The Common Curriculum Framework

for

K–12 MATHEMATICS

(10–12 is under development)

Western Canadian Protocol for Collaboration in Basic Education

GRADE 9

JUNE 1995

VI. GENERAL OUTCOMES, AND SPECIFIC OUTCOMES WITH ILLUSTRATIVE EXAMPLES (K–9)

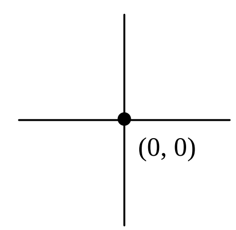
This section elaborates on the general outcomes and specific outcomes by providing illustrative examples, by grade, for the K–9 program. Note that the specific outcomes and illustrative examples for the Grade 10 to Grade 12 program will be developed at a later date.

CODING FOR ILLUSTRATIVE EXAMPLES (IEs)

The illustrative examples (IEs) listed on the following pages are organized by grade and have been correlated to specific outcomes (SOs). The coding used recognizes that IEs relating to more than one SO are listed before those relating to only one SO. Examples of the coding system are listed below.

1–4	Means that the IE relates to specific outcomes one through four in the subsection being addressed.
1, 3	Means that the IE relates to specific outcomes one and three in the subsection being addressed.
1, 3.1 1, 3.2	Means that the IEs relate to specific outcomes one and three in the subsection being addressed and that there are two of them.
6.1	Means that the IE relates to specific outcome six in the subsection being addressed.
4.1 4.2 4.3	Means that the IEs relate to specific outcome four in the subsection being addressed and that there are three of them.

Grade 9
Strand: Number (Number Concepts)
Students will:
- use numbers to describe quantities
- represent numbers in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Explain and illustrate the structure and the interrelationship of the sets of numbers within the rational number system.	1. Give examples of numbers that satisfy the conditions of natural, whole, integral and rational numbers, and show that these numbers comprise the rational number system. [C, CN, PS, R]	1–2 Explain why 6 belongs to the natural, whole, integral and rational numbers. Explain why –4 is a rational number but not a whole number. Give an example of a number that is an integer but not a whole number. Explain. Draw four boxes that nest inside one another. Label each box as natural numbers, whole numbers, integers or rational numbers to show how the number systems are “nested”.
	2. Describe, orally and in writing, whether or not a number is rational. [C, R]	2.1 The ratio of the circumference to the diameter of any circle is π. Explain whether or not π is a rational number.
	3. Give examples of situations where answers would involve the positive (principal) square root, or both positive and negative square roots of a number. [C, CN, PS, R]	3.1 What two values satisfy $x^2 = 16$? 3.2 If you wanted to find the length of one side of a garden whose area is 25 m^2, explain why you would use only the positive square root of 25. 3.3 A square has one corner at (0, 0) and an area of 36 square units. Find the possible coordinates of the other vertices. 

Grade 9
Strand: Number (Number Concepts)
Students will:
- use numbers to describe quantities
- represent numbers in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Develop a number sense of powers with integral exponents and rational bases.	4. Illustrate power, base, coefficient and exponent, using rational numbers or variables as bases or coefficients. [R, V]	4.1 What is the value of the coefficient in the expression $-x^4$? $\frac{x^2}{5}$? 4.2 Use cubes or draw diagrams to represent and explain the difference between 2^3 and 3^2.
	5. Explain and apply the exponent laws for powers with integral exponents. $x^m \bullet x^n = x^{m+n}$ $x^m \div x^n = x^{m-n}$ $\left(x^m\right)^n = x^{mn}$ $(xy)^m = x^m y^m$ $\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}, y \neq 0$ $x^0 = 1,\ x \neq 0$ $x^{-n} = \frac{1}{x^n}, x \neq 0$ [PS, R]	5.1 Explain, orally and in written form, why $2^3 \times 2^5 = 2^8$. Give other examples of multiplication of powers with the same base. What is the pattern? Generalize to variable bases and exponents. 5.2 Use the exponent laws, and guess and test to find values for *n*. $n^4 \times n^2 = 64$ $\quad$ $n^{-5} = \frac{1}{32}$ $n^5 \div n^3 = 25$ $\left(n^2\right)^3 = 729$

