×2

(ii) 7.3×8

(iii) 3.1×7

(iv) 7.37×7

(v) 8.12×3

(6N8.2)

Paper and Pencil

- Present the following questions to students:
 - (i) How much more does five cans of juice cost at \$1.29 each than 6 cans at \$0.99 each?
(6N8.1, 6N8.2, 6N8.3)
 - (ii) Milk at school costs \$0.55. There are 8 students in your class who order one milk each day. How much does it cost each day for milk in your class? How much does it cost for one week?
(6N8.1, 6N8.2, 6N8.3)
 - (iii) Allie bought three bags of bird seed. Each bag weighed 0.398 kg. What is the total mass of all three bags of bird seed? Demonstrate your understanding using pictures, numbers, and words.
(6N8.1, 6N8.2, 6N8.3)
 - (iv) Mr. Brown took his family of 8 to a local fast food restaurant. A meal for each person cost \$9.59. Estimate what Mr. Brown's bill will be before taxes and calculate the total cost. Show your workings and strategies.
(6N8.1, 6N8.2, 6N8.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Multiplying Money Amounts by One-Digit Numbers

TR: TG pp. 16 – 19

SB: pp. 296 – 299

Lesson 3: Multiplying Decimals by One-Digit Numbers

TR: pp. 20 – 23

SB: pp. 300 – 303

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicators:

6N8.2 (Continued) Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9.

6N8.3 (Continued) Place the decimal point in a product, using estimation; e.g., for $15.205 \text{ m} \times 4$, think $15 \text{ m} \times 4$, so the product is greater than 60 m.

Suggestions for Teaching and Learning

Students should also use strategies for multiplying whole numbers to solve a problem involving the multiplication of decimals. They should use estimation strategies to determine the placement of the decimal point. Consider 4.63×3 , for example. Students should determine the product of 463 and 3, as follows:

Multiplying Left to Right	Area Model	Standard Algorithm
$\begin{array}{r} 463 \\ \times 3 \\ \hline 1200 \\ 180 \\ + 9 \\ \hline 1389 \end{array}$	<p style="text-align: center;">$1200 + 180 + 9 = 1389$</p>	$\begin{array}{r} 463 \\ \times 3 \\ \hline 1389 \end{array}$

Using estimation, 4.63 is almost 5 and $5 \times 3 = 15$. This should lead students to place the decimal point after the 13, resulting in 13.89 as the product. **There is no reason to have students determine the placement of the decimal point by counting the number of decimal places in the factors, as this does not promote an understanding of place value or number sense.**

Students should be exposed to a variety of problem solving contexts as they develop their understanding of multiplication of decimals. Consider the following problem:

- Joshua would like to take his friends Ben and Christopher to a hockey game. Tickets to the game cost \$23.56. How much will it cost to purchase 3 tickets? Will \$75.00 be enough money?
- Provide students with various catalogues or local flyers. Tell them that they each get \$100.00 to spend, buying items of interest. However, they must buy the same item for their 2 friends as well. Students should present their choices to the class, discussing what item(s) they would buy, how much it costs for each item and the total cost. They should also discuss how estimation helped them in their decisions.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Journal

- Provide students with a multiplication sentence, such as $3 \times 16.17 = 4851$. Ask them to estimate the product to determine the correct placement of the decimal. Students should be able to explain their thinking. (6N8.3)
- Ask students to explain why the product of 0.6 and 3 will have a digit in the tenths place. Use words, pictures and numbers to explain your thinking. (6N8.2)

Portfolio

- Each product is missing a decimal point. Place the decimal in each product. Explain one answer.
 - (i) $15.97 \times 3 = 4791$
 - (ii) $4.326 \times 7 = 30282$
 - (iii) $6.821 \times 4 = 27284$
 - (iv) $82.26 \times 2 = 16452$
 (6N8.3)
- Ask students to find the numbers that, when multiplied, give the product shown:

$$\begin{array}{r} \square \cdot \square \\ \times \quad \square \\ \hline \boxed{1} \boxed{6} \cdot \boxed{4} \end{array} \qquad \begin{array}{r} \square \cdot \square \\ \times \quad \square \\ \hline \boxed{1} \boxed{6} \cdot \boxed{4} \end{array}$$

(6N8.1, 6N8.2, 6N8.3)

Paper and Pencil

- Ask students to solve each of the following problems:
 - (i) One soccer ball cost \$21.45 including tax. What is the cost for 8 soccer balls?
 - (ii) General admission at Cineplex is \$9.03. A combo containing two popcorn and 2 drinks costs \$21.45. What is the cost for 4 movie tickets and 2 combos??
 - (iii) Ben bought a book of 20 tickets at the fair for \$25.00. Jared bought 18 individual tickets for \$1.50/ticket. Who spent more money? How much more?

(6N8.2, 6N8.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Multiplying Money
Amounts by One-Digit Numbers

TR: pp. 16 – 19

SB: pp. 296 – 299

Lesson 3: Multiplying Decimals by
One-Digit Numbers

TR: pp. 20 – 23

SB: pp. 300 – 303

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicators:

6N8.2 (Continued) Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9.

6N8.3 (Continued) Place the decimal point in a product, using estimation; e.g., for $15.205 \text{ m} \times 4$, think $15 \text{ m} \times 4$, so the product is greater than 60 m.

6N8.4 Correct errors of decimal point placement in a given product or quotient without using paper and pencil.

Suggestions for Teaching and Learning

Consider using children's literature, such as *Piece=Part=Portion: Fraction=Decimal=Percent* to solve problems involving the multiplication of decimals. This book provides a visual representation of various decimals students encounter in everyday life. Students could be asked to create a story problem involving the multiplication of decimals. Consider the 0.75 of the sandwich illustration, for example. A related problem could be:

Rebecca and 5 of her friends are having lunch at her house. Rebecca's father has prepared 4 sandwiches. Each of the 6 girls would like 0.75 of a sandwich. Has Rebecca's dad prepared enough sandwiches? Explain.

Students could participate in a quiz-quiz-trade activity using their created problems. They would work in pairs to solve each others problem after which they should switch partners and repeat.

Students should be encouraged to use their estimation skills when determining the correct placement of the decimal in a given product. Consider the following example:

- You go to the store to buy 9 cases of water. Each case costs \$6.69. The cashier tells you the total is \$602.10. You know immediately that this is wrong. Correct the error and explain what you think the cashier did to get this total.

Analyzing problems that contain errors in the placement of the decimal point will strengthen student understanding of products.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Journal

- Ask students to explain whether or not John is right when he says that the answer to 4×4.5 is 0.18. Students should use pictures, numbers and words to explain their thinking.
(6N8.1, 6N8.3)
- Ask students to explain why the decimal point in each of the following problems is in the wrong place:
 - (i) Fred calculated that $315.2 \times 2 = 63.04$
How do you know his answer is incorrect? What is the correct answer?
(6N8.3, 6N8.4)
 - (ii) The postman gave 9 students stamps that were valued at \$10.45 each. "The total cost of the stamps is \$940.50" exclaimed one student. Was she correct in saying that? Explain.
(6N8.3, 6N8.4)
- Katie said that 3.45×4 must be 1.380 because there is only one digit before the decimal place in 3.45, so there must be one digit before the decimal place in the product. Respond to what Katie said.
(6N8.3, 6N8.5, 6N8.4, 6N8.2)

Presentation

- Provide students with several multiplication sentences that have the decimal point in the wrong location. Ask students to correct the error and explain how they determined the correct placement of the decimal.
 - (i) $4.35 \times 6 = 2.615$
 - (ii) $6.487 \times 2 = 129.74$
 - (iii) $8.947 \times 3 = 268.41$
 - (iv) $1.129 \times 5 = 56.45$
- (6N8.3, 6N8.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Multiplying Money
Amounts by One-Digit Numbers
TR: pp. 16 – 19
SB: pp. 296 – 299

Lesson 3: Multiplying Decimals by
One-Digit Numbers
TR: pp. 20 – 23
SB: pp. 300 – 303

Supplementary Resource

Math Curse - Jon Scieszka and
Lane Smith

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicator:

6N8.1 (Continued) Predict products and quotients of decimals, using estimation strategies.

Suggestions for Teaching and Learning

Focus for the second half of this unit is on division of decimals involving 1-digit natural number divisors. As with multiplication of decimals, students should begin by using manipulatives. Many of the strategies students use to compute division using whole numbers can also be applied to division of decimals. Teachers could begin with a review of division of whole numbers (2-digit and 3-digit by 1-digit divisors) before beginning work on dividing decimal numbers.

As with multiplication of decimals, estimation should precede calculations when beginning work on division of decimals. These estimates will be a basis for students to test the reasonableness of their answers when solving problems involving division of decimal numbers as well as in determining the placement of the decimal point in a quotient. It is important that students use proper terminology when working with division. The use of key words such as quotient, divisor and dividend, should be encouraged.

As with multiplication of decimals, students should use estimation strategies to predict the quotients of decimals and classify their estimate as being lower or higher than the actual quotient. When estimating the quotient $9.3 \div 3$ using front end estimation, for example, students would respond with $9.0 \div 3 = 3$. They should recognize that their prediction is an underestimate since 9 is less than 9.3. The actual product will be more than 3.

When predicting products of decimals encourage students to determine the nearest whole number that is a multiple of the divisor. Consider 24.83 divided by 3, for example. Students should recognize that the closest multiple of three is 24, and 24 divided by 3 results in 8 as the quotient.

To predict the quotient of a decimal number less than 1, encourage the use of compatible numbers and place value. When estimating, $0.057 \div 8$, for example, students should recognize that 57 is close to 56. 56 divided by 8 is 7. Students should conclude that 56 thousandths divided by 8 is 7 thousandths.

Students could also use the think multiplication strategy as they predict quotients of decimals. When estimating the quotient $9.3 \div 3$, for example, students could think $3 \times \underline{\quad} = 9$ to predict a quotient of 3.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- Present the following to students:
 - (i) Paula is building a bird house and she needs to have 24.6 m of lumber to complete the project. Each piece of lumber is 3 m long. Ask students about how many pieces of lumber will she need to build the bird house?
(6N8.1)
 - (ii) Philip is going to the store. He has \$15.00 in his pocket and he wants to buy as many trays of strawberries as he can. One tray of strawberries cost \$3.69. Ask students how estimation can help Philip determine how many trays he can buy with his \$15.00.
(6N8.1)
 - (iii) Ask students to think of a situation where front-end estimation would not be the best estimation strategy to use when solving a division problem involving decimals.
(6N8.1)

Performance

- Engage students in mental math activities encouraging the use of front-end estimation. Ask them to estimate the following quotients
 - (i) $36.317 \div 2$
 - (ii) $45.036 \div 3$
 - (iii) $16.02 \div 4$
 - (iv) $80.987 \div 9$
 - (v) $29.881 \div 5$
(6N8.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Estimating Quotients

TR: pp. 29 – 32

SB: pp. 306 – 308

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicators:

6N8.1 (Continued) Predict products and quotients of decimals, using estimation strategies.

6N8.2 (Continued) Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9.

6N8.5 Place the decimal point in a quotient, using estimation; e.g., for $\$26.83 \div 4$, think $\$24 \div 4$, so the quotient is greater than \$6.

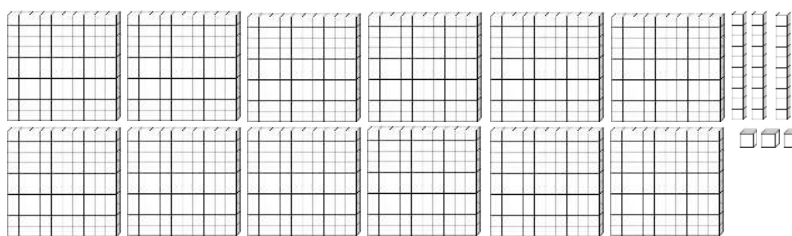
Suggestions for Teaching and Learning

Solving problems involving division of decimals may be more challenging for some students than multiplication of decimals. Using real life situations and story problems when presenting problems so that the numbers and operations have some sort of context for the students may make it easier for them to grasp. As with multiplication of decimals, students should begin by using manipulatives to determine the quotient.

Teachers should begin with an example that does require regrouping, such as:

Rebecca, Natalie, and Emily made \$12.33 from their lemonade stand. If the money is shared equally among the girls, how much does each girl receive?

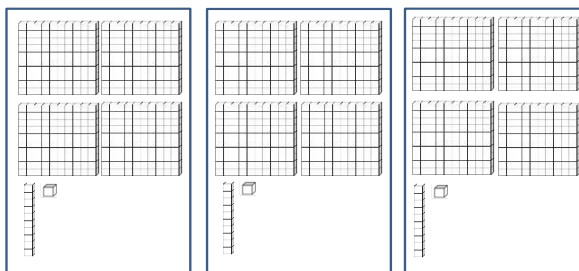
Students should recognize that this question requires them to determine $12.33 \div 3$. Ask students to represent 12.33 using base ten blocks:



Ask students questions such as the following:

- How can we share 12 flats into 3 equal groups?
- How can we share 3 rods into 3 equal groups?
- How can we share 33 units into 3 equal groups?
- What is the quotient?

Students should think of this division as sharing the blocks into equal groups, whereby the blocks in each group represent the quotient:



$$12.33 \div 3 = 4.11$$

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- Ask students to write a story problem using the following:

$$96.6 \div 7.$$

They should provide an answer key for the story problem including both an estimate for the quotient and the actual quotient.

(6N8.1, 6N8.2)

Performance

- Provide students with a grocery store flyer and ask them to choose an item they would like to purchase. Students should determine how many of the item they could buy with \$90.00.

(6N8.1, 6N8.2)

- Ask students to find the quotient of $2.4 \div 4$. Students should explain how using base-ten blocks could help determine the solution.

(6N8.2)

Journal

- Ask students to use the information given to determine the better buy:

(i) Apple juice – 2 L for \$1.99 or 4 L for \$3.89

(ii) Oranges – 4 for \$0.99 or 6 for \$1.59

(iii) Bananas – 3 kg for \$1.89 or 5 kg for \$3.19

Students should communicate their thinking.

(6N8.1, 6N8.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Exploring Division of Decimals

TR: pp. 33 – 36

SB: p. 309

Lesson 6: Dividing Decimals by One-Digit Numbers

TR: pp. 37 – 41

SB: pp. 310 – 313

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicators:

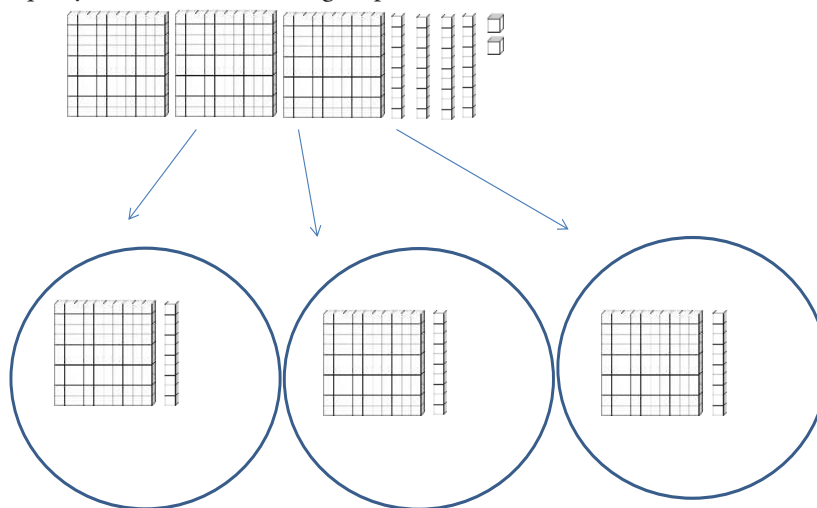
6N8.1 (Continued) Predict products and quotients of decimals, using estimation strategies.

6N8.2 (Continued) Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9.

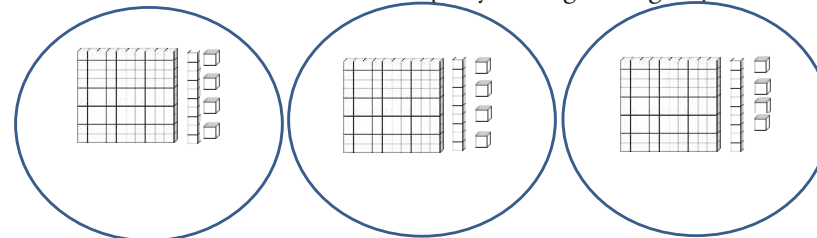
6N8.5 (Continued) Place the decimal point in a quotient, using estimation; e.g., for $\$26.83 \div 4$, think $\$24 \div 4$, so the quotient is greater than \$6.

Suggestions for Teaching and Learning

Students should also work with examples that require regrouping, such as $3.42 \div 3$. Many students will likely approach this problem in the same fashion as the previous example – by trying to divide the base ten block representation into 3 equal groups. Some experience difficulty when sharing the rods and the units since they cannot equally share 4 rods into 3 groups- there will be one rod (1 tenth) left over. Nor can they equally share 2 units into 3 groups:



To develop student understanding of this type of problem, ask students if there is another way to represent a tenth using base ten blocks. They should realize that one tenth is the same as 10 hundredths. There will now be 12 hundredths left to share equally among the 3 groups:



The quotient would be 1.14.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- Ask students to solve the following problems.
 - (i) Susie had 25.55 metres of string. She needed to hang 5 balloons from the gym ceiling. How much string did she use for each balloon if she hung each one equally spaced?
(6N8.1, 6N8.2)
 - (ii) A group of 7 students ordered pizza and the total cost was \$51.45. How much would each student have to pay if they shared the cost equally?
(6N8.1, 6N8.2)
 - (iii) Five friends found 4 loonies on the road. They are trying to figure out how to equally share this amount. Help the friends by showing them how this could be done.
(6N8.2)

Portfolio

- Ask students to create their own math assignment, accompanied by the answer key, that would require them to use different estimation strategies to solve division problems. Encourage students to share their assignments with the class.
(6N8.5, 6N8.1, 6N8.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Exploring Division of Decimals

TR: pp. 33 – 36

SB: p. 309

Lesson 6: Dividing Decimals by One-Digit Numbers

TR: pp. 37 – 41

SB: pp. 310 – 313

Number

Specific Outcomes

Students will be expected to

6N8 Continued...

Achievement Indicators:

6N8.1 (Continued) Predict products and quotients of decimals, using estimation strategies.

6N8.2 (Continued) Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9.

6N8.5 (Continued) Place the decimal point in a quotient, using estimation; e.g., for $26.83 \div 4$, think $24 \div 4$, so the quotient is greater than \$6.

6N8.3 (Continued) Place the decimal point in a product, using estimation; e.g., for $15.205 \text{ m} \times 4$, think $15 \text{ m} \times 4$, so the product is greater than 60 m.

