

Math Makes Sense



Québec Teacher Companion

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Technology tools that are recommended for use with the Student Book are the TI-108 calculator, *Appleworks* software, and *Graphers* drawing software.

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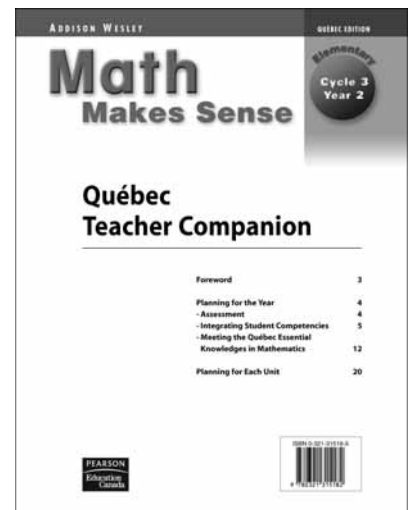
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Foreword

Addison Wesley Mathematics Makes Sense is a comprehensive program designed to support teachers in delivering core mathematics instruction in a way that makes key mathematical concepts accessible to all students – letting you teach for conceptual understanding, and helping students make sense of the mathematics they learn.

Your Teacher Guide was developed for a national text, and can be adapted for use in English-language schools in Québec for support of the Québec Education Program (QEP).

This **Québec Teacher Companion** provides additional support so that you can tailor the *Math Makes Sense* program to your specific needs. In particular, this module provides support to demonstrate how *Math Makes Sense* will help you nurture the development of the core competencies identified for the Québec Education Program, released by le Ministère de l'Éducation, du Loisir et de Sport du Québec, and provides tools to help you assess those competencies. Teaching notes highlight how specific Unit Problems might be expanded to more fully address the broad areas of learning, and help you create situational problems for work with your students.



Planning for the Year

Assessment

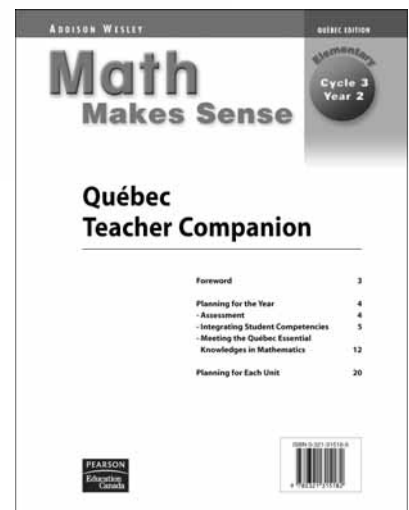
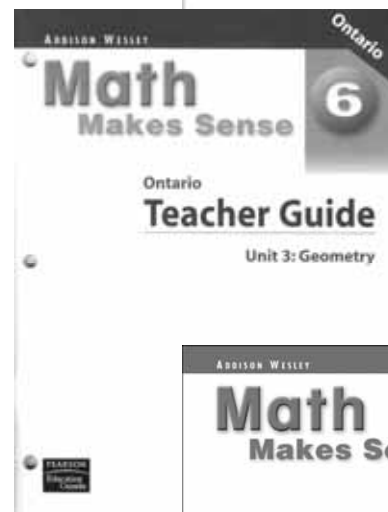
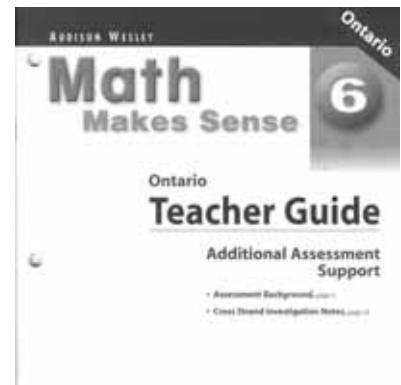
Your Teacher Guide includes a module entitled *Additional Assessment Support*.

This module includes a variety of general-use rubrics, checklists, and other assessment tools. Go to this module for these assessment tools, as well as teaching notes and assessment support for the **Cross-Strand Investigations**.

Each individual *Unit module* in your Teacher Guide includes a **Planning for Assessment** chart, and a variety of assessment tools that are written for specific assessment of the content of the unit, in reproducible master format.

Your *Québec Teacher Companion* includes additional Teaching Notes, lessons, and assessment tools to support the QEP program and the core competencies, with reproducible Masters for each unit.

The CD-ROM that accompanies your Teacher Guide provides assessment tools from the original Teacher Guide. Assessment tools from this Québec Teacher Companion are available in digital form as well, on the Pearson website. All are available in editable files that let you tailor these tools to the needs of your classroom.



Integrating Student Competencies

The Québec Education Program (QEP) emphasizes a competency-based approach to teaching and learning. At Cycle Three, there are nine identified cross-curricular competencies, and three subject-specific competencies.

The following tables demonstrate how the core competencies of the QEP are integrated throughout *Addison Wesley Mathematics Makes Sense*, through a variety of key features that arise in every lesson, in every unit.

For detailed support that guides you in focusing on one competency in a particular unit, see the section in this module entitled **Planning for Each Unit**, starting on page 20.

Correlation of *Math Makes Sense* to QEP Cross-Curricular Competencies

QEP Competency	<i>Math Makes Sense</i> Cycle 3
Intellectual competencies <ul style="list-style-type: none"> to use information 	<ul style="list-style-type: none"> Explore activities are opportunities for students to use given information to solve meaningful problems. Students frequently have the freedom to select the materials that best suit their needs for solving the problem, which enhances their creative thinking. Students read for information before engaging in problem-solving opportunities that arise: in every lesson in Explore activities and in Practice questions; in every unit when approaching Strategies Toolkits, Show What You Know questions, or Unit Problems.
Intellectual competencies <ul style="list-style-type: none"> to solve problems 	<ul style="list-style-type: none"> The Teacher Guide module Building a Mathematics Community provides practical suggestions for developing confident problem solvers in a positive, respectful, classroom environment. Problem-solving opportunities arise in every lesson in Explore activities and in Practice questions. For more comprehensive problem-solving opportunities, Strategies Toolkits, Unit Problems and Cross-Strand Investigations regularly promote students' critical and creative thinking as they approach a new problem. Self-Assessment opportunities, provided in the Teacher Guide, include such topics as I am a Problem Solver. The use of technology enriches students' learning experiences and allows them to extend critical thinking and problem-solving skills.
Intellectual competencies <ul style="list-style-type: none"> to exercise critical judgment 	<ul style="list-style-type: none"> Overall, the program promotes excellence, originality, and integrity in one's work, and supports appreciation for these qualities in the work of others. This comes through in the clarity of language, the accurate presentation of concepts, and the range of contexts and problems. Self-Assessment opportunities, provided in the Teacher Guide in the form of reproducible masters, promote students' critical judgment. The use of technology enriches students' learning experiences and allows them to extend critical thinking and problem-solving skills.

QEP Competency	Math Makes Sense Cycle 3
<p>Intellectual competencies</p> <ul style="list-style-type: none"> to use creativity 	<ul style="list-style-type: none"> The Teacher Guide module Building a Mathematics Community provides practical suggestions for developing confident learners who know they can bring their own understanding, their own strategies, and their own ideas to any new problem situations. Overall, the program promotes excellence, originality, and integrity in one's own work, and supports an appreciation for these qualities in the work of others. This comes through in the clarity of language, the clear, accurate presentation of mathematical concepts, and the range of contexts and problems provided across every unit. In Explore activities, students frequently have the freedom to select the materials that best suit their needs for solving the problem, which enhances their creative thinking.
<p>Methodological competencies</p> <ul style="list-style-type: none"> to adopt effective work methods 	<ul style="list-style-type: none"> The Explore in each lesson engages students in working together productively, harmoniously, and responsibly. In each lesson, the Show and Share prompts regularly allow students to discuss how they worked with an Explore activity, whether they think they had an effective approach and why, and how they organized their work in ways that helped them to keep track of their results. Each Connect reinforces the importance of clear communication and organized work by modelling mathematical solutions in a clear and readable presentation, following the conventions of mathematics. For students who need support in organizing their work, the Teacher Guide provides a Step-by-Step master for each Assessment Focus question in each Practice set; this reproducible master provides greater structure for students who need it, and help to build students' developing work habits.
<p>Methodological competencies</p> <ul style="list-style-type: none"> to use information and communications technologies (ICT) 	<ul style="list-style-type: none"> Technology lessons in the Student Book highlight opportunities for learning new mathematical concepts, or reinforce new concepts just developed, through the use of calculators or computers. When appropriate, activities in the Student Book suggest the use of a calculator or computer application to enrich the mathematics. The Numbers Every Day feature in every lesson regularly includes suggestions related to calculator skills, to ensure students develop an understanding of how to use technology as a meaningful tool. Addison Wesley Mathematics e-Tools software provides virtual manipulatives that help students develop mathematical concepts in the following ways: simultaneously connects the concrete with the symbolic; creates an interactive environment that is both open-ended and student controlled; and empowers students to build and observe dynamic mathematical representations and solutions; e-Tools is not required for success with the Math Makes Sense program, but it can help to enhance student achievement.

QEP Competency	<i>Math Makes Sense Cycle 3</i>
<p>Personal and social competencies</p> <ul style="list-style-type: none"> to construct his/her identity 	<ul style="list-style-type: none"> The Reflect prompt in each lesson with its opportunity for individual reflection, encourages students to examine their personal understanding, values, and abilities. Contextual problems throughout the program showcase a variety of positive options for students' leisure and fitness pursuits – reading, hiking, swimming, healthy eating, and so on. Photographs of children in the Student Book are representative of many cultures, and allow for a variety of activities suited to any gender, ethnicity, appearance, or ability. Students experience the positive effect of “seeing themselves” reflected in the pages of their Math Makes Sense Student Book. The Teacher Guide module Building a Math Community provides practical suggestions for creating a respectful classroom environment in which students can be comfortable working within their own range of abilities, learning preferences, and strengths.
<p>Personal and social competencies</p> <ul style="list-style-type: none"> to cooperate with others 	<ul style="list-style-type: none"> Explore activities and Practice questions provide for a range of cooperative grouping arrangements. Not only do students have multiple opportunities to cooperate with others, they also have regular opportunities to work in their preferred mode, while still being exposed to other grouping options to develop their cooperative learning skills. The recommended grouping for each Explore is indicated using a graphic icon in the Explore heading in the Student Book. The Teacher Guide module Building a Math Community provides practical suggestions for grouping students, and offers support for teachers as they incorporate cooperative learning in the classroom.
<p>Communication-related competency</p> <ul style="list-style-type: none"> to communicate appropriately 	<ul style="list-style-type: none"> Students' developing mathematical vocabulary is supported by the Key Words listed at the beginning of every unit, and connected to an illustrated Glossary at the back of the Student Book. In each Explore, the Show and Share discussion questions prompt students to listen and become dynamic learners, receptive to communication from other students. Each Connect models the correct use of mathematical language, codes, and conventions. Opportunities for students to communicate their self-analysis and evaluation occur in the lesson and unit Reflect features, as well as in Self-Assessment opportunities suggested in the Teacher Guide. As content allows, lessons feature the use of numbers and numeration in the media, arts, and the world of work. Technology lessons are included where appropriate for the students' level and the content at hand. This early exposure to media, arts, and technology helps prepare students for future life in our increasingly complex world and the multi-media communication channels that it presents..

Correlation of *Math Makes Sense* to QEP Mathematics Competencies

QEP Competency	<i>Math Makes Sense</i> Cycle 3
<p>Competency 1: to solve a situational problem</p> <ul style="list-style-type: none"> to model the situational problem 	<ul style="list-style-type: none"> Concrete materials are referenced regularly in Explore activities and in Practice questions, where modelling of mathematical ideas is central to the conceptual development. Strategies Toolkit lessons provide explicit instruction in a variety of problem-solving strategies, by posing a problem that students investigate and solve on their own, then modelling a strategy with a new problem, and finally providing a selection of problems that can be solved in a variety of ways. Problems that arise in Unit Problem and Cross-Strand Investigation features lend themselves well to a variety of modelling opportunities.
<p>Competency 1: to solve a situational problem</p> <ul style="list-style-type: none"> to apply different strategies to work out a solution 	<ul style="list-style-type: none"> Show and Share in each lesson allows students to hear the possible solutions of other students. Each lesson has a consistent Explore/Connect/Practice structure, to provide situational problems for students that are relevant to content and concepts. The Connect regularly presents multiple solutions for a given problem. Strategies Toolkit lessons provide explicit instruction in a variety of problem-solving strategies, and present a selection of problems that can be solved in a variety of ways.
<p>Competency 1: to solve a situational problem</p> <ul style="list-style-type: none"> to validate the solution 	<ul style="list-style-type: none"> Show and Share, in each lesson, gives students an opportunity to voice their mathematical explanations, validate their solutions, and listen to the possible solutions of others. Students have regular opportunities to create and share problems with a friend, then validate work – in Show and Share suggestions; in Practice questions; in Reflect prompts; and in the closing part of many Unit Problems.
<p>Competency 1: to solve a situational problem</p> <ul style="list-style-type: none"> to share information related to the solution 	<ul style="list-style-type: none"> The Explore activity introduces new concepts by presenting a situational problem to solve. Explore activities include whole group, partner, and independent problem-solving activities. Show and Share occurs as part of the Explore in each lesson, to give students an opportunity to voice their mathematical explanations, validate their solutions, and listen to the possible solutions of others. Students have regular opportunities to create and solve problems, and to share problems with a friend – in Show and Share suggestions; in Practice questions; in Reflect prompts; and in the closing part of many Unit Problems.
<p>Competency 1: to solve a situational problem</p> <ul style="list-style-type: none"> to decode the elements of the situational problem 	<ul style="list-style-type: none"> Students working collaboratively in Explore or Practice sections will naturally decode problems as they work together to discuss their understanding. For students who need extra support in decoding problems, the Teacher Guide provides a Step-by-Step master for the Assessment Focus question in each Practice set; this reproducible master helps the student break a challenging problem down into manageable, smaller tasks.

QEP Competency	<i>Math Makes Sense Cycle 3</i>
<p>Competency 2: to reason using mathematical concepts and processes</p> <ul style="list-style-type: none"> to define the elements of the mathematical situation 	<ul style="list-style-type: none"> In each Explore, students apply mathematical reasoning as they define the elements of a problem to solve. For students who need extra support, the Step-by-Step master in the Teacher Guide, provided for each Assessment Focus question, models for the student how she/he might isolate the defining elements of a mathematical situation. Connect sections model – for students, teachers, and parents – the mathematical reasoning involved in defining the elements of a situation, whether it be a real-world application or a mathematical context. Unit Problems and Cross-Strand Investigations provide rich opportunities for students to bring all of their reasoning abilities to bear on a specific open-ended problem.
<p>Competency 2: to reason using mathematical concepts and processes</p> <ul style="list-style-type: none"> to justify actions or statements by referring to mathematical concepts and processes 	<ul style="list-style-type: none"> In each Explore activity, students must select a suitable strategy to solve the problem, and then follow the Show and Share discussion prompts to justify their actions, exchange information, and arrive at conclusions. Each Assessment Focus question includes an opportunity for students to justify their ideas or explain their thinking. Connect sections model the reasoning that underlies new concept development: relating mathematical concepts and processes to create a chain of thought that leads students to new insights. By exemplifying sound mathematical reasoning without solving the original problem in the Explore, the Connect reinforces students’ reasoning abilities without detracting from the ideas that students themselves have brought to the problem.
<p>Competency 2: to reason using mathematical concepts and processes</p> <ul style="list-style-type: none"> to mobilize mathematical concepts and processes appropriate to the given situation 	<ul style="list-style-type: none"> In each Explore activity, students apply their mathematical reasoning as they define the elements of a problem, select a suitable strategy to solve the problem, make decisions about ways to model the problem and to record their work, and then arrive at their own solutions. Practice questions draw out student reasoning through thought-provoking problems that encourage students to model concepts, examine special cases, compare results, consider consequences, look for non-examples, and explain their thinking. Connect sections model – for students, teachers, and parents – the mathematical reasoning students can build as they work with problems to develop new concepts. Unit Problems and Cross-Strand Investigations provide rich opportunities for students to bring all of their mathematical understanding, and their reasoning abilities, to bear on a specific open-ended problem.

QEP Competency	<i>Math Makes Sense Cycle 3</i>
<p>Competency 2: to reason using mathematical concepts and processes</p> <ul style="list-style-type: none"> • to apply mathematical processes appropriate to the given situation 	<ul style="list-style-type: none"> • In each Explore activity, students apply their mathematical reasoning to select a suitable strategy to solve the problem, make decisions about ways to model the problem and to record their work, and then arrive at their own solutions. • A range of meaningful Practice questions draws out student reasoning with thought-provoking problems in which students apply mathematical concepts and processes developed during the Explore and consolidated in the Connect section. • Unit Problems and Cross-Strand Investigations provide rich opportunities for students to apply their reasoning abilities to solve an open-ended problem.

QEP Competency	<i>Math Makes Sense Cycle 3</i>
<p>Competency 3: to communicate by using mathematical language</p> <ul style="list-style-type: none"> to become familiar with mathematical vocabulary 	<ul style="list-style-type: none"> Each unit starts with a Key Words feature that teachers can use to create a word wall, and to reinforce important terminology. Key words are bold-faced the first time they appear in the unit and are defined in the illustrated Glossary at the back of the Student Book. Mathematical concepts are regularly connected to real-world situations drawn from Canadian culture, Canadian geography, and Aboriginal culture, in core lessons and also in World of Work pages, Unit Problems, and Cross-Strand Investigations. Students have an opportunity to observe how this language promotes understanding of the world.
<p>Competency 3: to communicate by using mathematical language</p> <ul style="list-style-type: none"> to interpret or produce mathematical messages 	<ul style="list-style-type: none"> Each Connect section models the correct use of mathematical language, while providing explicit instruction in mathematics terms and concepts. The Teacher Guide provides background regarding mathematical terms and concepts, so that teachers can model appropriate mathematical language. Students' oral language is emphasized in Explore activities and in Show and Share prompts. These communication opportunities encourage students' use of everyday language to communicate their understanding, only introducing the formal terminology in the Connect, once students have grasped the underlying fundamental concepts of the lesson. Students' written language is emphasized in Assessment Focus questions and in Reflect opportunities. In addition to prompting students to explain their thinking in pictures, numbers, or words, each Unit Problem also includes a writing opportunity in a final Reflect on the Unit, in which students are prompted to think about and communicate their mathematical learning for the whole unit.
<p>Competency 3: to communicate by using mathematical language</p> <ul style="list-style-type: none"> to make connections between mathematical language and everyday language 	<ul style="list-style-type: none"> In Explore activities there are communication opportunities that typically encourage students' use of everyday language to communicate their understanding, leaving the formal terminology to be established in the Connect, only after students have themselves articulated the underlying fundamental concepts of the lesson. Mathematical concepts are regularly connected to real-world situations drawn from Canadian culture, Canadian geography, and Aboriginal culture, in core lessons and also in World or Work pages, Unit Problems, and Cross-Strand Investigations. Students have an opportunity to observe how this language promotes understanding of the world. Math Link features in the Student Book highlight connections between mathematics concepts and other disciplines. The Teacher Guide supports these connections with further background on cross-curricular connections.

Meeting the Québec Essential Knowledges in Mathematics

Arithmetic: Understanding and Writing Numbers

Québec Essential Knowledges	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlations	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
Natural numbers <ul style="list-style-type: none"> natural numbers less than 1 000 000 (hundred thousands): reading, writing, representation, comparison, classification, order, equivalent expressions, writing numbers in expanded form, patterns, number line 	6-12, 32-42 (beyond 1 000 000)	
<ul style="list-style-type: none"> power, exponent 	Unit 2, Lesson 5A: New Lesson: Exponents pages 21d – 21f (Masters Q2.1 to Q2.3)	
<ul style="list-style-type: none"> approximation 	throughout units	
Fractions <ul style="list-style-type: none"> fractions: reading, writing, numerator, denominator, various representations, order, comparison, equivalent expressions, equivalent fractions 	288-297	320-331 (extension)
<ul style="list-style-type: none"> percentages 	308-319, 412-415	
Decimals <ul style="list-style-type: none"> up to three decimal places (tenths, hundredths, thousandths): reading, writing, various representations, order, equivalent expressions, writing numbers in expanded form 	114-124	
<ul style="list-style-type: none"> approximation 	126-128, 214-217	
Using Numbers <ul style="list-style-type: none"> converting from one type of notation to another: writing fractions, decimal numbers or percentages 	308-315, 412-415	
<ul style="list-style-type: none"> choosing the most suitable notation for a given context 	312-315	
Integers <ul style="list-style-type: none"> reading, writing, comparison, order, representation 	20-22 Unit 1, Lesson 5A: New Lesson: Comparing and Ordering Integers pages 20e –20j (Masters Q1.1 to Q1.6)	

Arithmetic: Meaning of Operations Involving Numbers

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
Natural numbers <ul style="list-style-type: none"> operation sense: multiplication (e.g. repeated addition, Cartesian product), product, factor, multiples of a natural number, division (repeated subtraction, sharing, number of times x goes into y), quotient, remainder, dividend, divisor, set of divisors of a natural number, properties of divisibility 	13-15, 43-44, 50-52, 72-75	
<ul style="list-style-type: none"> choice of operation: multiplication, division 	throughout units	
<ul style="list-style-type: none"> meaning of an equality relation (equation), meaning of an equivalence relation 	16-18, 24-25	
<ul style="list-style-type: none"> relationships between the operations 	64-67	
<ul style="list-style-type: none"> property of operations: distributive law 	50-52	
<ul style="list-style-type: none"> order of operations (series of operations involving natural numbers) 	54-57	
Decimals <ul style="list-style-type: none"> operation sense: multiplication and division 	137-139, 143-157	
Fractions <ul style="list-style-type: none"> operation sense (using objects and diagrams): addition, subtraction and multiplication by a natural number 	300-303, 304-306 Unit 8, Lesson 5A: New Lesson: Exploring Repeated Addition pages 27e – 27i (Masters Q8.1 to Q8.5)	

Arithmetic: Operations Involving Numbers

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
Natural numbers <ul style="list-style-type: none"> approximating the result of an operation: addition, subtraction, multiplication, division 	60-63	
<ul style="list-style-type: none"> own processes for mental computation: addition, subtraction, multiplication, division 	64-67	
<ul style="list-style-type: none"> conventional processes for written computation: multiplying a three-digit number by a two-digit number) 	68-75	
<ul style="list-style-type: none"> conventional processes for written computation: dividing a four-digit number by a two-digit number, expressing the remainder as a decimal that does not go beyond the second decimal place 	68-75	
<ul style="list-style-type: none"> series of operations in accordance with the order of operations 	54-57	
<ul style="list-style-type: none"> patterns: series of numbers, family of operations 	6-12	
<ul style="list-style-type: none"> finding prime factors 	45-47	
<ul style="list-style-type: none"> divisibility by 2, 3, 4, 5, 6, 8, 9, 10 	13-15	
Decimals <ul style="list-style-type: none"> approximating the result of an operation 	129-136, 147-157, 214-217	
<ul style="list-style-type: none"> mental computation: addition, subtraction, multiplication, division 	143-145	
<ul style="list-style-type: none"> written computation: multiplication whose product does not go beyond the second decimal place, division by a natural number less than 11 	147-157	
<ul style="list-style-type: none"> mental computation: multiplication and division of decimals by 10, 100, 1000 	137-142	

Arithmetic: Operations Involving Numbers continued

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
Fractions <ul style="list-style-type: none"> • establishing equivalent fractions 	288-290	
<ul style="list-style-type: none"> • reducing fractions, irreducible fractions 	288-290	
<ul style="list-style-type: none"> • adding fractions using objects and diagrams, when the denominator of one fraction is a multiple of the denominator of the other fraction 	300-303	
<ul style="list-style-type: none"> • subtracting fractions using objects and diagrams, when the denominator of one fraction is a multiple of the denominator of the other fraction 	304-306	
<ul style="list-style-type: none"> • multiplying a natural number by a fraction, using objects and diagrams 	Unit 8, Lesson 5A: New Lesson: Exploring Repeated Addition pages 27e – 27i (Masters Q8.1 to Q8.5)	