Grade 9
Strand: Number (Number Concepts)
Students will:
- use numbers to describe quantities
- represent numbers in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Develop a number sense of powers with integral exponents and rational bases.	6. Determine the value of powers with integral exponents, using the exponent laws. [PS, R]	6.1 Explore the values generated by 2^3, 2^2, 2^1, 2^0, 2^{-1}, 2^{-2}, etc., using a calculator. What would the next number in the sequence be? What is the calculator doing to get this? How does 2^3 compare with 2^{-3}? What is the meaning of the negative exponent? Use a similar pattern to explain the difference between 4^3 and 4^{-3}. 6.2 Explain why some calculators give a different answer for $(-2)^4$ and -2^4. 6.3 Explain how you could estimate the value of $(2 \times 3)^3$. Compare your answer with your calculator answer. 6.4 Which is greater, 2^{-5} or 5^{-2}. Explain your reasoning. Compare your answer with your calculator answers. 6.5 If the price of a hamburger doubles every two years, what would it cost in 100 years? Find an alternative way of solving this, using exponents.

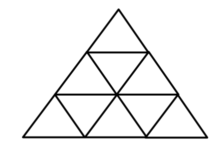
Grade 9
Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

General Outcome	Specific Outcomes	Illustrative Examples
Use a scientific calculator or a computer to solve problems involving rational numbers.	7. Document and explain the calculator keying sequences used to perform calculations involving rational numbers. [C, PS, T]	7.1 The set of keystrokes for the calculation (21.3 – 14.7) × (14.7 + 3.6) could be 21.3 – 14.7 = [M +] C 14.7 + 3.6 = × [MR] = for a total of 24 keystrokes. Devise another keying sequence that uses fewer key strokes. 7.2 Do the following calculation with as few keystrokes as possible. The calculation to be done is $\frac{21.6}{12.3\times(14.5-7.9)}$, which has the answer of 0.2660754. – Devise one way of obtaining this answer on your calculator. Write down the keystrokes that you used, both digit and operation keys, and record the number of keystrokes. – Now devise another method. Which method uses fewer keystrokes? Again, write down the keystrokes that you used, both digit and operation keys, and record the number of keystrokes used. – Explain each keying sequence, and explain why one of the sequences uses fewer keystrokes.
	8. Solve problems, using rational numbers in meaningful contexts. [CN, PS]	8.1 A swimming pool is filled by means of three pipes. The first pipe, by itself, can fill the pool in 8 hours; the second, by itself, can fill it in 12 hours; and the third pipe, by itself, can fill the pool in 24 hours. When all three pipes are in use at the same time, how long does it take to fill the pool?
Explain how exponents can be used to bring meaning to large and small numbers, and use calculators or computers to perform calculations involving these numbers.	9. Understand and use the exponent laws to simplify expressions with variable bases and evaluate expressions with numerical bases. [PS, R]	9.1 Using each of the digits from 1 to 5 only once, write the largest and smallest power possible. 9.2 What are the last two digits of 11^{100}? Explain how you arrived at your answer. 9.3 Use the exponent laws to simplify: $\frac{51x^{-4}y^{6}}{17x^{2}y^{-2}}$. Leave your answer in the form ax^by^c where a, b and c are integers. 9.4 Evaluate $\frac{5^3}{5^2}\times\frac{4^6\times4^{-2}}{\left(4^2\right)^2}$.

Grade 9
Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

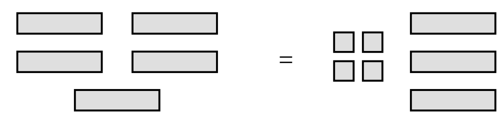
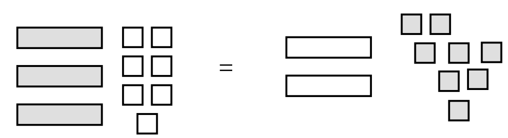
General Outcome	Specific Outcomes	Illustrative Examples
Explain how exponents can be used to bring meaning to large and small numbers, and use calculators or computers to perform calculations involving these numbers.	10. Use a calculator to perform calculations involving scientific notation and exponent laws. [PS, R, T]	10.1 Explain the keystrokes you could use to do the following on your calculator: $(5.1 \times 10^6) \times (2.34 \times 10^{-2}) =$ 10.2 The estimated mass of one of the smallest living organisms is 1.0×10^{-16} g. Write this mass in decimal notation. How many organisms are needed to have a mass of 1 g? 10.3 The Moon is 3.84×10^5 km away. The circumference of the Earth at the equator is 4.0×10^4 km. How many times around the Earth, at the equator, would be the same as the distance to the Moon?