Suggestions for Teaching and Learning

In addition to using manipulatives to solve problems involving the division of decimals, students should connect the concrete and pictorial models to symbolic representation (using the algorithms). They should use the strategies for division of whole numbers and determine the placement of the decimal using estimation. Consider the following problem:

Phillip brought 5.2 L of water to soccer practice. If he and three of his friends plan on sharing the water, how much will each person get?

Students should recognize that solving this problem involves division. Using one of their strategies for dividing whole numbers they would get:

Dividing By Sharing	Standard Algorithm	Renaming the dividend	Relating Division to Multiplication
$\begin{array}{r} 3 \\ 10 \\ 4 \overline{)52} \\ \underline{-40} \\ 12 \\ \underline{-12} \\ 0 \end{array}$	$\begin{array}{r} 13 \\ 4 \overline{)52} \\ \underline{-4} \\ 12 \\ \underline{-12} \\ 0 \end{array}$	$\begin{array}{l} 52 = 40 + 12 \\ 40 \div 4 = 10 \\ 12 \div 4 = 3 \\ 10 + 3 = 13 \end{array}$	$4 \times 13 = 52$

Using an estimation strategy will then determine the placement of the decimal. Students should recognize that the closest whole number divisor of 4 to 5.2 is 4. They should reason that 4 L of water shared among 4 players would result in each player receiving 1 L each. Since 4 is less than 5.2 the quotient should be a little more than 1 L. Students should conclude that $5.2 \div 4 = 1.3$. Each person would receive 1.3 L of water.

Students should solve a variety of problems involving decimals, where they have to determine whether the problem involves multiplication or division.

- Dylan found a piece of lumber in his shed. He cut 12.34 cm off each end where the piece was broken. Then he cut the remaining piece of lumber into 3 equal pieces. Each piece is now 21.57 cm long. How long was the piece of lumber when Dylan found it?
- Four friends purchased snacks for a sleepover. They bought 3 bags of popcorn at \$1.59 each and 2 cartons of orange juice at \$4.19 each. They agreed to split the bill equally among them. How much does each person have to pay?

They should be encouraged to predict the product or quotient before determining the solution. Encourage students to communicate their reasoning.

General Outcome: Develop Number Sense.

Suggested Assessment Strategies

Paper and Pencil

- Ask students to answer the following questions:
 - (i) Keith cut 0.5 m from a length of rope. Then he cut what was left into four equal pieces. If each of the four pieces was 1.25 m long, what was the length of the rope before Keith cut it?
(6N8.2)
 - (ii) Evan downloaded seven songs from the Internet. Two songs were 2.7 MB each, three were 4.6 MB each, and the other two songs were 2.7 MB and 8.1 MB. After the downloads, the disk where he stored the files held 35.5 MB of data. How much data was on the disk before the downloads?
(6N8.2)
 - (iii) Avery would like to purchase 3 CDs that cost \$12.69 each. She only has \$30.00. How much more money would she need so that she could buy the CDs?
(6N8.1, 6N8.2, 6N8.5)
 - (iv) Lily goes to the cafeteria during recess to buy cookies for her and her classmates. The cookies cost \$0.80 each. Lily has \$12.00. If there are 20 students in Lily's class, will each person get a cookie?
(6N8.1, 6N8.2, 6N8.5)
 - (v) John paid \$47.94 for 6 movie tickets. How much does each ticket cost? How much would 14 tickets cost?

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Exploring Division of Decimals

TR: pp. 33 – 36

SB: p. 309

Lesson 6: Dividing Decimals by One-Digit Numbers

TR: pp. 37 – 41

SB: pp. 310 – 313

Lesson 7: Solving Problems by Working Backwards

TR: pp. 46 – 48

SB: pp. 316 – 317

Note

Lesson 4 focusses on Working Backwards as a problem solving strategy. Students should be exposed to additional problem solving contexts than those provided in this lesson.

Math Game:

Low as You Go

TR: pp. 42 – 43

SB: p. 314

Curious Math:

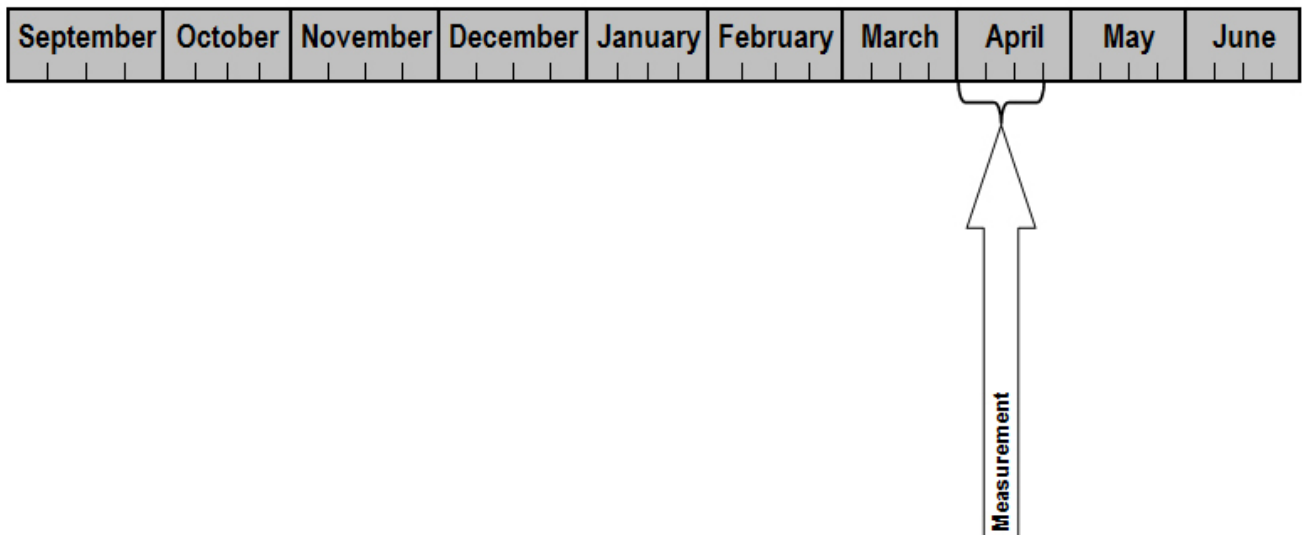
Magic Squares

TR: pp. 44 – 45

SB: p. 315

Measurement

Suggested Time: 3 Weeks



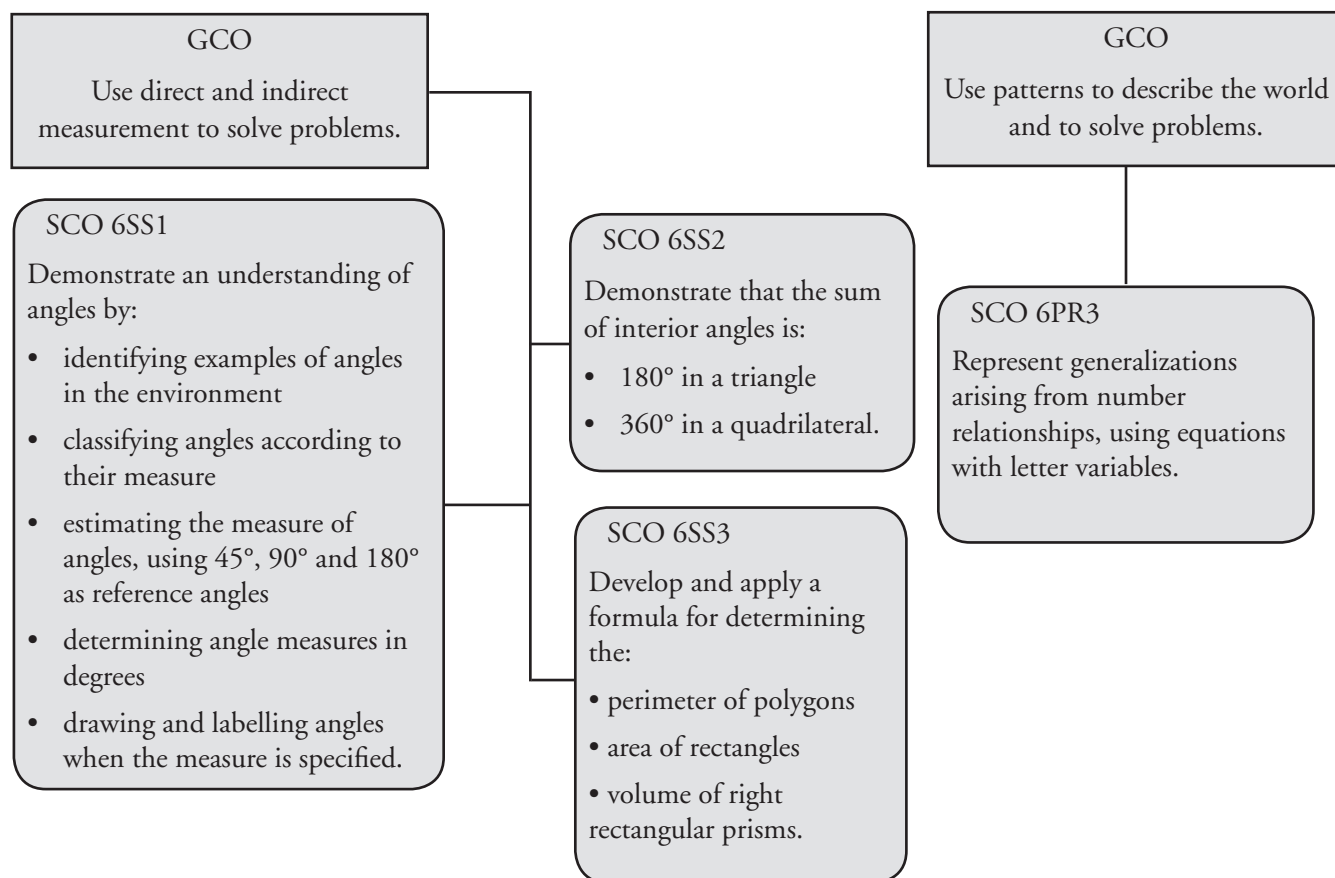
Unit Overview

Focus and Context

The focus of this unit is to develop an understanding of measurement as it relates to perimeter, area, volume and angles. Measurement involves the use of quantitative (numerical) values to describe a specific attribute. These measurable attributes may be tangible, or intangible (e.g., time, temperature, etc.). In order for measurement to be meaningful a holistic understanding of units of measure must be developed. A comprehensive understanding of measurement is fundamental to the development of concepts in other branches of mathematics such as Euclidian geometry, transformational geometry, algebra and statistics. It is also important that students have a sound understanding of the metric system and appropriate usage of units.

Measurement is an essential link between mathematics, sciences, the arts and other disciplines and has an endless variety of applications in real life situations. Encourage students to research how measurement is involved in careers and hobbies in which they are interested. Providing students with opportunities to engage in measurement based activities with real world application will enhance student learning, making it meaningful and relevant.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Shape and Space (Measurement)		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5SS1 Design and construct different rectangles, given either perimeter or area, or both (whole numbers), and draw conclusions. [C, CN, PS, R, V]</p> <p>5SS2 Demonstrate an understanding of measuring length (mm and km) by:</p> <ul style="list-style-type: none"> selecting and justifying referents for the unit mm modelling and describing the relationship between mm and cm units, and between mm and m units. selecting and justifying referents for the unit km. modelling and describing the relationship between m and km units. [C, CN, ME, PS, R, V] 	<p>6SS1 Demonstrate an understanding of angles by:</p> <ul style="list-style-type: none"> identifying examples of angles in the environment classifying angles according to their measure estimating the measure of angles, using 45°, 90° and 180° as reference angles determining angle measures in degrees drawing and labelling angles when the measure is specified. [C, CN, ME, V] <p>6SS2 Demonstrate that the sum of interior angles is:</p> <ul style="list-style-type: none"> 180° in a triangle 360° in a quadrilateral [C, R] <p>6SS3 Develop and apply a formula for determining the:</p> <ul style="list-style-type: none"> perimeter of polygons area of rectangles volume of right rectangular prisms. [C, CN, PS, R, V] 	<p>7SS1 Demonstrate an understanding of circles by:</p> <ul style="list-style-type: none"> describing the relationships among radius, diameter and circumference relating circumference to pi determining the sum of the central angles constructing circles with a given radius or diameter solving problems involving the radii, diameters and circumference of circles. [C, CN, PS, R, V] <p>7SS2 Develop and apply a formula for determining the area of:</p> <ul style="list-style-type: none"> triangles parallelograms circles. [CN, PS, R, V]
Strand: Patterns and Relations (Variables and Equations)		
	<p>6PR3 Represent generalizations arising from number relationships, using equations with letter variables. [C, CN, PS, R, V]</p>	

Mathematical Processes

[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[ME]	Mental Mathematics	[T]	Technology

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

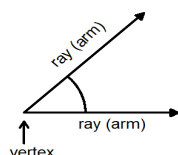
6SS1 Demonstrate an understanding of angles by:

- identifying examples of angles in the environment
- classifying angles according to their measure
- estimating the measure of angles, using 45° , 90° and 180° as reference angles
- determining angle measures in degrees
- drawing and labelling angles when the measure is specified.

[C, CN, ME, V]

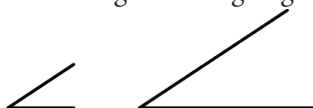
Strategies for Teaching and Learning

In Grade 5, students rotated a 2-D shape a half turn, a quarter turn, three quarters turn, and a full turn. The measuring of angles in degrees and the subsequent use of a protractor are new concepts for Grade 6 students. Teachers should begin by introducing students to the term angle. An angle is a figure formed by two rays that have the same endpoint; the endpoint is called the vertex of the angle:



Encourage students to think of an angle as the amount of rotation required to get from one arm of the angle to the other arm.

Students should create angles by using manipulatives such as popsicle sticks, straws, and rulers. This will reinforce what an angle is, how it is created, and the terminology used when referencing angles. Modelling angles will allow students to see that the length of the arms does not affect the measure of an angle. When asked to identify which of the two angles below is larger, some students might incorrectly identify the second angle as being larger.



Ask students to verify that both angles are the same measure by using tracing paper. They should trace one of the angles and place it over the other (aligning an arm and the vertices) to compare.

Achievement Indicator:

6SS1.1 Provide examples of angles found in the environment.

Students should identify examples of angles found in the environment. They might suggest:

- the corner of a door or window frames
- adjacent floor tiles
- hands of a clock
- the peak of a roof on a house
- artwork or posters around the classroom (in a star, for example)

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Ask students to identify angles in their surrounding environment. They may do this over the course of a class or a whole day. They should keep a log of where and on what object the angle was identified. Ask them to create a sketch of the object, highlighting the identified angle in a different colour. They should also include a brief description of the angle measure relative to the quarter-turn (right angle), half-turn (straight angle) and three-quarter turn benchmarks. Using the log of angles that they previously identified from their surroundings ask students to label each of the angles they recorded as acute, right, obtuse, straight or reflex.

(6SS1.1, 6SS1.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Identifying Angles

Teacher Resource (TR):

pp. 13 – 17

Student Book (SB): pp. 244 – 247

Supplementary Resource

Making Math Meaningful to

Canadian Students K-8 – Marian Small

- Support for 6SS1 can be found on pp. 455 – 466

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS1 Continued...

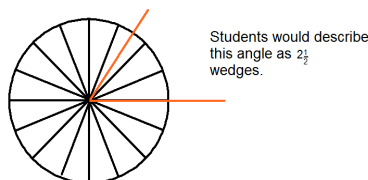
Achievement Indicator:

6SS1.2 Classify a given set of angles according to their measure; e.g., acute, right, obtuse, straight, reflex.

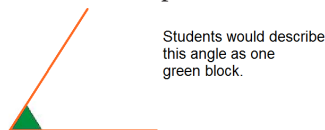
Strategies for Teaching and Learning

This is students' first exposure to measuring angles. It is important to explore this concept using nonstandard units before introducing them to the standard unit and the use of a standard protractor.

Students could create their own nonstandard unit protractors out of wax paper or parchment paper. They should cut out a large circle (about 12 cm diameter) and fold it in half four times. (Small, p. 459)

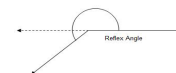
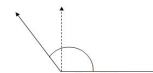
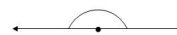


Alternatively, students could use pattern blocks as a nonstandard unit:



Students are familiar with the quarter, half and three quarter turn. Further exploration of this will help them develop their understanding of angle measures.

- Right Angle (quarter turn) – an angle that forms a square corner
- Straight Angle (half turn) – an angle that forms a straight line
- Acute Angle – an angle with a measure less than a right angle
- Obtuse Angle – an angle with a measure greater than a right angle but less than a straight angle
- Reflex Angle – an angle with a measure greater than a straight angle



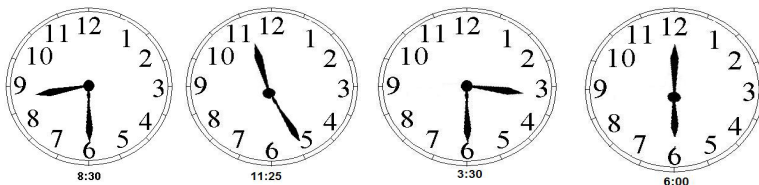
Some students may make the connection that there are two angles formed when two rays meet. An acute angle, for example, also has a reflex angle on the outside of its arms. This is the remainder of the circular rotation and is important when students are measuring and constructing angles later in the unit.

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Journal

- Ask students to identify the type of angle formed by the hands of a clock at various times of the day. Identify the type of angle created by each time in the clocks shown below.



At what time will each type of angle be formed again?

Note: Reflex angles may also be possible answers for 8:30, 11:25 and 3:30.

(6SS1.1, 6SS1.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Identifying Angles

TR: pp. 13 – 17

SB: pp. 244 – 247

Lesson 2: Constructing a Protractor

TR: pp. 18 – 21

SB: pp. 248 – 249

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS1 Continued...

Achievement Indicators:

6SS1.3 Estimate the measure of an angle, using 45° , 90° and 180° as reference angles.

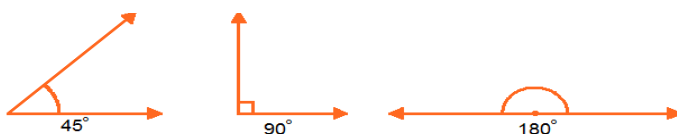
6SS1.4 Sketch 45° , 90° and 180° angles without the use of a protractor, and describe the relationship among them.