Geometry: Geometric Figures and Spatial Sense

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
Space	186-189, 248-255	
<ul style="list-style-type: none"> locating objects on an axis 		
<ul style="list-style-type: none"> locating objects in a Cartesian plane 	186-189, 248-255 Unit 5, Lesson 5A: New Lesson: Graphing on a Coordinate Grid Part 2 pages 24g – 24k (Masters Q5.1 to Q5.5)	190-193 (extension)
Solids	98-101	102-105 (extension)
<ul style="list-style-type: none"> recognizing nets for convex polyhedrons 		
<ul style="list-style-type: none"> testing Euler’s theorem (relationship between faces, vertices and edges of a convex polyhedron) 	388-391	
Plane figures		(covered in Cycle 3, Year 1)
<ul style="list-style-type: none"> describing triangles: right triangles, isosceles triangles, scalene triangles, equilateral triangles 		
<ul style="list-style-type: none"> classifying triangles 	86-89	256-263 (extension)
<ul style="list-style-type: none"> measuring angles in degrees using a protractor 	82-85	92-95 (extension)
<ul style="list-style-type: none"> studying the features of a circle: radius, diameter, circumference, central angle 	Unit 9, Lesson 1A: New Lesson: Investigating Circles pages 28d – 28g (Masters Q9.1 to Q9.4)	
Frieze patterns and tessellations	248-251, 277-279	267-273 (extension)
<ul style="list-style-type: none"> observing and producing (grids, tracing paper) frieze patterns by means of translations: translation, translation arrow (length, direction, sense) 		
<ul style="list-style-type: none"> observing and producing tessellations by means of translations 	248-255, 277-279	

Measurement

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
Lengths: estimating and measuring <ul style="list-style-type: none"> conventional units (km, m, dm, cm, mm) 	228-231	342-345 (prior knowledge)
<ul style="list-style-type: none"> relationships between units of measure 		(covered in Cycle 3, Year 1)
Angles: estimating and measuring <ul style="list-style-type: none"> degree 	82-85	92-95 (extension)
Surface areas: estimating and measuring <ul style="list-style-type: none"> conventional units (m^2, dm^2, cm^2), relationships between the units of measure 	220-223, 228-231, 346-349, 352-361, 366-369	370-372 (extension)
Volumes: estimating and measuring <ul style="list-style-type: none"> conventional units (m^3, dm^3, cm^3), relationships between the units of measure 	224-235, 362-365	
Capacities: estimating and measuring <ul style="list-style-type: none"> unconventional units 		
<ul style="list-style-type: none"> conventional units (L, mL), relationships between the units of measure 	232-235	
Masses: estimating and measuring <ul style="list-style-type: none"> unconventional units 		
<ul style="list-style-type: none"> conventional units (kg, g), relationships between the units of measure 	238-241	
Time: estimating and measuring <ul style="list-style-type: none"> relationships between units of measure 		209-212 (extension)
Temperatures: estimating and measuring <ul style="list-style-type: none"> conventional units ($^{\circ}C$) 	20-22	206-212 and 393-396 (extension)

Statistics

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
<ul style="list-style-type: none"> formulating questions for a survey 	197-199	
<ul style="list-style-type: none"> collecting, describing and organizing data using tables 	197-199	380-387 (extension)
<ul style="list-style-type: none"> interpreting data using a circle graph 	168-171, 178-181	
<ul style="list-style-type: none"> arithmetic mean (meaning, calculation) 	172-175	

Probability

Québec Essential Knowledge	<i>Math Makes Sense</i> Cycle 3, Year 2 Correlation	<i>Math Makes Sense</i> Cycle 3, Year 2 Optional Pages
<ul style="list-style-type: none"> experimentation with activities involving chance 	408-415, 422-425	
<ul style="list-style-type: none"> predicting the likelihood of an event (certainty, possibility, or impossibility) 		(covered in Cycle 3, Year 1)
<ul style="list-style-type: none"> probability that a simple event will occur (more likely, just as likely, less likely) 		(covered in Cycle 3, Year 1)
<ul style="list-style-type: none"> enumerating the possible outcomes of a random experiment using a table, a tree diagram 	416-419, 422-425	
<ul style="list-style-type: none"> comparing the outcomes of a random experiment with known theoretical probabilities 	408-411, 422-425	
<ul style="list-style-type: none"> doing simulations with or without a computer 	Unit 11, Lesson 3A: New Lesson: Simulations pages 30e – 30i (Masters Q11.1 to Q11.5)	

Planning for Unit 1: Number Patterns

Meeting the Quebec Essential Knowledges

- Use Lesson 5A (Masters Q1.1 to Q1.6) after Lesson 5, with supporting Teaching Notes (pages 20a – 20d).

Supporting Cross-Curricular Competencies

Unit Focus: to adopt effective work methods

Materials

Masters Q1.1 to Q1.6:

Lesson 5A: Comparing and Ordering Integers

Master Q1.7:

Unit Rubric: Number Patterns

Master Q1.8:

Performance Assessment Rubric: Crack the Code!

Master Q1.9:

Peer and Self Assessment: Unit Problem (Unit 1)

Number Patterns is a fitting topic for emphasizing the importance of working effectively. Use these Student Book and Teacher Guide features to support students' development of effective work and management habits:

- The **Show and Share** section in each lesson (for example, on pages 6 and 10) prompts students to discuss how they worked in the **Explore** activity; encourage students to talk about whether they think they had an effective approach and why, and how they organized their work to keep track of their results.
- Each **Connect** section (for example, on pages 14 and 17) models an effective method for solving a problem.
- In each module of the Teacher Guide, a **Step-by-Step** master for each Assessment Focus question in each Practice set is provided; use these reproducible masters to provide greater structure to students who need it, and to help foster effective solution methods.

Use Master Q1.7: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning:

Health and Well-Being

Educational Aim: to ensure that students adopt a self-monitoring procedure concerning the development of good living habits related to health, well-being, sexuality and safety

The Unit Problem can be opened up mathematically, and extended.

Have students brainstorm a list of puzzles and mental games they enjoy, such as chess, checkers, crossword puzzles, Sudoku, word scrambles, and so on. Ask questions, such as:

- Why do you enjoy these games?
- How do you think puzzles and games help contribute to your health and well-being?

Point out that mental exercise is important to overall well-being. People who engage in puzzles and "code-breaking" keep their minds active and healthy.

Have students choose a puzzle or mental game they find stimulating. Have them solve the puzzle or play the game, then write to tell how it stimulated their minds. Tell students to include any patterns or strategies they used to work on the puzzle or play the game. Have students trade puzzles or games with another student, then compare patterns and/or strategies.

Use Master Q1.8: Performance Assessment Rubric and Master Q1.9: Peer and Self Assessment to support the assessment of the Unit Problem.

Lesson Organizer

80–100 min

Curriculum Focus

Use a number line to order and compare integers.

Student Materials

- atlases, Internet access, or elevation data (Master Q1.5)
- number lines (Master Q1.6)

Vocabulary

elevation, sea level

Assessment

Master Q1.7 Unit Rubric:
Number Patterns

Key Math Learning

Greater integers are to the right of lesser integers on a number line.

LESSON 5A: COMPARING AND ORDERING INTEGERS

BEFORE

Get Started

Ask students:

- What does "sea level" mean? (*Surface of a calm sea*)
- How would you order the numbers 885, 342, 889, and 311 from least to greatest? (*Compare the hundreds digits, then the tens digits, then the ones digits: 311, 342, 885, and 889.*)
- When you compare two numbers on a number line, how are their positions related? (*The lesser number is to the left and the greater number is to the right.*)

Present *Explore*. Ensure students can use atlases or the Internet (search using "elevation") correctly to find data. If you do not have atlases or Internet access, provide students with copies of Master Q1.5: *Elevation Data*.

DURING

Explore

Ongoing Assessment: Observe and Listen

As students work, ask questions, such as:

- What extreme elevations did you choose? (*We chose the Puerto Rico Trench, 8648 m below sea level; Mount Kilimanjaro, 5895 m above sea level; Mount Everest, 8850 m above sea level; and Bentley Subglacial Trench, 2540 m below sea level.*)
- How could integers be used to write each elevation? (*Above sea level are positive integers, below sea level are negative integers.*)
- How did you order the elevations from least to greatest? (*The least elevations are the farthest below sea level and the greatest elevations are the highest above sea level. The elevations from least to greatest are: $-10\,924$, -8648 , -2540 , -458 , -411 , $+4897$, $+5895$, $+7485$, $+8850$*)

AFTER

Connect

Invite students to share the strategies they used to order the elevations.

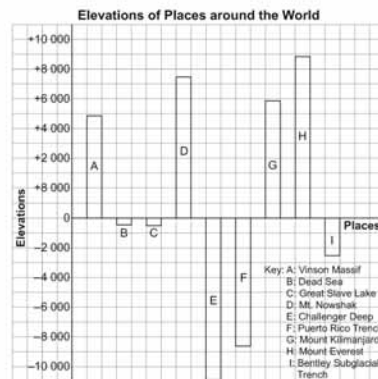
Students may use vertical number lines, organize all positive integers then all negative integers, or pick two to place in order, then order the rest one by one in correct relative position to these.

The data could be displayed as a bar graph above and below a horizontal line, as shown on page 20b.

Teaching Notes

Math Link

Have students discuss how elevation above or below sea level affects life in specific countries.



Reinforce that the integers increase as we move from left to right on the number line. The lesser numbers are to the left and greater numbers are to the right.

Review the *Examples* in *Connect*.

As an extension, challenge students to create other patterns similar to those in *Practice* question 12. Have students work in pairs to find their partner's pattern. Ensure students explain the pattern rules after a solution is attempted.

Practice

Provide students with copies of *Number Lines* (Master Q1.6).

Assessment focus: Question 8

Students will likely use a number line to answer these questions. Although students have not yet learned to add and subtract integers, the questions they make up may involve concepts of "more than" and "less than."

Assessment for Learning

What to Look for	What to Do
<p>Knowledge and Understanding</p> <ul style="list-style-type: none"> ✓ Students recognize that greater numbers are to the right of lesser numbers on a number line. <p>Application</p> <ul style="list-style-type: none"> ✓ Students can mark positive and negative integers on a number line. ✓ Students can order integers. <p>Thinking</p> <ul style="list-style-type: none"> ✓ Students can choose appropriate strategies to solve ordering integer problems. 	<p>Extra Support: Have students turn a piece of paper sideways and sketch a number line that includes more numbers than those on <i>Number Lines</i> (Master Q1.6). These sketches do not have to be accurate—they are models.</p> <p>Extra Practice: Have students use weather reports from newspapers to order the temperatures from greatest to least for places in Canada, or around the world, where the temperatures are above and below zero.</p>
Recording and Reporting	Master Q1.7 Unit Rubric: Number Patterns

Math Note

On a number line, a positive integer is a measured distance to the right of 0. A negative integer is a measured distance to the left of 0. An integer is a directed distance, and *not* a point on a line. To emphasize this, use an arrow to represent an integer.

Math Link

Have students discuss how elevation above or below sea level affects life in specific countries.

REACHING ALL LEARNERS

Early Finishers

Have students research then order other extreme elevations. They can investigate categories such as cities, mountains, and lakes. Have students compare their findings with those of others.

Common Misconceptions

✓ Students confuse the symbols for less *than* and *greater than*.

How to Help: Have students examine the $<$ symbol. Ask which side of the symbol is larger. Tell students that this side of the symbol goes with the greater number. The pointed side of the symbol points to the lesser number.

✓ Students order negative integers in reverse order.

How to Help: Students' understanding of negative integers will increase if they relate them to real-life situations. Have students answer questions, such as:

Which temperature is higher: -20°C or -15°C ? (-15°C)

So, which integer is greater: -20 or -15 ? (-15)

Who is higher: Diver A at 13 m below sea level (-13) or Diver B at 25 m below sea level (-25)? (*The diver at -13 m is higher.*)

So, which integer is greater: -13 or -25 ? (-13)

ESL Strategies

For students from other countries, suggest they research elevations in the countries where they were born.

Sample Answers

1.a) $-3, +1, +3$

b) $-8, -6, -4, -2, 0$

2.a) $-1, +5, +13$

b) $-5, -4, -3$

c) $-2, +3, +4$

3.a) $+8, +4, +1$

b) $-3, -5, -7$

c) $+4, 0, -4$

4.a) $-5, -2, +2, +4, +5$

b) $-12, -10, -8, 0, +10$

c) $-41, -39, -25, -15, +41$

d) $-2, -1, +1, +2, +3$

5.a) $+14, +3, -10, -25, -30$

b) $+2, +1, 0, -1, -2$

c) $+27, +6, -4, -11, -29$

d) $+10, +8, -7, -9, -11$

6.a) Students' thermometers should show $-61, -53, -47, -64, -58$, and -54 .

b) The least temperature is the lowest number on the thermometer going up to the greatest temperature which is the highest number on the thermometer.

$-64, -61, -58, -54, -53, -47$

7.a) $<$

b) $>$

c) $<$

d) $<$

e) $>$

f) $<$

8.a) i) $+4, +8, +9$

ii) 0

iii) -8

iv) $0, -5, -8$

b) Which integers are opposites? $+8$ and -8

Which is the greatest integer? $+9$

Which is the least integer? -8

Which integer is closest to 0 ? $+4$

9. The warmest temperature is the one closest to 0°C on a thermometer and the coldest is the one farthest from 0°C on a thermometer when all temperatures are below 0°C .

Charlottetown, P.E.I.; Sydney, Nova Scotia

Teaching Notes

10.a) i) 0 ii) -2 iii) -3 iv) +2 v) -1 vi) -5

b) The number that is halfway between -5 and +1 is -2.

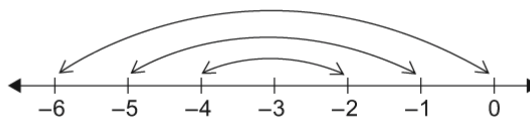
The number that is halfway between -5 and -1 is -3.

The halfway numbers are different because the numbers +1 and -1 are on opposite sides of 0.

So, the distance between -5 and +1 is 6 spaces and the distance between -5 and -1 is 4 spaces.

c) There are many answers here. Some pairs of integers are shown below:

-4, -2; -5, -1; 0, -6; ... This pattern continues.



11. -46°C

12.a) Start at -5. Move 2 spaces right on a number line each time. +3, +5, +7

b) Start at +7. Move 3 spaces left on a number line each time. -5, -8, -11

c) Start at -20. Move 2 spaces right on a number line each time. -12, -10, -8

d) Start at -5. Move 5 spaces left on a number line each time. -25, -30, -35

Reflect

When two integers have different signs, the positive integer is always greater: $+4 > -2$.

When two integers have the same sign, there are two cases.

If both integers are positive, the one with the larger size (number part) is greater: $+5 > +3$.

If both integers are negative, the one with the smaller size (number part) is greater: $-5 > -8$.

Compare the numbers on a number line. A number to the right is always greater than a number to the left.

Calculator Skills

Before-tax cost of 6 markers: $6 \times 4.95 = \$29.70$

Tax: $29.70 \times 0.15 = \$4.46$

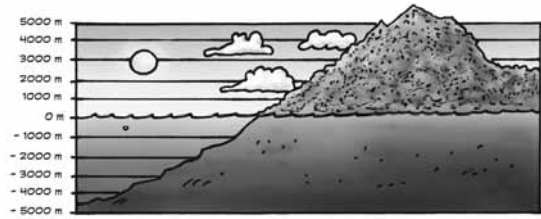
Total $\$29.70 + \$4.46 = \$34.16$

Or: Total = $\$29.70 \times 1.15 = \34.16

Amount Tina started with is $\$13.42 + \$34.16 = \$47.58$.

Answer: $\$47.58$

Elevation is the height above or below sea level. Elevation influences climate and how people live. For example, crops will not grow at elevations above 5300 m.



Explore

Work with a partner.
 You will need an atlas or Internet access.
 Here are some examples of extreme elevations around the world:

Vinson Massif, Antarctica	4897 m above sea level
Dead Sea, Israel/Jordan	411 m below sea level
Bottom of Great Slave Lake	458 m below sea level
Mt. Nowshak, Afghanistan	7485 m above sea level
Challenger Deep, Pacific Ocean	10 924 m below sea level

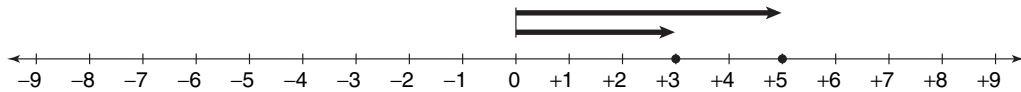
Research to find at least 4 more extreme elevations in Canada.
 Two should be above sea level, and two should be below sea level.
 Order *all* the elevations from least to greatest.

Show and Share

What strategies did you use to order the elevations?
 What other ways could you display these data to show the different elevations?

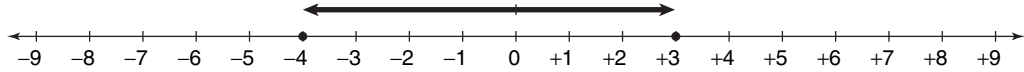
Connect

We use the symbols $>$ and $<$ to show order.
 The symbol points to the lesser number.

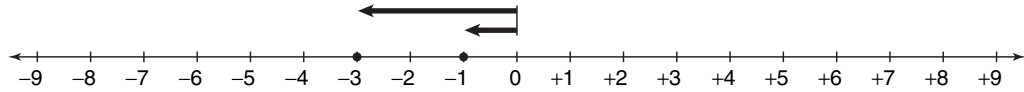


$+5$ is to the right of $+3$ on a number line.
 $+5$ is greater than $+3$, so we write: $+5 > +3$
 $+3$ is less than $+5$, so we write: $+3 < +5$

LESSON FOCUS | Use a number line to order and compare integers.



+3 is to the right of -4 on a number line.
 +3 is greater than -4, so we write: $+3 > -4$
 -4 is less than +3, so we write: $-4 < +3$



-3 is to the left of -1 on a number line.
 -3 is less than -1, so we write: $-3 < -1$
 -1 is greater than -3, so we write: $-1 > -3$

Example

For the integers 0, +1, -2, +3, -5:

- a) Use a number line to order the integers from least to greatest.
- b) Write the opposite of each integer.
 Show the opposites on a number line.
- c) Order the opposites from least to greatest.

Solution

- a) Mark each integer on a number line.



The integers increase from left to right.

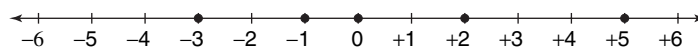
So, the integers from least to greatest: -5, -2, 0, +1, +3

- b) The opposite of an integer is its mirror image reflected in a vertical line drawn through 0 on a number line.

The opposite of -5 is +5. The opposite of -2 is +2.

Since 0 is the reference point, 0 is its own opposite.

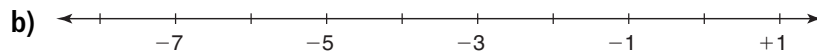
The opposite of +1 is -1. The opposite of +3 is -3.



- c) So, the opposite integers from least to greatest: -3, -1, 0, +2, +5

Practice

1. Copy each number line. Fill in the missing integers.



2. Order the integers in each set from least to greatest.

- a) +5, +13, +1 b) -3, -5, -4 c) +4, -2, +3

3. Order the integers in each set from greatest to least.

- a) +4, +1, +8 b) -7, -5, -3 c) 0, +4, -4

4. Order the integers in each set from least to greatest.

- a) +5, -5, +4, +2, -2 b) -8, -12, +10, 0, -10
c) +41, -39, -41, -15, -25 d) +1, -1, +2, -2, +3

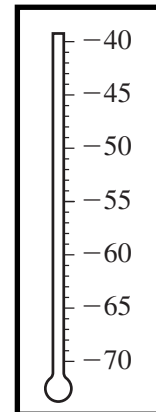
5. Order the integers in each set from greatest to least.

- a) +14, -25, -30, +3, -10 b) 0, +1, +2, -1, -2
c) -29, +27, -11, -4, +6 d) -7, +8, -9, +10, -11

6. This table shows the coldest temperatures ever recorded in 6 provinces and territories.

- a) Draw a thermometer like the one shown.
Mark each temperature on it.

Province or Territory	Coldest Temperature °C
Alberta	- 61
Manitoba	- 53
Nova Scotia	- 47
Nunavut	- 64
Ontario	- 58
Quebec	- 54



A real thermometer does not show negative signs. We include them for better understanding.

- b) Order the temperatures in part a from least to greatest.
How can you use your thermometer to do this?

7. Copy and complete by placing < or > between the integers.
Use a number line if it helps.

- a) +5 +10 b) -5 -10 c) -6 0
d) -5 -4 e) +100 -101 f) -80 -40

Calculator Skills

Tina bought 6 packages of markers for her friends. Each package cost \$4.95. The cashier charged 15% tax. Tina left the store with \$13.42. How much money did Tina start with?

8. Assessment Focus

Look at the integers in the box.

	+4	
-8		-5
	+9	
0		+8

- a) Which integers are:
- i) greater than 0?
 - ii) between -3 and $+3$?
 - iii) greater than -10 and less than -5 ?
 - iv) less than $+1$?
- b) What other questions can you ask about these integers? Write down your questions and answer them.

9. On January 18, 2002, the temperature in Charlottetown, Prince Edward Island, was -21°C ; in Sydney, Nova Scotia, it was -23°C ; in Point Lepreau, New Brunswick, it was -22°C . Which place was the warmest? Coldest? How do you know?

Take It Further

10. a) Draw a number line from -6 to $+6$. Find the integer that is:
- i) halfway between -6 and $+6$
 - ii) halfway between -5 and $+1$
 - iii) halfway between -5 and -1
 - iv) 1 less than $+3$
 - v) 3 more than -4
 - vi) 4 less than -1
- b) Explain why the answer for part a, ii is different from the answer for part a, iii.
- c) -3 is halfway between two integers on a number line. Draw a number line and mark the two integers on it.

11. One day, the temperature in Wabash Lake, Newfoundland, was -41°C ; in Pelly Bay, Nunavut, it was -51°C . The temperature in Churchill, Manitoba, was halfway between these temperatures. What was the temperature in Churchill?

12. Copy each pattern. Extend the pattern for 3 more terms. Describe each pattern in words.

- a) $-5, -3, -1, +1, \dots$ b) $+7, +4, +1, -2, \dots$
 c) $-20, -18, -16, -14, \dots$ d) $-5, -10, -15, -20, \dots$



Reflect

When two integers have different signs, how can you tell which is greater? When two integers have the same sign, how can you tell which is greater?