Grade 9
Strand: Patterns and Relations (Patterns)
Students will:
- use patterns to describe the world and to solve problems.

General Outcome	Specific Outcomes	Illustrative Examples
Generalize, design and justify mathematical procedures, using appropriate patterns, models and technology.	1. Use logic and divergent thinking to present mathematical arguments in solving problems. [C, PS, R]	1.1 This figure contains several "upright" triangles. Construct your own definition of an "upright" triangle. Using your definition, how many "upright" triangles are there in a similar figure with 10 rows?  1.2 Explain how you can determine the last two digits of 6^{1000}. 1.3 Explain how you can use the laws of exponents, and a calculator, to order the following powers from largest to smallest: 3^{666}, 4^{555}, 5^{444}, 6^{333}.
	2. Model situations that can be represented by first-degree expressions. [CN, PS]	2.1 Write an expression or equation to represent each situation. The cost to rent a VCR is a $25 deposit, plus $10 for each day. How much will it cost to rent a VCR for 4 days? For 10 days? For *d* days? Bruce bought some licorice. It cost $3.75 for the first kilogram and $3.25 for each additional kilogram. How much would he pay for 3 kg? 10 kg? *m* kg?
	3. Write equivalent forms of algebraic expressions, or equations, with rational coefficients. [C, CN, R]	3.1 Explain how $\frac{x}{2}+\frac{3}{5}=4$, $\frac{3x}{2}+\frac{9}{5}=12$ and $5x + 6 = 40$ are related. 3.2 Which of the following expressions is equivalent to $\frac{x+3}{2}$? Justify your choice. $x+3\div 2$ $\frac{x}{2}+\frac{3}{2}$ $2(x+3)$ 3.3 Explain how $C = 2\pi r$ and $r = \frac{C}{2\pi}$ are related. 3.4 Given that density is mass divided by volume, explain why volume is mass divided by density.

Grade 9
Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

<table>
<tr><th>General Outcome</th><th>Specific Outcomes</th><th>Illustrative Examples</th></tr>
<tr><td>Solve and verify linear equations and inequalities in one variable.</td>
<td>4. Illustrate the solution process for a first-degree, single-variable equation, using concrete materials or diagrams. [PS, R, V]

5. Solve and verify first-degree, single-variable equations of forms, such as:
• $ax = b + cx$
• $a(x + b) = c$
• $ax + b = cx + d$
• $a(bx + c) = d(ex + f)$
• $\frac{a}{x} = b$
where a, b, c, d, e and f are all rational numbers (with a focus on integers), and use equations of this type to model and solve problem situations. [C, PS, V]</td>
<td>4–5.1
The equation $5x = 4 + 3x$ has been modelled with algebra tiles. Explain how you can use the tiles to justify an algebraic solution process.

4–5.2
Use algebra tiles to justify an algebraic solution to $3x – 7 = –2x + 8$


5.1 A string measuring 50 cm in length is cut into three pieces. One piece is twice as long as the shortest piece and the other piece is 10 cm longer than the shortest piece. Find the length of each piece of string.

5.2 Dennis has $25 and can save $2.80 per day. Jeena has $18 and can save $3.70 per day. Who will be the first to be able to buy a $72 tennis racquet?

5.3 Yutaka goes to the record store. Compact disks cost $14 for the first one and $13 for each additional one. If Yutaka buys M compact disks and spends D dollars, write an equation that represents the relationship between M and D.