Strategies for Teaching and Learning

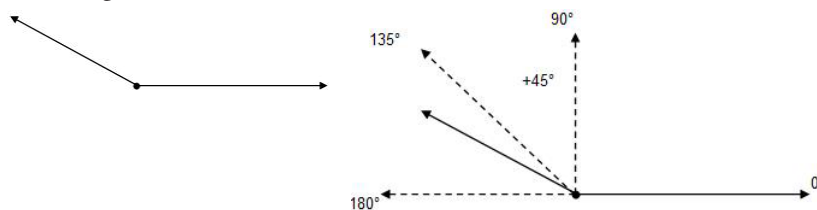
Introduce the degree as the standard unit of measurement for angles. Some students may attempt to make an association between degrees of a circle and degrees Celsius or Fahrenheit used for measuring temperature. It may be necessary to differentiate between the two. Although the word degree is used in both cases, they are units of measurement for two unrelated quantities.

The measure of rotation for a full turn within a circle will always be 360° . This is true regardless of the size (diameter) of the circle. Students may have heard “360” used to describe a stunt performed by snow boarders, skateboarders, ice skaters, etc., where the athlete makes a complete spin and ends up facing forward in his/her original position. Students may also be familiar with the stunt called a “180”, where the athlete performs a half spin and ends up facing opposite the original position. Hence, the term “180” is used because the athlete rotated his/her body in a half circle, and 180° is half of 360° .

Students should be able to establish benchmarks for 90° and 45° . Since a half turn has a measure of 180° , a quarter turn (half of 180°) would thus have a measure of 90° and an eighth of a turn (half of 90°) would measure 45° . Encourage students to sketch what these angles would look like:



Once the 45° , 90° and 180° benchmarks have been established students can use these to estimate the measure of other angles. Consider the following:



Students may visualize or sketch benchmark angles on a separate sheet of paper or directly on the given angle, as shown. The given angle is between 135° and 180° . Its measure might be estimated to be 150° .

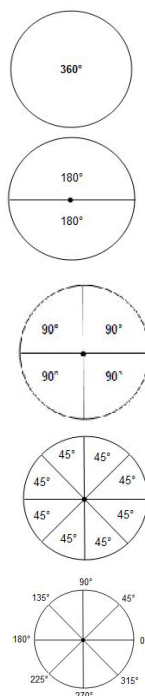
General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Ask students to construct their own 360° protractor using a circular piece of paper. Through this process 45° , 90° and 180° benchmarks may be established.
 - Students must first be aware that a circle (full turn) has a measure of 360° .
 - Fold the circle in half. If a full circle measures 360° , a half of a circle must measure 180° .
 - Fold the half circle in half again. This represents a quarter of the whole circle. If half of the circle measures 180° , a quarter must measure 90° .
 - Fold the quarter circle in half again. This represents an eighth of the whole circle. If a quarter of the circle measures 90° , an eighth must measure 45° .
 - Once the circle is unfolded it will be evident that there are eight sets of 45° in the whole. Choose a fold line as 0° ; label each fold line in the counter-clockwise direction as a consecutive multiple of 45° , as shown below.

Students should use their protractors to estimate the measure of angles.
- Angle “I Spy” Game – Ask students to identify an angle in the classroom. Write down the type of angle (acute, right, obtuse, reflex or straight), an estimate of its measure and draw a sketch of its orientation. Trade angles information with a partner and attempt to locate the angle in the classroom (e.g., floor, wall, corner).
(6SS1.1, 6SS1.2, 6SS1.3, 6SS1.4)
- Provide students with illustrations from books. Ask them to identify and estimate the measure of angles found in each picture. Students can create a list of the angles and their approximated measures. Another possibility would be to provide photocopies of the illustrations so that students can highlight or colour the identified angles and write their estimated measures on the picture.
(6SS1.3)



Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Constructing a Protractor

TR: pp. 18 – 21

SB: pp. 248 – 249

Lesson 3: Estimating Angle Measures

TR: pp. 22 – 25

SB: pp. 250 – 253

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS1 Continued...

Achievement Indicator:

6SS1.5 Measure, using a protractor, given angles in various positions.

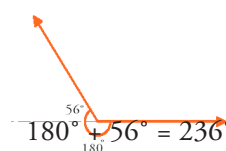
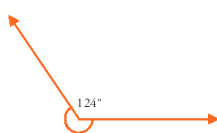
Strategies for Teaching and Learning

The initial use of a circular (360°) protractor rather than a semi-circular (180°) protractor is recommended. This will reinforce students' understanding of an angle as a rotation within a full circle. Teachers should explain the design of the protractor. The degrees on the protractor are only labelled in multiples of ten. Each unlabeled tick represents 1° .

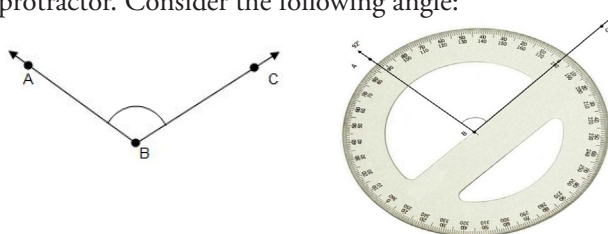
Teachers should model the use of a protractor with students. When measuring angles using a protractor it is important that students always place the center of the protractor at the vertex of the angle and that the arm lines up with baseline of the protractor. All readings begin at 0° .

A common error occurs when students use the incorrect scale when reading the angle measure. Emphasize that once they place their protractor along one of the arms of the angle they should identify the 0° mark and use this scale to determine the measure of the angle.

When using an 180° protractor students will need guidance to measure reflex angles, such as 236° . Students could measure the acute angle (the inside angle) and subtract it from 360° (since 360° represents a complete turn). Alternatively, they could extend one arm of the angle to create a 180° angle and then measure the remainder of the reflex angle (56°). The sum of these two values is the measure of the reflex angle.



Encourage students to estimate angle measures before using the protractor. This will help them check the reasonableness of their answer and help them pick up on errors in using the wrong scale on the protractor. Consider the following angle:



Students should recognize that the given angle is more than a right angle and would estimate its measure to be around 95° . If they incorrectly measured the angle to be 88° (using the wrong scale) as opposed to the correct measurement of 92° , they should realize that this measurement does not make sense based on their estimate.

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Provide students with printed paper copies of flags from various provinces, states and countries that have linear designs or are composed of various shapes. The Newfoundland and Labrador flag would be a good example. Ask students to identify and record all of the angles they can find on the flag and classify them as either acute, right, obtuse, straight or reflex. Students should then measure the angles using a protractor.

(6SS1.5)

Journal

- Ask students to respond to the following journal prompt:

Pretend you work for a company that makes and sells protractors. You have been given the job of writing instructions for the protractor package. Write a detailed step-by-step set of instructions (with diagrams if needed) to explain how to measure any angle using the protractor. Assume the reader has never seen a protractor before.

Trade instructions with a partner and follow them to measure a given angle.

What changes would you make to your partner's instructions?

(6SS1.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 4: Measuring Angles

TR: pp. 26 - 30

SB: pp. 254 – 257

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS1 Continued...

Achievement Indicator:

6SS1.6 Draw and label a specified angle in various positions, using a protractor.

Strategies for Teaching and Learning

This would also be an appropriate time to introduce the correct method of naming angles. When an angle is presented with three labelled points, the angle would be named using the angle symbol \angle and the three points written with the vertex in the middle. Consider the following:



This angle could be named $\angle BAC$ or $\angle CAB$.

Once students are comfortable with the use of a protractor they should construct and label a specified angle using a protractor and straightedge.

After students have become proficient measuring angles with a protractor ask them to reverse the process to construct angles with a specified measure using a ruler and protractor. When completed, students should verify the measure of their angle using the protractor to ensure that they completed the construction correctly.

When constructing angles, students should always use a straight edge to construct the first arm. In the beginning stages, ask students to construct the first arm horizontally. Next ask them to place the centre mark of the protractor on the endpoint of the first arm and align the baseline with the 0° mark. Students should then rotate from 0° to the specified measure and mark that degree. They should remove the protractor and connect the mark to the vertex using a straight edge. The angle must be indicated by drawing an arc between the two arms and any given points should be labelled correctly remembering that the vertex is always found in the middle of the angle name.

Students may have difficulty using a semi-circular protractor to construct reflex angles. They must recognize that to construct a 210° angle, for example, they must subtract the given measure from 360° . This results in 150° which is a measure indicated on their protractors. They should construct an angle having this measure. Remind them to correctly identify the reflex angle when completed.

Ask student to draw and label the following angles:

- 67°
- 150°
- 230°

Teachers should extend angle construction to include angles that are in various positions (i.e., the first arm should not always be horizontal).

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Resources/Notes

Paper and Pencil

- Use a straightedge and protractor to draw the following angles:

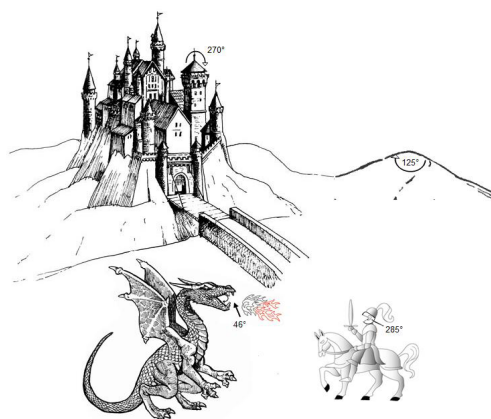
- (i) 54°
- (ii) 135°
- (iii) 75°
- (iv) 156°

Label each of the constructed angles and the specified measure.

(6SS1.6)

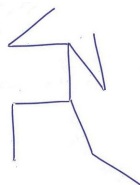
Performance

- Angle Art – Ask students to create pieces of art that incorporate a number of specified angle measures. E.g., “Draw a scene that contains a 46° , 125° , 270° and a 285° angle.” Use a protractor to construct these angles. Label each of the constructed angles using an arc and the specified measure. If students do not want to write the angle measures on their artwork they may wish to use a colour key. This would involve colouring the arms of each specified angle a different colour and using a key/legend to indicate its measure.



(6SS1.6)

- Ask students to make a stick person out of pipe cleaners or wire and pose it so that the assigned angles are displayed somewhere on its body.



(6SS1.6)

Authorized Resource

Math Focus 6

Lesson 5: Drawing Angles

TR: pp. 31 – 34

SB: pp. 258 – 261

Curious Math:

Strange Buildings

TR: pp. 37 – 38

SB: p. 264

Math Game:

Buried Treasure

TR: pp. 39 – 40

SB: pp. 265

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS2 Demonstrate that the sum of interior angles is:

- 180° in a triangle
- 360° in a quadrilateral.

[C, R]

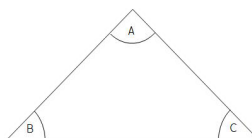
Achievement Indicator:

6SS2.1 Explain, using models, that the sum of the interior angles of a triangle is the same for all triangles.

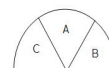
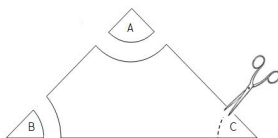
Strategies for Teaching and Learning

Students should investigate the sum of the interior angles in triangles and quadrilaterals to discover the relationships that exist. Teachers may need to discuss with students the difference between an interior angle and an exterior angle before exploration.

To demonstrate that the sum of the interior angles of any triangle is 180° , students should create several different types and sizes of triangles on construction paper or card stock. Use a protractor to trace an arc between the arms of the three angles in a triangle.



Ask students to cut the corners (the angles) off a triangle along the curved arc and arrange them such that they are all joined at the vertices (resulting in the formation of a straight angle).



Students should observe that the three angles form a half circle (180°).

Students should repeat this procedure for other triangles. Ask them what they notice about the angles in each case. They should conclude that the sum of the three interior angles for any triangle is 180° . They could verify this by measuring the interior angles and finding the sum.

Technology, such as FX Draw or features of interactive whiteboard software, could also be used to demonstrate the relationship between the interior angles in a triangle. Students should observe that no matter how they change the shape and size of the triangle, the sum of the interior angles is always 180° .

Ask students how they could use the result of their explorations to determine the measure of a missing angle in a given triangle when two other angle measures are known. They should recognize that they can subtract the given measures from 180° to determine the unknown angle measure.



General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- In groups of two, ask one student to construct an acute, right, or obtuse angle. They should form a triangle by connecting the ends of the arms. Using a protractor, the second student should measure the other two angles in the triangle and verify that the sum of the interior angles is 180°

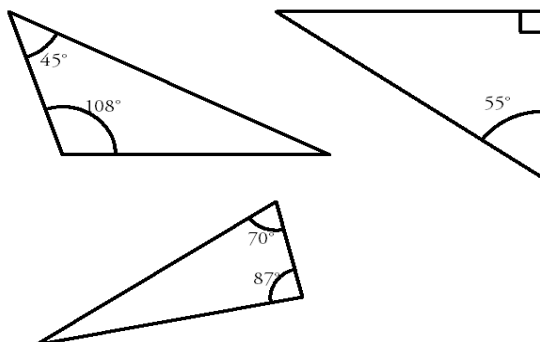
(6SS1.5, 6SS1.6, 6SS2.1)

- In FX Draw, students could use the triangle shape tool  to create a triangle of any size or shape, and the angle measure tool  to determine the measure of each interior angle. Ask them to determine the sum of the interior angles. They should then create a different triangle and repeat this process. Alternatively, students could drag one of the vertices of the original triangle to a different position to create a triangle of a new shape and size.

(6SS2.1)

Paper and Pencil

- Provide students with a set of triangles with two given angles such as the ones shown below and have them determine the measure of the third angle.



(6SS2.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Angle Relationships in Triangles

TR: pp. 41 – 45

SB: pp. 266 – 269

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

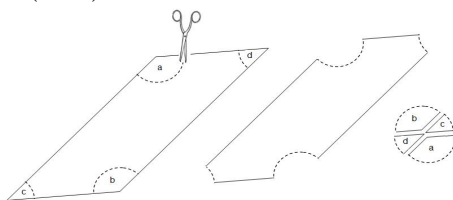
6SS2 Continued...



Achievement Indicator:

6SS2.2 Explain, using models, that the sum of the interior angles of a quadrilateral is the same for all quadrilaterals.

Strategies for Teaching and Learning

Students should investigate the sum of the interior angles of a quadrilateral in a similar manner as their exploration with triangles. Ask students to cut out quadrilaterals of various shapes and sizes. Use a protractor to draw arcs between the arms of each interior angle. Cut out each angle along the arc and arrange them so that their vertices are joined. Students will observe that the four angles of any quadrilateral form a full circle (360°).



FX Draw could also be used to illustrate this concept along with Interactive Whiteboard technology. Use the quadrilateral shape tool  to draw a quadrilateral of any shape and size on the interactive whiteboard. Label the measure of the interior angles using the angle measure tool. . Students should repeat this process for other quadrilaterals (or change the position of one of the original vertices to create different quadrilaterals). They should recognize that the sum of the four angles of any quadrilateral will always be 360° .

After establishing that the sum of interior angles for any triangle is 180° , students could use this information to explore the sum of the interior angles of any quadrilateral. They should recognize that any given quadrilateral is composed of two triangles. This can be reinforced using pattern blocks (a quadrilateral can be created by joining two triangles) or by constructing a diagonal in a given quadrilateral. Since the sum of the interior angles of a triangle is 180° , students should deduce that the sum of the interior angles of the quadrilateral would be 360° .

Ask students how they can determine the measure of a missing angle in a quadrilateral if they are given the measure of any three angles. Students should recognize that this can be accomplished by subtracting measures of the given angles from 360° (or by subtracting the sum of the three known angles from 360°).

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

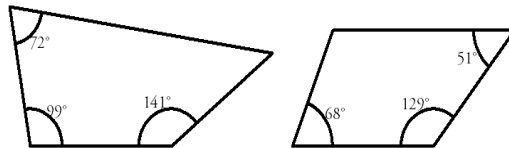
Performance

- Organize stations within the classroom. Each station will have a quadrilateral or triangle cut-out. All interior angles would be labelled on the cut out except for one angle which has been torn off each shape. Assign students in small groups or pairs to a station. Ask them to find the missing angle measure for their given quadrilateral or triangle. Groups will rotate from station to station until they have found all the missing angle measures.

(6SS2.2)

Paper and Pencil

- Provide students with a set of quadrilaterals and ask them to determine the missing angle:



(6SS2.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 7: Angle Relationships in Quadrilaterals

TR: pp. 46 – 50

SB: pp. 270 – 273

Strand: Patterns and Relations (Variables and Equations)

Outcomes

Students will be expected to

6SS3 Develop and apply a formula for determining the:

- **perimeter of polygons**
- **area of rectangles**
- **volume of right rectangular prisms.**

[C, CN, PS, R, V]

6PR3 Represent generalizations arising from number relationships, using equations with letter variables.

[C, CN, PS, R, V]

Achievement Indicators:

6SS3.1 Explain, using models, how the perimeter of any polygon can be determined.

6SS3.2 Generalize a rule (formula) for determining the perimeter of polygons, including rectangles and squares.

6PR3.3 Write and explain the formula for finding the perimeter of any given rectangle.

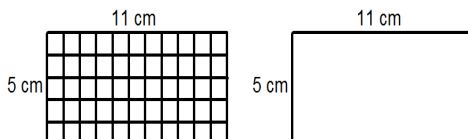
Elaborations—Strategies for Learning and Teaching

In Grade 5, students were asked to design and construct different rectangles given either perimeter or area or both (whole numbers) and draw conclusions. It is important to note that students' exposure to area and perimeter was limited to rectangles. No other polygons were explored. They also estimated and determined the volume of right rectangular prisms. In Grade 6, students will extend this knowledge to determine and apply a formula to determine the perimeter of polygons, area of rectangles and the volume of right rectangular prisms. They will generalize these formulas using equations with letter variables.

To activate prior knowledge, remind students that perimeter is the distance around a shape and is often measured in millimeters, centimeters and meters. Demonstrate the concept of perimeter by asking a student to walk along the walls of the classroom and count their steps, or trace the edges of their desk or textbook cover with their finger.

Students can use models such as pattern blocks, geoboards or 1 cm grid paper to explore the perimeter of polygons. They could determine the perimeter by using measuring tools or by determining the number of units along each side and adding them together.

Provide students with a rectangle, such as the one shown below, and ask them to determine its perimeter.



Many students would respond that the perimeter is 32 cm. To guide students in the development of a formula for the perimeter of a rectangle ask questions such as:

- How did you determine the perimeter of the rectangle?

Some students may say they added the sides. The perimeter is $5\text{ cm} + 5\text{ cm} + 11\text{ cm} + 11\text{ cm}$. Ask if the expression can be simplified. Students should respond with $2(5\text{ cm}) + 2(11\text{ cm})$.