Master Q1.5

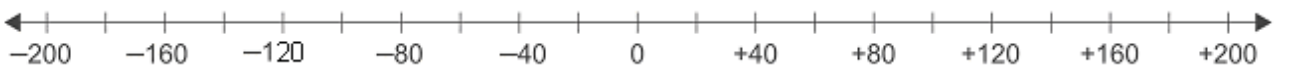
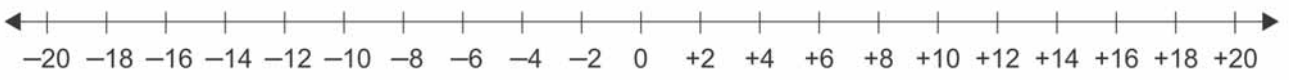
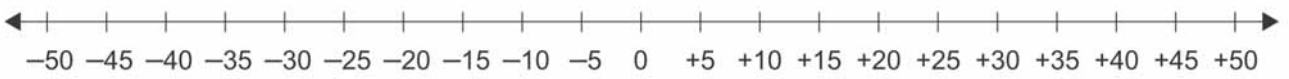
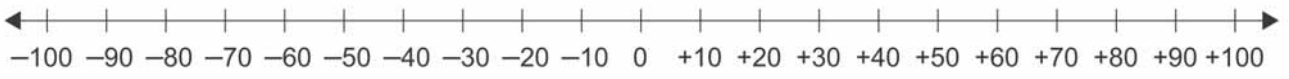
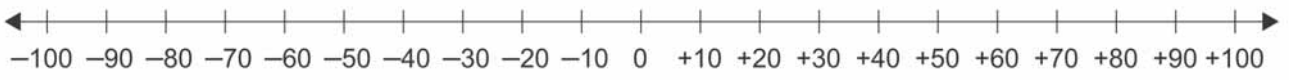
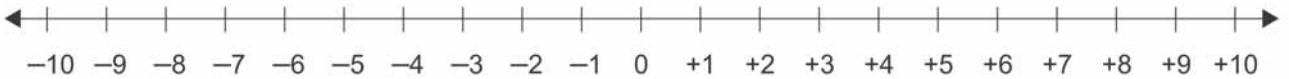
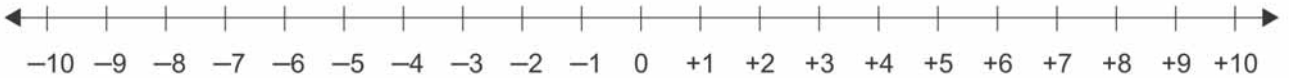
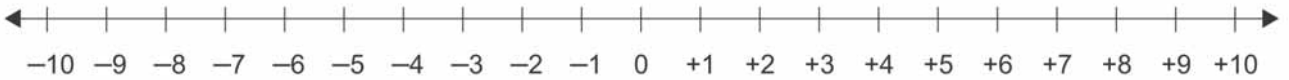
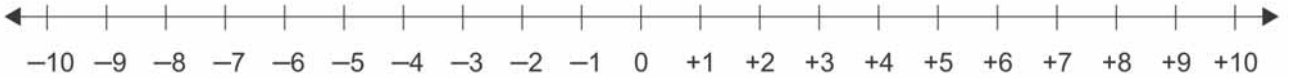
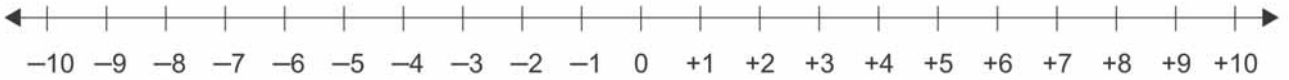
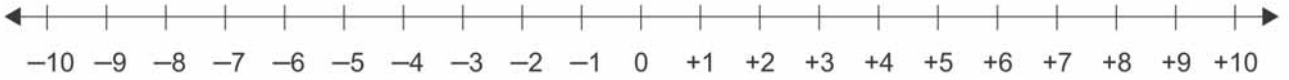
Elevation Data

Location	Elevation
Aconcagua, Argentina	6960 m above sea level
Bahia Blanca, Argentina	42 m below sea level
Bentley Subglacial Trench	2540 m below sea level
Caspian Sea Shore	28 m below sea level
Death Valley, California	86 m below sea level
Elbrus, Russia	5642 m above sea level
Eurasia Basin, Arctic Ocean	5450 m below sea level
Everest, Nepal	8850 m above sea level
Java Trench, Indian Ocean	7125 m below sea level
Kilimanjaro, Tanzania	5895 m above sea level
Kosciusko, Australia	2228 m above sea level
Lake Assal, Djibouti	156 m below sea level
Lake Eyre	12 m below sea level
McKinley, Alaska	6194 m above sea level
Mont Blanc, France/Italy	4807 m above sea level
Puerto Rico Trench, Atlantic Ocean	8648 m below sea level
Puncak Jaya, New Guinea	5040 m above sea level
Whitney, California	4418 m above sea level

Name _____ Date _____

Master Q1.6

Number Lines



Master Q1.7

Unit Rubric: Number Patterns

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding of number patterns by: - demonstrating and explaining pattern rules - using patterns to clarify relationships and verify predictions - using patterns to explore divisibility rules - using patterns to explore, compare, and order integers	shows little understanding; may be unable to: - demonstrate and explain pattern rules - use patterns to clarify relationships and verify predictions - use patterns to explore divisibility rules - use patterns to explore, compare, and order integers	shows some understanding; partially able to: - demonstrate and explain pattern rules - use patterns to clarify relationships and verify predictions - use patterns to explore divisibility rules - use patterns to explore, compare, and order integers	shows understanding; able to: - demonstrate and explain pattern rules - use patterns to clarify relationships and verify predictions - use patterns to explore divisibility rules - use patterns to explore, compare, and order integers	shows thorough understanding; in various contexts, able to: - demonstrate and explain pattern rules - use patterns to clarify relationships and verify predictions - use patterns to explore divisibility rules - use patterns to explore, compare, and order integers
Processes • accurately: - identifies and extends patterns - identifies missing terms - finds the value of a missing number in an equation	limited accuracy; often makes major errors or omissions in: - identifying and extending patterns - identifying missing terms - finding the value of a missing number in an equation	partially accurate; makes frequent minor errors or omissions in: - identifying and extending patterns - identifying missing terms - finding the value of a missing number in an equation	generally accurate; makes few errors or omissions in: - identifying and extending patterns - identifying missing terms - finding the value of a missing number in an equation	accurate; rarely makes errors or omissions in: - identifying and extending patterns - identifying missing terms - finding the value of a missing number in an equation
Solves situational problems				
• uses number patterns to solve and create problems, and to validate and explain solutions	has difficulty using number patterns to solve and create problems; unable to validate or explain solutions	with some support or prompting, uses number patterns to solve and create familiar problems, and to validate and explain solutions	uses number patterns to solve and create problems, and to validate and explain solutions	uses number patterns, in effective and often innovative ways, to solve and create problems, and to validate and explain solutions
Communicates using mathematical language				
• interprets and produces messages about number patterns, using exact mathematical language, and a variety of concrete, visual, and symbolic representations	has difficulty interpreting and producing mathematical messages	partially able to interpret and produce mathematical messages about number patterns	interprets and produces mathematical messages about number patterns	interprets and produces precise mathematical messages about number patterns
Cross-curricular competency: to adopt effective work methods				
• derives satisfaction from successfully completing a task	rarely completes tasks successfully; does not make connections between own efforts and task	needs support to complete a task successfully; shows some satisfaction in result	in most cases, willing to invest time needed to complete tasks successfully; derives satisfaction from result	self-directed; invests time effectively to complete tasks with a high degree of success; derives satisfaction from result

**Performance Assessment Rubric:
Crack the Code!**

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
Concepts <ul style="list-style-type: none"> shows understanding of number patterns by choosing appropriate strategies and offering reasonable explanations or solutions 	shows little understanding; may be unable to choose appropriate strategies or explain solutions	shows partial understanding by choosing some appropriate strategies and offering partially reasonable explanations	shows understanding by choosing appropriate strategies and offering reasonable explanations	shows thorough understanding by choosing appropriate strategies and offering complete, reasonable, and effective explanations
Processes <ul style="list-style-type: none"> accurately: <ul style="list-style-type: none"> applies patterning skills and concepts completes a place-value chart for base 2 	limited accuracy; makes frequent major errors or omissions in place-value chart	partially accurate; makes frequent minor errors or omissions in place-value chart	generally accurate; few errors or omissions in place-value chart	accurate; very few, if any, errors or omissions in place value chart
Solves situational problems				
<ul style="list-style-type: none"> uses appropriate strategies to decode and create messages using binary code 	uses very limited strategies; unable to decode and create messages using binary code	uses some appropriate strategies, with partial success, to decode and create messages using binary code	uses appropriate strategies to successfully decode and create messages using binary code	uses innovative, efficient, and effective strategies to successfully decode and create messages using binary code
Communicates using mathematical language				
<ul style="list-style-type: none"> uses exact mathematical language represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	uses few appropriate mathematical terms does not represent his/her thinking and solutions clearly	uses some appropriate mathematical terms represents his/her thinking and solutions with some clarity; may be hard to follow in places	uses appropriate mathematical terms represents his/her thinking and solutions clearly	uses a range of appropriate mathematical terms with precision represents his/her thinking and solutions clearly and precisely

Master Q1.9

Peer and Self Assessment: Unit Problem (Unit 1)

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The place-value chart for base 2 is complete and accurate.				
The message written in binary code is decoded.				
A secret message in binary code is created.				
Processes are explained clearly, using mathematical language.				

Planning for Unit 2: Whole Numbers

Meeting the Quebec Essential Knowledges

- Use Lesson 5A (Masters Q2.1 to Q2.3) after Lesson 5, with supporting Teaching Notes (pages 21a – 21c).

Supporting Cross-Curricular Competencies

Unit Focus: to construct his/her identity

Materials

Masters Q2.1 to Q2.3:

Lesson 5A: Exponents

Master Q2.4:

Unit Rubric: Whole Numbers

Master Q2.5:

Performance Assessment Rubric: At the Apiary

Master Q2.6:

Peer and Self Assessment: Unit Problem (Unit 2)

The Whole Numbers unit provides students with many opportunities to make decisions, express their thoughts and feelings, and take responsibility for their actions. Employ these Student Book and Teacher Guide features to support students as they develop their own identities:

- In each lesson, the **Reflect** prompt (for example, on pages 34 and 38) allows for individual reflection; encourage students to examine their personal understanding, thoughts, and opinions, and to share them with others in the class.
- The **Explore** activities and **Practice** questions include contextual problems that promote responsibility to one's self, peers, and community; highlight these positive options for students (such as healthy eating, active living, participating in fundraising events, and so on).
- The Teacher Guide module **Building a Math Community** provides practical suggestions for creating a respectful classroom environment; revisit these ideas throughout the year.

Use Master Q2.4: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning:

Environmental Awareness and Consumer Rights and Responsibilities

Educational Aim: to encourage students to develop an active relationship with their environment while maintaining a critical attitude towards exploitation of the environment, technological development and consumer goods

The Unit Problem can be opened up mathematically, and extended.

Have students investigate and report on local honey producers. Encourage students to include the following information in their reports:

- Identify who keeps bees.
- Tell about specific qualities of honey that relate to the environment (e.g., the plants that provide pollen).
- Describe environmental factors that affect bee keeping and honey production.
- Determine how much honey is produced locally.
- Create a set of environmental guidelines that help bees and honey production.
- Draw tables and/or graphs displaying honey production and/or consumption during a period of time.

Use Master Q2.5: Performance Assessment Rubric and Master Q2.6: Peer and Self Assessment to support the assessment of the Unit Problem.

Lesson Organizer

40–50 min

Curriculum Focus

Use exponents to represent repeated multiplication.

Teacher materials

- transparent Colour Tiles

Student Materials

- Colour Tiles
- interlocking cubes
- calculators

Vocabulary

exponent form, base, exponent, power, square number, cube number

Assessment

Master Q2.4 Unit Rubric:
Whole Numbers

Key Math Learnings

1. Repeated factors can be written in exponent form. The base is the repeated factor. The exponent indicates how many times the base is used as a factor.
2. A power with exponent 2 is a square number.
3. A power with exponent 3 is a cube number.

LESSON 5A: EXPONENTS

BEFORE

Get Started

Display a Colour Tile on the overhead projector. Elicit from students that the tile is a 1 unit by 1 unit square with area 1 square unit.

Present *Explore*. Ensure students understand that each successive square will have one more square on each side. You may wish to model how to build the next possible square and fill in the next row of the table. Students should continue to build squares until they run out of tiles.

DURING

Explore

Ongoing Assessment: Observe and Listen

Ask questions, such as:

- How many tiles did you use to build the next square? (*4 tiles*)
- What are the dimensions of the square? (*2 units by 2 units*) The area? (*4 square units*)
- What will the dimensions of the third square be? (*3 units by 3 units*) The area? (*9 square units*)
- What is the largest square you can build with 50 tiles? (*7 units by 7 units*) How do you know? (*A 7 unit by 7 unit square will use 49 tiles. We only have 50 tiles to build squares.*)
- What can you say about all the squares you build? (*They are similar.*) How do you know they are similar? (*They have exactly the same shape.*)

AFTER

Connect

Invite volunteers to describe the dimensions and areas of the larger squares. Record the dimensions and areas in a table on the board.

Ask:

- What patterns do you see in the lengths and widths columns of the table? (*The numbers 1 increase by one each time.*)
- What pattern do you see in the areas? (*The area of the first square is 1 square unit. You add 3 square units for the second square, then increase the number of square units you add by 2 each time.*)
- How could you write the area of the tenth square as a product? (*10×10*)

Read through *Connect*. Refer students to the last column of the tables they made in *Explore*. Ask:

- In which form are the areas written? (*Expanded form*)

Teaching Notes

Have students record each area in exponent form and standard form (for example, 3^2 ; 9 square units)

Record these repeated factors on the board: $4 \times 4 \times 4$, $3 \times 3 \times 3 \times 3$, and $2 \times 2 \times 2 \times 2 \times 2$. Call on students to record each in exponent form and standard form. You may choose to model the use of a calculator to find the standard form.

Practice

Have calculators available. Students will need interlocking cubes to complete question 9.

Assessment Focus: Question 7

Students understand that a square number represents the product of a number multiplied by itself (for example, $2 \times 2 = 2^2$), and a cube number represents the product of a number multiplied by itself twice (for example, $2 \times 2 \times 2 = 2^3$).

Assessment for Learning

What to Look for	What to Do
<p>Knowledge and Understanding</p> <ul style="list-style-type: none"> ✓ Students understand the concept of repeated multiplication. ✓ Students understand that repeated factors can be written in exponent form. <p>Application</p> <ul style="list-style-type: none"> ✓ Students can write repeated factors in exponent form and in standard form. <p>Communication</p> <ul style="list-style-type: none"> ✓ Students use proper terminology such as exponent, base, power, square number, and cube number. 	<p>Extra Practice: Provide students with index cards with exponents written on one side and expanded and standard forms on the other. Students work in pairs to quiz one another.</p> <p>Extension: Challenge students to find numbers that can be written in exponent form in more than one way (for example, 16 can be written as 2^4 or 4^2).</p>
Recording and Reporting	Master Q2.4: Unit Rubric: Whole Numbers

REACHING ALL LEARNERS

Early Finishers

Have students work in pairs. Each student writes 3 repeated multiplications. They trade papers and write the repeated multiplications in exponent form and in standard form.

Common Misconceptions

✓ Students multiply the base by the exponent to find the standard form.

How to Help: Stress that exponent form is an alternative way of writing repeated multiplication. Provide students with examples to compare.

For example: $4 \times 3 = 3 + 3 + 3 + 3 = 12$

$$4^3 = 4 \times 4 \times 4 = 64$$

Sample Answers

1.a) 2^3

b) 6^2

c) 3^5

d) 7^2

e) 5^3

f) 9^6

2.a) $4 \times 4 \times 4 \times 4 \times 4$

b) $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$

c) 8×8

d) $11 \times 11 \times 11$

e) $12 \times 12 \times 12 \times 12$

f) $3 \times 3 \times 3$

g) $10 \times 10 \times 10 \times 10 \times 10$

h) $15 \times 15 \times 15 \times 15 \times 15 \times 15 \times 15 \times 15$

3.a) 4

b) 64

c) 10 000

d) 243

4. a) 6561

b) 4 782 969

c) 1 000 000

d) 4096

e) 262 144

f) 1024

g) 1 953 125

h) 2 097 152

5.a) $6^3 = 6 \times 6 \times 6 = 216$; $3^6 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 729$

So, $3^6 > 6^3$

b) $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$; $5^2 = 5 \times 5 = 25$

So, $2^5 > 5^2$

c) $4^5 = 4 \times 4 \times 4 \times 4 \times 4 = 1024$; $5^4 = 5 \times 5 \times 5 \times 5 = 625$

So, $4^5 > 5^4$

6.a) <

b) <

c) =

d) =

e) >

f) <

7.a) $10^2 = 10 \times 10 = 100$

So, 10 equals 100 when it is squared.

b) $4^3 = 4 \times 4 \times 4 = 64$

So, 4 equals 64 when it is cubed.

c) $64 = 8 \times 8 = 8^2$; $64 = 4 \times 4 \times 4 = 4^3$

So, 64 is a square number and a cube number.

8.a) 5^2

b) 3^2

c) 7^2

9.a) $27 = 3 \times 3 \times 3 = 3^3$

b) 125 is a cube number because $5 \times 5 \times 5 = 125 = 5^3$

10.a) $32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5$

b) $4 = 2 \times 2 = 2^2$

c) $128 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^7$

d) $16 = 2 \times 2 \times 2 \times 2 = 2^4$

11.a) $64 = 4 \times 4 \times 4 = 4^3$

b) $16 = 4 \times 4 = 4^2$

c) $256 = 4 \times 4 \times 4 \times 4 = 4^4$

d) $1024 = 4 \times 4 \times 4 \times 4 \times 4 = 4^5$

12.a) $1000 = 10 \times 10 \times 10 = 10^3$

b) $100 = 10 \times 10 = 10^2$

c) $100\ 000 = 10 \times 10 \times 10 \times 10 \times 10 = 10^5$

d) $10\ 000 = 10 \times 10 \times 10 \times 10 = 10^4$

13. $2^8 = 256$ So, there will be 256 bacteria.

Reflect

The number 81 can be written as 81^1 , 3^4 , and as 9^2 . So the student is right.

Numbers Every Day

216 and 306 are divisible by

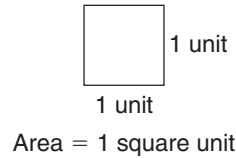
6. I know because the numbers are even and the sum of their digits is divisible by 3.

Lesson 5A Exponents

Explore



You will need 50 Colour Tiles.
 Each tile is a 1 unit by 1 unit square.
 The area of each tile is 1 square unit.



Build the next possible square.
 Copy and complete the table.

Number of Tiles	Length (units)	Width (units)	Area (square units)	Area as a Product
1	1	1	1	1×1

Continue to build larger and larger squares.
 Record the results in the table.

Show and Share

Share your results with another pair of students.
 What patterns do you see in the table?
 Use the patterns to predict the areas of the next 3 squares.

Connect

► When we multiply a number by itself, it is called repeated multiplication.

You can show the repeated factors by writing them in **exponent form**.

$$5 \times 5 \times 5 \times 5 = 5^4$$

└──────────┘
← exponent
← base

repeated factors

The **base** is the repeated factor.
 The **exponent** tells how many times the base is used as a factor.

LESSON FOCUS | Use exponents to represent repeated multiplication.

MASTER Q2.2

We read 5^4 as: 5 to the power of 4
or
5 to the 4th

5^4 is a power of 5.

Numbers that involve exponents can be written in 3 different ways:

Exponent form: 5^4

Expanded form: $5 \times 5 \times 5 \times 5$

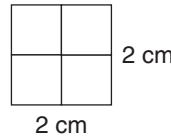
Standard form: 625

Five times 5 equals 25;
25 times 5 equals 125;
125 times 5 equals 625.



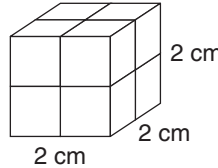
► There are two special powers.

- A power with exponent 2 is a **square number**.
 2^2 is 2 to the second power, or 2 *squared*.



A square with side length 2 cm has area 4 cm^2 .
 $2 \text{ cm} \times 2 \text{ cm} = 4 \text{ cm}^2$

- A power with exponent 3 is a **cube number**.
 2^3 is 2 to the third power, or 2 *cubed*.



A cube with two 2-cm by 2-cm layers has volume 8 cm^3 .
 $2 \text{ cm} \times 2 \text{ cm} \times 2 \text{ cm} = 8 \text{ cm}^3$

► You can use a calculator to express a power, such as 3^4 , in standard form.

Press: $\boxed{3} \boxed{\times} \boxed{=} \boxed{=} \boxed{=}$ to display 81

Practice

1. Write in exponent form.

- | | | |
|--------------------------|--------------------------|-----------------------------------------------------|
| a) $2 \times 2 \times 2$ | b) 6×6 | c) $3 \times 3 \times 3 \times 3 \times 3$ |
| d) 7×7 | e) $5 \times 5 \times 5$ | f) $9 \times 9 \times 9 \times 9 \times 9 \times 9$ |

2. Write in expanded form.

- | | | | |
|-----------|----------|-----------|-----------|
| a) 4^5 | b) 2^7 | c) 8^2 | d) 11^3 |
| e) 12^4 | f) 3^3 | g) 10^5 | h) 15^8 |

3. Write in standard form.

- | | | | |
|----------|----------|-----------|----------|
| a) 2^2 | b) 4^3 | c) 10^4 | d) 3^5 |
|----------|----------|-----------|----------|

4. Write in standard form.

- | | | | |
|----------|-------------|-----------|-------------|
| a) 3^8 | b) 9^7 | c) 10^6 | d) 2^{12} |
| e) 4^9 | f) 2^{10} | g) 5^9 | h) 8^7 |



MASTER Q2.3

5. Which is the greater number in each pair? Explain.

- a) 6^3 or 3^6 b) 2^5 or 5^2 c) 4^5 or 5^4

6. Copy and complete. Replace each \square with $>$, $<$, or $=$.

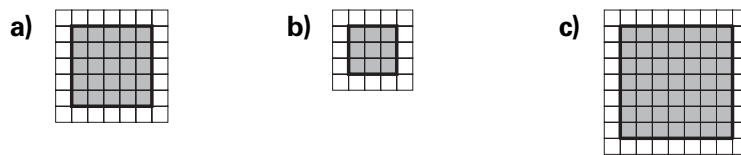
- a) $5^2 \square 5^3$ b) $4^3 \square 3^4$ c) $10^3 \square 10 \times 10 \times 10$
 d) $4^2 \square 2^4$ e) $10^4 \square 4 \times 10$ f) $7^3 \square 3^7$



7. Find each number. Show your work.

- a) The number that equals 100 when it is squared
 b) The number that equals 64 when it is cubed
 c) A number that is both a square number and a cube number

8. Write the number of small squares in each larger square as a power.



9. a) Use 27 interlocking cubes. Make a larger cube.

Write 27 as a power.

b) Is 125 a cube number? Explain.

10. Write as a power of 2.

- a) 32 b) 4 c) 128 d) 16

11. Write as a power of 4.

- a) 64 b) 16 c) 256 d) 1024

12. Write as a power of 10.

- a) 1000 b) 100 c) 100 000 d) 10 000

13. The number of bacteria in a culture doubles every hour.

After 1 h, there are 2 bacteria.

How many bacteria will there be after 8 h?

Reflect

A student says that the number 81 can be written in exponent form in more than one way. Is the student correct? Explain.

Numbers Every Day

Number Strategies

Which numbers are divisible by 6? How do you know?

- 216
 215
 303
 306
 346

Master Q2.4

Unit Rubric: Whole Numbers

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding of whole numbers by: - comparing and ordering numbers - approximating the result of operations - modelling and describing products, factors, multiples, prime factors, and exponents - choosing and explaining appropriate operations and methods	limited understanding; may be unable to: - compare and order numbers - approximate the result of operations - model and describe products, factors, multiples, prime factors, and exponents - choose and explain appropriate operations and methods	some understanding; partially able to: - compare and order numbers - approximate the result of operations - model and describe products, factors, multiples, prime factors, and exponents - choose and explain appropriate operations and methods	shows understanding; able to: - compare and order numbers - approximate the result of operations - model and describe products, factors, multiples, prime factors, and exponents - choose and explain appropriate operations and methods	shows thorough understanding; able to: - compare and order numbers - approximate the result of operations - model and describe products, factors, multiples, prime factors, and exponents - choose and explain appropriate operations and methods
Processes • accurately: - reads, writes, and represents numbers - uses order of operations - uses mental math to add, subtract, multiply, and divide - multiplies and divides - uses the order of operations	limited accuracy; often makes major errors or omissions in: - reading, writing, and representing numbers - mental computations - multiplying and dividing - using the order of operations	partially accurate; makes frequent minor errors or omissions in: - reading, writing, and representing numbers - mental computations - multiplying and dividing - using the order of operations	generally accurate; makes few errors or omissions in: - reading, writing, and representing numbers - mental computations - multiplying and dividing - using the order of operations	accurate; rarely makes errors or omissions in: - reading, writing, and representing numbers - mental computations - multiplying and dividing - using the order of operations
Solves situational problems				
• solves and creates problems using whole numbers, and validates and explains solutions	has difficulty solving and creating problems using whole numbers; unable to validate or explain solutions	with some support, solves and creates problems using whole numbers in familiar contexts; needs help to validate and explain solutions	solves and creates problems using whole numbers; validates and explains solutions	solves and creates problems using whole numbers in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about whole numbers and number operations, using exact mathematical language and a variety of concrete, visual, and symbolic representations	has difficulty interpreting and producing mathematical messages about whole numbers and number operations	partially able to interpret and produce mathematical messages about whole numbers and number operations	interprets and produces mathematical messages about whole numbers and number operations	interprets and produces precise mathematical messages about whole numbers and number operations
Cross-curricular competency: to construct his/her identity				
• reacts openly and receptively to activities and discussion, including those that are unfamiliar	does not react openly and receptively to new activities or discussion	with teacher support, willing to engage in new activities and discussion	reacts openly and receptively to most new activities and discussion	reacts openly and enthusiastically to new activities and discussion

**Performance Assessment Rubric:
At the Apiary**

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
<p>Concepts</p> <ul style="list-style-type: none"> • shows understanding of whole numbers by choosing appropriate strategies and offering reasonable explanations or solutions 	shows little understanding; may be unable to choose appropriate strategies or explain solutions	shows partial understanding by choosing some appropriate strategies and offering partially reasonable explanations	shows understanding by choosing appropriate strategies and offering reasonable explanations	shows thorough understanding by choosing appropriate strategies and offering complete, reasonable, and effective explanations
<p>Processes</p> <ul style="list-style-type: none"> • accurately: <ul style="list-style-type: none"> - compares, multiplies, and divides whole numbers - offers reasonable estimates 	limited accuracy; makes frequent major errors or omissions in: <ul style="list-style-type: none"> - multiplying and dividing - comparing - estimating 	partially accurate; makes frequent minor errors or omissions in: <ul style="list-style-type: none"> - multiplying and dividing - comparing - estimating 	generally accurate; few errors or omissions in: <ul style="list-style-type: none"> - multiplying and dividing - comparing - estimating 	accurate; very few, if any, errors or omissions in: <ul style="list-style-type: none"> - multiplying and dividing - comparing - estimating
Solves situational problems				
<ul style="list-style-type: none"> • chooses appropriate strategies to: <ul style="list-style-type: none"> - solve multi-step problems - create and solve story problems using data about honeybees - check reasonableness of results 	unable to use appropriate strategies to solve and create problems, including: <ul style="list-style-type: none"> - solving multi-step problems - creating and solving story problems using data about honeybees - checking reasonableness of results 	uses somewhat appropriate strategies, with partial success, to solve and create some of the problems, including: <ul style="list-style-type: none"> - solving multi-step problems - creating and solving story problems using data about honeybees - checking reasonableness of results 	uses appropriate strategies to successfully solve and create most of the problems including: <ul style="list-style-type: none"> - solving multi-step problems - creating and solving story problems using data about honeybees - checking reasonableness of results 	uses effective, efficient, and often innovative strategies to successfully solve and create problems including: <ul style="list-style-type: none"> - solving multi-step problems - creating and solving story problems using data about honeybees - checking reasonableness of results
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses appropriate mathematical language • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	uses few appropriate mathematical terms does not represent his/her thinking and solutions clearly	uses some appropriate mathematical terms represents his/her thinking and solutions with some clarity; may be hard to follow in places	uses appropriate mathematical terms represents his/her thinking and solutions clearly	uses a range of appropriate mathematical terms with precision represents his/her thinking and solutions clearly and precisely

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
Each problem is solved using a correct operation.				
Calculations are complete and correct.				
A challenging story problem using whole numbers is created and solved.				
Solutions are explained clearly, using appropriate mathematical language.				