5.4 Solve for x: $2 (4x – 5)=3 (–2x + 6)$

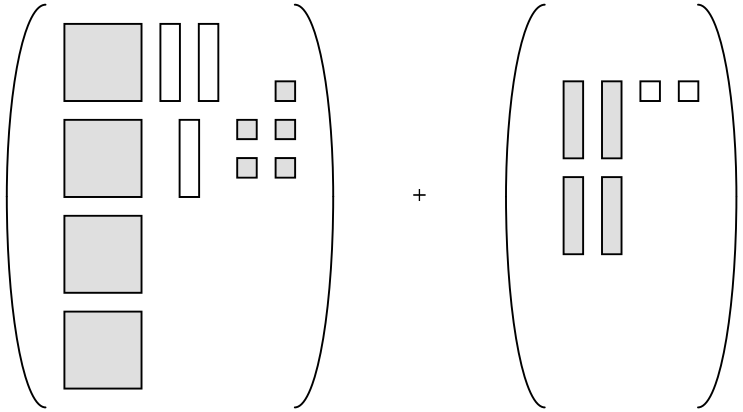
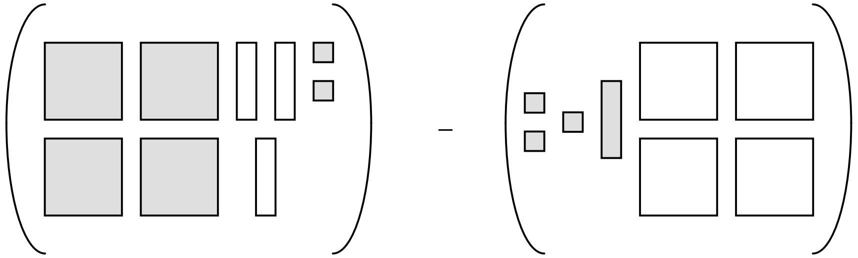
5.5 C represents the number of compact disks and $C + C + 4 + 2C = 56$. Using this information, write a problem.

5.6 Explain the steps you would use to solve $\frac{12}{x} = 6$ algebraically.</td></tr>
</table>

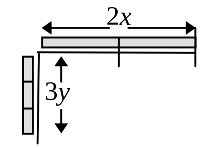
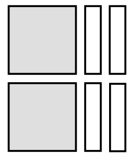
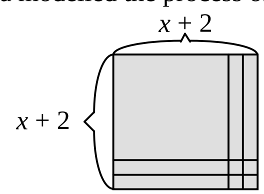
Grade 9
Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Solve and verify linear equations and inequalities in one variable.	6. Solve, algebraically, first-degree inequalities in one variable, display the solutions on a number line and test the solutions. [PS, R, V]	6.1 Lillian received 77%, 69%, 81% and 76% on her mathematics tests. What mark does she need on her fifth test in order to achieve an arithmetic mean (average) of at least 80%? 6.2 Solve the following inequalities, and graph each solution on a number line. $x - 5 < 12$ $^{-}2x + 3 > 10$ 6.3 Explain whether or not each of the following numbers {–3, +4, –7, +7} is a solution to the inequality $2x - 3 > 5$.
Generalize arithmetic operations from the set of rational numbers to the set of polynomials.	7. Identify constant terms, coefficients and variables in polynomial expressions. [C]	7.1 What is the numerical coefficient of $-6a^4b$? 7.2 What is the constant term in the expression $4x - 3 = 2y$?
	8. Evaluate polynomial expressions, given the value(s) of the variable(s). [E]	8.1 Evaluate the following expressions for the numbers given. $x^{-3} + y^3$ when $x = 2$ and $y = -2$ $2x + 6x^2 - 7$ when $x = -1$

Grade 9
Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Generalize arithmetic operations from the set of rational numbers to the set of polynomials.	9. Represent and justify the addition and subtraction of polynomial expressions, using concrete materials and diagrams. [C, R, V]	9.1 Explain how the algebra tiles given below can be used to justify an algebraic process for simplifying: $(4x^2 - 3x + 5) + (4x - 2)$.  9.2 Explain how the algebra tiles given below can be used to justify an algebraic process for simplifying: $(4x^2 - 3x + 2) - (3 + x - 4x^2)$ 
	10. Perform the operations of addition and subtraction on polynomial expressions. [R]	