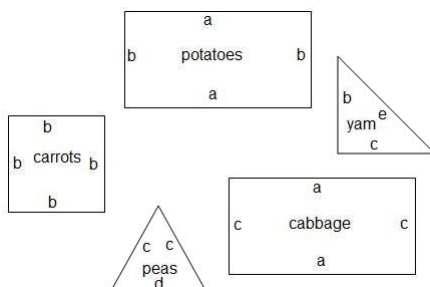
Others students may suggest the perimeter was found by multiplying 5 cm by 2, multiplying 11 cm by 2 and determining the sum: $2(5\text{ cm}) + 2(11\text{ cm})$.

General Outcome: Represent Algebraic Expressions in Multiple Ways

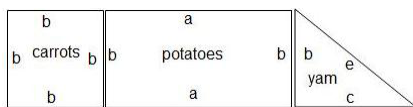
Suggested Assessment Strategies

Performance

- Farmer's Fence - Provide students with a variety of polygons (e.g., squares, rectangle, triangles, parallelograms) cut out from card stock or construction paper and having common side lengths labelled with a variable. Each polygon represents a different shaped field on a farm.



In groups students can arrange the polygons to create various combinations of different shaped farms. For example:



You (The Farmer) want to build a fence around your farm. Write a formula for the perimeter of your farm. The formula for the above farm would be $P = 3b + 2a + c + e$.

Once students have found the formula for the perimeter of their farm assign each variable a number value and ask students to use their formula to find the perimeter. For example: if $a = 5$ metres, $b = 2$ metres, $c = 3$ metres, $e = 4$ metres. The perimeter of the farm above would be

$$P = 3(2) + 2(5) + 3 + 4$$

$$P = 6 + 10 + 3 + 4 = 23 \text{ metres}$$

This activity could also be extended to incorporate other outcomes involving multiplication with decimals by giving students a set price per metre of fencing and asking them to calculate the total cost of fencing their farm.

(6SS3.1, 6SS3.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 9: Perimeter of a Polygon

TR: pp. 55 – 58

SB: p. 277

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS3 Continued...

6PR3 Continued...

Achievement Indicators:

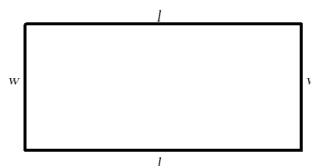
6SS3.1 (Continued) Explain, using models, how the perimeter of any polygon can be determined.

6SS3.2 (Continued) Generalize a rule (formula) for determining the perimeter of polygons, including rectangles and squares.

6PR3.3 (Continued) Write and explain the formula for finding the perimeter of any given rectangle.

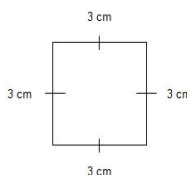
Strategies for Teaching and Learning

- What is the rule for determining the perimeter of a rectangle?
Multiply the width by 2, multiply the length by 2 and add the results. Alternatively, students might suggest adding the width and the length and multiplying by two.
- Suppose you didn't know the width or the length of the rectangle. How could you generalize this expression to determine the perimeter?



$$P = 2w + 2l \text{ or } P = 2(w + l)$$

Students should also generalize a formula for the perimeter of a square, using pattern blocks or a given square:



In the square above the perimeter may be written as $3 \text{ cm} + 3 \text{ cm} + 3 \text{ cm} + 3 \text{ cm}$, or $4 \times 3 \text{ cm} = 12 \text{ cm}$. Students should recognize that if one side length in a square is known then all other sides have that same length. Ask them how they could represent the side length of a square if it were unknown. While students may be familiar with use of the variables l (length) and w (width), they may be unsure of which variables to use in the case of a square or other polygons. For a square or a regular polygon the variable s (side) is often used. The rule for determining the perimeter of a square is “multiply the side length by 4.” This results in the formula for the perimeter of any square: $P = 4s$.

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Ask students to measure the length and width of a rectangular object within their classroom. Students should derive and apply a formula to calculate the object's perimeter.

(6PR3.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 9: Perimeter of a Polygon

TR: pp. 55 – 58

SB: p. 277

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS3 Continued...

6PR3 Continued...

Achievement Indicators:

6SS3.1 (Continued) Explain, using models, how the perimeter of any polygon can be determined.

6SS3.2 (Continued) Generalize a rule (formula) for determining the perimeter of polygons, including rectangles and squares.

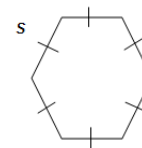
6PR3.4 Develop and justify equations using letter variables that illustrate the commutative property of addition and multiplication; e.g., $a + b = b + a$ or $a \times b = b \times a$.

6SS3.3 Solve a given problem involving the perimeter of polygons, the area of rectangles and/or the volume of right rectangular prisms.

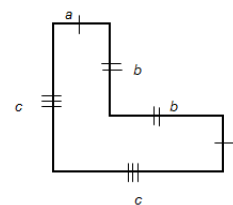
Strategies for Teaching and Learning

Students should explore other polygons in the same manner. Provide them with a variety of polygons on paper or cardstock. Ask them to identify which dimensions of that particular polygon are congruent (the same) and select a variable to represent the sides. Students should derive the formula for the perimeter of the given polygon.

- Students can use the variable s to represent the side length of the regular hexagon. The expression for its perimeter can be written as $s + s + s + s + s + s$. The perimeter of a regular hexagon is given by the formula: $P = 6s$.



- In the polygon shown, students should use a different variable for each pair of congruent sides as indicated by the hatch marks. The expression for the perimeter is $a + a + b + b + c + c$, or $P = 2a + 2b + 2c$.



It is important for students to realize that the order in which an addition is performed does not affect the result. This can be illustrated to students using number examples, such as $2 + 4 = 6$ and $4 + 2 = 6$. They should also understand that the commutative property of addition applies when working with formulas. Give students a rectangle, with a length of 7 cm and a width of 4 cm, and ask them to compare the result of applying $P = 2w + 2l$ and $P = 2l + 2w$.

Students should solve a variety of problems involving the perimeter of polygons. Remind them that for a regular polygon all side lengths are equal.

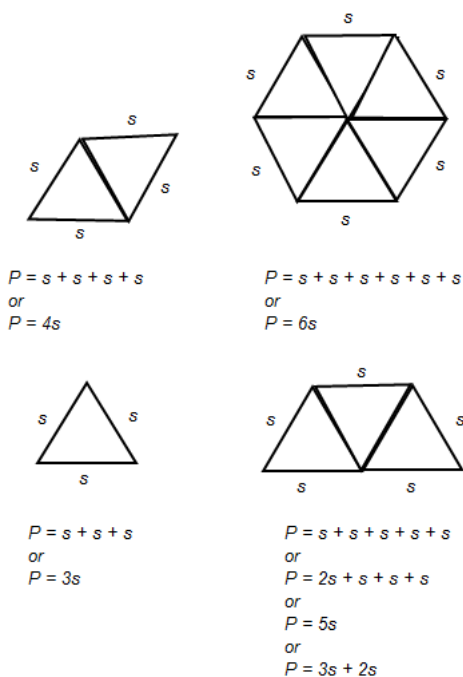
General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Provide students with pattern blocks and other manipulatives of varying shape and size. Ask them to identify which dimensions (sides) on the pattern blocks are of equal length. Trace these patterns on paper. Assign the equal sides a common variable or colour to represent the unknown length that these sides share. Write the formula to represent the perimeter of each pattern block.

E.g.,



(6SS3.2)

Paper and Pencil

- Ask students to answer questions such as the following:
 - Judy has designed a rectangular quilt 2 m by 3 m. What is the perimeter of the quilt?
 - John is making a display board for his Science Fair project. The display board is 1 m by 2 m. He wants to add a border around the display. If the border costs \$3.00 per meter, how much will it cost?
 - Felicia is training for a race. She runs a trail that is the shape of a regular hexagon. If the total distance she runs is 12 km, how long is each leg (side) of the trail?

(6SS3.2)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 9: Perimeter of a Polygon

TR: pp. 55 – 58

SB: p. 277

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS3 Continued...

6PR3 Continued...

Achievement Indicators:

6SS3.4 Explain, using models, how the area of any rectangle can be determined.

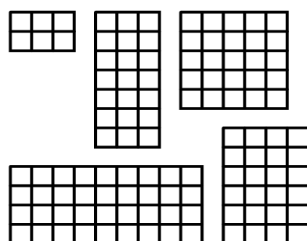
6SS3.5 Generalize a rule (formula) for determining the area of rectangles.

6PR3.5 Write and explain the formula for finding the area of any given rectangle.

Strategies for Teaching and Learning

Begin by reviewing area as the amount of flat (2-dimensional) surface within an enclosed shape. Students may find it easier to think of area in terms of what they would be colouring in if asked to colour a shape. This may be illustrated using computer drawing programs. Ask students to construct any enclosed shape and then use the “fill” or “paint” feature to colour in the shape. Students should be given the opportunity to discover how to determine the area of a rectangle and not simply given the formula.

Provide students with 1 cm² grid paper. Remind them that each square unit on the grid paper has a 2-D area of 1 cm² meaning it has linear dimensions of 1 cm in height and 1 cm in width. Ask students to draw 5 rectangles with various dimensions on their grid paper. They should determine the area by counting the number of 1 cm² units enclosed within the rectangle. After students have determined the area of the rectangle, ask them to determine the length and width of each rectangle. They should record their results in a table similar to the one shown below:



Area (cm ²)	Length (cm)	Width (cm)
6	3	2
21	3	7
25	5	5
36	9	4
24	4	6

Ask students questions such as the following:

- What do you notice about the relationship among the length, width and area of the rectangle?
- How can you determine the area of a rectangle if you know its dimensions (length and width)?

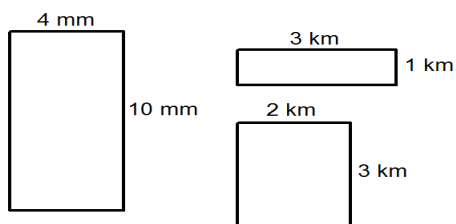
Students should recognize that the rule for determining the area of a rectangle is to multiply its length by its width. Using l to represent the length of the rectangle and w to represent the width results in the formula $A = lw$. Students should be able to apply this formula to determine the area of any given rectangle.

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Paper and Pencil

- Provide students with a set of rectangles, such as the ones shown below, and ask them to determine the area of each.



(6SS3.5)

- Ask students to determine the area of rectangles in their environment, such as the following:
 - the front of a textbook
 - the top of their desk
 - a poster on the wall
 - their television screen

(6SS3.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 8: Area of a Rectangle

TR: pp. 51 – 54

SB: pp. 274 – 276

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS3 Continued...

6PR3 Continued...

Achievement Indicators:

6SS3.3 (Continued) Solve a given problem involving the perimeter of polygons, the area of rectangles and/or the volume of right rectangular prisms.

6PR3.4 (Continued) Develop and justify equations using letter variables that illustrate the commutative property of addition and multiplication; e.g., $a + b = b + a$ or $a \times b = b \times a$.

Strategies for Teaching and Learning

Students should solve a variety of problems involving the area of rectangles. Consider the following:

Ellen has a flower garden that measures 6 m by 8 m. If one bag of fertilizer covers 16 square meters, how many bags would she need to fertilize her entire garden?

Teachers could provide students with a variety of flags from different countries that have rectangular patterns (i.e., Newfoundland Independent Flag, Ireland, Latvia, Costa Rica, France, Germany, Austria, Yemen, Poland, Spain, Ivory Coast). Alternatively, the flags could be printed or drawn and coloured on 1 cm² grid paper to make the length and width of each rectangle in the flag easier to identify. Ask students to identify the length and width of each rectangle in their flag's design (by measuring using a ruler or counting the units along the edge if it is on grid paper). They should use these measurements to determine the area. If students were given the Newfoundland Independent flag, for example, they would determine the area of the pink rectangle, the area of the white rectangle and the area of the green rectangle. Students could repeat this activity for different flags.

It is important that students realize that the order in which multiplication is performed does not affect the result. Teachers could ask students to determine 2×5 and then 5×2 . Ask them what they notice about the results.

Students should explore the commutative property of multiplication as it relates to the formula for the area of a rectangle. Give students a rectangle with a length of 7 cm and a width of 4 cm and ask them to compare the result of applying $A = lw$ and $A = wl$.

General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Designing a Dream House - Provide students with 1cm^2 grid paper. Ask them to design a floor plan for their dream house. Rooms can be rectangles of various dimensions. Students may even design two or three floors on separate sheets of grid paper. Once the floor plans are complete, ask students to use the formula they derived for area of a rectangle to find the area for each room in their floor plan. Once the floor area of each room is found, students can then find the combined floor area of the entire house.

(6SS3.3)

- This activity could be extended to incorporate outcomes from other units. For instance students could be asked to develop a scale for their floor plan. What would each square centimetre represent in a real house? Students could also be given prices for various square areas of flooring and asked to calculate the cost of flooring their dream house. This could be part of a cumulative project, incorporating outcomes from multiple unit.

(6SS3.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 8: Area of a Rectangle

TR: pp. 51 – 54

SB: pp. 274 – 276

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to
6SS3 Continued...

Achievement Indicator:

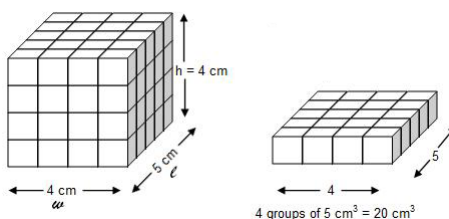
6SS3.6 Explain, using models, how the volume of any right rectangular prism can be determined.

Strategies for Teaching and Learning

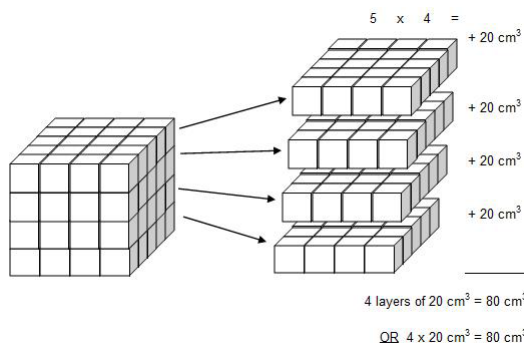
Teachers should remind students that volume is the amount of 3-dimensional space occupied by an object. It is measured in cubic units such as mm^3 , cm^3 , and m^3 .

Teachers should use cubic centimetre blocks to model a right rectangular prism. As each cube has a volume of 1cm^3 , the total volume can initially be found by counting the number of cubes in the prism. Students should recognize this as being very time-consuming, especially if they are dealing with a large prism. Guide them in developing the formula for the volume of a rectangular prism.

Begin by establishing the three dimensions of the prism. This is done simply by counting the number of cubes along the length, width and height. These dimensions are linear distances and are not measured in cubic units. The height of the prism indicates how many layers of cubes are in the prism. Students should begin by determining the volume of one layer. In the prism below, for example, the bottom layer is composed of four rows of five 1cm^3 blocks. They should conclude the volume of the bottom layer would be 20cm^3 ($4 \times 5 = 20$).



Since there are 4 layers and each has a volume of 20cm^3 , students should conclude that the total volume of the prism must be 80cm^3 (4 groups of 20cm^3).



General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Performance

- Arrange students into small groups or pairs. Provide each group with a different number of cubic unit manipulatives. These could be cubic centimetre blocks, multi-link cubes or both depending on what is available. Have each group construct the largest right rectangular prism that they can, using the blocks they were given. Ask each group to determine the volume of their own prism. Students can then leave their prism at their desk as a station. Groups can then rotate around the room finding the volume of the prisms constructed by other groups. Once the activity is complete ask students to share their findings with those of other groups to compare their methods and verify their results.

(6SS3.6)

- Provide students with various base-ten blocks. Ask them to determine the volume of each different type of block (e.g., A unit is 1 cm^3 , a rod is 10 cm^3 , a flat is 100 cm^3 , and the cube block is 1000 cm^3).

(6SS3.6)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 10: Volume of a Rectangular Prism

TR: pp. 59 – 62

SB: pp. 278 – 281

Shape and Space (Measurement)

Specific Outcomes

Students will be expected to

6SS3 Continued...

Achievement Indicator:

6SS3.7 Generalize a rule (formula) for determining the volume of right rectangular prisms.

6PR3.4 (Continued) Develop and justify equations using letter variables that illustrate the commutative property of addition and multiplication; e.g., $a + b = b + a$ or $a \times b = b \times a$.

6SS3.3 (Continued) Solve a given problem involving the perimeter of polygons, the area of rectangles and/or the volume of right rectangular prisms.

Strategies for Teaching and Learning

From this model students should generalize a rule for determining the volume of a right rectangular prism. The volume of a given right rectangular prism can be found by finding the number of cubes in one layer (length \times width), and then multiplying by the number of layers (height). Thus, the formula for determining the volume of a prism is $V = l \times w \times h$, where V = volume, l = length, w = width and h = height. This can also be expressed as $V = (\text{Area of the Base}) \times \text{height}$.

Remind students of the commutative property of multiplication and that the formula for the volume of a rectangular prism may be written with the three dimensions being multiplied in any order:

$$V = l \times w \times h$$

$$V = w \times h \times l$$

$$V = h \times l \times w$$

Provide students with a rectangular prism and ask them to apply each of these formulas to verify the result is the same.

Students should solve a given problem involving the volume of right rectangular prisms.

- Philip has made 3 rectangular prisms out of Lego blocks:

(i) 12 cm \times 5 cm \times 8 cm

(ii) 6 cm \times 17 cm \times 10 cm

(ii) 24 cm \times 4 cm \times 10 cm

Which has the largest volume?

Once students have been exposed to perimeter, area, and volume, teachers should provide a mixture of problems to assess student understanding of the three concepts.

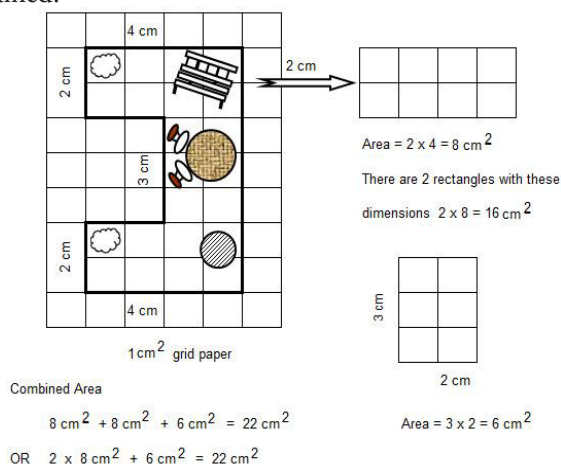
General Outcome: Use Direct and Indirect Measurement to Solve Problems.

Suggested Assessment Strategies

Paper and Pencil

- Ask students to design a patio/deck floor plan for their Dream House on 1 cm^2 grid paper. The deck design must be composed of two or more rectangles. Ask students to answer the following questions :

- What is the total area of the deck that would need to be stained?