Planning for Unit 3: Geometry

Supporting Cross-Curricular Competencies

Recommended Software: *The Geometer's Sketchpad*

Unit Focus: to cooperate with others

Materials

Master Q3.1:

Unit Rubric: Geometry

Master Q3.2:

Performance Assessment Rubric: Angle Hunt

Master Q3.3:

Peer and Self Assessment: Unit Problem (Unit 3)

The Geometry unit provides students with many opportunities to engage in group activities. Here are some of the Student Book features that promote teamwork:

- The **Explore** section in each lesson encourages students to work collaboratively to complete each activity (for example, on pages 86, 92, and 98); different groupings are recommended.
- The **Show and Share** section in each lesson (for example, on pages 82, 87, and 102) gives students a chance to share what they learned in the **Explore** activity.
- Encourage students to re-read the **Connect** in each lesson, in pairs or in a group, to reinforce understanding of new concepts (for example, on pages 93 and 103).
- Allow time for students to share answers to the **Reflect** activities to foster discussion and appreciation of their peers' ideas and opinions (for example, on pages 97 and 101).

Use Master Q3.1: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning: Personal and Career Planning

Educational Aim: to enable students to undertake and complete projects that develop their potential and help them integrate into society

The Unit Problem can be opened up mathematically, and extended.

Invite students to examine various architectural features of the school or other community buildings. Have students identify any angles, patterns, or shapes in the building, and why they think architects and builders use these features in their work. In pairs, have students research geometry, specifically angles, in architecture and buildings, by completing one or more of the following activities:

- Research the work of a particular architect or architectural style (e.g., Douglas Cardinal; Art Deco). Describe how the architect or architectural style makes use of angles, patterns, shapes, and so on.
- Analyse and report on a famous Canadian building (e.g., the CN Tower; the Supreme Court of Canada). Include descriptions of any angles, patterns, and shapes in the building.
- Compare two buildings from different periods.

Use Master Q3.2: Performance Assessment Rubric and Master Q3.3: Peer and Self Assessment to support the assessment of the Unit Problem.

Master Q3.1
Unit Rubric: Geometry

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding of spatial relations by: - recognizing and constructing nets for polyhedrons - building and describing figures and solids	shows little understanding; may be unable to: - recognize and construct nets for polyhedrons - build and describe figures and solids	some understanding; partially able to: - recognize and construct nets for polyhedrons - build and describe figures and solids	shows understanding; able to: - recognize and construct nets for polyhedrons - build and describe figures and solids	thorough understanding; in various contexts, able to: - recognize and construct nets for polyhedrons - build and describe figures and solids
Processes • accurately: - classifies triangles - measures angles in degrees using a protractor	limited accuracy; often makes major errors or omissions in: - classifying triangles - measuring angles using a protractor	partially accurate; makes frequent minor errors or omissions in: - classifying triangles - measuring angles using a protractor	generally accurate; makes few errors or omissions in: - classifying triangles - measuring angles using a protractor	accurate; rarely makes errors or omissions in: - classifying triangles - measuring angles using a protractor
Solves situational problems				
• solves and creates problems involving geometry, and validates and explains solutions	has difficulty solving and creating problems involving geometry; unable to validate or explain solutions	with some support or prompting, solves and creates problems involving geometry in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving geometry; validates and explains solutions	solves and creates problems involving geometry in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about geometry, using appropriate mathematical language and a variety of concrete, visual, and symbolic representations	has difficulty interpreting and producing mathematical messages about number patterns	partially able to interpret and produce mathematical messages about number patterns	interprets and produces mathematical messages about number patterns	interprets and produces precise mathematical messages about number patterns
Cross-curricular competency: to cooperate with others				
• participates actively; considers and builds on others' ideas and suggestions	does not participate actively and cooperatively	sometimes participates actively and cooperatively; inconsistent; often needs reminding	usually participates actively and cooperatively; may need occasional reminders	participates actively and cooperatively in a variety of contexts and groups

Master Q3.2

**Performance Assessment Rubric:
Angle Hunt**

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
<p>Concepts</p> <ul style="list-style-type: none"> • explanations and instructions show understanding of: <ul style="list-style-type: none"> - geometric properties, attributes, and relationships of angles and figures 	<p>explanations and instructions show little understanding of geometric concepts</p>	<p>explanations and instructions show partial understanding of geometric concepts</p>	<p>explanations and instructions show understanding of geometric concepts</p>	<p>explanations and instructions show thorough understanding of geometric concepts</p>
<p>Processes</p> <ul style="list-style-type: none"> • accurately applies geometric skills to: <ul style="list-style-type: none"> - identify angles in the environment (classroom objects) - estimate and measure angles - construct and draw angles and figures 	<p>limited accuracy; makes frequent major errors or omissions in: <ul style="list-style-type: none"> - identifying angles in the environment (classroom objects) - estimating and measuring angles - constructing and drawing angles and figures </p>	<p>partially accurate; makes frequent minor errors or omissions in: <ul style="list-style-type: none"> - identifying angles in the environment (classroom objects) - estimating and measuring angles - constructing and drawing angles and figures </p>	<p>generally accurate; few errors or omissions in: <ul style="list-style-type: none"> - identifying angles in the environment (classroom objects) - estimating and measuring angles - constructing and drawing angles and figures </p>	<p>accurate; very few, if any, errors or omissions in: <ul style="list-style-type: none"> - identifying angles in the environment (classroom objects) - estimating and measuring angles - constructing and drawing angles and figures </p>
Solves situational problems				
<ul style="list-style-type: none"> • uses appropriate strategies (e.g., estimating, measuring, sketching) to: <ul style="list-style-type: none"> - solve problems on the game cards - create a new game, including game cards 	<p>uses a few simple strategies with limited success to:</p> <ul style="list-style-type: none"> - solve problems on the game cards - create a new game, including game cards 	<p>uses some appropriate strategies, with partial success, to:</p> <ul style="list-style-type: none"> - solve problems on the game cards - create a new game, including game cards 	<p>uses appropriate strategies, with considerable success to:</p> <ul style="list-style-type: none"> - solve problems on the game cards - create a new game, including game cards 	<p>uses appropriate, efficient, and often innovative, strategies to successfully:</p> <ul style="list-style-type: none"> - solve problems on the game cards - create a new game, including game cards
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	<p>uses few appropriate mathematical terms</p> <p>does not represent his/her thinking and solutions clearly</p>	<p>uses some appropriate mathematical terms</p> <p>represents his/her thinking and solutions with some clarity; may be hard to follow in places</p>	<p>uses appropriate mathematical terms</p> <p>represents his/her thinking and solutions clearly</p>	<p>uses a range of appropriate mathematical terms with precision</p> <p>represents his/her thinking and solutions clearly and precisely</p>

Master Q3.3

Peer and Self Assessment: Unit Problem (Unit 3)

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The objects match the description on the game cards.				
The figures on the cards are drawn accurately.				
The game is interesting.				
The instructions are clear, using appropriate mathematical language.				

Planning for Unit 4: Decimals

Supporting Cross-Curricular Competencies

Unit Focus: to solve problems

Materials

Master Q4.1:

Unit Rubric: Decimals

Master Q4.2:

Performance Assessment Rubric: Harnessing the Wind

Master Q4.3:

Peer and Self Assessment: Unit Problem (Unit 4)

In the Decimals unit, students solve problems in various contexts. Utilize these Student Book and Teacher Guide features to support students' development of effective problem solving skills:

- In all of the **Explore** activities and in **Practice** questions, problem-solving opportunities are presented in relevant contexts; encourage students to share their problem-solving strategies with the class.
- In the **Strategies Toolkit** lesson (Lesson 13), students approach new problems involving critical and creative thinking; review the given list of strategies and encourage students to solve the Practice questions using more than one strategy.
- In the Teacher Guide module **Grade 6 Planning and Program Masters**, Program Master 3 (Self-Assessment: Problem Solving) promotes individual reflection about the problem-solving process; use this assessment tool with any problem throughout the unit.

Use Master Q4.1: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning: Environmental Awareness and Consumer Rights and Responsibilities

Educational Aim: to encourage students to develop an active relationship with their environment while maintaining a critical attitudes towards exploitation of the environment, technological development and consumer goods

The Unit Problem can be opened up mathematically, and extended.

As a class, list ways electricity can be produced in Canada (e.g., hydroelectric, nuclear, gas turbines, wind turbines, and so on). Have students work in groups. Assign each group one type of electricity to research and report on. Brainstorm with students what information their reports should include, for example:

- how the type of electricity is produced
- advantages/disadvantages of the type of electricity
- costs
- where it is used the most (in Canada)
- sustainability

Encourage students to include diagrams, illustrations, tables, and graphs in their reports. Have groups present their reports. Challenge students to develop personal action plans for reducing their use of electricity.

Use Master Q4.2: Performance Assessment Rubric and Master Q4.3: Peer and Self Assessment to support the assessment of the Unit Problem.

Master Q4.1
Unit Rubric: Decimals

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding of decimals and decimal operations by: - demonstrating and describing equivalent decimals - comparing and ordering decimals - approximating the result of an operation - justifying the reasonableness of a solution or approximation	limited understanding; may be unable to: - demonstrate and describe equivalent decimals - compare and order decimals - approximate the result of an operation - justify the reasonableness of a solution or approximation	some understanding; partially able to: - demonstrate and describe equivalent decimals - compare and order decimals - approximate the result of an operation - justify the reasonableness of a solution or approximation	shows understanding; able to: - demonstrate and describe equivalent decimals - compare and order decimals - approximate the result of an operation - justify the reasonableness of a solution or approximation	thorough understanding; in various contexts, able to: - demonstrate and describe equivalent decimals - compare and order decimals - approximate the result of an operation - justify the reasonableness of a solution or approximation
Processes • accurately works to two decimal places, including: - representing, reading, and writing decimals to hundredths - multiplying - mental computation	limited accuracy; often makes major errors or omissions in: - representing, reading, and writing decimals to hundredths - multiplying - mental computation	partially accurate; makes frequent minor errors or omissions in: - representing, reading, and writing decimals to hundredths - multiplying - mental computation	generally accurate; makes few errors or omissions in: - representing, reading, and writing decimals to hundredths - multiplying - mental computation	accurate; rarely makes errors or omissions in: - representing, reading, and writing decimals to hundredths - multiplying - mental computation
Solves situational problems				
• solves and creates problems involving decimals, and validates and explains solutions	has difficulty solving and creating problems involving decimals; unable to validate or explain solutions	with some support or prompting, solves and creates problems involving decimals in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving decimals; validates and explains solutions	solves and creates problems involving decimals in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about decimals, using mathematical language and objects, drawings, tables, symbols, graphs, or words	has difficulty interpreting and producing mathematical messages about decimals	partially able to interpret and produce mathematical messages about decimals	interprets and produces mathematical messages about decimals	interprets and produces precise mathematical messages about decimals
Cross-curricular competency: to solve problems				
• identifies successful strategies and analyses difficulties	unable to identify successful strategies or analyse difficulties (often because they are unable to address the problem)	identifies successful strategies, and some of the difficulties encountered; little analysis	identifies successful strategies and analyses difficulties encountered; explains how difficulties were/could be solved	insightful in identifying successful strategies and analysing difficulties; generalizes beyond the current problem

Performance Assessment Rubric: Harnessing the Wind

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
Concepts <ul style="list-style-type: none"> • shows understanding of decimals and decimal operations by choosing and explaining appropriate strategies and procedures for each task 	shows little understanding; may be unable to choose or explain appropriate strategies and procedures for most tasks	shows partial understanding by choosing and explaining (partially) appropriate strategies and procedures for some tasks	shows understanding by choosing and explaining appropriate strategies and procedures for most tasks	shows thorough understanding by choosing appropriate strategies and procedures for all tasks and offering complete and effective explanations
Processes <ul style="list-style-type: none"> • accurately: <ul style="list-style-type: none"> - reads and writes decimals - performs operations with decimals - multiplies by tenths, hundredths, and thousandths - rounds decimals 	limited accuracy; makes frequent major errors or omissions in: <ul style="list-style-type: none"> - reading and writing decimals - performing operations with decimals - multiplying by tenths, hundredths, and thousandths - rounding decimals 	partially accurate; makes frequent minor errors or omissions in: <ul style="list-style-type: none"> - reading and writing decimals - performing operations with decimals - multiplying by tenths, hundredths, and thousandths - rounding decimals 	generally accurate; few errors or omissions in: <ul style="list-style-type: none"> - reading and writing decimals - performing operations with decimals - multiplying by tenths, hundredths, and thousandths - rounding decimals 	accurate; very few, if any, errors or omissions in: <ul style="list-style-type: none"> - reading and writing decimals - performing operations with decimals - multiplying by tenths, hundredths, and thousandths - rounding decimals
Solves situational problems				
<ul style="list-style-type: none"> • uses appropriate strategies to create and solve a problem involving decimals 	uses very limited strategies; unable to create and solve a problem involving decimals	uses some appropriate strategies to create and solve a problem involving decimals with partial success	uses appropriate strategies to successfully create and solve a problem involving decimals	uses appropriate, efficient, and often innovative strategies to successfully create and solve a problem involving decimals
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	uses few appropriate mathematical terms does not represent his/her thinking and solutions clearly	uses some appropriate mathematical terms represents his/her thinking and solutions with some clarity; may be hard to follow in places	uses appropriate mathematical terms represents his/her thinking and solutions clearly	uses a range of appropriate mathematical terms with precision represents his/her thinking and solutions clearly and precisely

Master Q4.3

Peer and Self Assessment: Unit Problem (Unit 4)

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The answers are calculated correctly.				
Appropriate strategies are used to find the solutions.				
An interesting story problem using decimals is created and solved.				
Solutions and strategies are explained clearly, using appropriate mathematical language.				

Planning for Unit 5: Data Management

Meeting the Quebec Essential Knowledges

- Use Lesson 5A (Masters Q5.1 to Q5.5) after Lesson 5, with supporting Teaching Notes (pages 24a – 24f).

Supporting Cross-Curricular Competencies

Recommended Software: *Appleworks*

Unit Focus: to use information/communication technologies

In the Data Management unit, opportunities exist for students to use various technologies (e.g., computers, calculators) to reinforce new concepts. Employ these Student Book and Teacher Guide features to support students' development of technology-based skills:

- The **Technology** lessons (pages 182-185 and 194-196) give students a chance to draw line graphs and scatter plots using a computer; review the steps with students before they begin their displays.
- In some of the **Explore** activities or **Practice** questions, it is recommended that a calculator be used to enrich the mathematics; make calculators available in these situations (for example, on page 174, **Practice** question 3).
- The **e-Tools** software provides virtual manipulatives that help students develop mathematical concepts and enhance student success; the **e-Tools** appropriate for this unit include Spreadsheet/Data/Grapher.

Use Master Q5.6: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning:

Citizenship and Community Life

Educational Aim: to ensure that students take part in the democratic life of the classroom or the school and develop a spirit of openness to the world and respect for diversity

The Unit Problem can be opened up mathematically, and extended.

Have students brainstorm languages spoken by children in the class and their families, and by other community members. Prompt discussion about the value of linguistic diversity by asking questions, such as:

- Why is it useful to speak more than one language?
- If you could learn another language (besides French and English) what would you choose? Why?

Have students collect simple materials in a variety of languages, such as signs, menus, advertisements, children's books, newspapers, guidebooks, and so on. Encourage students to use the Internet as a source. In pairs, have students analyse one language they do not know well by completing the activities from the Unit Problem.

Have pairs report on their findings. Create a class summary that identifies some common features of each language students analysed.

Use Master Q5.7: Performance Assessment Rubric and Master Q5.8: Peer and Self Assessment to support the assessment of the Unit Problem.

Materials

Masters Q5.1 to Q5.5:

Lesson 5A: Graphing on a Coordinate Grid, Part 2

Master Q5.6:

Unit Rubric: Data Management

Master Q5.7:

Performance Assessment Rubric: Playing with Letters

Master Q5.8:

Peer and Self Assessment: Unit Problem (Unit 5)

Teaching Notes

Lesson Organizer

80–100 min

Curriculum Focus

Locate and graph points in four quadrants on a coordinate grid.

Teacher Materials

- overhead transparency of Coordinate Grid (Master Q5.6)

Student Materials

- Coordinate Grid (Master Q5.6)
- 0.5-cm grid paper (PM 22)

Vocabulary

horizontal axis (x -axis), vertical axis (y -axis), coordinate grid, coordinate, ordered pair, origin, quadrant

Assessment

Master Q5.7 Unit Rubric: Data Management

Key Math Learnings

1. An ordered pair of integers can be used to locate a point on a coordinate grid.
2. The x - and y -axes divide the coordinate grid into four quadrants.

Math Link

Have students research the life of Rene Descartes.

Read the story *The Fly on the Ceiling: A Math Reader* by Dr. Julie Glass to students.

LESSON 5A: GRAPHING ON A COORDINATE GRID, PART 2

BEFORE

Get Started

Review graphing in the first quadrant. Ask:

- Point A is how many units to the right of the vertical axis? (3)
- Point A is how many units above the horizontal axis? (2)

Explain that the coordinates of A are written as the ordered pair (3, 2). Stress that the order of the numbers is important. Show that (2, 3) is not the same as (3, 2) by graphing both points. Have volunteers identify the coordinates of these points: B(1, 4), C(0, 2), D(6, 5).

Review how to identify and plot a point on the horizontal axis. Plot point E(2, 0), and have students identify the coordinates.

Present *Explore*.

DURING

Explore

Ongoing Assessment: Observe and Listen

As students work, ask questions, such as:

- Now that there are four regions in your graph, what does the first coordinate of an ordered pair tell you? (*The distance right or left from the vertical axis*)
- How could we distinguish between moving right and moving left? (*Use positive integers for moving right and negative integers for moving left.*)
- What does the second coordinate of an ordered pair tell you? (*The distance up or down from the horizontal axis*)
- How should we distinguish between moving up and moving down? (*Use positive integers for moving up and negative integers for moving down.*)

AFTER

Connect

On an overhead transparency of a coordinate grid with 4 quadrants, have volunteers take turns to draw their figures and describe any problems their partners had.

Review *Connect* and introduce the terminology that labels the horizontal and vertical axes x and y , respectively.

On a grid, have volunteers plot several points in each quadrant and label them with their coordinates. Help students make these generalizations:

Teaching Notes

- If a point lies in Quadrant 1, both its coordinates are positive.
- If a point lies in Quadrant 2, its x -coordinate is negative and its y -coordinate is positive.
- If a point lies in Quadrant 3, both its coordinates are negative.
- If a point lies in Quadrant 4, its x -coordinate is positive and its y -coordinate is negative.

Have volunteers plot several points on each axis and label them with their coordinates.

Help students make these generalizations:

- If a point lies on the x -axis, its y -coordinate is 0.
- If a point lies on the y -axis, its x -coordinate is 0.

Review the *Example* and ensure students know how to plot points and identify their coordinates before they begin *Practice*.

Practice

Students require 0.5-cm grid paper (PM 22) or copies of *Coordinate Grid* (Master Q5.6) for all questions.

Assessment Focus: Question 6

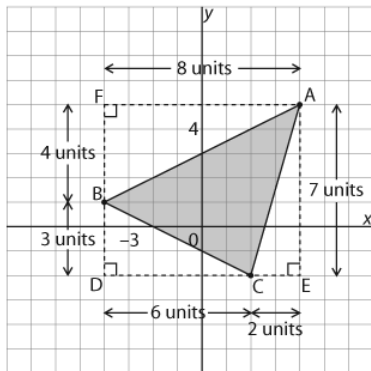
Students may begin by finding the factors of 12, and using each pair of factors as the base and height of a rectangle. A level 4 response could include bases and heights that are decimals.

Assessment for Learning

What to Look for	What to Do
<p>Knowledge and Understanding</p> <p>✓ Students understand that the position of a point on a coordinate grid can be described by its coordinates.</p> <p>Thinking</p> <p>✓ Students can solve problems related to the areas of figures on a grid.</p> <p>Communication</p> <p>✓ Students can explain how to use coordinates to plot a point.</p> <p>Application</p> <p>✓ Students can plot ordered pairs on a coordinate grid.</p>	<p>Extra Support: Students could use 12 square tiles to find the possible rectangles for question 6.</p> <p>Extra Practice: Students could repeat question 6 for rectangles or other figures with different areas.</p> <p>Extension: Have students plot these points on a coordinate grid: $(-1, 2)$, $(2, -4)$. Ask them to graph and give the coordinates of ten other points that lie on the line through these points.</p>
Recording and Reporting	Master Q5.7: Unit Rubric: Data Management

Teaching Notes

5. Answers may vary. Here is a possible answer:



a) $A(4, 5)$; $B(-4, 1)$; $C(2, -2)$

b) Draw a rectangle around the triangle, so the sides of the rectangle are horizontal and vertical. To find the area of $\triangle ABC$, find the area of rectangle AFDE, then subtract the areas of right triangles: $\triangle FBA$, $\triangle AEC$, and $\triangle BDC$.

$$\text{Area of AFDE} = 8 \times 7 = 56$$

$$\text{Area of } \triangle FBA = \frac{1}{2} \times 8 \times 4 = 16$$

$$\text{Area of } \triangle AEC = \frac{1}{2} \times 7 \times 2 = 7$$

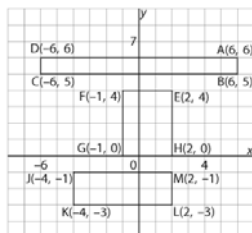
$$\text{Area of } \triangle BDC = \frac{1}{2} \times 6 \times 3 = 9$$

$$\text{So, area of } \triangle ABC = 56 - 16 - 7 - 9 = 24$$

The area of $\triangle ABC$ is 24 units².

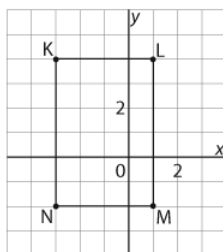
6. For a rectangle to have area 12 units², the product of its base and height is 12. I found pairs of factors of 12: 1×12 , 2×6 , 3×4 ; then I thought about base and height that are decimals of a unit, such as 0.5×24 ; 1.5×8 ; 7.5×1.6 .

I could plot a rectangle with base 0.5 units and height 24 units, and a 1.5-unit by 8-unit rectangle.



But a rectangle with base 7.5 units and height 1.6 units would be difficult to plot because I'd have to estimate a length of 1.6 units. To draw the rectangles, I counted squares, plotted points, then labelled them with their coordinates.