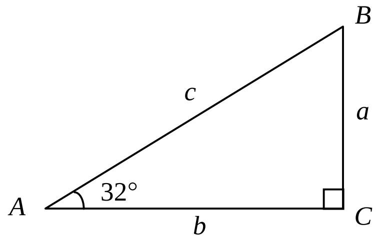
Grade 9
Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Generalize arithmetic operations from the set of rational numbers to the set of polynomials.	11. Represent multiplication, division and factoring of monomials, binomials, and trinomials of the form x^2+bx+c, using concrete materials and diagrams. [R, V]	11–12.1 Justin used algebra tiles and an area model to explain the multiplication $2x(3y)$. He set up the model by drawing a frame with dimensions $2x$ and $3y$.  Show how he filled the area model in to get the product. 11–12.2 Explain why the area model with algebra tiles can justify the product: $2x(x – 2)$  11–12.3 Use an area model with algebra tiles to explain your algebraic solution to the product $(4x + 1)(x + 2)$. 11.1 Natalka modelled the process of factoring $x^2 + 4x + 4$ by using algebra tiles and forming a square with them.  What are the factors of $x^2 + 4x + 4$? Use Natalka's method to factor $x^2 + 5x + 6$. Use algebra tiles to factor $x^2 – x – 2$.
	12. Find the product of two monomials, a monomial and a polynomial, and two binomials. [R]	12.1 Find the product of $–2x – 3$ and $3x + 4$.

Grade 9
Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

General Outcome	Specific Outcomes	Illustrative Examples
Generalize arithmetic operations from the set of rational numbers to the set of polynomials.	13. Determine equivalent forms of algebraic expressions by identifying common factors and factoring trinomials of the form x^2+bx+c. [PS, R]	13.1 Simplify the following expressions by combining like terms, identifying any common factors and completing the factorization. $x^2 + 7x + 10$ $3x^2 + 15x + 18$ $6x^2 - 3x + x^2 - 18x + 7$ $5x^2 - 11x + 3x^2 + 32 - 29x$
	14. Find the quotient when a polynomial is divided by a monomial. [R]	14.1 Find the quotient: $\frac{12x^3 - 16x^2 + 8x}{4x}$.

Grade 9
Strand: Shape and Space (Measurement)
Students will:
- describe and compare everyday phenomena, using either direct or indirect measurement.

General Outcome	Specific Outcomes	Illustrative Examples
Use trigonometric ratios to solve problems involving a right triangle.	1. Explain the meaning of sine, cosine and tangent ratios in right triangles. [C]	1.1 The calculator shows the sine of 32° is equal to 0.5299. This implies that for ΔABC: $a = 0.5299$ and $c = 1.000$ $a = 5299$ and $c = 10\ 000$ the length of a is 0.5299 of the length of c the length of c is 1.887 of the length of a.  Explain why each of above statements is true.
	2. Demonstrate the use of trigonometric ratios (sine, cosine and tangent) in solving right triangles. [PS]	2–4.1 A 10-m ladder is leaning against a building. The angle between the ladder and the ground is 40°. The base of the ladder is 1.5 m from the building. How far is the top of the ladder from the ground?
	3. Calculate an unknown side or an unknown angle in a right triangle, using appropriate technology. [PS, T]	2–4.2 Jenna walked across a rectangular school yard from one corner to the opposite corner. If the school yard is 40 m by 60 m, at what angle, with respect to the longer side, did she walk?
	4. Model and then solve given problem situations involving only one right triangle. [PS, T, V]	

Grade 9
Strand: Shape and Space (Measurement)
Students will:
- describe and compare everyday phenomena, using either direct or indirect measurement.

General Outcome	Specific Outcomes	Illustrative Examples
Describe the effects of dimension changes in related 2-D shapes and 3-D objects in solving problems involving area, perimeter, surface area and volume.	5. Relate expressions for volumes of pyramids to volumes of prisms, and volumes of cones to volumes of cylinders. [CN, R]	5.1 Carlos and Marie made nets and constructed a pyramid and a prism with identical heights and congruent triangular bases. They made similar pairs with congruent square bases. They estimated how much greater the volume of the prism was than the volume of the pyramid for each pair. Then they used sand to measure and compare their estimates. – Carry out their investigation, and find the relationship between the volume of a pyramid and the volume of a prism with the same base and height. – State this relationship in words. – Does the same relationship apply to cylinders and cones having identical heights and bases? – Explain, using models.
	6. Calculate and apply the rate of volume to surface area to solve design problems in three dimensions. [PS, T, V]	6.1 What is the maximum number of boxes measuring 6 cm $\times$ 3 cm $\times$ 2 cm that can be packed into a box measuring 24 cm by 8 cm by 11 cm? If each of the dimensions of the large packing box doubles, how many smaller boxes will fit?
		6.2 Create a graph that illustrates height versus surface area for several cans with the same radii. Conduct a similar investigation to determine how the volumes of the cans are related.
		6.3 Design three different containers that will hold 12 centimetre cubes and determine the most cost efficient container.
		6.4 Dana and Akira made nets to construct cylinders. They both used the same rectangular piece, but Dana used the length to form the circumference of the cylinder and Akira used the width. Which cylinder will have the greatest surface area? Explain. Which cylinder will have the greatest volume? Explain. How would the results of this activity be useful to the canning industry?