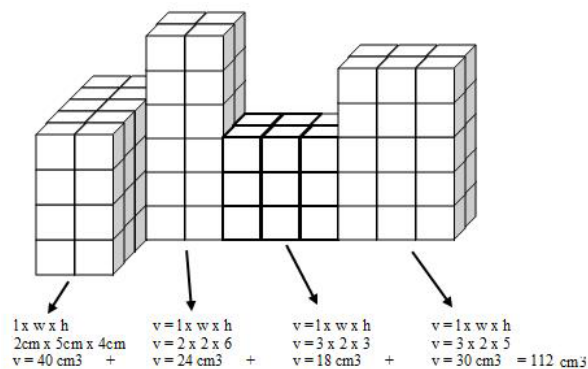


- If you want to put patio lanterns around the perimeter of your deck, how much wire would you need?

(6SS3.3, 6SS3.4, 6SS3.1, 6SS3.2, 6SS3.7)

Performance

- 3-D Building - Ask students to construct right rectangular prisms of various dimensions using multi-link cubes or Lego/Duplo blocks. Combine these prisms to create a large building. Ask students to calculate the total volume of the building.



(6SS3.5, 6SS3.6, 6SS3.7)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 10: Volume of a Rectangular Prism

TR: pp. 59 – 62

SB: pp. 278 – 281

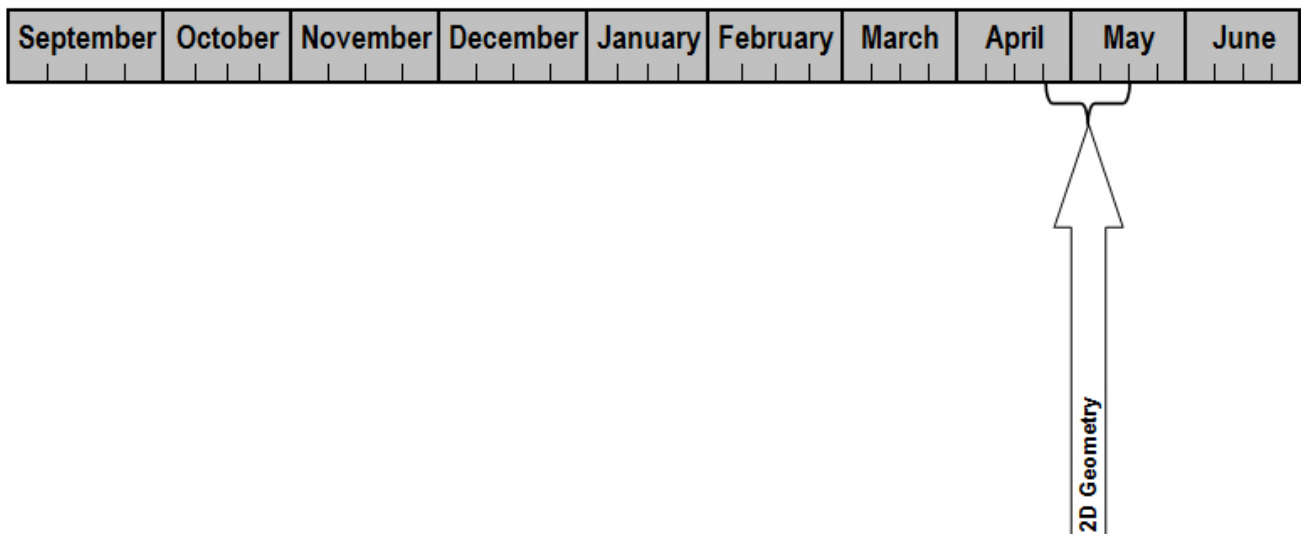
Lesson 11: Solving a Problem by Solving a Simpler Problem

TR: pp. 63 – 66

SB: pp. 282 – 283

2-D Geometry

Suggested Time: 3 Weeks



Unit Overview

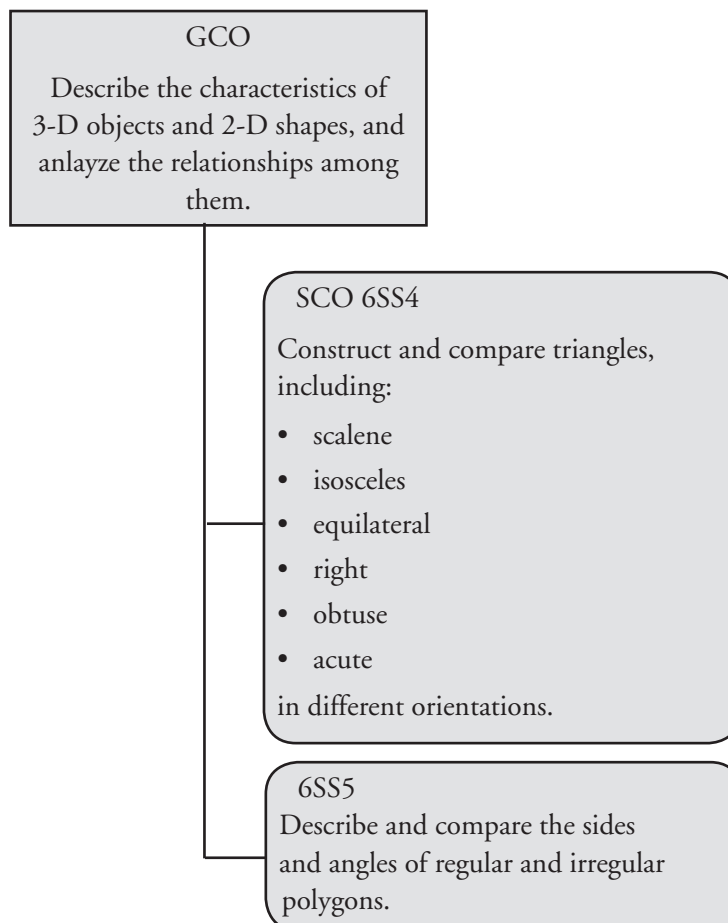
Focus and Context

As students develop mathematically and become more familiar with geometric attributes, they are increasingly able to identify and name a shape by examining its properties and using reasoning. Through their explorations, students will learn that triangles can be categorized and sorted according to the lengths of their sides (scalene, isosceles, equilateral) and also according to the measure of the interior angles (acute, right, obtuse). Students will also learn how to draw a specified triangle.

In the second part of the unit students will continue their study of polygons by exploring regular and irregular polygons. They will demonstrate congruence in regular polygons by superimposing and measuring and will replicate a triangle, demonstrating congruence.

Students develop their spatial sense by making connections to their everyday life and the environment. This unit provides opportunities to make these connections. From road signs, to quilting, to architecture, triangles and other polygons surround them. Allowing students to reflect and apply the content of this unit to their own lives will strengthen understanding.

Outcomes Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Shape and Space (3-D Objects and 2-D Shapes)		
Specific Outcomes	Specific Outcomes	Specific Outcomes
5SS5 Identify and sort quadrilaterals, including: <ul style="list-style-type: none"> • rectangles • squares • trapezoids • parallelograms • rhombuses (or rhombi) according to their attributes. [C, R, V]	6SS4 Construct and compare triangles, including: <ul style="list-style-type: none"> • scalene • isosceles • equilateral • right • obtuse • acute in different orientations. [C, PS, R, V] 6SS5 Describe and compare the sides and angles of regular and irregular polygons. [C, PS, R, V]	7SS3 Perform geometric constructions, including: <ul style="list-style-type: none"> • perpendicular line segments • parallel line segments • perpendicular bisectors • angle bisectors [CN, R, V]

Mathematical Processes

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS4 Construct and compare triangles, including:

- scalene
- isosceles
- equilateral
- right
- obtuse
- acute

in different orientations.

[C, PS, R, V]

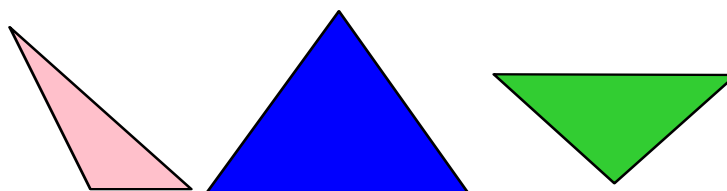
Achievement Indicator:

6SS4.1 Identify the characteristics of a given set of triangles according to their sides and/or their interior angles.

Suggestions for Teaching and Learning

In Grade 5, students categorized quadrilaterals according to side length and whether or not opposite sides were parallel. Students will expand their knowledge of characteristics of 2-D shapes to construct and compare triangles in different orientations. They will categorize triangles based on their side length and their interior angle measures.

Students should begin their exploration of the characteristics of triangles by examining the side lengths of the sides in various triangles. Provide them with a set of triangles, such as the ones below, and ask them to measure the lengths of the sides:

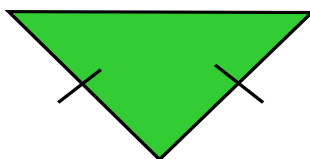


Students should discover that the first triangle has no sides equal in length. The lengths of all three sides in the second triangle are the same. The last triangle has two sides with the same length.

Discuss with students that they can name triangles according to their side lengths:

- Scalene – no equal sides
- Isosceles – two equal sides
- Equilateral – three equal sides

To indicate equal side lengths students should use tick marks (or hatch marks), as shown in the diagram below:



General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies

Performance

- Provide students with a geoboard, elastic bands and square dot paper. Ask them to create three different scalene triangles on the geoboard and then reproduce the triangles on the dot paper. Ask students to explain how they know they have created scalene triangles. Repeat the activity for isosceles and equilateral triangles. (6SS4.1)
- Ask students to play *Monster Munch*. (6SS4.1)
- Ask students to create a foldable to highlight the difference between scalene, isosceles, and equilateral triangles. Students should include examples of each type, along with the characteristics of each triangle. (6SS4.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Classifying Triangles by Side Length

Teacher Resource (TR):

pp. 13 – 16

Student Book (SB): pp. 350 – 352

Lesson 2: Exploring Triangles

TR: pp. 17 – 20

SB: p. 353

Note

Lessons 1 and 2 may be combined.

Supplementary Resources

Making Math Meaningful to Canadian Students K-8 – Marian Small

- Support for SCO 6SS4 can be found on pp.292 – 296

Teaching Student-Centered Mathematics Grades 3-5 – John Van de Walle and LouAnn Lovin

- Support for SCO 6SS4 can be found on pp. 220 - 225

Suggested Resource

<https://www.k12pl.nl.ca/curr/k-6/math/grade-6/links/unit-10.html>

- Monster Munch Game

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS4 Continued...

Achievement Indicator:

6SS4.1 (Continued) *Identify the characteristics of a given set of triangles according to their sides and/or their interior angles.*

Suggestions for Teaching and Learning

The use of concrete models should help students visualize side length and classify triangles. It should also help them realize that the orientation of a triangle does not affect its classification. Provide students with a photograph of a scene containing triangles. They should measure the length of each side and classify the triangles accordingly. Alternatively, teachers could ask students to find an example of an equilateral triangle, a scalene triangle, and an isosceles triangle in their environment. Encourage students to take a picture (or print one from the Internet) and present their findings to their classmates.

Teachers should have students construct specific triangles using various manipulatives, such as geoboards and elastic bands, pre-cut straws or pipecleaners. Ask them to construct a scalene triangle, an equilateral triangle, and an isosceles triangle using their manipulatives. They should be able to justify their construction.

Teachers could take this opportunity to review the concept of perimeter and ask students to determine the perimeter of their triangle by measuring the side lengths. A problem such as the following could be used to assess student understanding of the side length classification of triangles:

- One side of a triangle measures 7 cm. What might the side lengths of the other two sides be if you wanted the triangle to be an equilateral triangle? What might the side lengths of the other two sides be if you wanted the triangle to be isosceles? What might the side lengths be if you wanted the triangle to be scalene?

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies

Journal

- Ask students to discuss the statement, “An equilateral triangle is a special type of isosceles triangle.”
- (6SS4.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Classifying Triangles by Side Length

TR: pp. 13 – 16

SB: pp. 350 – 352

Lesson 2: Exploring Triangles

TR: pp. 17 – 20

SB: p. 353

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

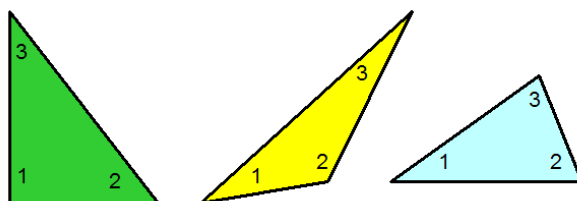
6SS4 Continued...

Achievement Indicator:

6SS4.1 (Continued) Identify the characteristics of a given set of triangles according to their sides and/or their interior angles.

Suggestions for Teaching and Learning

Students should examine the characteristics of a set of triangles according to their interior angles. Provide students with a set of triangles such as the following:



Students should measure each angle in each triangle and classify it as acute, obtuse, or right:

Triangle #1			Triangle #2			Triangle #3		
Measure of Angle #1	Measure of Angle #2	Measure of Angle #3	Measure of Angle #1	Measure of Angle #2	Measure of Angle #3	Measure of Angle #1	Measure of Angle #2	Measure of Angle #3
Type of Angle	Type of Angle	Type of Angle	Type of Angle	Type of Angle	Type of Angle	Type of Angle	Type of Angle	Type of Angle

Introduce students to the other classifications of triangles, based on their interior angles:

- A right triangle has one 90° angle.
- An acute triangle has all angles less than 90° .
- An obtuse triangle has one angle greater than 90° .

Further discussion should occur regarding the remaining angles in a right triangle and an obtuse triangle. Students should recognize that in a right triangle the other two angles must be acute angles. In an obtuse triangle the remaining two angles must be acute angles.

Exploration should lead to the discovery of the angle relationships in equilateral triangles and isosceles triangles. The definition of equilateral triangles, isosceles triangles and scalene triangles should then be expanded to include interior angles.

- Equilateral triangle – has all sides equal and all angles equal
- Isosceles triangle – has two equal sides and two equal angles
- Scalene triangle – has no equal sides or equal angles

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies

Resources/Notes

Performance

- Ask students to create their own ‘What type of triangle am I?’ card and use them to play with a friend (e.g., I am a triangle with one angle measuring 120° and two equal sides. What type of triangle am I? Answer: obtuse isosceles triangle).
(6SS4.1)
- Provide students with a sheet of paper. Students should cut off each of the four corners to form four different triangles. They should use a ruler and protractor to name the triangles according to both their side lengths and angle measures.
(6SS4.1)
- Ask students to participate in a *Triangle Hunt*. In small groups students should explore their classrooms, hallways, playgrounds, etc., to locate as many triangles as possible in their environment. They should identify the type of triangle, document their findings with photos (or sketches) and present to their class.
(6SS4.1)
- Ask students to create a piece of art that involves at least two of the triangle types they have studied.
(6SS4.1)

Journal

- Ask students to answer the following questions:
 - (i) Can you create a triangle with more than one obtuse angle? Explain using words, pictures and/or numbers.
(6SS4.1)
 - (ii) Can an obtuse triangle be an equilateral triangle? Explain using words, pictures and/or numbers.
(6SS4.1)
 - (iii) Can a right triangle be an isosceles triangle? Explain using words, pictures, and/or numbers.
(6SS4.1)

Authorized Resource

Math Focus 6

Lesson 3: Classifying Triangles by Interior Angles

TR: pp. 21 – 24

SB: pp. 354 – 357

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS4 Continued...

Achievement Indicator:

6SS4.2 Sort a given set of triangles and explain the sorting rule.

6SS4.3 Draw a specified triangle, e.g., scalene.

Suggestions for Teaching and Learning

Provide students with a set of triangles and ask them to sort them by completing a table similar to the one below:

Triangle \ Type	Equilateral Triangle	Isosceles Triangle	Scalene Triangle	Right Triangle	Acute Triangle	Obtuse Triangle
A						
B						
C						
D						

During this activity, students should discover that each triangle will have two classifications. It can be classified according to the side lengths and according to the measure of the interior angles. A right triangle, for example, can also be an isosceles triangle. An equilateral triangle, however, can never be a right triangle or an obtuse triangle.

Students should be given opportunities to explore the possible combinations of right, acute and obtuse triangles and scalene, isosceles and equilateral triangles: right isosceles, right scalene, acute isosceles, acute equilateral, acute scalene, obtuse isosceles and obtuse scalene.

Students sometimes experience difficulty with drawing a specified triangle and will need practice to become proficient with their drawings. Teachers should begin by asking students to construct **any** scalene triangle, **any** isosceles triangle, and **any** equilateral triangle. Then ask them to draw **any** right triangle, **any** acute triangle, and **any** obtuse triangle. Next, teachers could add a measurement to the specified triangle: an isosceles triangle having two sides 7.2 cm long, for example. Teachers should continue to add more specifications to the triangles. Ask students to construct, for example, a right triangle having a 4 cm side and a 5 cm side.

Through investigations, students should recognize that two angles and one side length results in a unique triangle. If two students were asked to draw a triangle with a 3 cm side and angles measuring 40° and 70° at its endpoints, for example, their resulting triangles will be congruent acute isosceles triangles. The orientation of the student drawings may be different. Remind them that orientation of the triangles does not make them different triangles. Students should be able to identify any unspecified angles and side lengths after drawing their triangles.

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies

Resources/Notes

Paper and Pencil

- Ask students to draw three different obtuse isosceles triangles.
(6SS4.1, 6SS4.3)
- Ask students to construct a triangle with one angle measuring 65° and one angle measuring 40° . Ask questions such as:
 - (i) What is the measure of the third angle?
 - (ii) What type of triangle did you make? Justify.
 (6SS4.1, 6SS4.3)

Performance

- Provide students with a copy of a number of triangles. Be sure to include at least one of each of the three types. Ask students to sort the triangles.
(6SS4.1, 6SS4.2)
- Ask students to create any triangle with construction paper. Put students in groups and ask them to sort their triangles into two groups using a sorting rule of their choice.
(6SS4.2)
- Provide students with a Venn diagram template and ask them to sort given triangles according to two chosen properties (e.g., isosceles triangles and right triangles).
(6SS4.2)

Authorized Resource

Math Focus 6

Lesson 3: Classifying Triangles by Interior Angles
TR: pp. 21 – 24
SB: pp. 354 – 357

Lesson 4: Drawing Triangles
TR: pp. 25 – 28
SB: 358 – 360

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS4 Continued...

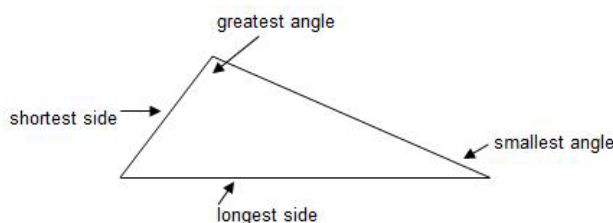
Achievement Indicator:

6SS4.3 (Continued) Draw a specified triangle, e.g., scalene.