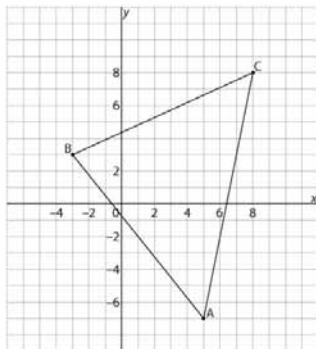
7.a)



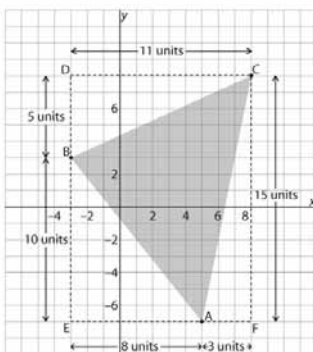
b) To find the coordinates of N, I drew a vertical line through K and a horizontal line through M. These lines meet at N. The coordinates of N are $(-3, -2)$.

Teaching Notes

8.a)



b) To find the area of $\triangle ABC$, draw an enclosing rectangle, as in question 5.



Draw rectangle DCFE.

Area of $\triangle ABC$ = Area rectangle DCFE – (area $\triangle BDC$ + area $\triangle BEA$ + area $\triangle CFA$)

$$= 11 \times 15 - \left(\frac{1}{2} \times 11 \times 5 + \frac{1}{2} \times 10 \times 8 + \frac{1}{2} \times 15 \times 3 \right)$$

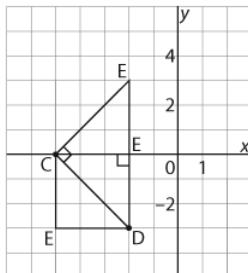
$$= 165 - (27.5 + 40 + 22.5)$$

$$= 165 - 90$$

$$= 75$$

The area of $\triangle ABC$ is 75 units².

9.



E can lie where the horizontal line through D meets the vertical line through C, at $E(-5, -3)$.

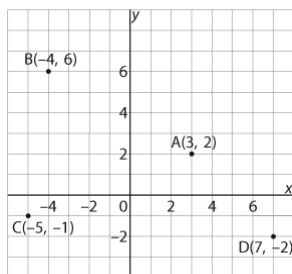
E can lie where the vertical line through D meets the horizontal line through C (the x-axis) at $E(-2, 0)$.

Use a protractor to draw a right angle at C. Another point E lies anywhere on this line.

One point is at $E(-2, 3)$.

Reflect

I chose A(3, 2), B(-4, 6), C(-5, -1), and D(7, -2).



To plot point A, begin at 3 on the x -axis and move 2 units up.

To plot point B, begin at -4 on the x -axis and move 6 units up.

To plot point C, begin at -5 on the x -axis and move 1 unit down.

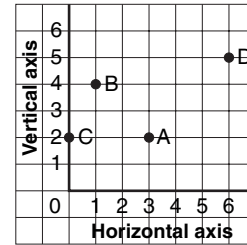
To plot point D, begin at 7 on the x -axis and move 2 units down.

You have plotted points with whole-number coordinates on a grid.

Point A has coordinates (3, 2).

What are the coordinates of point B? Point C?

Point D?



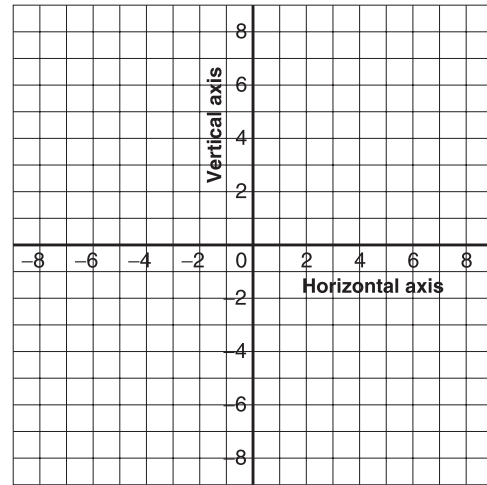
A vertical and a horizontal number line intersect at right angles at 0.

This produces a grid on which you can plot points with integer coordinates.

Explore



Work with a partner.
You will need grid paper and a ruler.
Copy this grid.



Draw a figure on the grid.
Make sure there is at least one vertex in each of the 4 parts on the grid.
Each vertex should be at a point where grid lines meet.
Label each vertex with a letter and the coordinates of the point.

List the vertices, with their coordinates, in order.
Trade lists with your partner.
Use the list to draw your partner's figure.

Show and Share

Compare the figures you and your partner drew.
If they do not match, try to find which figure is incorrect, and why.

LESSON FOCUS | Locate and graph points in four quadrants on a coordinate grid.

Connect

A vertical number line and a horizontal number line that intersect at right angles at 0 form a **coordinate grid**.

The horizontal axis is the **x-axis**.

The vertical axis is the **y-axis**.

The axes meet at the **origin**.

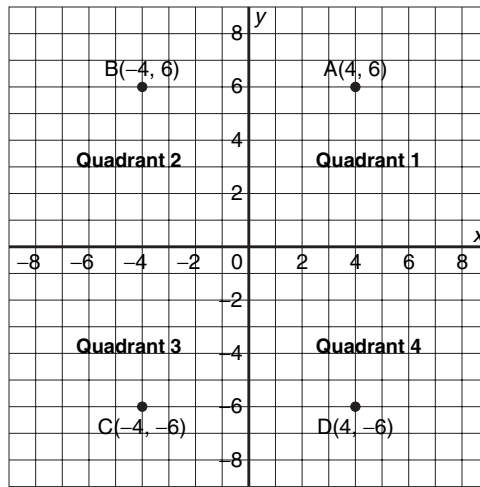
The axes divide the plane into four **quadrants**.

They are numbered counterclockwise.

We do not need arrows on the axes.

A pair of coordinates is called an ordered pair.

We do *not* include a + sign for a positive coordinate.

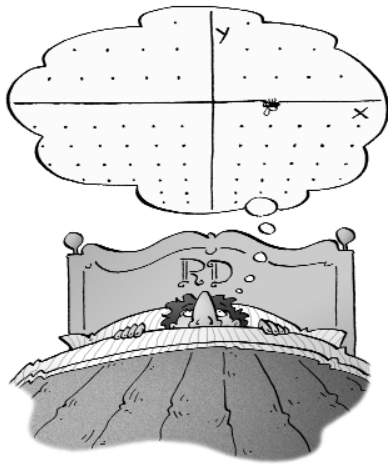


In Quadrant 1, point A has coordinates (4, 6).

In Quadrant 2, point B has coordinates (-4, 6).

In Quadrant 3, point C has coordinates (-4, -6).

In Quadrant 4, point D has coordinates (4, -6).



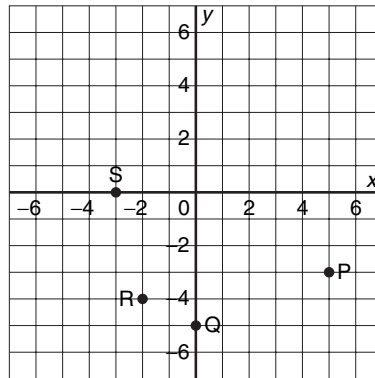
Math Link

History

René Descartes lived in the 17th century. He developed the coordinate grid. It is named the Cartesian grid in his honour. There is a story that René was lying in bed and watching a fly on the ceiling. He invented coordinates as a way to describe the fly's position.

Example

- a) Write the coordinates of each point.
 i) P ii) Q iii) R iv) S

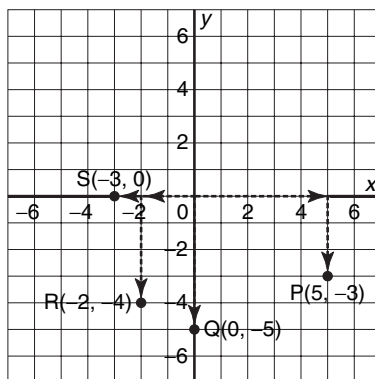


- b) Plot each point on a grid.
 i) $D(-1, 3)$ ii) $E(-3, -5)$ iii) $F(0, -2)$ iv) $G(-4, 0)$

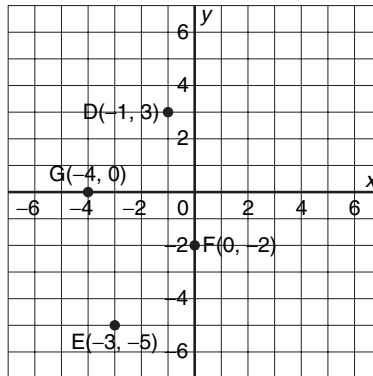
Solution

Remember, first move left or right, then up or down.

- a) Start at the origin each time.
 i) To get to P, move 5 units right and 3 units down.
 So, the coordinates of P are $(5, -3)$.
 ii) To get to Q, move 0 units right and 5 units down.
 So, the coordinates of Q are $(0, -5)$.
 iii) To get to R, move 2 units left and 4 units down.
 So, the coordinates of R are $(-2, -4)$.
 iv) To get to S, move 3 units left and 0 units down.
 So, the coordinates of S are $(-3, 0)$.

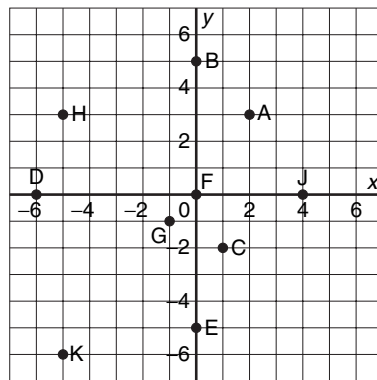


- b) i) $D(-1, 3)$
 Start at -1 on the x -axis.
 Move 3 units up. Mark point D.
- ii) $E(-3, -5)$
 Start at -3 on the x -axis.
 Move 5 units down. Mark point E.
- iii) $F(0, -2)$
 Start at the origin.
 Move 2 units down the y -axis. Mark point F.
- iv) $G(-4, 0)$
 Start at -4 on the x -axis.
 Since there is no movement up or down,
 point G lies on the x -axis. Mark point G.



Practice

1. Write the coordinates of each point from A to K.



Calculator Skills

Calculate the surface area of a rectangular prism with dimensions 2.2 cm by 4.4 cm by 7.7 cm.

Remember that congruent rectangles are *not* different.

Take It Further

2. Use the coordinate grid in question 1. Which points have:

a) x -coordinate 0?	b) y -coordinate 0?
c) the same x -coordinate?	d) the same y -coordinate?
e) equal x - and y -coordinates?	f) y -coordinate +2?

3. Draw a coordinate grid. Label the axes. Plot each point.

a) $A(6, -6)$	b) $B(5, 0)$	c) $C(-2, 7)$
d) $D(-3, 8)$	e) $E(3, 1)$	f) $F(0, -4)$
g) $O(0, 0)$	h) $H(-4, -1)$	i) $J(-8, 0)$

4. Suppose you are given the coordinates of a point. You do not plot the point. How can you tell which quadrant the point will be in?

5. Draw a scalene triangle on a coordinate grid. Each vertex should be in a different quadrant.
 - a) Label each vertex with its coordinates.
 - b) What is the area of the triangle?

6. **Assessment Focus**
 Use a coordinate grid. How many different rectangles can you draw that have area 12 units²? For each rectangle you draw, label its vertices.

7.
 - a) Plot these points: $K(-3, 4)$, $L(1, 4)$, $M(1, -2)$
 - b) Find the coordinates of point N that forms rectangle $KLMN$.

8.
 - a) Plot these points on a grid: $A(5, -7)$, $B(-3, 3)$, and $C(8, 8)$. Join the points.
 - b) Find the area of $\triangle ABC$.

9. Plot the points $C(-5, 0)$ and $D(-2, -3)$. E is a point such that $\triangle CDE$ is a right triangle. Find at least three possible positions for E . Write the coordinates of each point.

Reflect

Choose four points, one in each quadrant. Write instructions to plot each point. Draw a grid to show your work.

Master Q5.6

Unit Rubric: Data Management

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding of data management by appropriately: - formulating survey questions - organizing and describing data in tables - discussing reasonableness of data and results	limited understanding; may be unable to: - formulate survey questions - describe data in tables - discuss reasonableness of data and results	some understanding; partially able to: - formulate survey questions - describe data in tables - discuss reasonableness of data and results	shows understanding; able to: - formulate survey questions - describe data in tables - discuss reasonableness of data and results	thorough understanding; in various contexts, able to: - formulate survey questions - describe data in tables - discuss reasonableness of data and results
Processes • accurately: - collects and records data - interprets a circle graph - calculates mean - locates objects in a Cartesian Plane	limited accuracy; often makes major errors or omissions in: - collecting and organizing data - interpreting a circle graph - calculating mean - locating objects in a Cartesian Plane	partially accurate; makes frequent minor errors or omissions in: - collecting and organizing data - interpreting a circle graph - calculating mean - locating objects in a Cartesian Plane	generally accurate; makes few errors or omissions in: - collecting and organizing data - interpreting a circle graph - calculating mean - locating objects in a Cartesian Plane	accurate; rarely makes errors or omissions in: - collecting and organizing data - interpreting a circle graph - calculating mean - locating objects in a Cartesian Plane
Solves situational problems				
• solves and creates problems involving statistics, and validates and explains solutions	has difficulty solving and creating problems involving statistics; unable to validate or explain solutions	with some support or prompting, solves and creates problems involving statistics in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving statistics; validates and explains solutions	solves and creates problems involving statistics in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about data management, using mathematical language and objects, drawings, tables, symbols, graphs, or words	has difficulty interpreting and producing mathematical messages about data management	partially able to interpret and produce mathematical messages about data management	interprets and produces mathematical messages about data management	interprets and produces precise mathematical messages about data management
Cross-curricular competency: to use information/communication technologies				
• uses computer software to collect data and produce graphic representations	unable to use computer software appropriately	with support, able to use computer software for simple data collection and graphic representations	uses computer software appropriately for simple data collection and graphic representations	uses computer software effectively for data collection and to create a variety of graphic representations

**Performance Assessment Rubric:
Playing with Letters**

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
<p>Concepts</p> <ul style="list-style-type: none"> shows understanding of data management concepts by offering reasonable predictions, inferences, and conclusions, supported by explanations and convincing evidence 	<p>shows little understanding of data management concepts in:</p> <ul style="list-style-type: none"> - comparisons of the graph in Part 1 to population data - predictions and inferences based on sample of a Cree text - explanations and verifications of predictions about letter frequency in French 	<p>shows partial understanding of data management concepts in:</p> <ul style="list-style-type: none"> - comparisons of the graph in Part 1 to population data - predictions and inferences based on sample of a Cree text - explanations and verifications of predictions about letter frequency in French 	<p>shows understanding of data management concepts in:</p> <ul style="list-style-type: none"> - comparisons of the graph in Part 1 to population data - predictions and inferences based on sample of a Cree text - explanations and verifications of predictions about letter frequency in French 	<p>shows thorough understanding of data management concepts in:</p> <ul style="list-style-type: none"> - comparisons of the graph in Part 1 to population data - predictions and inferences based on sample of a Cree text - explanations and verifications of predictions about letter frequency in French
<p>Processes</p> <ul style="list-style-type: none"> applies data skills appropriately to construct, interpret, and compare graphs accurately 	<p>limited accuracy; makes frequent major errors or omissions in:</p> <ul style="list-style-type: none"> - constructing graphs - reading and interpreting graphs - comparing graphs 	<p>partially accurate; makes frequent minor errors or omissions in:</p> <ul style="list-style-type: none"> - constructing graphs - reading and interpreting graphs - comparing graphs 	<p>generally accurate; few errors or omissions in:</p> <ul style="list-style-type: none"> - constructing graphs - reading and interpreting graphs - comparing graphs 	<p>accurate; rarely makes errors or omissions in:</p> <ul style="list-style-type: none"> - constructing graphs - reading and interpreting graphs - comparing graphs
Solves situational problems				
<ul style="list-style-type: none"> uses appropriate strategies for identifying whether or not a sample of language is Cree, and to analyse why languages such as Navajo can be used to make good codes 	<p>unable to use appropriate strategies to:</p> <ul style="list-style-type: none"> - identify whether or not a sample of language is Cree - analyse why languages such as Navajo can be used to make good codes 	<p>uses some appropriate strategies, with partial success, to:</p> <ul style="list-style-type: none"> - identify whether or not a sample of language is Cree - analyse why languages such as Navajo can be used to make good codes 	<p>uses appropriate strategies to successfully:</p> <ul style="list-style-type: none"> - identify whether or not a sample of language is Cree - analyse why languages such as Navajo can be used to make good codes 	<p>uses appropriate, efficient, and often innovative strategies to successfully:</p> <ul style="list-style-type: none"> - identify whether or not a sample of language is Cree - analyse why languages such as Navajo can be used to make good codes
Communicates using mathematical language				
<ul style="list-style-type: none"> uses mathematical language correctly represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	<p>uses few appropriate mathematical terms</p> <p>does not represent his/her thinking and solutions clearly</p>	<p>uses some appropriate mathematical terms</p> <p>represents his/her thinking and solutions with some clarity; may be hard to follow in places</p>	<p>uses appropriate mathematical terms</p> <p>represents his/her thinking and solutions clearly</p>	<p>uses a range of appropriate mathematical terms with precision</p> <p>represents his/her thinking and solutions clearly and precisely</p>

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The graphs are constructed correctly and labelled appropriately.				
Reasonable predictions and conclusions are made.				
There are convincing reasons to support the conclusions.				
Procedures are explained clearly, using appropriate mathematical language.				

Planning for Unit 6: Measurement

Supporting Cross-Curricular Competencies

Unit Focus: to cooperate with others

Materials

Master Q6.1:

Unit Rubric: Measurement

Master Q6.2:

Performance Assessment Rubric: Travelling Time

Master Q6.3:

Peer and Self Assessment: Unit Problem (Unit 6)

The Measurement unit provides students with many opportunities to engage in group activities. Here are some of the Student Book features that promote teamwork:

- The **Explore** section in each lesson encourages students to work collaboratively to complete each activity (for example, on pages 214, 220, and 224); different groupings are recommended.
- The **Show and Share** section in each lesson (for example, on pages 228 and 233) gives students a chance to share what they learned in the **Explore** activity.
- Encourage students to re-read the **Connect** in each lesson, in pairs or in a group, to reinforce understanding of new concepts (for example, on pages 221 and 229).
- Allow time for students to share answers to the **Reflect** activities to foster discussion and appreciation of their peers' ideas and opinions (for example, on pages 217 and 223).

Use Master Q6.1: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning:

Environmental Awareness and Consumer Rights and Responsibilities

Educational Aim: to encourage students to develop an active relationship with their environment while maintaining a critical attitudes towards exploitation of the environment, technological development and consumer goods

The Unit Problem can be opened up mathematically, and extended.

Have students examine environmental implications of the transportation choices people make, and the amount of luggage people travel with. Consider having students complete one or more of the following activities:

- Look at the choices Anika is making for her vacation. In groups, find the most cost effective and energy efficient way for her to travel around Alberta. For example, public transportation, walking, renting bicycles, and so on.
- Estimate and calculate the savings in fuel costs if every passenger takes 16 kg of luggage rather than 32 kg.
- Plan a cost-effective, energy-efficient vacation for your family.

Use Master Q6.2: Performance Assessment Rubric and Master Q6.3: Peer and Self Assessment to support the assessment of the Unit Problem.

Master Q6.1

Unit Rubric: Measurement

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts <ul style="list-style-type: none"> shows understanding of measurement by: <ul style="list-style-type: none"> estimating surface area demonstrating and explaining the relationship between capacity and volume estimating volume constructing objects of a specific volume choosing and explaining appropriate procedures 	limited understanding; may be unable to: <ul style="list-style-type: none"> demonstrate and explain the relationship between capacity and volume estimate volume construct objects of a specific volume choose and explain appropriate procedures 	some understanding; partially able to: <ul style="list-style-type: none"> demonstrate and explain the relationship between capacity and volume estimate volume construct objects of a specific volume choose and explain appropriate procedures 	shows understanding; able to: <ul style="list-style-type: none"> demonstrate and explain the relationship between capacity and volume estimate volume construct objects of a specific volume choose and explain appropriate procedures 	thorough understanding; able to: <ul style="list-style-type: none"> demonstrate and explain the relationship between capacity and volume estimate volume construct objects of a specific volume choose and explain appropriate procedures
Processes <ul style="list-style-type: none"> accurately: <ul style="list-style-type: none"> relates units of measure (time, money, volume, capacity, mass) estimates, measures, and compares surface area, mass, volume, and capacity 	limited accuracy; often makes major errors or omissions in: <ul style="list-style-type: none"> relating units of measure estimating, measuring, and comparing surface area, mass, volume, and capacity 	partially accurate; makes frequent minor errors or omissions in: <ul style="list-style-type: none"> relating units of measure estimating, measuring, and comparing surface area, mass, volume, and capacity 	generally accurate; makes few errors or omissions in: <ul style="list-style-type: none"> relating units of measure estimating, measuring, and comparing surface area, mass, volume, and capacity 	accurate; rarely makes errors or omissions in: <ul style="list-style-type: none"> relating units of measure estimating, measuring, and comparing surface area, mass, volume, and capacity
Solves situational problems				
<ul style="list-style-type: none"> solves and creates problems involving measurement, and validates and explains solutions 	has difficulty solving and creating problems involving measurement; unable to validate or explain solutions	with some support, solves and creates problems involving measurement in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving measurement; validates and explains solutions	solves and creates problems involving measurement in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
<ul style="list-style-type: none"> interprets and produces messages about measurement, using mathematical language and drawings, tables, symbols, graphs, or words 	has difficulty interpreting and producing mathematical messages about measurement	partially able to interpret and produce mathematical messages about measurement	interprets and produces mathematical messages about measurement	interprets and produces precise mathematical messages about measurement
Cross-curricular competency: to cooperate with others				
<ul style="list-style-type: none"> shows commitment when working with a partner or group by supporting others and sharing responsibility for the processes the group uses 	little commitment to teamwork; does not support others or share responsibility	some commitment to teamwork; supports others and is willing to follow processes suggested by others	shows commitment to teamwork; supports others and shares responsibility for determining the processes the group uses	shows strong commitment to teamwork; supports others and shares responsibility for the processes the group uses; negotiates effectively as needed

Performance Assessment Rubric: Travelling Time

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
<p>Concepts</p> <ul style="list-style-type: none"> • explanations and instructions show understanding of relationships among units and measures 	<p>explanations and instructions show little understanding of relationships among units and measures</p>	<p>explanations and instructions show partial understanding of relationships among units and measures</p>	<p>explanations and instructions show understanding of relationships among units and measures</p>	<p>explanations and instructions show thorough understanding of relationships among units and measures</p>
<p>Processes</p> <ul style="list-style-type: none"> • accurately applies measurement skills to: <ul style="list-style-type: none"> - calculate total travelling times and flying times - calculate mass of the luggage - determine possible dimensions of suitcase - calculate least possible volume of baggage department 	<p>limited accuracy; makes frequent major errors or omissions in: <ul style="list-style-type: none"> - calculating total travelling times and flying times - calculating mass of the luggage - determining possible dimensions of suitcase - calculating least possible volume of baggage department </p>	<p>partially accurate; makes frequent minor errors or omissions in: <ul style="list-style-type: none"> - calculating total travelling times and flying times - calculating mass of the luggage - determining possible dimensions of suitcase - calculating least possible volume of baggage department </p>	<p>generally accurate; few errors or omissions in: <ul style="list-style-type: none"> - calculating total travelling times and flying times - calculating mass of the luggage - determining possible dimensions of suitcase - calculating least possible volume of baggage department </p>	<p>accurate; very few, if any, errors or omissions in: <ul style="list-style-type: none"> - calculating total travelling times and flying times - calculating mass of the luggage - determining possible dimensions of suitcase - calculating least possible volume of baggage department </p>
Solves situational problems				
<ul style="list-style-type: none"> • uses appropriate strategies (e.g., estimating, measuring, sketching) to solve the problems 	<p>uses a few simple strategies to attempt the problems; limited success</p>	<p>uses some appropriate strategies, with partial success, to solve the problems</p>	<p>uses appropriate strategies with considerable success to solve the problems</p>	<p>uses appropriate, efficient, and often innovative, strategies to solve the problems successfully</p>
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	<p>uses few appropriate mathematical terms</p> <p>does not represent his/her thinking and solutions clearly</p>	<p>uses some appropriate mathematical terms</p> <p>represents his/her thinking and solutions with some clarity; may be hard to follow in places</p>	<p>uses appropriate mathematical terms</p> <p>represents his/her thinking and solutions clearly</p>	<p>uses a range of appropriate mathematical terms with precision</p> <p>represents his/her thinking and solutions clearly and precisely</p>

Master Q6.3

Peer and Self Assessment: Unit Problem (Unit 6)

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The reasons for recommending which flight Anika should take are explained and justified.				
All calculations of time are correct (Part 1).				
All calculations about the suitcases and baggage are correct (Part 2).				
All work and solutions are shown clearly, using appropriate mathematical language.				