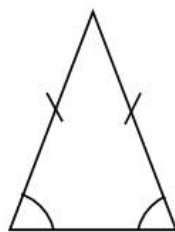
Suggestions for Teaching and Learning

Having an understanding of the properties that exist within triangles is beneficial when drawing them. Useful properties include:

- The greatest angle is opposite the longest side, and the smallest angle is opposite the shortest side.



- The sum of the two shorter sides must be greater than the longest side.
- When two angles of a triangle are congruent, then the sides opposite them are congruent (and vice versa).



Students should be encouraged to use appropriate tick marks on triangles to indicate which sides and angles are equal.

- The sum of the interior angles of any triangle is 180° .
- A triangle can never have more than one obtuse angle or one right angle.

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies*Performance*

- Provide students with a geoboard and geobands. Ask them to construct a triangle with two 45° angles. Ask students to make three different triangles having the same angle measures. Students should explain how their triangles are the same and how they are different. They should classify the type of triangle they have made.

(6SS4.1, 6SS4.3)

Resources/Notes**Authorized Resource***Math Focus 6*

Lesson 4: Drawing Triangles

TR: pp. 25 – 28

SB: pp. 358 – 360

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS5 Describe and compare the sides and angles of regular and irregular polygons.

[C, PS, R, V]

Achievement Indicators:

6SS5.1 Sort a given set of 2-D shapes into polygons and non-polygons, and explain the sorting rule.

6SS5.2 Demonstrate that the sides of a given regular polygon are of the same length and that the angles of a regular polygon are of the same measure.

Suggestions for Teaching and Learning

In Grade 3 students sorted regular and irregular polygons. It may be necessary to review the definition of a polygon - a closed 2-D figure bound by straight line segments that intersect at the vertices. Naming polygons may also benefit students as they describe and compare the sides and angles of regular and irregular polygons. They will sort a set of shapes into polygons and non-polygons. They will investigate the side lengths and angle measures to discover the difference between a regular polygon and an irregular polygon and sort a set of polygons accordingly. Students will make connections between their environment and regular and irregular polygons. They will finish the unit by replicating a triangle.

Teachers should provide students with a set of polygons, non-polygons, and a template such as the following:

Polygons	Non-polygons

Students should cut out their shapes and glue or tape them into the appropriate section of the template. Teachers could extend this template to add additional sorting characteristics:

	Polygon	Non-polygon
Quadrilateral		
Not Quadrilateral		

The definition of a regular polygon should be developed through a discovery approach. Provide students with several regular polygons. Ask them to measure the angles and side lengths and discuss what they notice. They should recognize that all angles are equal and all sides are equal. Introduce the term regular polygon as a polygon having all equal sides and all equal angles.


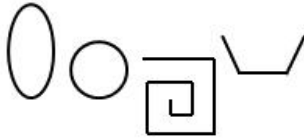
Discuss with students that because the angles in a given polygon are equal does not mean all sides are also equal. A rectangle, for example, has four 90 degrees angles, yet all side lengths might not be the same. Teachers could also discuss symmetry in regular polygons. The number of lines of symmetry in a regular polygon is equal to the number of sides in the polygon.

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies

Paper and Pencil

- Provide students with a template for the Frayer Model. Ask them to complete the sections individually to demonstrate their understanding of the geometric concept “polygon”.

Definition A polygon is a closed 2-D figure bound by straight line segments that intersect at the vertices	Characteristics - a closed 2-D figure with sides - the number of vertices is equal to the number of sides - does not have curves
Examples 	Nonexamples 

(6SS5.1)

Journal

- Ask students to draw a polygon and a non-polygon, and explain why one is a polygon and the other is not.

(6SS5.1)

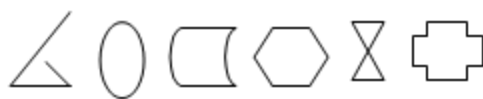
- Ask students to agree or disagree with the statement below and to explain their thinking:

Since all the angles of a rectangle measure 90° , all rectangles are regular polygons.

(6SS5.2)

Performance

- Ask students to sort these shapes into two groups: polygons and non-polygons.



(6SS5.1)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 5: Sorting Polygons

TR: pp. 34 – 37

SB: pp. 364 – 367

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS5 Continued...

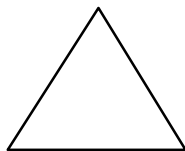
Achievement Indicators:

6SS5.3 *Sort a given set of polygons as regular or irregular, and justify the sorting.*

6SS5.4 *Identify and describe regular and irregular polygons in the environment.*

Suggestions for Teaching and Learning

Teachers should provide students with a set of polygons to sort as regular or irregular. While sometimes it may be obvious that a polygon is irregular, encourage students to use their rulers and protractors to verify. Sometimes the sides in a polygon might appear to be the same length but upon further inspection they are not. An example such as the following will reinforce the importance of using their measuring tools to verify their predictions:



Sides 49mm, 46.6mm & 47.2mm
Angles 62.97°, 57.99° & 59.04°

Some students might predict that this polygon is regular (because it “looks” as though the sides and angles are equal). However, when they measure the lengths of the sides or measure the angles, this is not the case.

Students are surrounded by polygons in the environment:

- road signs
- windows
- patches on a soccer ball
- architecture
- artwork
- quilting

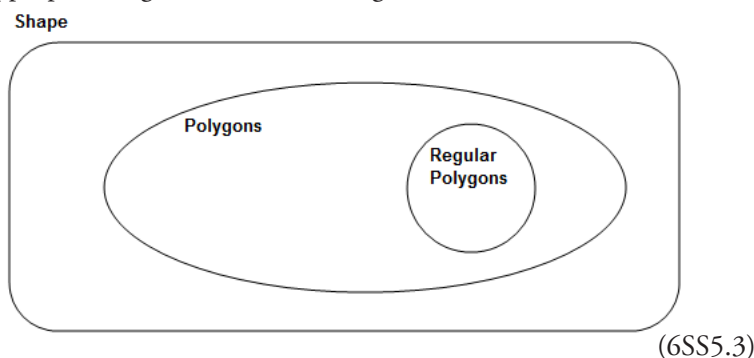
Teachers could ask students to participate in a polygon scavenger hunt. They should explore their school and schoolyard to locate examples of polygons. They could take pictures and present their findings to the class. They should be able to name each polygon and classify it as regular or irregular, explaining their choice. Alternatively, students could explore their home environment to identify and describe regular and irregular polygons.

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies

Performance

- Provide students with several polygons and ask them to measure the angles with a protractor and side lengths with a ruler. Students should identify whether the polygons are regular or irregular. (6SS5.3)
- Provide students with a set of shapes including several regular polygons, irregular polygons, one non-polygon, and a Venn diagram similar to the one below. Students should place each shape in the appropriate region of the Venn diagram.



- Using children's literature *Shape up! Fun with Triangles and Other Polygons*, have students work in small groups to complete each suggested exploration. Students use three pretzel rods, for example, to create an equilateral triangle. Students should confirm the triangle is equilateral by measuring the side lengths. (6SS4.1, 6SS5.1)

Journal

- Ask students to write about the characteristics of a regular polygon. Students should discuss which characteristic they prefer to use to check whether a polygon is regular or irregular and explain their choice. (6SS5.2)

Resources/Notes

Authorized Resource

Math Focus 6
Lesson 5: Sorting Polygons
TR: pp. 34 – 37
SB: pp. 364 – 367

Suggested Resource

Shape up! Fun with Triangles and Other Polygons - David A, Adler

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS5 Continued...

Achievement Indicators:

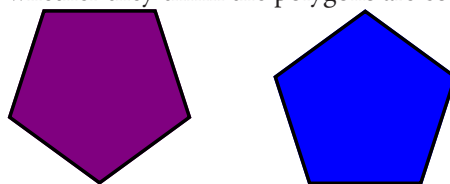
6SS5.5 Demonstrate congruence (sides to sides and angles to angles) in a regular polygon by superimposing.

6SS5.6 Demonstrate congruence (sides to sides and angles to angles) in a regular polygon by measuring.

Suggestions for Teaching and Learning

Students will build upon their existing knowledge of transformational geometry to demonstrate congruence in regular polygons. They should understand that two polygons are congruent if they are identical in size and shape. The polygons must have the same side lengths and the same angle measures to be congruent.

Provide students with two congruent regular polygons and ask them whether they think the polygons are congruent:



Ask them how they can prove that they are congruent. One strategy that can be used to demonstrate congruence in regular polygons is to superimpose an image. This can be done using tracing paper, cut outs or a Mira™. Students could trace one of the polygons or cut one out and determine whether the polygons coincide (whether the polygons match up). Remind students that sometimes it is necessary to turn (rotate) or flip the tracing paper to get the two polygons to match.

Students could also demonstrate congruency by measuring the side lengths of the polygon using a ruler and measure the angles using a protractor. If the side lengths are the same and the angles between matching sides are the same then the polygons are congruent.

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

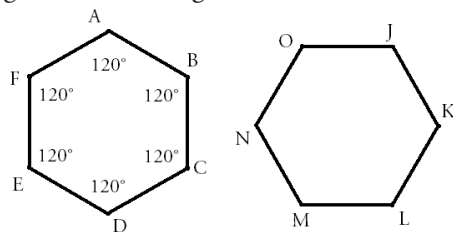
Suggested Assessment Strategies

Performance

- Provide students with a set of regular polygons. Include several sets of congruent and similar polygons. Ask students to identify pairs of congruent polygons and to explain how they found them. (6SS5.5, 6SS5.6)

Paper and Pencil

- Provide students with triangular dot paper. Ask them to draw a regular hexagon. Ask them to show that all sides and all angles are congruent by measuring or superimposing. (6SS5.5, 6SS5.6)
- Provide students with a copy of two congruent regular polygons in different positions. Label the vertices of both polygons. On one, indicate the side lengths and angle measures, but not on the other. Ask students to write the measure of each angle in the second polygon without using a protractor, and the measure of each side length without using a ruler.



(6SS5.6)

Journal

- Ask students to respond to the following: What does it mean when two regular polygons are congruent? Use pictures and words to explain your understanding.

(6SS5.5, 6SS5.6)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 6: Congruent Polygons

TR: pp. 38 – 41

SB: pp. 368 – 371

Lesson 7: Communicating about Polygons

TR: pp. 42 – 44

SB: pp. 372 – 373

Math Game:

Matching Cards

TR: pp. 45 – 46

SB: p. 374

Chapter Task:

Polygon Contest

TR: pp. 51 – 52

SB: p. 379

Shape and Space (3-D Objects and 2-D Shapes)

Specific Outcomes

Students will be expected to

6SS4 Continued...

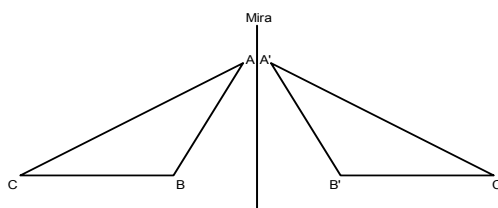
Achievement Indicator:

6SS4.4 Replicate a given triangle and show that the two are congruent.

Suggestions for Teaching and Learning

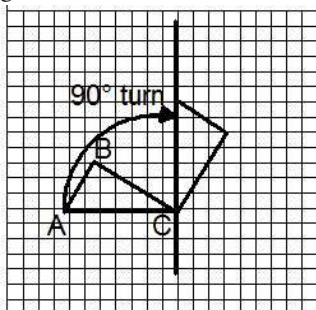
In the motion geometry unit students learned that when you translate an object, rotate it or reflect it, the size of the object does not change. The image is congruent to the original. Students should use this knowledge to replicate a given triangle and then verify that the two triangles are congruent by superimposing or measuring.

The use of a Mira™, grid paper, trace paper, pattern blocks, and geoboards will assist students in replicating a given triangle. Using a Mira™, for example, students could create a reflection of the triangle shown:



Students should recognize that while the orientation of the triangle has changed, the size has not.

Using grid paper and tracing paper students could also replicate a triangle. Ask students to trace the given triangle on a piece of tracing paper. They could change the direction of the tracing paper by rotating it 90 degrees clockwise, for example, and transfer the traced shape to a grid:



Students could work in pairs and use geoboards and geobands to replicate a given triangle. One student should construct a triangle on their geoboard. The second student should then replicate the given triangle on their geoboard. Encourage them to create a triangle that is not in the same direction as the first triangle.

To replicate a given triangle students could also measure the lengths of the given sides and measures of the given angles and reproduce these measures such that the triangle is in a different direction.

General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationship among them.

Suggested Assessment Strategies*Paper and Pencil*

- Provide students with dot paper. Ask them to draw a triangle and use their knowledge of transformational geometry to replicate the given triangle.

(6SS4.4)

Resources/Notes**Authorized Resource***Math Focus 6*

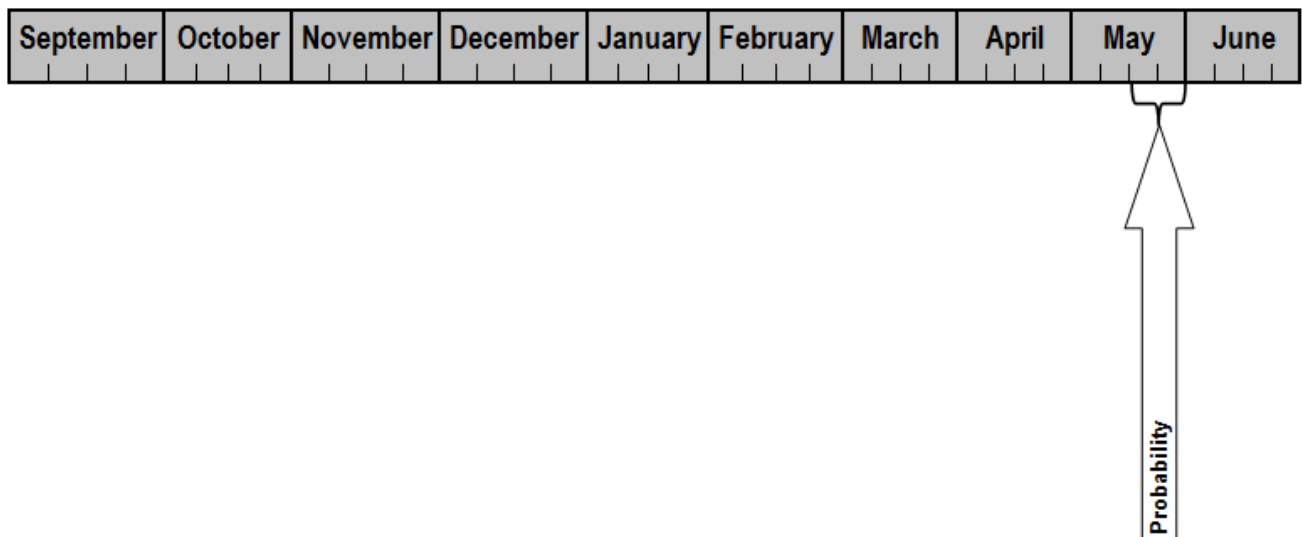
Lesson 6: Congruent Polygons

TR: pp. 38 – 41

SB: pp. 368 – 371

Probability

Suggested Time: 2 Weeks



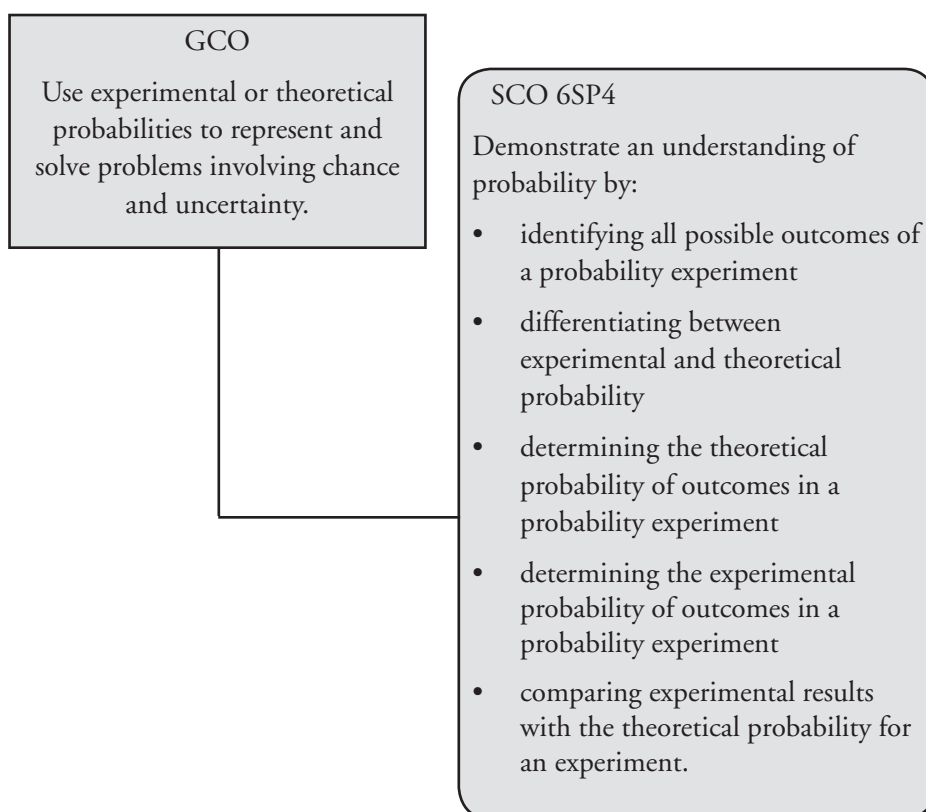
Unit Overview

Focus and Context

In Grade 5, students described the likelihood of a single outcome occurring as impossible, possible, or certain. They also compared the likelihood of two possible outcomes as less likely, equally likely, or more likely. In Grade 6, students will build upon this knowledge to list the possible outcomes of a probability experiment and to determine the theoretical probability of an outcome or event in a probability experiment. They will conduct experiments to determine the experimental probability and compare this to the theoretical probability. Students will learn that as the number of trials in an experiment increases the experimental probability approaches the theoretical probability. They are encouraged to participate in a variety of games, activities and investigations in which they predict outcomes and then test their predictions through their first hand experiences.

An understanding of probability is essential for students to interpret probabilities reported in weather forecasts, in the medical field (the likelihood of various illnesses/diseases), and in the media or newspapers. Students should be encouraged to relate the concepts that they learn in this unit to their everyday life and to raise these observations in class.

Outcome Framework



SCO Continuum

Grade 5	Grade 6	Grade 7
Strand: Statistics and Probability (Chance and Uncertainty)		
Specific Outcomes	Specific Outcomes	Specific Outcomes
<p>5SP3 Describe the likelihood of a single outcome occurring, using words such as:</p> <ul style="list-style-type: none"> impossible possible certain <p>[C, CN, PS, R]</p> <p>5SP4 Compare the likelihood of two possible outcomes occurring, using words such as:</p> <ul style="list-style-type: none"> less likely equally likely more likely <p>[C, CN, PS, R]</p>	<p>6SP4 Demonstrate an understanding of probability by:</p> <ul style="list-style-type: none"> identifying all possible outcomes of a probability experiment differentiating between experimental and theoretical probability determining the theoretical probability of outcomes in a probability experiment determining the experimental probability of outcomes in a probability experiment comparing experimental results with the theoretical probability for an experiment. <p>[C, ME, PS, T]</p>	<p>7SP4 Express probabilities as ratios, fractions and percents.</p> <p>[C, CN, R, T, V]</p> <p>7SP5 Identify the sample space (where the combined sample space has 36 or fewer elements) for a probability experiment involving two independent events.</p> <p>[C, ME, PS]</p> <p>7S6 Conduct a probability experiment to compare the theoretical probability (determined using a tree diagram, table or other graphic organizer) and experimental probability of two independent events.</p> <p>[C, PS, R, T]</p>

Mathematical Processes

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[ME] Mental Mathematics and Estimation	[T] Technology
	[V] Visualization

Statistics and Probability (Chance and Uncertainty)

Specific Outcomes

Students will be expected to

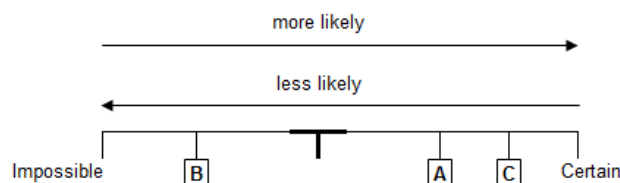
6SP4 Demonstrate an understanding of probability by:

- identifying all possible outcomes of a probability experiment
- differentiating between experimental and theoretical probability
- determining the theoretical probability of outcomes in a probability experiment
- determining the experimental probability of outcomes in a probability experiment
- comparing experimental results with the theoretical probability for an experiment.

[C, ME, PS, T]

Suggestions for Teaching and Learning

In Grade 5, students described the likelihood of a single outcome occurring, and compared the likelihood of two possible outcomes occurring. Students created probability lines (shown below) to describe and compare probabilities.



Event A could be any event that is fairly likely but not certain, such as rain during the third week of April

Event B could be an event that is less likely but not impossible, such as an animal coming into the classroom.

Event C could be an event that is more likely but not certain, such as school happening tomorrow.

They designed and conducted probability experiments in Grade 5 meeting specific conditions: one outcome less likely than the other outcome, one outcome is equally likely to occur as the other outcome, and one outcome is more likely to occur than the other outcome. Students learned that probabilities range from impossible to certain. To activate prior knowledge, teachers could present a simple probability experiment, such as choosing a student name from a bag to win a free recess. Place each name in a bag and ask questions such as:

- How would you describe the likelihood of Maddie winning the free recess?
- How would you compare the likelihood of Maddie winning the free recess with the likelihood of Phil winning the free recess?

In Grade 6 students will continue their exploration of probability concepts. They will examine and carry out experiments involving spinners, linking cubes, coins, and other manipulatives to develop methods for determining the theoretical and experimental probabilities of various outcomes. They will compare these two values and recognize the relationship between their values and the number of trials in an experiment.

General Outcome: Use Experimental or Theoretical Probabilities to Represent and Solve Problems Involving Uncertainty.

Suggested Assessment Strategies

Paper and Pencil

- Discuss the following terms with students:

impossible

possible

less likely

equally likely

more likely

certain

Students should use these terms to describe the probability of each of the following events:

- School will start in September
- Trees shed their leaves in July
- If you run a lap around the track, you can run a marathon
- If you toss a coin, it will land on heads

(6SP4)

Presentation

- Students should use their understanding of probability to discuss the following:

- The sun will rise tomorrow
- An adult will be home when you get home from school
- You will have pizza for dinner
- A moose will come to the schoolyard on Friday

(6SP4)

Resources/Notes

Supplementary Resources

Making Math Meaningful to Canadian Students K-8 – Marian Small

- Support for SCO 6SP4 can be found on pp. 543 – 564

Teaching Student-Centered Mathematics Grades 3-5 – John Van de Walle and LouAnn Lovin

- Support for SCO 6SP4 can be found on pp. 339 - 355

Statistics and Probability (Chance and Uncertainty)

Specific Outcomes

Students will be expected to

6SP4 Continued...

Achievement Indicators:

6SP4.1 List the possible outcomes of a probability experiment, such as:

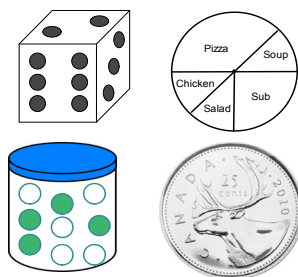
- *tossing a coin*
- *rolling a die with a given number of sides*
- *spinning a spinner with a given number of sectors.*

6SP4.2 Determine the theoretical probability of an outcome occurring for a given probability experiment.

6SP4.3 Predict the probability of a given outcome occurring for a given probability experiment by using theoretical probability.

Suggestions for Teaching and Learning

Provide students with various manipulatives, such as a quarter, a six-sided die, a jar of marbles or a spinner:



Ask students to list the possible outcomes for each probability experiment:

- rolling a six-sided die (1, 2, 3, 4, 5, 6)
- spinning the spinner (pizza, sub, salad, soup, chicken)
- selecting a marble from the jar (black, white)
- flipping a quarter (heads, tails)

Ask students if each outcome is equally likely. Students should recognize that the spinner, for example, is more likely to land on pizza since the size of the pizza sector is larger than the others.

Teachers should ask students what the likelihood is for a particular outcome. What is the probability of rolling a 4 on a six-sided die? Some students may respond “1 out of six”. Make the connection between this statement and the fraction $\frac{1}{6}$. Ask them what the 1 represents. Students might respond “the number of fours on the die”. Ask them what the 6 represents. They could respond “the number of possible outcomes when we roll a die.” This leads nicely into theoretical probability.

Theoretical probability is based on analyzing the outcomes of a probability experiment in a logical way. It is the expected probability. To determine the theoretical probability, students must determine the ratio of favourable (equally likely) outcomes to the total number of possible (equally likely) outcomes.

$$\text{Probability of Event A} = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}}$$

Probability is often expressed as a fraction. While it can also be written as a ratio, a decimal or a percent students are not expected to convert a given probability from a fraction into any of these forms. This will be addressed in Grade 7 Mathematics.

General Outcome: Use Experimental or Theoretical Probabilities to Represent and Solve Problems Involving Uncertainty.

Suggested Assessment Strategies

Paper and Pencil

- Students should determine the probability of rolling an even number on a standard six-sided die.
(6SP4.2, 6SP4.3)
- Tell students that you are visiting a kennel that has 3 German Shepherds, 5 Labrador Retrievers, 3 Chihuahuas, 4 Poodles, and 5 West Highland Terriers. When you arrive, the dogs are taking a walk. What is the probability of seeing a German Shepherd first?
(6SP4.2, 6SP4.3)
- Tell students that there are 10 yogurt bars in a bag. 3 bars are caramel flavoured, which Dave likes, 2 are strawberry flavoured, which he dislikes, and 5 are orange flavoured, which he also likes. Dave puts his hand in the bag without looking, and pulls out a bar. Ask students:
 - What is the probability that he will select a yogurt bar that he dislikes?
 - What is the probability of him selecting a blueberry yogurt bar?
 Students should create their own probability question about the yogurt bars and ask their classmates to solve it.
(6SP4.2, 6SP4.3)

Performance

- Ask students to watch as you put linking cubes into a bag. First place 20 blue, 10 yellow and 5 green. Ask students questions about which colour they think you will pull from the bag:
 - Are all outcomes equally likely?
 - What are the chances of pulling an orange cube out?
 Empty the bag and fill it again with 1 green, 1 blue, 1 brown and 1 red. Discuss the possible outcome with this combination of colours in the bag. Students should describe the probability using fractions.
(6SP4.1, 6SP4.2, 6SP4.3)

Resources/Notes

Authorized Resource

Math Focus 6

Getting Started: Choosing Snacks
Teacher Resource (TR):

pp. 10 – 11

Student Book (SB): pp. 324 – 325

Math Game:

Take A Chance

TR: pp. 17 – 18

SB: p. 327

Lesson 2: Theoretical Probability

TR: pp. 19 – 23

SB: pp. 328 – 331

Statistics and Probability (Chance and Uncertainty)

Specific Outcomes

Students will be expected to

6SP4 Continued...

Achievement Indicators:

6SP4.1 (Continued) List the possible outcomes of a probability experiment, such as:

- *tossing a coin*
- *rolling a die with a given number of sides*
- *spinning a spinner with a given number of sectors.*

6SP4.2 (Continued) Determine the theoretical probability of an outcome occurring for a given probability experiment.

6SP4.3 (Continued) Predict the probability of a given outcome occurring for a given probability experiment by using theoretical probability.

Suggestions for Teaching and Learning

Introduce students to the notation used when describing the probability of an event occurring. Instead of writing in words “the probability of rolling a 4 on a standard die is $\frac{1}{6}$,” students can write $P(4) = \frac{1}{6}$.

Students should determine the theoretical probability for an outcome for a variety of situations. Consider a jar, for example, containing 10 blue marbles, 4 green marbles and 6 red marbles, for example. Ask students to determine each of the following probabilities:

- $P(\text{black})$
- $P(\text{red})$
- $P(\text{green})$
- $P(\text{red or black})$
- $P(\text{green or red})$

Based on the theoretical probabilities, students should predict the probability of a given outcome occurring for a probability experiment. Ask them questions such as the following:

- If a marble was selected 20 times, how many times would you expect it to be red? green? blue?
- If a marble was selected 40 times, how many times would you expect it to be green? blue? red?

It is important for students to realize that theoretical probability can only be used when each outcome for the experiment is equally likely to occur. Consider the following spinner, for example:



Some students might incorrectly state $P(\text{Ice Skating}) = \frac{1}{5}$. To accurately determine the theoretical probability, students should divide the spinner into equal parts:



This will allow them to accurately determine the probability,

$$P(\text{Ice Skating}) = \frac{2}{6}.$$

General Outcome: Use Experimental or Theoretical Probabilities to Represent and Solve Problems Involving Uncertainty.

Suggested Assessment Strategies

Journal

- Bring a Farmer's Almanac to show the students. Ask students how they think authors of The Farmer's Almanac make their predictions about weather for a year. How do they use probability?

(6SP4.3)

• *Performance*

Ask students to create spinners with paper, pencils and paper clips. Sections of the spinners should be equal in size and coloured different colours. Have student pairs calculate the theoretical probability (expressed as a fraction, a decimal a ratio or a percent) of each outcome of their own spinners and those of their partners. Then, ask students to calculate the experimental probability of spinning one colour. Demonstrate spinning the spinner 10 times. Then, ask students to record the results of 25 spins of their own spinners in a tally chart.

(6SP4.3)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 2: Theoretical Probability

TR: pp. 19 – 23

SB: pp. 328 – 331

Statistics and Probability (Chance and Uncertainty)

Specific Outcomes

Students will be expected to

6SP4 Continued...

Achievement Indicators:

6SP4.4 Distinguish between theoretical probability and experimental probability, and explain the differences.

6SP4.5 Conduct a probability experiment, with or without technology, and compare the experimental results with the theoretical probability.

6SP4.6 Explain that as the number of trials in a probability experiment increases, the experimental probability approaches theoretical probability of a particular outcome.

Suggestions for Teaching and Learning

Students should be able to differentiate between theoretical probability and experimental probability. Experimental probability is the likelihood that an event will occur based on the results of an experiment. Students should conduct probability experiments to develop and strengthen their understanding between the two. They should be asked to determine the theoretical probability for a given outcome and then conduct an experiment to determine the experimental probability and compare the two. Consider tossing a coin, for example. Ask students questions such as:

- What is the theoretical probability of a coin landing on heads?
Students should recognize that the theoretical probability of this outcome is $\frac{1}{2}$.
- Does this mean that when we flip a coin 10 times, it **must** land on heads 5 times or when we flip a coin 50 times, it **must** land on heads 25 times?

Students should recognize that when the experiment is conducted any outcome can occur.

Students should be encouraged to conduct this experiment- flip a coin 10 times and determine the experimental probability of landing on heads. They should compare this result to the theoretical probability. Through such investigations students will discover that the experimental probability is not always equal to the theoretical probability.

Students should go on to investigate what happens to the experimental probability if they increase the number of trials in an experiment. They could continue flipping the coin until they have a total of 100 trials. They should determine the experimental probability for 100 trials and compare the result with the theoretical probability. Students should recognize that more trials result in an experimental probability that is closer to the theoretical probability.

Teachers should allow students to conduct probability experiments using technology. There are numerous websites available that support this achievement indicator (refer to the Professional Learning Site for suggestions).

General Outcome: Use Experimental or Theoretical Probabilities to Represent and Solve Problems Involving Uncertainty.

Suggested Assessment Strategies

Performance

- Place two Snap Cubes (1 red and 1 blue) in a paper bag. Ask students to determine the theoretical probability of selecting a red cube. They should also determine the theoretical probability of selecting a blue cube. Students should conduct an experiment by selecting a snap cube 10 times and record the results in a tally chart. Ask students to compare the theoretical probability to the experimental probability.
(6SP4.2, 6SP4.3, 6SP4.5)
- Ask students to take 10 two coloured counters and drop them on a table. They should record how many land with the red side up and how many land with the white side up. They should complete at least 10 trials and record the results. Ask them what is the theoretical probability of the counter landing with the white side up? What is the experimental probability?
(6SP4.5)

Journal

- Ask students to respond to the following:
Margaret spun a spinner 10 times. Blue turned up on three spins. Red turned up on seven spins. Margaret says that there is a 3-in-10 chance of spinning blue. Carla then spun the same spinner 100 times. Carla recorded 53 spins of blue and 47 spins of red. Carla says that the chance of spinning blue on this spinner is about even. Who do you think is more likely to be correct? Explain. Student should sketch a spinner they think they could have been using (Van de Walle & Lovin, 354).
(6SP4.1, 6SP4.4, 6SP4.5)
- Ask students to respond to the following prompt:
How would you explain experimental and theoretical probability to someone? Use pictures, numbers and word in your explanation.
(6SP4.4)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 1: Predicting Probabilities

TR: pp. 13 - 16

SB: p. 326

Lesson 3: Comparing
Experimental and Theoretical
Probability

TR: pp. 27 - 31

SB: pp. 334 - 337

Statistics and Probability (Chance and Uncertainty)

Specific Outcomes

Students will be expected to

6SP4 Continued...

Achievement Indicators:

6SP4.1 (Continued) List the possible outcomes of a probability experiment, such as:

- *tossing a coin*
- *rolling a die with a given number of sides*
- *spinning a spinner with a given number of sectors.*

6SP4.2 (Continued) Determine the theoretical probability of an outcome occurring for a given probability experiment.

6SP4.3 (Continued) Predict the probability of a given outcome occurring for a given probability experiment by using theoretical probability.

6SP4.4 (Continued) Distinguish between theoretical probability and experimental probability, and explain the differences.

6SP4.6 (Continued) Explain that as the number of trials in a probability experiment increases, the experimental probability approaches theoretical probability of a particular outcome.

Suggestions for Teaching and Learning

As a culminating activity, teachers could design probability centers around their classroom, whereby small groups of students conduct a given probability experiment, consolidating their understanding of the concepts in this unit. Encourage students to present their experiment and results to the class, using appropriate mathematical language.

Consider using children's literature, such as Susan Meddaugh's *Martha Blah Blah*. After reading this book, students could work in pairs to create their own alphabet soup by selecting letters they would like to use (the same letter can be used more than once). Teachers may decide other conditions for the soup, such as the minimum number of letters to use in their soup. After students have created their alphabet soup, they should develop probability questions for particular outcomes and suggest an experiment to compare the theoretical probability for a particular letter to the experimental probability. Encourage students to share their soup with their classmates and complete the designed questions.

General Outcome: Use Experimental or Theoretical Probabilities to Represent and Solve Problems Involving Uncertainty.

Suggested Assessment Strategies

Performance

- Prepare three paper bags, one with 2 blue and 8 yellow cubes, one with 5 blue and 5 yellow cubes and one with 8 blue and 2 yellow cubes. Tell students the content of the three bags, but not which bag is which. Pull a cube from one of the bags, allow students to see the colour and then return the cube to the bag. Repeat the draw 10 times. Ask students how many yellow cubes are in the bag – 2, 5 or 8. Ask them to justify their answer.

(6SP4.3, 6SP4.5)

- Ask students to design a spinner where green, for example, would come up 7 times out of 10. They should list the possible outcomes and then spin their spinner 50 times. Students should determine the experimental probability and compare it to the theoretical probability.

(6SP4.1, 6SP4.2, 6SP4.3, 6SP4.4, 6SP4.5)

- Ask students what the probability is of rolling ‘doubles’ using two number cubes. Make a chart and then roll the number cube 20 times. Record the results of your rolls.

Ask:

- What is the theoretical probability of rolling doubles?
- What is the theoretical probability of not rolling doubles?
- What patterns do you see? Record your observations in your journal or exercise book.
- Make a chart to list all possible outcomes of rolling two number cubes.

(6SP4.5)

Resources/Notes

Authorized Resource

Math Focus 6

Lesson 3: Comparing Experimental and Theoretical Probability

TR: pp. 27 – 31

SB: pp. 334 – 337

Lesson 4: Communicating about Probability

TR: pp. 32 – 35

SB: p. 338

Curious Math:

Fair or Unfair?