Planning for Unit 7: Transformational Geometry

Supporting Cross-Curricular Competencies

Recommended Software: *The Geometer's Sketchpad*

Unit Focus: to use creativity

Materials

Master Q7.1:

Unit Rubric: Transformational Geometry

Master Q7.2:

Performance Assessment Rubric: Art and Architecture

Master Q7.3:

Peer and Self Assessment: Unit Problem (Unit 7)

The Transformational Geometry unit encourages students to bring their own understanding, their own strategies, and their own ideas to new problem situations. Make use of these Student Book features that promote creative thinking:

- Many of the **Explore** activities allow students to select materials that best suit their needs for solving each problem; ensure a variety of materials are available for student use to encourage creative solutions (for example, on pages 256 and 260).
- The **Reflect** activities (for example, on pages 251 and 255) give students the opportunity to show originality in their thinking; in addition to students using words, pictures, and numbers to explain their thinking, encourage them to reflect on their learning in other ways (such as making a model or writing a poem).
- Encourage students to solve the Practice questions in the **Strategies Toolkit** lesson (Lesson 7) using different strategies; provide opportunities for students to share their strategies with the class. Use Master Q7.1: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning: *Citizenship and Community Life*

Educational Aim: to ensure that students take part in the democratic life of the classroom or the school and develop a spirit of openness to the world and respect for diversity

The Unit Problem can be opened up mathematically, and extended.

Use the Unit Problem to initiate a study of famous buildings in different cultures (e.g., the Alhambra, the Taj Mahal, the Egyptian pyramids.) In pairs, have students select a famous building, then research and report on it, including:

- its location
- an analysis of the architecture and design (types of angles, patterns, and shapes)
- an explanation of its cultural or religious significance

Have students display their research. Encourage them to create a digital slide show (e.g., PowerPoint).

Use Master Q7.2: Performance Assessment Rubric and Master Q7.3: Peer and Self Assessment to support the assessment of the Unit Problem.

Master Q7.1
Unit Rubric: Transformational Geometry

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding by demonstrating and explaining: - location on an axis - the effect of translations - the relationship between tessellations and translations	limited understanding; may be unable to demonstrate or explain: - location on an axis - the effect of translations - the relationship between tessellations and translations	some understanding; partially able to demonstrate or explain: - location on an axis - the effect of translations - the relationship between tessellations and translations	shows understanding; able to demonstrate or explain: - location on an axis - the effect of translations - the relationship between tessellations and translations	thorough understanding; in various contexts, able to demonstrate or explain: - location on an axis - the effect of translations - the relationship between tessellations and translations
Processes • accurately: - analyses and describes designs using translations - applies translations	limited accuracy; often makes major errors or omissions in: - analysing and describing designs using translations - applying translations	partially accurate; makes frequent minor errors or omissions in: - analysing and describing designs using translations - applying translations	generally accurate; makes few errors or omissions in: - analysing and describing designs using translations - applying translations	accurate; rarely makes errors or omissions in: - analysing and describing designs using translations - applying translations
Solves situational problems				
• solves and creates problems involving transformations, and validates and explains solutions	has difficulty solving and creating problems involving transformations; unable to validate or explain solutions	with some support or prompting, solves and creates problems involving transformations in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving transformations; validates and explains solutions	solves and creates problems involving transformations in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about transformations, using mathematical language and objects, drawings, tables, symbols, graphs, or words	has difficulty interpreting and producing mathematical messages about transformations	partially able to interpret and produce mathematical messages about transformations	interprets and produces mathematical messages about transformations	interprets and produces precise mathematical messages about transformations
Cross-curricular competency: to use creativity				
• systematically prepares and organizes steps to complete a creative task	has difficulty determining how to prepare and organize steps for a creative task	with prompting and support, makes basic preparations and organizes the main steps for a creative task	makes basic preparations and organizes key steps for a creative task	makes thorough preparations and organizes steps for a creative task; able to foresee potential need for alternate methods

**Performance Assessment Rubric:
Art and Architecture**

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
Concepts <ul style="list-style-type: none"> descriptions and explanations show understanding of transformations and symmetry 	descriptions and explanations show little understanding of transformations and symmetry	descriptions and explanations show partial understanding of transformations and symmetry	descriptions and explanations show understanding of transformations and symmetry	descriptions and explanations show thorough understanding of transformations and symmetry
Processes <ul style="list-style-type: none"> accurately identifies transformations in patterns 	makes frequent major errors or omissions in identifying transformations in patterns	partially accurate; makes frequent minor errors or omissions in identifying transformations in patterns	generally accurate; few errors or omissions in identifying transformations in patterns	accurate; very few, if any, errors or omissions in identifying transformations and symmetry in patterns
Solves situational problems				
<ul style="list-style-type: none"> uses appropriate strategies (e.g., estimating, measuring, sketching) to design a mural using transformations 	uses a few simple strategies, with limited success, to design a mural using transformations	uses some appropriate strategies, with partial success, to design a mural using transformations	uses appropriate strategies, with considerable success, to design a mural using transformations	uses appropriate, efficient, and often innovative strategies to design a mural using transformations
Communicates using mathematical language				
<ul style="list-style-type: none"> communicates procedures and reasoning clearly, using appropriate geometric language presents sketches and designs clearly, using appropriate geometric conventions 	limited effectiveness; does not communicate clearly designs are often unclear	some effectiveness; communicates with some clarity presents designs with some clarity	considerable effectiveness; communicates clearly presents designs clearly	a high degree of effectiveness; communicates clearly and precisely presents designs clearly and precisely

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The transformations in each pattern are identified (Part 1).				
An interesting mural is designed that uses transformations.				
There is a clear description of how transformations are used in the design.				
Appropriate mathematical language is used in all explanations.				

Planning for Unit 8: Fractions, Percents, Ratios, and Rates

Meeting the Quebec Essential Knowledges

- Use Lesson 5A (Masters Q8.1 to Q8.5) after Lesson 5, with supporting Teaching Notes (pages 27a – 27d).

Supporting Cross-Curricular Competencies

Unit Focus: to solve problems

Materials

Masters Q8.1 to Q8.5:

Lesson 5A: Exploring Repeated Addition

Master Q8.6:

Unit Rubric: Fractions, Percents, Ratios, and Rates

Master Q8.7:

Performance Assessment Rubric: Read the Label!

Master Q8.8:

Peer and Self Assessment: Unit Problem (Unit 8)

In the Fractions, Percents, Ratios, and Rates unit, students solve problems in various contexts. Utilize these Student Book and Teacher Guide features to support students' development of effective problem solving skills:

- In all of the **Explore** activities and in **Practice** questions, problem-solving opportunities are presented in relevant contexts; encourage students to share their problem-solving strategies with the class.
- In the **Strategies Toolkit** lesson (Lesson 12), students approach new problems involving critical and creative thinking; review the given list of Strategies for Success and encourage students to share the strategies they used to solve the Practice questions with the class.
- In the Teacher Guide module **Grade 6 Planning and Program Masters**, Program Master 3 (Self-Assessment: Problem Solving) promotes individual reflection about the problem-solving process; use this assessment tool with any problem throughout the unit.

Use Master Q8.6: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning:

Health and Well-Being

Educational Aim: to ensure that students adopt a self-monitoring procedure concerning the development of good living habits related to health, well-being, sexuality and safety

The Unit Problem can be opened up mathematically, and extended.

- In pairs, have students compare their typical breakfasts (question 5), then make a plan to improve or maintain the nutritional quality of their breakfasts.
- Have students identify other nutritional requirements/recommendations (e.g., fibre, Vitamins) and compare their daily intake to recommended amounts.
- Create a "class requirement" chart by multiplying daily recommendations for key nutrients by the number of students in the class. For a week, combine all students' intake of these nutrients and record the results. Have students analyse the eating habits of the class as a whole and determine strengths and weaknesses. Consider inviting a guest speaker, or contacting a nutritionist by e-mail, to get recommendations about ways in which the class can eat in a more healthy way.
- Have students plan and create a nutrition guide and diary (for tracking nutritional value of food) they can share with their families.

Use Master Q8.7: Performance Assessment Rubric and Master Q8.8: Peer and Self Assessment to support the assessment of the Unit Problem.

Lesson Organizer

80–100 min

Curriculum Focus

Multiply a fraction by a whole number.

Teacher Materials

- fraction strips (Masters Q8.4 and Q8.5)

Student Materials

- fraction strips (Masters Q8.4 and Q8.5)
- 0.5-cm grid paper (PM 22)

Assessment

Master Q8.6 Unit Rubric: Fractions, Percents, Ratios, and Rates

Key Math Learning

The repeated addition of fractions can be illustrated as a product in a similar way to the repeated addition of whole numbers.

Number Strategies

To divide by 10, move the decimal point one place to the left. Since dividing by 10 is the same as multiplying by 0.1, the answers in each row are equal.

LESSON 5A: EXPLORING REPEATED ADDITION

BEFORE

Get Started

Have students share their strategies for finding the sum of repeated whole numbers. Some will do the addition as it is, others may look for groupings of 10 (5 twos) and 4 more twos, or write it as $9 \times 2 = 18$. Provide fraction strips and grid paper.

DURING

Explore

Ongoing Assessment: Observe and Listen

As students work in pairs, ask:

- Which strategy did you use?
(*I added $\frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} = \frac{27}{4} = 6\frac{3}{4}$.*)
- What other strategy could you have used? (*I know that $\frac{3}{4} + \frac{3}{4} = 1\frac{1}{2}$. So, eight $\frac{3}{4}$ s will be $1\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2} = 6$; and one more $\frac{3}{4}$ makes $6\frac{3}{4}$.*)
- How does your strategy relate to adding repeated whole numbers? (*The sum of 9 $\frac{3}{4}$ s is the same as 9 times $\frac{3}{4}$, which is $\frac{27}{4} = 6\frac{3}{4}$.*)

AFTER

Connect

Have students share their strategies with the class. Review the examples in *Connect*, reinforcing that repeated addition is the same as multiplying the whole number and the numerator of the fraction. The denominator is not affected.

For *Example 2*, review that $3 \times 5 = 5 \times 3 = 15$. This property is true for any numbers, so $\frac{3}{5} \times 5 = 5 \times \frac{3}{5}$.

Use Cuisenaire rods to model the products in the *Examples* in *Connect*.

For *Example 1*, since the denominator is 8, use the rod that is 8 cm long, the brown rod, to represent one whole. Then $\frac{3}{8}$ is represented by the light green rod.

Place 9 light green rods in a line.

Beneath these rods, place as many brown rods as needed to find the total of the fractions represented by the light green rods.

Teaching Notes

We need 4 brown rods. The light green rods align to show 3 wholes and $\frac{3}{8}$. The sum $\frac{27}{8}$ can be written as $3\frac{3}{8}$.

For *Example 2a*, use the yellow rod to represent one whole, and the light green rod to represent $\frac{3}{5}$. Align the green rods. Align the yellow rods. Three yellow rods align with 5 green rods to show that $\frac{3}{5} \times 5 = 3$.

For *Example 2b*, use the dark green rod to represent one whole and the yellow rod to represent $\frac{5}{6}$. The rods illustrate that $\frac{35}{6}$ can be written as $5\frac{5}{6}$.

Practice

Provide 0.5-cm grid paper (PM 22) for students to record their pictures.

Assessment Focus: Question 8

Students can represent $5 \times \frac{1}{2}$ as 5 congruent rectangles, with $\frac{1}{2}$ of each rectangle shaded. For $\frac{1}{2} \times 5$, students know it is $2\frac{1}{2}$ (from part a), so they can interpret $\frac{1}{2} \times 5$ as $\frac{1}{2}$ of 5, and draw a set of 5 objects, with $2\frac{1}{2}$ of them shaded.

Assessment for Learning

What to Look for	What to Do
<p>Knowledge and Understanding</p> <p>✓ Students understand that the repeated addition of a fraction is the same as the product of a whole number (which is the number of fractions) and the fraction.</p> <p>Application</p> <p>✓ Student can apply what they know about the product of whole numbers to the product of a fraction and a whole number.</p> <p>Thinking</p> <p>✓ Students can use the product of a fraction and a whole number to solve problems.</p>	<p>Extra Support: Have students continue to draw diagrams or use fraction strips to model each question.</p> <p>Extra Practice: Have students work in pairs, with grid paper and 3 number cubes labelled 1 to 6, 3 to 8, and 5 to 10. One student rolls the cubes, and uses the 3 numbers to write a fraction and a whole number. The other student multiplies the fraction and whole number, then draws a picture to illustrate the product. Students take turns to roll the cubes.</p> <p>Extension: Have students choose 3 different numbers between 0 and 10. They use these numbers to write as many different multiplication questions as they can, and find each product.</p>
<p>Recording and Reporting</p>	<p>Master Q8.6: Unit Rubric: Fractions, Percents, Ratios, and Rates</p>

REACHING ALL LEARNERS

Early Finishers

Have students make up another problem similar to question 9, and solve it. Students trade problems with a classmate, then solve the classmate's problem, and compare solutions. Students may need to edit their problems and/or solutions after other students have tried them.

Common Misconceptions

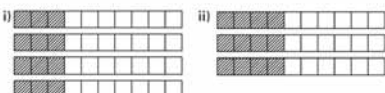
✓ Students erroneously multiply the denominator by the whole number.

How to Help: Encourage students to read the problem aloud; for example, 4 times three-fifths is twelve-fifths. Alternatively, have students write the product as a sum of fractions first.

Sample Answers

- 1.a) $3 \times \frac{1}{4}$ b) $5 \times \frac{2}{7}$ c) $4 \times \frac{3}{10}$
 2.a) $\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}$ b) $\frac{2}{5} + \frac{2}{5} + \frac{2}{5}$ c) $\frac{5}{12} + \frac{5}{12} + \frac{5}{12} + \frac{5}{12}$
 3.a) $\frac{12}{7}$ b) $\frac{5}{12}$ c) $\frac{4}{3}$ d) 9 e) $\frac{14}{5}$ f) $\frac{9}{2}$
 4.a) $\frac{12}{5}$ b) $\frac{7}{2}$ c) 5 d) $\frac{5}{2}$ e) 7 f) 6


5. 16 h

- 6.a)  i) and ii) are both $\frac{12}{10}$

b) The products are equal. The numerator and whole number are interchanged.

$$5 \times \frac{3}{8} = 3 \times \frac{5}{8} = \frac{15}{8}$$

7. $\frac{9}{4}$ cups = $2\frac{1}{4}$ cups

- 8.a)  $\frac{5}{2}$ or $2\frac{1}{2}$

b) $\frac{1}{2} \times 5$ is equal to $5 \times \frac{1}{2} = 2\frac{1}{2}$. So, $\frac{1}{2}$ of 5 is $2\frac{1}{2}$. Since $\frac{1}{2}$ of 5 is $2\frac{1}{2}$, then $\frac{1}{2} \times 5$ means $\frac{1}{2}$ of 5. I have 5 cookies. I give my friend half of the cookies. My friend has $2\frac{1}{2}$ cookies.



9. Jacob fills 1 shelf in $\frac{3}{4}$ h. Henry fills 2 shelves in $\frac{3}{4}$ h. So, together they fill 3 shelves in $\frac{3}{4}$ h.

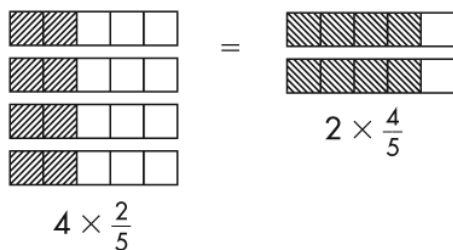
They have 15 shelves to fill. Since $15 = 3 \times 5$, they will take $5 \times \frac{3}{4}$ h = $\frac{15}{4}$ h = $3\frac{3}{4}$ h.

Answers to Number Strategies

600; 60; 6; 0.6

Teaching Notes

Reflect



$4 \times \frac{2}{5} = 2 \times \frac{4}{5} = \frac{8}{5}$ because we multiply the whole number and numerator to get the total number of fifths.

How many ways can you find this sum?

$$2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2$$

You can use the same strategies in *Explore*.

Explore



Work with a partner.

Jan takes $\frac{3}{4}$ h to walk to her music lesson.

Jan has a music lesson once a week, for 9 weeks.

How much time does Jan spend walking to her music lessons?

Show and Share

Compare your strategy for solving the problem with that of another pair of classmates.

Did you get the same answers?

If not, who is correct? Explain.

Connect

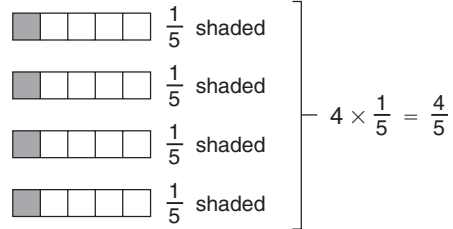
$$\frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5} = \frac{4}{5}$$

All the fractions added are $\frac{1}{5}$.

Repeated addition can be written as multiplication.

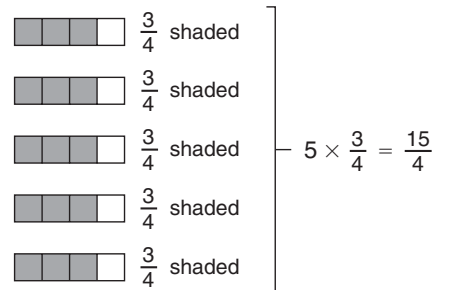
$$\frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5} = 4 \times \frac{1}{5} = \frac{4}{5}$$

We can show this as a picture.



$$\begin{aligned} \text{Similarly: } & \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} \\ & = 5 \times \frac{3}{4} \\ & = \frac{15}{4} \end{aligned}$$

We can show this as a picture.



LESSON FOCUS | Multiply a fraction by a whole number.

Example 1

Use multiplication to find this sum.

$$\frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8}$$

Solution

$$\begin{aligned} \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} &= 9 \times \frac{3}{8} \\ &= \frac{27}{8} \end{aligned}$$

Think:

9 times 3 eighths is 27 eighths.

Example 2

Multiply.

a) $\frac{3}{5} \times 5$

b) $7 \times \frac{5}{6}$

Solution

a) $\frac{3}{5} \times 5 = \frac{15}{5}$
 $= 3$

Think:

$\frac{15}{5}$ means $15 \div 5$, which is 3.

b) $7 \times \frac{5}{6} = \frac{35}{6}$

Think:

7 times 5 sixths is 35 sixths.

Practice

1. Write each repeated addition as a multiplication question.

a) $\frac{1}{4} + \frac{1}{4} + \frac{1}{4}$

b) $\frac{2}{7} + \frac{2}{7} + \frac{2}{7} + \frac{2}{7} + \frac{2}{7}$

c) $\frac{3}{10} + \frac{3}{10} + \frac{3}{10} + \frac{3}{10}$

2. Write each multiplication question as repeated addition.

Draw a picture to show each answer.

a) $5 \times \frac{1}{8}$

b) $\frac{2}{5} \times 3$

c) $4 \times \frac{5}{12}$

3. Multiply. Draw a picture to show each answer.

a) $3 \times \frac{4}{7}$

b) $5 \times \frac{1}{12}$

c) $\frac{2}{15} \times 10$

d) $4 \times \frac{9}{4}$

e) $\frac{2}{5} \times 7$

f) $9 \times \frac{1}{2}$

Number Strategies

Calculate each answer.

$6000 \div 10$ 6000×0.1

$600 \div 10$ 600×0.1

$60 \div 10$ 60×0.1

$6 \div 10$ 6×0.1

What patterns do you see in the questions and answers?

Take It Further

4. Multiply.
- a) $3 \times \frac{4}{5}$ b) $5 \times \frac{7}{10}$ c) $\frac{5}{6} \times 6$
 d) $\frac{1}{2} \times 5$ e) $12 \times \frac{7}{12}$ f) $\frac{2}{3} \times 9$
5. It takes $\frac{2}{3}$ h to pick all the apples on one tree at Springwater Farms. There are 24 trees. How long will it take to pick all the apples? Show your work.
6. a) Draw a picture to show each product. What is each answer?
 i) $4 \times \frac{3}{10}$ ii) $3 \times \frac{4}{10}$
 b) How are the questions in part a related? Write 2 more questions like these. Find each product. What do you notice?
7. A cookie recipe calls for $\frac{3}{4}$ cup of oatmeal. How much oatmeal is needed to make 3 batches of cookies?
8. **Assessment Focus**
 a) Draw a picture to show $5 \times \frac{1}{2}$.
 b) What meaning can you give to $\frac{1}{2} \times 5$? Draw a picture to show your thinking.
9. Jacob takes $\frac{3}{4}$ h to fill one shelf at the supermarket. Henry can fill the shelves in half Jacob's time. There are 15 shelves. Henry and Jacob work together. How long will it take to fill the shelves? Justify your answer.



Reflect

Draw a picture to show why $4 \times \frac{2}{5}$ is the same as $\frac{2}{5} + \frac{2}{5} + \frac{2}{5} + \frac{2}{5}$. Explain your picture. Draw a different picture to show the same answer.