TR: pp. 36 – 37

SB: p. 340

Math Game:

Predict and Score

TR: pp. 39 – 40

SB: p. 341

Suggested Resource

Martha Blah Blah - Susan Meddaugh

Appendix:

**Outcomes with Achievement Indicators
Organized by Strand
(With Curriculum Guide page references)**

Strand: Number	General Outcome: Develop number sense	
Specific Outcomes	Achievement Indicators	Page Reference
Students will be expected to:	<i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	
6N1 Demonstrate an understanding of place value, including numbers that are: <ul style="list-style-type: none"> • greater than one million • less than one thousandth. [C, CN, R, T]	6N1.1 Explain how the pattern of the place value system, i.e., the repetition of ones, tens and hundreds within each period, makes it possible to read and write numerals for numbers of any magnitude. 6N1.2 Provide examples of where large and small numbers are used; e.g., media, science, medicine, technology.	pp. 22-27, 34-39 pp. 28, 38
6N2 Solve problems involving whole numbers and decimal numbers. [ME, PS, T]	6N2.1 Identify which operation is necessary to solve a given problem, and solve it. 6N2.2 Estimate the solution to, and solve, a given problem. 6N2.3 Determine the reasonableness of an answer. 6N2.4 Determine whether the use of technology is appropriate to solve a given problem, and explain why. 6N2.5 Use technology when appropriate to solve a given problem.	pp. 30-33 pp. 30-33 pp. 30-33 pp. 32-35 pp. 32-35
6N3 Demonstrate an understanding of factors and multiples by: <ul style="list-style-type: none"> • determining multiples and factors of numbers less than 100 • identifying prime and composite numbers • solving problems using multiples and factors. [CN, PS, R, V]	6N3.1 Determine all the whole number factors of a given number, using arrays. 6N3.2 Identify the factors for a given number, and explain the strategy used; e.g., concrete or visual representations, repeated division by prime numbers or factor trees. 6N3.3 Solve a given problem involving factors or multiples. 6N3.4 Identify multiples and factors for a given number, and explain the strategy used to identify them. 6N3.5 Provide an example of a prime number, and explain why it is a prime number. 6N3.6 Provide an example of a composite number, and explain why it is a composite number. 6N3.7 Sort a given set of numbers as prime and composite. 6N3.8 Explain why 0 and 1 are neither prime nor composite.	p. 44 pp. 46-49, 56-59 pp. 48, 52, 58 pp. 48-51 pp. 52-55 pp. 53-55 p. 54 p. 56

Strand: Number	General Outcome: Develop number sense	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6N4 Relate improper fractions to mixed numbers. [CN, ME, R, V]	6N4.1 Demonstrate, using models, that a given improper fraction represents a number greater than 1. 6N4.2 Translate a given improper fraction between concrete, pictorial and symbolic forms. 6N4.3 Express improper fractions as mixed numbers. 6N4.4 Translate a given mixed number between concrete, pictorial and symbolic forms. 6N4.5 Express mixed numbers as improper fractions. 6N4.6 Place a given set of fractions, including mixed numbers and improper fractions, on a number line, and explain strategies used to determine position.	pp. 181-191 p. 192 pp. 194-197 p. 198 pp. 200-203 pp. 202-205 pp. 202-205
6N5 Demonstrate an understanding of ratio, concretely, pictorially and symbolically. [C, CN, PS, R, V]	6N5.1 Write a ratio from a given concrete or pictorial representation. 6N5.2 Express a given ratio in multiple forms, such as 3:5, or 3 to 5. 6N5.3 Explain the part/whole and part/part ratios of a set; e.g., for a group of 3 girls and 5 boys, explain the ratios 3:5, 3:8 and 5:8. 6N5.4 Provide a concrete or pictorial representation for a given ratio. 6N5.5 Identify and describe ratios from real-life contexts, and record them symbolically. 6N5.6 Demonstrate an understanding of equivalent ratios. 6N5.7 Solve a given problem involving ratio.	pp. 160-163 pp. 160-163 p. 162 p. 164 p. 166 pp. 168-171 p. 172
6N6 Demonstrate an understanding of percent (limited to whole numbers), concretely, pictorially and symbolically. [C, CN, PS, R, V]	6N6.1 Explain that “percent” means “out of 100.” 6N6.2 Explain that percent is a ratio out of 100. 6N6.3 Use concrete materials and pictorial representations to illustrate a given percent. 6N6.4 Record the percent displayed in a given concrete or pictorial representation. 6N6.5 Identify and describe percents from real-life contexts, and record them symbolically. 6N6.6 Express a given percent as a fraction and a decimal. 6N6.7 Solve a given problem involving percents.	p. 174 p. 174 p. 176 p. 176 p. 178 p. 178 p. 180-183

Strand: Number	General Outcome: Develop number sense	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6N7 Demonstrate an understanding of integers, concretely, pictorially and symbolically. [C, CN, R, V]	6N7.1 Extend a given number line by adding numbers less than zero, and explain the pattern on each side of zero. 6N7.2 Describe contexts in which integers are used; e.g., on a thermometer. 6N7.3 Place given integers on a number line, and explain how integers are ordered. 6N7.4 Order given integers in ascending or descending order. 6N7.5 Compare two integers; represent their relationship using the symbols $<$, $>$ and $=$; and verify the relationship, using a number line.	p. 60 p. 62 p. 62 p. 62 p. 64
6N8 Demonstrate an understanding of multiplication and division of decimals (1-digit whole number multipliers and 1-digit natural number divisors). [C, CN, ME, PS, R, V]	6N8.1 Predict products and quotients of decimals, using estimation strategies. 6N8.2 Solve a given problem that involves multiplication and division of decimals using multipliers from 0 to 9 and divisors from 1 to 9. 6N8.3 Place the decimal point in a product, using estimation; e.g., for $15.205 \text{ m} \times 4$, think $15 \text{ m} \times 4$, so the product is greater than 60 m. 6N8.4 Correct errors of decimal point placement in a given product or quotient without using paper and pencil. 6N8.5 Place the decimal point in a quotient, using estimation; e.g., for $\$26.83 \div 4$, think $\$24 \div 4$, so the quotient is greater than \$6.	pp. 210-213, 220-227 pp. 214-219, 222- 227 pp. 214-219, 226 p. 218 pp. 222-227
6N9 Explain and apply the order of operations, excluding exponents, with and without technology (limited to whole numbers). [C, CN, ME, PS, T]	6N9.1 Explain, using examples, why there is a need to have a standardized order of operations. 6N9.2 Apply the order of operations to solve multistep problems with and without technology; e.g., a computer, a calculator.	pp. 66-69 p. 68

Strand: Patterns and Relations (Patterns)	General Outcome: Use patterns to describe the world and to solve problems.	
Specific Outcomes	Achievement Indicators	Page Reference
Students will be expected to:	<i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	
6PR1 Demonstrate an understanding of the relationships within tables of values to solve problems. [C, CN, PS, R]	6PR1.1 Create a concrete or pictorial representation of the relationship shown in a table of values. 6PR1.2 Describe the pattern within each column of a given table of values. 6PR1.3 State, using mathematical language, the relationship in a given table of values. 6PR1.4 Predict the value of an unknown term, using the relationship in a table of values, and verify the prediction. 6PR1.5 Formulate a rule to describe the relationship between two columns of numbers in a table of values. 6PR1.6 Generate values in one column of a table of values, given values in the other column and a pattern rule. 6PR1.7 Create a table of values to record and reveal a pattern to solve a given problem. 6PR1.8 Identify missing elements in a given table of values. 6PR1.9 Identify errors in a given table of values.	p. 74 p. 74 p. 74 pp. 74, 78-83 p. 76-83 p. 80 p. 82 p. 88 p. 88
6PR2 Represent and describe patterns and relationships, using graphs and tables. [C, CN, ME, PS, R, V]	6PR2.1 Create a table of values from a given pattern or a given graph. 6PR2.2 Translate a pattern to a table of values, and graph the table of values (limited to linear graphs with discrete elements). 6PR2.3 Describe, using everyday language, orally or in writing, the relationship shown on a graph.	p. 116 p. 116 p. 116

Strand: Patterns and Relations (Variables and Equations)	General Outcome: Represent algebraic expressions in multiple ways.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6PR3 Represent generalizations arising from number relationships, using equations with letter variables. [C, CN, PS, R, V]	6PR3.1 Describe the relationship in a given table, using a mathematical expression. 6PR3.2 Represent a pattern rule, using a simple mathematical expression such as $4d$ or $2n + 1$. 6PR3.3 Write and explain the formula for finding the perimeter of any given rectangle. 6PR3.4 Develop and justify equations using letter variables that illustrate the commutative property of addition and multiplication; e.g., $a + b = b + a$ or $a \times b = b \times a$. 6PR3.5 Write and explain the formula for finding the area of any given rectangle.	pp. 86-91 pp. 86-91 pp. 246-251 pp. 250, 254, 258 p. 252
6PR4 Demonstrate and explain the meaning of preservation of equality, concretely and pictorially. [C, CN, PS, R, V]	6PR4.1 Model the preservation of equality for addition, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process. 6PR4.2 Model the preservation of equality for subtraction, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process. 6PR4.3 Model the preservation of equality for multiplication, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process. 6PR4.4 Model the preservation of equality for division, using concrete materials (e.g., a balance, pictorial representations), and explain and record the process. 6PR4.5 Write equivalent forms of a given equation by applying the preservation of equality and verify using concrete materials, e.g., $3b = 12$ is the same as $3b + 5 = 12 + 5$ or $2r = 7$ is the same as $3(2r) = 3(7)$.	pp. 92-95 pp. 92-95 pp. 92-95 pp. 92-95 p. 96

Strand: Shape and Space (Measurement)	General Outcome: Use direct or indirect measurement to solve problems.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
<p>6SS1 Demonstrate an understanding of angles by:</p> <ul style="list-style-type: none"> identifying examples of angles in the environment classifying angles according to their measure estimating the measure of angles, using 45°, 90° and 180° as reference angles determining angle measures in degrees drawing and labelling angles when the measure is specified. <p>[C, CN, ME, V]</p>	<p>6SS1.1 Provide examples of angles found in the environment.</p> <p>6SS1.2 Classify a given set of angles according to their measure; e.g., acute, right, obtuse, straight, reflex.</p> <p>6SS1.3 Estimate the measure of an angle, using 45°, 90° and 180° as reference angles.</p> <p>6SS1.4 Sketch 45°, 90° and 180° angles without the use of a protractor, and describe the relationship among them.</p> <p>6SS1.5 Measure, using a protractor, given angles in various positions.</p> <p>6SS1.6 Draw and label a specified angle in various positions, using a protractor.</p>	<p>p. 232</p> <p>p. 234</p> <p>p. 236</p> <p>p. 236</p> <p>p. 238</p> <p>p. 240</p>
<p>6SS2 Demonstrate that the sum of interior angles is:</p> <ul style="list-style-type: none"> 180° in a triangle 360° in a quadrilateral. <p>[C, R]</p>	<p>6SS2.1 Explain, using models, that the sum of the interior angles of a triangle is the same for all triangles.</p> <p>6SS2.2 Explain, using models, that the sum of the interior angles of a quadrilateral is the same for all quadrilaterals.</p>	<p>p. 242</p> <p>p. 244</p>
<p>6SS3 Develop and apply a formula for determining the:</p> <ul style="list-style-type: none"> perimeter of polygons area of rectangles volume of right rectangular prisms. <p>[C, CN, PS, R, V] (pp. 280-283, 286-289, 292-297)</p>	<p>6SS3.1 Explain, using models, how the perimeter of any polygon can be determined.</p> <p>6SS3.2 Generalize a rule (formula) for determining the perimeter of polygons, including rectangles and squares.</p> <p>6SS3.3 Solve a given problem involving the perimeter of polygons, the area of rectangles and/or the volume of right rectangular prisms.</p> <p>6SS3.4 Explain, using models, how the area of any rectangle can be determined.</p> <p>6SS3.5 Generalize a rule (formula) for determining the area of rectangles.</p> <p>6SS3.6 Explain, using models, how the volume of any right rectangular prism can be determined.</p> <p>6SS3.7 Generalize a rule (formula) for determining the volume of right rectangular prisms.</p>	<p>pp. 246-251</p> <p>pp. 246-251</p> <p>pp. 250, 254, 258</p> <p>p. 252</p> <p>p. 252</p> <p>p. 256</p> <p>p. 258</p>

Strand: Shape and Space (3-D Objects and 2-D Shapes)	General Outcome: Describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6SS4 Construct and compare triangles, including: <ul style="list-style-type: none"> • scalene • isosceles • equilateral • right • obtuse • acute in different orientations. [C, PS, R, V]	6SS4.1 Identify the characteristics of a given set of triangles according to their sides and/or their interior angles. 6SS4.2 Sort a given set of triangles, and explain the sorting rule. 6SS4.3 Draw a specified triangle; e.g., scalene. 6SS4.4 Replicate a given triangle and show that the two are congruent.	pp. 264-269 p. 270 pp. 270-273 p. 280
6SS5 Describe and compare the sides and angles of regular and irregular polygons. [C, PS, R, V]	6SS5.1 Sort a given set of 2-D shapes into polygons and non-polygons, and explain the sorting rule. 6SS5.2 Demonstrate that the sides of a given regular polygon are of the same length and that the angles of a regular polygon are of the same measure. 6SS5.3 Sort a given set of polygons as regular or irregular, and justify the sorting. 6SS5.4 Identify and describe regular and irregular polygons in the environment. 6SS5.5 Demonstrate congruence (sides to sides and angles to angles) in a regular polygon by superimposing. 6SS5.6 Demonstrate congruence (sides to sides and angles to angles) in a regular polygon by measuring.	p. 274 p. 274 p. 276 p. 276 p. 278 p. 278

Strand: Shape and Space (Transformations)	General Outcome: Describe and analyze position and motion of objects and shapes.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6SS6 Perform a combination of translations, rotations and/or reflections on a single 2-D shape, with and without technology, and draw and describe the image. [C, CN, PS, T, V]	6SS6.1 Model a given set of successive translations, successive rotations or successive reflections of a 2-D shape.	p. 146
	6SS6.2 Draw and describe a 2-D shape and its image, given a combination of transformations.	pp. 146, 150-153
	6SS6.3 Describe the transformations performed on a 2-D shape to produce a given image.	p. 148
	6SS6.4 Demonstrate that a 2-D shape and its transformation image are congruent.	p. 148
	6SS6.5 Model a given combination of two different types of transformations of a 2-D shape.	p. 150
	6SS6.6 Model a given set of successive transformations (translations, rotations and/or reflections) of a 2-D shape.	p. 150
	6SS6.7 Perform and record one or more transformations of a 2-D shape that will result in a given image.	p. 152
6SS7 Perform a combination of successive transformations of 2-D shapes to create a design, and identify and describe the transformations. [C, CN, T, V]	6SS7.1 Analyze a given design created by transforming one or more 2-D shapes, and identify the original shape(s) and the transformations used to create the design.	p. 154
	6SS7.2 Create a design using one or more 2-D shapes, and describe the transformations used.	p. 154

Strand: Shape and Space (Transformations)	General Outcome: Describe and analyze position and motion of objects and shapes.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6SS8 Identify and plot points in the first quadrant of a Cartesian plane, using whole number ordered pairs. [C, CN, V]	6SS8.1 Label the axes of the first quadrant of a Cartesian plane, and identify the origin.	p. 102
	6SS8.2 Plot a point in the first quadrant of a Cartesian plane, given its ordered pair.	p. 104
	6SS8.3 Match points in the first quadrant of a Cartesian plane with their corresponding ordered pair.	pp. 104-107
	6SS8.4 Plot points in the first quadrant of a Cartesian plane with intervals of 1, 2, 5 or 10 on its axes, given whole number ordered pairs.	p. 106
	6SS8.5 Draw shapes or designs, given ordered pairs, in the first quadrant of a Cartesian plane.	p. 106
	6SS8.6 Draw shapes or designs in the first quadrant of a Cartesian plane, and identify the points used to produce them.	p. 108
	6SS8.7 Determine the distance between points along horizontal and vertical lines in the first quadrant of a Cartesian plane.	p. 110
6SS9 Perform and describe single transformations of a 2-D shape in the first quadrant of a Cartesian plane (limited to whole number vertices). [C, CN, PS, T, V]	6SS9.1 Identify the coordinates of the vertices of a given 2-D shape (limited to the first quadrant of a Cartesian plane).	p. 136
	6SS9.2 Perform a transformation on a given 2-D shape, and identify the coordinates of the vertices of the image (limited to the first quadrant).	pp. 136-145
	6SS9.3 Describe the positional change of the vertices of a given 2-D shape to the corresponding vertices of its image as a result of a transformation (limited to the first quadrant).	pp. 136-145

Strand: Statistics and Probability (Data Analysis)	General Outcome: Collect, display and analyze data to solve problems.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6SP1 Create, label and interpret line graphs to draw conclusions. [C, CN, PS, R, V]	6SP1.1 Determine the common attributes (title, axes and intervals) of line graphs by comparing a given set of line graphs.	p. 112
	6SP1.2 Determine whether a given set of data can be represented by a line graph (continuous data) or a series of points (discrete data), and explain why.	pp. 112-115
	6SP1.3 Create a line graph from a given table of values or a given set of data.	p. 114
	6SP1.4 Interpret a given line graph to draw conclusions.	p. 114-117
6SP2 Select, justify and use appropriate methods of collecting data, including: <ul style="list-style-type: none">• questionnaires• experiments• databases• electronic media. [C, CN, PS, R, T]	6SP2.1 Design and administer a questionnaire for collecting data to answer a given question, and record the results.	p. 122-125
	6SP2.2 Explain when it is appropriate to use a database as a source of data.	p. 126
	6SP2.3 Gather data for a given question by using electronic media, including selecting data from databases.	p. 126
	6SP2.4 Answer a given question by performing an experiment, recording the results and drawing a conclusion.	p. 128
	6SP2.5 Select a method for collecting data to answer a given question, and justify the choice.	p. 130
6SP3 Graph collected data, and analyze the graph to solve problems. [C, CN, PS, R, T]	6SP3.1 Determine an appropriate type of graph for displaying a set of collected data, and justify the choice of graph.	pp. 118-131
	6SP3.2 Solve a given problem by graphing data and interpreting the resulting graph.	pp. 118-131

Strand: Statistics and Probability (Chance and Uncertainty)	General Outcome: Use experimental or theoretical probabilities to represent and solve problems involving uncertainty.	
Specific Outcomes Students will be expected to:	Achievement Indicators <i>The following set of indicators help determine whether students have met the corresponding specific outcome:</i>	Page Reference
6SP4 Demonstrate an understanding of probability by: <ul style="list-style-type: none"> • identifying all possible outcomes of a probability experiment • differentiating between experimental and theoretical probability • determining the theoretical probability of outcomes in a probability experiment • determining the experimental probability of outcomes in a probability experiment • comparing experimental results with the theoretical probability for an experiment. [C, ME, PS, T]	6SP4.1 List the possible outcomes of a probability experiment, such as: <ul style="list-style-type: none"> • tossing a coin • rolling a die with a given number of sides • spinning a spinner with a given number of sectors. 	pp. 288-291, 294
	6SP4.2 Determine the theoretical probability of an outcome occurring for a given probability experiment.	pp. 288-291, 294
	6SP4.3 Predict the probability of a given outcome occurring for a given probability experiment by using theoretical probability.	pp. 288-291, 294
	6SP4.4 Distinguish between theoretical probability and experimental probability, and explain the differences.	pp. 292-295
	6SP4.5 Conduct a probability experiment, with or without technology, and compare the experimental results with the theoretical probability.	pp. 292-295
	6SP4.6 Explain that as the number of trials in a probability experiment increases, the experimental probability approaches theoretical probability of a particular outcome.	pp. 292-295

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