Master Q8.4

Fraction Strips 1

1

$\frac{1}{2}$

$\frac{1}{2}$

$\frac{1}{3}$

	$\frac{2}{3}$
--	---------------

$\frac{1}{4}$

			$\frac{3}{4}$
--	--	--	---------------

	$\frac{2}{4}$
--	---------------

	$\frac{2}{4}$
--	---------------

$\frac{1}{5}$

			$\frac{4}{5}$
--	--	--	---------------

	$\frac{2}{5}$
--	---------------

		$\frac{3}{5}$
--	--	---------------

$\frac{1}{6}$

			$\frac{5}{6}$
--	--	--	---------------

	$\frac{2}{6}$
--	---------------

		$\frac{4}{6}$
--	--	---------------

	$\frac{3}{6}$
--	---------------

	$\frac{3}{6}$
--	---------------

Master Q8.5

Fraction Strips 2

$\frac{1}{8}$								$\frac{7}{8}$
	$\frac{2}{8}$							$\frac{6}{8}$
		$\frac{3}{8}$						$\frac{5}{8}$
			$\frac{4}{8}$					$\frac{4}{8}$

$\frac{1}{10}$									$\frac{9}{10}$
	$\frac{2}{10}$								$\frac{8}{10}$
		$\frac{3}{10}$							$\frac{7}{10}$
			$\frac{4}{10}$						$\frac{6}{10}$
				$\frac{5}{10}$					$\frac{5}{10}$

Master Q8.6
Unit Rubric: Fractions, Percents, Ratios, and Rates

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding by: - demonstrating and explaining fractions, percents, and decimals, and their relationships - relating improper fractions and mixed numbers	limited understanding; may be unable to: - demonstrate or explain fractions, percents, and decimals, and their relationships - relate improper fractions and mixed numbers	some understanding; partially able to - demonstrate or explain fractions, percents, and decimals, and their relationships - relate improper fractions and mixed numbers	shows understanding; able to: - demonstrate or explain fractions, percents, and decimals, and their relationships - relate improper fractions and mixed numbers	thorough understanding; able to: - demonstrate or explain fractions, percents, and decimals, and their relationships - relate improper fractions and mixed numbers
Processes • accurately: - expresses fractions in simplest form - estimates and calculates percents - compares and orders mixed numbers and fractions - relates percents to fractions and decimals - adds and subtracts fractions - multiplies fractions by a natural number	limited accuracy; often makes major errors or omissions in: - expressing fractions in simplest form - estimating and calculating percents - comparing and ordering mixed numbers and fractions - relating percents to fractions and decimals - adding, subtracting, and multiplying fractions	partially accurate; makes frequent minor errors or omissions in: - expressing fractions in simplest form - estimating and calculating percents - comparing and ordering mixed numbers and fractions - relating percents to fractions and decimals - adding, subtracting, and multiplying fractions	generally accurate; makes few errors or omissions in: - expressing fractions in simplest form - estimating and calculating percents - comparing and ordering mixed numbers and fractions - relating percents to fractions and decimals - adding, subtracting, and multiplying fractions	accurate; rarely makes errors or omissions in: - expressing fractions in simplest form - estimating and calculating percents - comparing and ordering mixed numbers and fractions - relating percents to fractions and decimals - adding, subtracting, and multiplying fractions
Solves situational problems				
• solves and creates problems involving fractions, percents, and decimals, and validates and explains solutions	has difficulty solving and creating problems involving fractions, percents, and decimals; unable to explain solutions	with some support, solves and creates problems involving fractions, percents, and decimals; needs help to explain solutions	solves and creates problems involving fractions, percents, and decimals; explains solutions	solves and creates problems involving fractions, percents, and decimals in effective and often innovative ways; explains solutions
Communicates using mathematical language				
• interprets and produces messages about fractions, percents, and decimals, using mathematical language and drawings, symbols, or words	has difficulty interpreting and producing mathematical messages about fractions, percents, and decimals	partially able to interpret and produce mathematical messages about fractions, percents, and decimals	interprets and produces mathematical messages about fractions, percents, and decimals	interprets and produces precise mathematical messages about fractions, percents, and decimals
Cross-curricular competency: to solve problems				
• organizes information to address a specific question or task	has difficulty organizing information in helpful ways	given a template and clear direction, able to organize information	able to organize information in ways that are helpful	able to organize information effectively in new contexts

**Performance Assessment Rubric:
Read the Label!**

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
<p>Concepts</p> <ul style="list-style-type: none"> • explanations and instructions show understanding of fractions, percents, decimals, and their relationships 	<p>explanations and instructions show little understanding of fractions, percents, decimals and their relationships</p>	<p>explanations and instructions show partial understanding of fractions, percents, decimals and their relationships</p>	<p>explanations and instructions show understanding of fractions, percents, decimals and their relationships</p>	<p>explanations and instructions show thorough understanding of fractions, percents, decimals and their relationships</p>
<p>Processes</p> <ul style="list-style-type: none"> • accurately calculates: - information about Robert's breakfast (questions 1-4) - information about own breakfast (question 5) 	<p>makes frequent major errors or omissions in calculating:</p> <ul style="list-style-type: none"> - information about Robert's breakfast (questions 1-4) - information about own breakfast (question 5) 	<p>partially accurate; makes frequent minor errors or omissions in calculating:</p> <ul style="list-style-type: none"> - information about Robert's breakfast (questions 1-4) - information about own breakfast (question 5) 	<p>generally accurate; few errors or omissions in calculating:</p> <ul style="list-style-type: none"> - information about Robert's breakfast (questions 1-4) - information about own breakfast (question 5) 	<p>accurate; very few, if any, errors or omissions in calculating:</p> <ul style="list-style-type: none"> - information about Robert's breakfast (questions 1-4) - information about own breakfast (question 5)
Solves situational problems				
<ul style="list-style-type: none"> • uses appropriate strategies to estimate and calculate nutritional information and evaluate the results (determine whether or not breakfast is healthy) 	<p>unable to use appropriate strategies to successfully estimate and calculate nutritional information and evaluate the results (determine whether or not breakfast is healthy)</p>	<p>uses appropriate strategies to successfully estimate and calculate nutritional information and evaluate the results (determine whether or not breakfast is healthy)</p>	<p>uses appropriate strategies to successfully estimate and calculate nutritional information and evaluate the results (determine whether or not breakfast is healthy)</p>	<p>uses appropriate, efficient, and often innovative strategies to successfully estimate and calculate nutritional information and evaluate the results (determine whether or not breakfast is healthy)</p>
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	<p>uses few appropriate mathematical terms</p> <p>does not represent his/her thinking and solutions clearly</p>	<p>uses some appropriate mathematical terms</p> <p>represents his/her thinking and solutions with some clarity; may be hard to follow in places</p>	<p>uses appropriate mathematical terms</p> <p>represents his/her thinking and solutions clearly</p>	<p>uses a range of appropriate mathematical terms with precision</p> <p>represents his/her thinking and solutions clearly and precisely</p>

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
Answers about Robert's breakfast are calculated accurately.				
Answers about own breakfast are calculated accurately.				
All calculations are shown.				
Appropriate mathematical language is used for all solutions and explanations.				

Planning for Unit 9: Perimeter, Area, and Volume

Meeting the Quebec Essential Knowledges

- Use Lesson 1A (Masters Q9.1 to Q9.4) after Lesson 1, with supporting Teaching Notes (pages 28a – 28c).

Supporting Cross-Curricular Competencies

Unit Focus: to cooperate with others

Materials

Masters Q9.1 to Q9.4:

Lesson 1A: Investigating Circles

Master Q9.5:

Unit Rubric: Perimeter, Area, and Volume

Master Q9.6:

Performance Assessment Rubric: Stationery Design

Master Q9.7:

Peer and Self Assessment: Unit Problem (Unit 9)

The Perimeter, Area, and Volume unit provides students with many opportunities to engage in group activities. Here are some of the Student Book features that promote teamwork:

- The **Explore** section in each lesson encourages students to work collaboratively to complete each activity (for example, on pages 342, 346, and 352); different groupings are recommended.
- The **Show and Share** section in each lesson (for example, on pages 355, 558, and 362) gives students a chance to share what they learned in the **Explore** activity.
- Encourage students to re-read the **Connect** in each lesson, in pairs or in a group, to reinforce understanding of new concepts (for example, on pages 366 and 370).
- Allow time for students to share answers to the **Reflect** activities to foster discussion and appreciation of their peers' ideas and opinions (for example, on pages 349 and 354).

Use Master Q9.5: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning: Media Literacy

Educational Aim: to develop students' critical and ethical judgment with respect to media and to give them opportunities to produce media documents that respect individual and collective rights

The Unit Problem can be opened up mathematically, and extended.

Initiate a study of how the media and advertising companies influence the celebration of holidays and special occasions, by having students complete one or more of the following activities:

- Choose a traditional celebration or special day, such as Mother's Day, and find out how it started and how it has changed over time.
- Conduct a "media watch" to see how a traditional holiday is portrayed in both news stories and advertising.
- Survey family members to find out their views on how the media and advertisers influence people's expectations about gifts associated with a holiday.
- Identify promotions in your community associated with special occasions, such as birthdays or anniversaries. Use a table or graph to display your findings.

Use Master Q9.6: Performance Assessment Rubric and Master Q9.7: Peer and Self Assessment to support the assessment of the Unit Problem.

Lesson Organizer

80–100 min

Curriculum Focus

Measure radius and diameter, and discover their relationship.

Student Materials

- objects with circular cross sections
- compasses
- scissors
- rulers
- protractors
- copies of logo for Lesson 1A Practice Question 9 (Master Q9.4)
- 3-column charts (PM 18)

Vocabulary

radius, diameter, cross section

Assessment

Master Q9.5 Unit Rubric: Perimeter, Area, and Volume

Key Math Learnings

1. The length of the radius of a circle is one-half of the diameter.
2. The length of the diameter of a circle is twice the length of the radius.
3. The diameter of a circle is the longest line segment that joins two points on the circle.

LESSON 1A: INVESTIGATING CIRCLES

BEFORE

Get Started

List on the board the student responses to the question in the lesson introduction. All the objects have circular cross sections. You may need to explain what a cross section is. Having a model (for example, a soup can, paper towel roll, orange, or Styrofoam ball that you can slice) that you can use to demonstrate is helpful for kinesthetic learners.

Present *Explore*.

Distribute copies of 3-Column Chart (PM 18) to pairs of students. Have students write these headings in the table: "Object," "Distance from the centre," and "Distance across the circle." Students use this table for the second activity in *Explore*.

DURING

Explore

Ongoing Assessment: Observe and Listen

Some students may have difficulties using a compass. Be prepared to help with this.

Finding the centre of the circle may be difficult for some students. Have students share their technique with you before completing *Explore*.

As students work, ask questions, such as:

- How did you decide that you had found the longest segment? (*We drew many segments until we found three that were equal and the longest.*)
- How did you find the centre of the circle? (*We folded the circle in half, twice. The centre of the circle is where the fold lines intersect.*)
- Can you describe another way to find the centre of the circle? (*Find two line segments that are the longest and where they intersect is the centre of the circle.*)
- What patterns do you see in your results? (*The distance from the centre of the circle to the circle is one-half the distance across the circle through its centre.*)

AFTER

Connect

Use students' results or *Connect* to illustrate the relationship between diameter and radius.

Review the *Example* to illustrate how to draw a circle, given its radius or diameter.

Practice

Questions 1, 2, 8, and 10 require a ruler and compass. Question 9 requires Logo for Lesson 1A *Practice* Question 9 (Master Q9.4).

Assessment Focus: Question 9

Students should be able to explain how to find the centre of a circle using a reliable, consistent method. Students should also be able to explain the relationship between the radius and the diameter of a circle. (*The radius is one-half the diameter*).

Assessment for Learning

What to Look for	What to Do
<p>Knowledge and Understanding</p> <ul style="list-style-type: none"> ✓ Students understand the terms radius, diameter, line segment, and midpoint, and how these apply to circles. ✓ Students can find the centre of a circle. <p>Thinking</p> <ul style="list-style-type: none"> ✓ Students can solve problems related to radii and diameters of circles. <p>Application</p> <ul style="list-style-type: none"> ✓ Students can use the relationship between diameter and radius to find one measure when the other is given. 	<p>Extra Support: As students complete <i>Practice</i> question 7, provide them with a cardboard cutout of a circle with radius 3.5 cm and a rectangle that measures 40 cm by 25 cm, so they can use these manipulatives to solve the problem.</p> <p>Extra Practice: Have students make up and solve problems similar to <i>Practice</i> question 6.</p> <p>Extension: Have students estimate, then draw to check, how many circles with equal radii of a given measure will fill a page. Have them investigate if they can fit more circles if they are not arranged in an array.</p>
<p>Recording and Reporting</p>	<p>Master Q9.5: Unit Rubric: Perimeter, Area, and Volume</p>

REACHING ALL LEARNERS

Alternative Explore

Materials: compasses and rulers

Have students draw different circles, measure the diameter and radius of each circle, and determine the relationship between radius and diameter.

Common Misconceptions

✓ Students think the space enclosed by a circle and the centre of the circle are parts of the circle.

How to Help: Show students a hula-hoop. Ask one student to stand inside the hula-hoop. Explain that the hula-hoop is a circle and the student is standing inside the circle. The student is not part of the circle, but is *inside* the circle.

Which attribute do these objects share?



Explore



Work with a partner.

You will need circular objects, a compass, ruler, and scissors.

- Use a compass. Draw a large circle.
 - Use a ruler.
 - Draw a line segment that joins two points on the circle.
 - Measure the line segment. Label the line segment with its length.
 - Draw and measure other segments that join two points on the circle.
 - Find the longest segment in the circle.
 - Repeat the activity for other circles.

- Trace a circular object.
 - Find a way to locate the centre of the circle.
 - Measure the distance from the centre to the circle.
 - Measure the distance across the circle, through its centre.
 - Record the measurements in a table.
 - Repeat the activity with other circular objects.
 - What pattern do you see in your results?

Show and Share

Compare your results with those of another pair of classmates.

Where is the longest segment in any circle?

What relationship did you find between the distance across a circle through its centre, and the distance from the centre to the circle?

LESSON FOCUS | Measure radius and diameter, and discover their relationship.

The word *radii* is the plural of *radius*.

Number Strategies

The mean of 3 numbers is 30.
The least number is 26.
What might the other 2 numbers be?
Find as many answers as you can.

This is the logo for the Aboriginal Health Department of the Vancouver Island Health Authority.



Take It Further

3. a) How many radii does a circle have?
b) How many diameters does a circle have?
4. A circle has diameter 3.8 cm. What is the radius?
5. A circle has radius 7.5 cm. What is the diameter?
6. A circular tabletop is to be cut from a rectangular piece of wood that measures 1.20 m by 1.80 m.
What is the radius of the largest tabletop that could be cut?
Justify your answer. Include a sketch.
7. A glass has a circular base with radius 3.5 cm.
A rectangular tray has dimensions 40 cm by 25 cm.
How many glasses will fit on the tray?
What assumptions do you make?
8. a) Draw a circle.
Draw a diameter. Label it AB.
Choose a point P on the circle.
Join AP and PB. Measure $\angle APB$.
b) Choose another point Q on the circle.
Join AQ and QB. Measure $\angle AQB$.
c) Repeat parts a and b for a different circle.
What do you notice?
9. **Assessment Focus** Your teacher will give you a large copy of this logo.
Find the radius and diameter of each circle in this logo.
Show your work.
10. A circular area of grass needs watering.
A sprinkler is to be placed at the centre of the circle.
Explain how you would locate the centre of the circle.
Include a diagram in your explanation.



Reflect

How are the diameter and radius of a circle related?
When you know the diameter, how can you find the radius?
When you know the radius, how can you find the diameter?
Include examples in your explanation.

MasterQ9.4

Logo for Lesson 1A *Practice Question 9*



Master Q9.5
Unit Rubric: Perimeter, Area, and Volume

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	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding by demonstrating and explaining: - relationships among metric prefixes and related units of surface area and volume - the development of procedures and rules for surface area and volume of rectangular prisms	limited understanding; may be unable to demonstrate or explain: - relationships among metric prefixes and related units of surface area and volume - the development of procedures and rules for surface area and volume of rectangular prisms	some understanding; partially able to demonstrate or explain: - relationships among metric prefixes and related units of surface area and volume - the development of procedures and rules for surface area and volume of rectangular prisms	shows understanding; able to demonstrate or explain: - relationships among metric prefixes and related units of surface area and volume - the development of procedures and rules for surface area and volume of rectangular prisms	thorough understanding; able to demonstrate or explain: - relationships among metric prefixes and related units of surface area and volume - the development of procedures and rules for surface area and volume of rectangular prisms
Processes • accurately: - converts among SI units of surface area and volume - estimates and determines surface area and volume of rectangular prisms (without using a formula)	limited accuracy; often makes major errors or omissions in: - converting among SI units - estimating and determining surface area and volume of rectangular prisms	partially accurate; makes frequent minor errors or omissions in: - converting among SI units - estimating and determining surface area and volume of rectangular prisms	generally accurate; makes few errors or omissions in: - converting among SI units - estimating and determining surface area and volume of rectangular prisms	accurate; rarely makes errors or omissions in: - converting among SI units - estimating and determining surface area and volume of rectangular prisms
Solves situational problems				
• solves and creates problems involving surface area and volume, and validates and explains solutions	has difficulty solving and creating problems involving surface area and volume; unable to validate or explain solutions	with some support or prompting, solves and creates problems involving surface area and volume in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving surface area and volume; validates and explains solutions	solves and creates problems involving surface area and volume in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about measurement	has difficulty interpreting and producing mathematical messages about measurement	partially able to interpret and produce mathematical messages about measurement	interprets and produces mathematical messages about measurement	interprets and produces precise mathematical messages about measurement
Cross-curricular competency: to cooperate with others				
• shows commitment when working with a partner or group by supporting others and sharing responsibility for the processes the group uses	little commitment to teamwork; does not support others or share responsibility	some commitment to teamwork; supports others and is willing to follow processes suggested by others	shows commitment to teamwork; supports others and shares responsibility for determining the processes the group uses	shows strong commitment to teamwork; supports others and shares responsibility for the processes the group uses; negotiates effectively as needed

Performance Assessment Rubric: Stationery Design

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
<p>Concepts</p> <ul style="list-style-type: none"> • explanations show understanding of linear dimensions and surface area, and their relationships 	shows little understanding; may be unable to explain choices and procedures	partially able to explain choices and procedures	shows understanding by explaining choices and procedures	shows thorough understanding in explanations of choices and procedures
<p>Processes</p> <ul style="list-style-type: none"> • accurately: <ul style="list-style-type: none"> - records a pattern for a card and envelope - calculates the area of the card and envelope - determines the number of cards or envelopes that could be cut from the specified piece of paper 	limited accuracy; often makes major errors or omissions in: <ul style="list-style-type: none"> - recording a pattern for a card and envelope - calculating the area of the card and envelope - determining the number of cards or envelopes that could be cut from the specified piece of paper 	partially accurate; makes frequent minor errors or omissions in: <ul style="list-style-type: none"> - recording a pattern for a card and envelope - calculating the area of the card and envelope - determining the number of cards or envelopes that could be cut from the specified piece of paper 	generally accurate; few errors or omissions in: <ul style="list-style-type: none"> - recording a pattern for a card and envelope - calculating the area of the card and envelope - determining the number of cards or envelopes that could be cut from the specified piece of paper 	accurate and precise; very few, if any, errors or omissions in: <ul style="list-style-type: none"> - recording a pattern for a card and envelope - calculating the area of the card and envelope - determining the number of cards or envelopes that could be cut from the specified piece of paper
Solves situational problems				
<ul style="list-style-type: none"> • uses appropriate strategies, including estimating, to design a greeting card and envelope 	unable to design an appropriate card and envelope	designs a card and envelope that is either slightly too large for the paper, or is too small for its function	designs an appropriate card and envelope	designs an appropriate card and envelope; shows some innovation; may introduce some additional complexity
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	uses few appropriate mathematical terms does not represent his/her thinking and solutions clearly	uses some appropriate mathematical terms represents his/her thinking and solutions with some clarity; may be hard to follow in places	uses appropriate mathematical terms represents his/her thinking and solutions clearly	uses a range of appropriate mathematical terms with precision represents his/her thinking and solutions clearly and precisely

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
A pattern for a card and envelope is recorded on grid paper.				
The area of the card and envelope is correct.				
The number of cards and envelopes that could fit on a 28 cm by 43 cm paper is accurate.				
The shape and dimensions of the card and envelope are explained clearly, using appropriate mathematical language.				

Planning for Unit 10: Patterns in Number and Geometry

Supporting Cross-Curricular Competencies

Recommended Software: *Appleworks*

Unit Focus: to use information and communication technologies

Materials

Master Q10.1:

Unit Rubric: Patterns in Number and Geometry

Master Q10.2:

Performance Assessment Rubric: Camping in Treetops!

Master Q10.3:

Peer and Self Assessment: Unit Problem (Unit 10)

In the Patterns in Number and Geometry unit, opportunities exist for students to use various technologies (e.g., computers, calculators) to reinforce new concepts. Employ these Student Book and Teacher Guide features to support students' development of technology-based skills:

- The **Technology** lesson (pages 397-399) gives students a chance to use a spreadsheet to explore patterns; review the steps with students before they begin.
- The **Numbers Every Day** feature regularly includes suggestions related to calculator skills; encourage students to check their solutions using a calculator (for example, on page 390, students can check the products with a calculator).
- The **e-Tools** software provides virtual manipulatives that help students develop mathematical concepts and enhance student success; the **e-Tools** appropriate for this unit include Geometry Shapes and Spreadsheet/Data/Grapher.

Use Master Q10.1: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning: Health and Well-Being

Educational Aim: to ensure that students adopt a self-monitoring procedure concerning the development of good living habits related to health, well-being, sexuality and safety

The Unit Problem can be opened up mathematically, and extended.

Initiate research related to outdoor activities and clubs in the community by having students complete one or both of the following activities:

- Create a directory of summer camps, outdoor clubs, or other activities for children your age. For each type of activity, identify the major physical and mental benefits, as well as any restrictions or drawbacks.
- Work with a partner or group to research and report on a specific outdoor activity such as rock climbing, hiking, horseback riding, or orienteering. Your report might include the following information: where can someone participate in the activity, physical requirements or restrictions, cost, time commitment, equipment needed, benefits, potential problems or dangers, age requirements, a personal analysis of the appeal or appropriateness of the activity. Include diagrams, photographs, tables, and/or graphs in your report.

Use Master Q10.2: Performance Assessment Rubric and Master Q10.3: Peer and Self Assessment to support the assessment of the Unit Problem.

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding by demonstrating, applying, and explaining various ways of representing patterns	shows little understanding; may be unable to demonstrate, apply, and explain patterns	shows some understanding; partially able to demonstrate, apply, and explain patterns	shows understanding; able to demonstrate, apply, and explain patterns	shows thorough understanding; in various contexts, appropriately demonstrates, applies, and explains patterns
Processes • accurately: - identifies a pattern rule and predicts the next element - represents patterns in different ways	limited accuracy; makes major errors or omissions in: - identifying a pattern rule and predicting the next element - representing patterns in different ways	partially accurate; makes frequent minor errors or omissions in: - identifying a pattern rule and predicting the next element - representing patterns in different ways	generally accurate; makes few errors or omissions in: - identifying a pattern rule and predicting the next element - representing patterns in different ways	accurate; rarely makes errors or omissions in: - identifying a pattern rule and predicting the next element - representing patterns in different ways
Solves situational problems				
• solves and creates problems involving patterns in number and geometry, and validates and explains solutions	has difficulty solving and creating problems involving patterns in number and geometry; unable to validate or explain solutions	with some support or prompting, solves and creates problems involving patterns in number and geometry in familiar contexts; needs help to validate and explain solutions	solves and creates problems involving patterns in number and geometry; validates and explains solutions	solves and creates problems involving patterns in number and geometry in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about patterns, using mathematical language and objects, drawings, tables, symbols, graphs, or words	has difficulty interpreting and producing mathematical messages about patterns	partially able to interpret and produce mathematical messages about patterns	interprets and produces mathematical messages about patterns	interprets and produces precise mathematical messages about patterns
Cross-curricular competency: to use information and communication technologies				
• uses computer software to explore and create patterns	unable to use computer software to explore and create patterns	with step-by-step support, can use computer software to explore and create patterns	uses computer software to explore and create patterns	uses computer software effectively to explore and create patterns

Performance Assessment Rubric: Camping in Treetops!

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
Concepts • descriptions, explanations, and predictions show understanding of patterns and relationships	descriptions, explanations, and predictions show little understanding of patterns and relationships	descriptions, explanations, and predictions show partial understanding of patterns and relationships	descriptions, explanations, and predictions show understanding of patterns and relationships	descriptions, explanations, and predictions show thorough understanding of patterns and relationships
Processes • accurately: - measures and records lengths of the rope - constructs a graph - identifies patterns in the graph	makes frequent major errors or omissions in: - measuring and recording lengths of the rope - constructing a graph - identifying patterns in the graph	partially accurate; makes frequent minor errors or omissions in: - measuring and recording lengths of the rope - constructing a graph - identifying patterns in the graph	generally accurate; few errors or omissions in: - measuring and recording lengths of the rope - constructing a graph - identifying patterns in the graph	accurate; very few, if any, errors or omissions in: - measuring and recording lengths of the rope - constructing a graph - identifying patterns in the graph
Solves situational problems				
• uses appropriate strategies (e.g., estimating, measuring, sketching) to investigate the relationships between the number of knots and the lengths of the rope	uses a few simple strategies with limited success to solve the problems	uses some appropriate strategies with partial success to solve the problems	uses appropriate strategies with considerable success to solve the problems	uses appropriate, efficient, and often innovative strategies to solve the problems successfully
Communicates using mathematical language				
• uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words	uses few appropriate mathematical terms does not represent his/her thinking and solutions clearly	uses some appropriate mathematical terms represents his/her thinking and solutions with some clarity; may be hard to follow in places	uses appropriate mathematical terms represents his/her thinking and solutions clearly	uses a range of appropriate mathematical terms with precision represents his/her thinking and solutions clearly and precisely

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
The length of the rope at each step is measured and recorded accurately.				
A labelled graph shows the number of knots compared to the length of the rope at each step.				
Patterns are described accurately.				
The relationship between the number of knots and the length of rope is explained clearly, using appropriate mathematical language.				

Planning for Unit 11: Probability

Meeting the Quebec Essential Knowledges

- Use Lesson 3A (Masters Q11.1 to Q11.5) after Lesson 3, with supporting Teaching Notes (pages 30a – 30d).

Supporting Cross-Curricular Competencies

Unit Focus: to exercise critical judgment

Materials

Masters Q11.1 to Q11.5:

Lesson 3A: Simulations

Master Q11.6:

Unit Rubric: Probability

Master Q11.7:

Performance Assessment Rubric: Alien Encounters!

Master Q11.8:

Peer and Self Assessment: Unit Problem (Unit 11)

Probability concepts support the use of critical judgement by encouraging students to show logic and intuition, while taking different contexts into account. Highlighted below are some of the Student Book and Teacher Guide features that support students' development of well-thought-out opinions:

- The **Explore** activities present students with a range of contexts and problems that aim to extend critical thinking and problem-solving skills; encourage students to formulate questions and make connections between the information presented and their existing knowledge.
- Each **Connect** section uses language that is clear, and communicates concepts in a logical, organized manner (for example, on page 409); discuss new concepts presented, encouraging students to express their judgments.
- In the Teacher Guide, there are various assessment tools that promote Self-Assessment (for example, Program Master 2: Self Assessment); utilize these tools to help develop students' critical judgment skills.

Use Master Q11.6: Unit Rubric, to support your ongoing assessment during the unit, with a focus on the cross-curricular competency highlighted here.

Addressing Broad Areas of Learning:

Media Literacy

Educational Aim: to develop students' critical and ethical judgment with respect to media and to give them opportunities to produce media documents that respect individual and collective rights

The Unit Problem can be opened up mathematically, and extended.

Have students consider why the media and advertisers use games and contests by completing the following activities:

- Analyse a game or contest from a magazine or other media and determine who is sponsoring the game/contest, what the sponsors hope to gain by offering the game/contest, what people who are considering playing the game/contest should know before entering, and the probability of winning the game/contest.
- Create a list of reasons why a media outlet or a business might sponsor a game or contest.

Have students present and discuss their findings. As a class, develop a set of criteria for determining whether or not someone should enter a contest or game. Have students write a self-reflection about what they have learned about how advertisers or sponsors use games and contests.

Use Master Q11.7: Performance Assessment Rubric and Master Q11.8: Peer and Self Assessment to support the assessment of the Unit Problem.

Lesson Organizer

80–100 min

Curriculum Focus

Use simulations to estimate probabilities.

Student Materials

- coins, number cubes labelled 1 to 6, paper clips, decks of cards, rulers, coloured pencils, calculators

Optional

- spinners (Master Q11.5)

Vocabulary

simulation, model, equally likely outcomes

Assessment

Master Q11.6 Unit Rubric: Probability

Key Math Learnings

1. A simulation models or imitates a real-life situation.
2. A simulation can be more practical than gathering data when determining the probability of an event.

LESSON 3A: SIMULATIONS

BEFORE

Get Started

Prompt a short discussion about simulations. Have students share any information that they know about simulations.

Present *Explore*. Distribute the number cubes. Students may find it helpful to record the results of their experiment in a table with these headings.

Simulation	First Roll	Second Roll
1		
2		
3		
4		
5		
6		

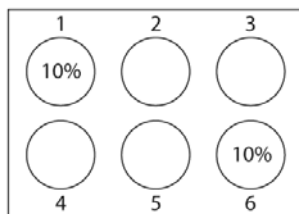
DURING

Explore

Ongoing Assessment: Observe and Listen

As students work, ask questions, such as:

- How can the situation of scratching circles on the Scratch and Save card be simulated with the number cubes? (*Suppose the matching percents are in the 1st and 6th positions, as shown.*)



The possibilities for the first roll are: 1, 2, 3, 4, 5, or 6.

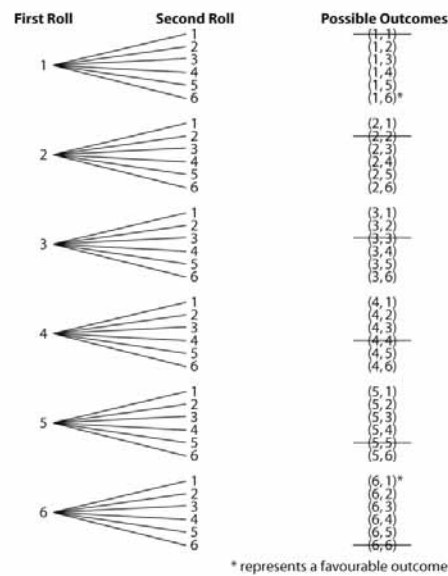
Rolling the second time also has six possibilities: 1, 2, 3, 4, 5, or 6.

Let a roll of 1 and 6 represent the favourable event of scratching two matching percents. This is represented by (1, 6) or (6, 1).

I can draw a tree diagram to show the possible outcomes, but I need to consider something else.

Suppose the first circle is scratched on the card. On the next scratch, it is not possible to scratch the first circle again. The same is true if I scratch the second circle on my first scratch. That is, it is not possible to scratch the second circle on the second scratch, and so on. So, cross out (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), and (6, 6) from the possible outcomes.

So, here is my tree diagram:



In my experiment, I will record all the results of 2 rolls. If (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), or (6, 6) is the outcome, I will repeat the trial. The favourable outcomes are (1, 6) and (6, 1). There are 2 favourable outcomes. So, the probability of scratching 2 matching percents is: $\frac{2}{30} = \frac{1}{15}$

AFTER

Connect

Ask:

- What criteria did you use to design a spinner for this experiment? (The spinner had to have six equally likely outcomes; so, we divided the spinner into six equal sectors and each sector is labelled with a percent.)

Present *Connect*.

Practice

Question 1: Students will need coins, number cubes, spinners, paper clips, and cards. Students are required to combine results with 3 other pairs of students.

Assessment Focus: Question 5

Encourage students to conduct the simulation many times for a better probability estimate.

Assessment for Learning

What to Look for	What to Do
<p>Knowledge and Understanding</p> <ul style="list-style-type: none"> ✓ Students understand what model to use to conduct a simulation for an event. <p>Communication</p> <ul style="list-style-type: none"> ✓ Students can describe when a simulation can be used to estimate the probability of an event. <p>Application</p> <ul style="list-style-type: none"> ✓ Students can design and apply a simulation to estimate the probability of an event. 	<p>Extra Support: Students who are having difficulty understanding what model to use to conduct a simulation may benefit from counting the number of equally likely outcomes of the event and then identifying if it is appropriate to use a coin, number cube, spinner or a combination of these to model that event.</p> <p>Extra Practice: Have students design a simulation for <i>Practice</i> question 4. Have students conduct the simulation in <i>Practice</i> question 2 to estimate the required probability.</p> <p>Extension: Have students write a problem that can be modelled using a simulation, then design and conduct a simulation to solve the problem.</p>
Recording and Reporting	Master Q11.6: Unit Rubric: Probability

REACHING ALL LEARNERS

Alternative Explore

Have students work with a partner. Students construct a spinner with four congruent sectors each having a different colour. Tell them that a Scratch and Win ticket has 4 circles on it. Under the circles there are three matching amounts and one different amount. Suppose they scratch 3 circles. If they get the three matching amounts, they win. The amounts are arranged randomly on the card.

Ask them to design a spinner to estimate the probability of scratching three matching amounts. Students conduct the experiment as many times as they can, and record their results.

Common Misconceptions

- ✓ Students may have difficulty understanding when and how an event can be simulated.

How to Help: Remind students that an event can only be simulated when the outcomes are equally likely. Encourage them to ask themselves the question: Are the outcomes equally likely? If the answer is yes, then the event can be simulated. Remind students that once they know the event can be simulated, then the method of simulation depends on the number of equally likely outcomes. When there are two equally likely outcomes, a coin can be used to simulate the event. When there are 6 equally likely outcomes, a number cube can be used to simulate the event. For other numbers of outcomes, such as 3 or 4, use a spinner with the same number of congruent sections as the number of equally likely outcomes. For a large number of equally likely outcomes, combine a coin, with a spinner or a coin with a cube or two cubes, as shown in the *Example*.

Number Strategies

$$72 = 2 \times 2 \times 2 \times 3 \times 3$$

$$73 = 1 \times 73$$

$$74 = 2 \times 37$$

$$75 = 3 \times 5 \times 5$$

$$76 = 2 \times 2 \times 19$$

Sample Answers

1. For example: We combined our results with those of three other pairs of students for 100 simulations. There were 21 times where a month occurred 2 or more times. Therefore, the estimated probability that in a group of 4 people, 2 or more people have their birthdays in the same month is about 0.21.
4. These events have the same probability, 0.25.
- 5.a) Each question has 4 answers that are equally likely. Design a spinner that has 4 congruent sectors, each a different colour. Choose a colour to represent the correct answer, say red. Spin the pointer on the spinner. If it lands on red, the correct answer has been selected, if not, the answer is incorrect.
 - b) Spin the pointer 5 times and record the colour the pointer lands on each time. Getting three correct answers is represented by landing on the colour red three times in 5 spins.
 - c) Results may vary. In 100 simulations, the event "the pointer landed on red 3 times" occurred 13 times. The estimated probability of getting 3 correct answers out of five is $\frac{13}{100} = 0.13$.
- 8.a) Use 10 cards from a standard deck. Seven cards should be red and 3 cards should be black. A red card indicates a successful foul shot. A black card indicates a missed shot. Shuffle the cards. Choose a card randomly. Record the colour of the card, then replace it. Shuffle the cards again, choose one card, record its colour, and replace the card. Repeat the simulation of choosing a card, replacing it, shuffling the pile, then choosing a card again, many times.

b) Results may vary.

Successful shots	0	1	2
Frequency	2	3	15

c) Results may vary. According to my results, the probability of the team winning the game is

$$\frac{15}{20} = \frac{3}{4}$$

Reflect

A simulation is used to estimate a probability for an event where it is not practical to gather data. For example, to estimate the probability that a bitch will have exactly 2 females in a litter of 5 pups, you can use a simulation. Toss a coin 5 times. Complete the simulation many times. Let heads represent females. Record the number of times that you get exactly 2 heads.

Lesson 3A Simulations

A real-life situation can be simulated by a probability experiment.
For certain events, a **simulation** is more practical than gathering data.

Explore

Work with a partner.
You will need a number cube labelled 1 to 6.
A store has a “Scratch and Save” day.
The store gives each customer a card with 6 circles on it.
Under the circles there are two matching percents and
four different percents.
You scratch two circles.



If you get the two matching percents, you have that discount on all items you buy in the store that day.
The percents are arranged randomly on the card.
What is the probability you will scratch two matching percents?

- How can you use the number cube to estimate the probability you will scratch two matching percents?
- Conduct the experiment as many times as you can. Record each result.
- What is the experimental probability you will scratch two matching percents?

Show and Share

Compare your results with those of another pair of classmates.
Are the probabilities equal? Explain.
Work together to sketch a spinner you could use, instead of a number cube, to carry out this experiment.

LESSON FOCUS | Use simulation to estimate probabilities.

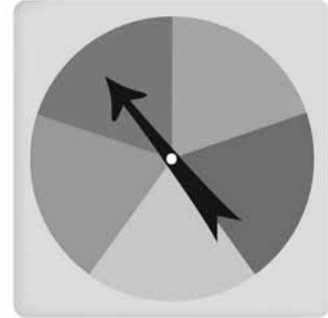
Connect



When we use a simulation to estimate probability, the model we use must have the same number of outcomes as the real situation. We use a coin when there are 2 equally likely outcomes.

We use a number cube, labelled 1 to 6, when there are 6 equally likely outcomes.

We use a spinner divided into congruent sectors, where the number of sectors matches the number of equally likely outcomes.



Example

In a Grade 6 class, for a group of 4 students, what is the probability that 2 or more students will have birthdays the same month? Design a simulation to find out.

Solution

There are 12 months in a year.
 So, the probability of being born in a particular month is $\frac{1}{12}$.
 We need a simulation that has 12 equally likely outcomes.
 Use a number cube labelled 1 to 6, and a coin.
 For each number on the cube, assign a head or a tail.
 Then, let each month be represented by one of these pairs:
 January H1, February T1,
 March H2, April T2,
 May H3, June T3,
 July H4, August T4,
 September H5, October T5,
 November H6, December T6
 Toss a coin and roll a number cube 4 times;
 one for each student in the group.
 Record if any month occurred two or more times.
 Conduct the experiment 100 times.
 An estimate of the probability is:

$$\frac{\text{The number of times a month occurred two or more times}}{100}$$

Practice

1. Work with a partner.
 You will need a coin and a number cube labelled 1 to 6.
 Conduct the experiment in the *Example* 25 times.
 Combine your results with those of 3 other pairs of students.
 Estimate the probability that, in a group of 4 people,
 2 or more people have birthdays in the same month.
2. What if you want to estimate the probability that, in a group of 6 students, at least 3 students have birthdays in the same month.
 How could you change the experiment in the *Example* to do this?
3. a) When a child is born, the child is either female or male.
 What could you use to simulate this?
 b) You want to estimate the probability there are exactly 3 girls in a family of 4 children.
 Describe a simulation you could use.
 c) Conduct the simulation in part b.
 What is the estimated probability?
 d) Use a tree diagram to calculate the probability of exactly 3 girls.
 e) How do your answers to parts c and d compare? Explain.
4. What if you wanted to estimate or calculate the probability of exactly 1 boy in a family of 4 children.
 How could you use the results in question 3 to do this?
5. **Assessment Focus** A multiple-choice test has 5 questions.
 Each question has 4 answers.
 For each question, a student randomly chooses an answer.
 a) Design a spinner you could use to estimate the probability of getting 1 question correct.
 b) Make this spinner. Conduct a simulation to estimate the probability of getting 3 correct answers out of the 5 questions.
 c) How many times did you conduct the simulation?
 What is your estimate for the probability?
 Show your work.

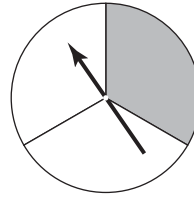


Number Strategies

Write each number as a product of its prime factors.
72, 73, 74, 75, 76

6. Moira is on the school baseball team.
On average, Moira gets 1 hit every 3 times at bat.
Moira goes up to bat 4 times during a game.

a) How can this spinner be used to simulate Moira's batting average? Justify your answer.



b) Conduct the simulation 30 times. Copy and complete this table. Record the frequency of each number of hits per game.

Hits per Game	0	1	2	3	4
Frequency					

c) Estimate the probability that, in a game, Moira will get each number of hits.
i) 0 hits ii) 1 hit iii) 2 hits iv) 3 hits v) 4 hits

7. The weather forecast for each of the next 6 days is a 50% chance of rain.
Describe a simulation to estimate the probability that it will rain on 3 of those 6 days.
Conduct the simulation. Explain the result.

Take It Further



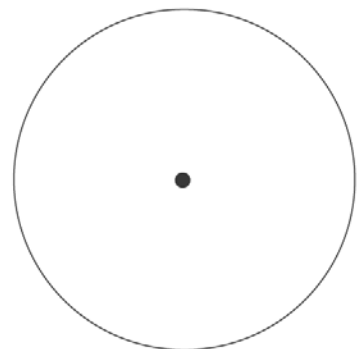
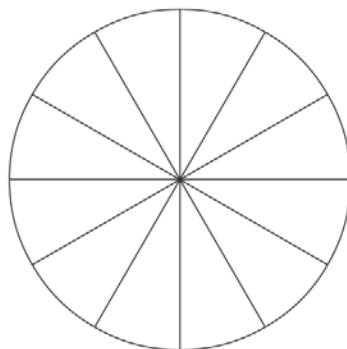
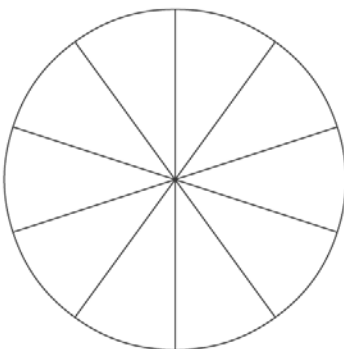
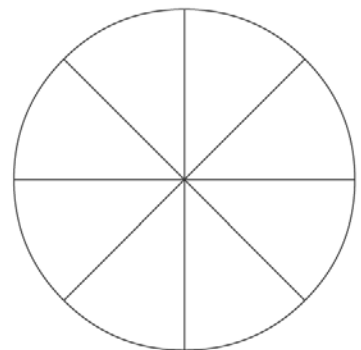
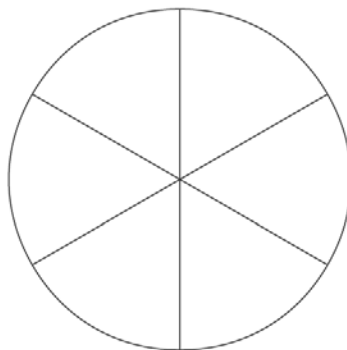
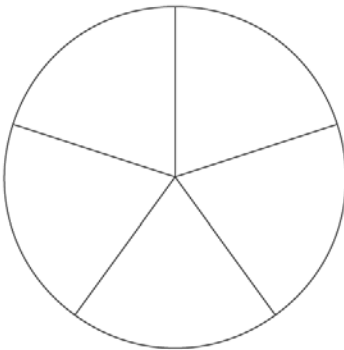
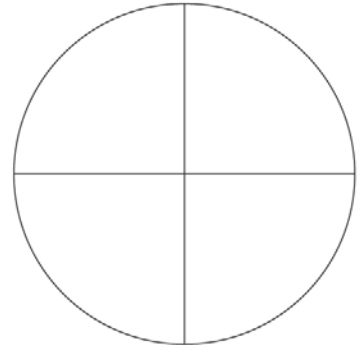
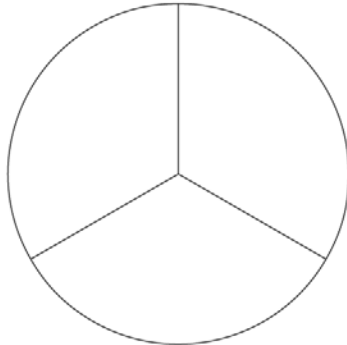
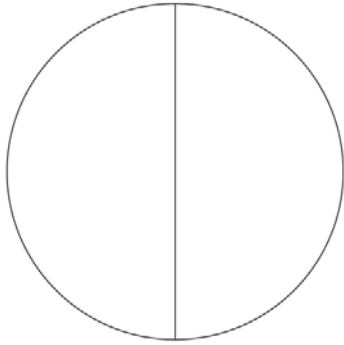
8. A basketball player has a 70% shooting average. He is about to take 2 foul shots.
There is very little time remaining in the game, and his team is behind by 1 point.
a) Describe a simulation to represent the player's shooting ability.
b) Conduct 20 simulations of the player's 2 foul shots.
c) What is the experimental probability that the player's team will win the game?

Reflect

When would you use a simulation to estimate a probability? Include an example in your explanation.

Master Q11.5

Spinners



Master Q11.6
Unit Rubric: Probability

This assessment tool is designed to record overall student performance as you accumulate evidence by reviewing portfolios, observation records, unit assessment activities, and other work. It can be used to guide feedback and help prepare for reporting. It should not be used for just one specific activity.

To create a profile of a student's achievement, use a highlighter to identify behaviours you have observed.

	Level 1	Level 2	Level 3	Level 4
Uses mathematical processes and concepts				
Concepts • shows understanding by demonstrating and explaining: - experiments with activities involving chance - comparisons between experimental and theoretical probabilities - that different outcomes may occur when repeating the same experiment	limited understanding; may be unable to demonstrate or explain: - experiments with activities involving chance - comparisons between experimental and theoretical results - that different outcomes may occur when repeating the same experiment	some understanding; partially able to demonstrate or explain: - experiments with activities involving chance - comparisons between experimental and theoretical results - that different outcomes may occur when repeating the same experiment	shows understanding; able to demonstrate or explain: - experiments with activities involving chance - comparisons between experimental and theoretical results - that different outcomes may occur when repeating the same experiment	thorough understanding; able to demonstrate or explain: - experiments with activities involving chance - comparisons between experimental and theoretical results - that different outcomes may occur when repeating the same experiment
Processes • accurately: - lists all possible outcomes of a random experiment using a table or tree diagram - uses fractions and percents to describe probability	limited accuracy; often makes major errors or omissions in: - listing possible outcomes - using fractions and percents to describe probability	partially accurate; makes frequent minor errors or omissions in: - listing possible outcomes - using fractions and percents to describe probability	generally accurate; makes few errors or omissions in: - listing possible outcomes - using fractions and percents to describe probability	accurate; rarely makes errors or omissions in: - listing possible outcomes - using fractions and percents to describe probability
Solves situational problems				
• solves and creates problems and experiments involving probability, and validates and explains solutions	has difficulty solving and creating problems and experiments involving probability; unable to validate or explain solutions	with some support or prompting, solves and creates problems and experiments involving probability in familiar contexts; needs help to validate and explain solutions	solves and creates problems and experiments involving probability; validates and explains solutions	solves and creates problems and experiments involving probability in effective and often innovative ways; validates and explains solutions
Communicates using mathematical language				
• interprets and produces messages about probability, using mathematical language and objects, drawings, tables, symbols, graphs, or words	has difficulty interpreting and producing mathematical messages about probability	partially able to interpret and produce mathematical messages about probability	interprets and produces mathematical messages about probability	interprets and produces precise mathematical messages about probability
Cross-curricular competency: to exercise critical judgment				
• questions and discusses own interpretations and judgements of the data presented	does not question own or others' interpretations; accepts the first answer/perspective given	with scaffolding, questions and discusses own and others' interpretations; has difficulty seeing more than one perspective	questions and discusses own and others' interpretations and judgements in familiar situations	questions and discusses own and others' interpretations and judgements in a range of situations; insightful

Performance Assessment Rubric: Alien Encounters!

	Level 1	Level 2	Level 3	Level 4
Uses mathematical concepts and processes				
Concepts <ul style="list-style-type: none"> • explanations show understanding of probability, including: <ul style="list-style-type: none"> - justifying predictions - distinguishing between and comparing experimental and theoretical results - recognizing that different outcomes may occur when repeating the same experiment 	explanations show little understanding of probability, including: <ul style="list-style-type: none"> - justifying predictions - distinguishing between and comparing experimental and theoretical results - recognizing that different outcomes may occur when repeating the same experiment 	explanations show partial understanding of probability, including: <ul style="list-style-type: none"> - justifying predictions - distinguishing between and comparing experimental and theoretical results - recognizing that different outcomes may occur when repeating the same experiment 	explanations show understanding of probability, including: <ul style="list-style-type: none"> - justifying predictions - distinguishing between and comparing experimental and theoretical results - recognizing that different outcomes may occur when repeating the same experiment 	explanations show thorough understanding of probability, including: <ul style="list-style-type: none"> - justifying predictions - distinguishing between and comparing experimental and theoretical results - recognizing that different outcomes may occur when repeating the same experiment
Processes <ul style="list-style-type: none"> • accurately determines: <ul style="list-style-type: none"> - the number of different face types possible (question 1) - the probability of being chosen (question 2) - the experimental probability of each difference (question 3) - all possible differences and their theoretical probabilities (question 4) 	limited accuracy; major errors or omissions in determining: <ul style="list-style-type: none"> - the number of different face types possible - the probability of being chosen - the experimental probability of each difference - all possible differences and their theoretical probabilities 	partially accurate; frequent minor errors or omissions in determining: <ul style="list-style-type: none"> - the number of different face types possible - the probability of being chosen - the experimental probability of each difference - all possible differences and their theoretical probabilities 	generally accurate; few errors or omissions in determining: <ul style="list-style-type: none"> - the number of different face types possible - the probability of being chosen - the experimental probability of each difference - all possible differences and their theoretical probabilities 	accurate; very few, if any, errors or omissions in determining: <ul style="list-style-type: none"> - the number of different face types possible - the probability of being chosen - the experimental probability of each difference - all possible differences and their theoretical probabilities
Solves situational problems				
<ul style="list-style-type: none"> • uses appropriate strategies to determine which predictions are most and least likely to win the trip 	uses a few simple strategies, with limited success, to determine which predictions are most and least likely to win the trip	uses some appropriate strategies, with partial success, to determine which predictions are most and least likely to win the trip	uses appropriate strategies, with considerable success, to determine which predictions are most and least likely to win the trip	uses appropriate, efficient, and often innovative, strategies to determine which predictions are most and least likely to win the trip
Communicates using mathematical language				
<ul style="list-style-type: none"> • uses mathematical language correctly • represents and describes his/her thinking and solutions clearly, using objects, drawings, tables, symbols, or words 	uses few appropriate mathematical terms does not represent his/her thinking and solutions clearly	uses some appropriate mathematical terms represents his/her thinking and solutions with some clarity; may be hard to follow in places	uses appropriate mathematical terms represents his/her thinking and solutions clearly	uses a range of appropriate mathematical terms with precision represents his/her thinking and solutions clearly and precisely

Names: _____

- 4=Excellent/Always
- 3=Very satisfactory/Most of the time
- 2=Satisfactory/Sometimes
- 1=Needs further work/Rarely or never

	Self Assessment		Peer Assessment	
	Rating	Explanation	Rating	Explanation
A table or tree diagram is used to find the number of face types correctly (question 1).				
The probability of each given outcome is correct (question 2).				
The experimental probability and the theoretical probability for each difference in the game is correctly determined (questions 3 and 4).				
The numbers that would be most and least likely to win the trip are correctly determined (question 5).				



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