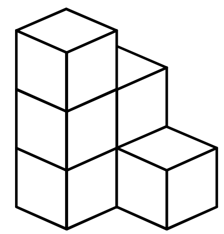
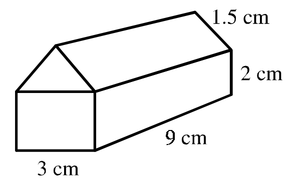
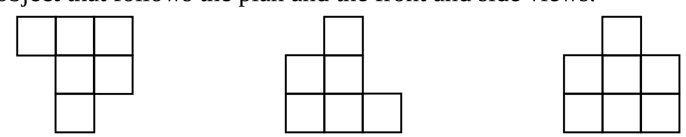
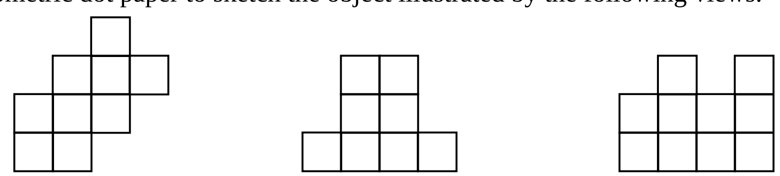
Grade 9
Strand: Shape and Space (Measurement)
Students will:
- describe and compare everyday phenomena, using either direct or indirect measurement.

General Outcome	Specific Outcomes	Illustrative Examples
Describe the effects of dimension changes in related 2-D shapes and 3-D objects in solving problems involving area, perimeter, surface area and volume.		6.5 Cereal is packed in boxes with a volume of 1000 cm^3. What dimensions should the cereal company choose for the boxes? Explain the reasons for your choice.
	7. Calculate and apply the rate of area to perimeter to solve design problems in two dimensions. [PS, T, V]	7.1 Barrie wanted to fence off a rectangular garden area. The fencing material comes in 1-m long units that cannot be cut. If Barrie has 12 m of fencing, what are the dimensions of the largest garden area he can make? Draw a diagram to explain your reasoning. 7.2 A store owner wants to make a rectangular area for a special display in one corner of his store. He has 6 m of enclosure rope to block off two sides of the area, using walls for the other 2 sides. What are the dimensions of the largest area he could rope off? 7.3 If you had a length of chicken wire that could bend anywhere, how could you find the largest area you could enclose without measuring? Explain, using different geometric shapes. If you had 16.25 m of the chicken wire, what would the dimensions be?

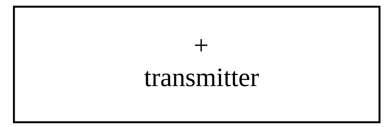
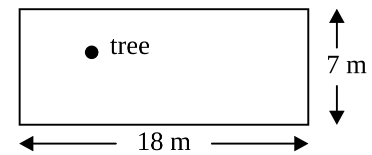
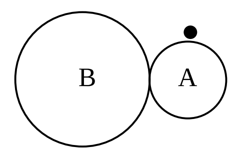
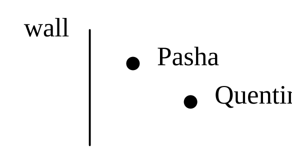
Grade 9
Strand: Shape and Space (3-D Objects and 2-D Shapes)
Students will:
- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

General Outcome	Specific Outcomes	Illustrative Examples
Specify conditions under which triangles may be similar or congruent, and use these conditions to solve problems.	8. Recognize when, and explain why, two triangles are similar, and use the properties of similar triangles to solve problems. [C, PS, R, T]	8.1 Given one triangle, magnify two of the sides by a factor of 2. Explore the relationships between the angles and sides of the original triangle and the enlarged triangle. 8.2 A person 180 cm tall casts a shadow 45 cm long. A nearby telephone pole casts a shadow 300 cm long at the same time of day. What is the height of the pole? 8.3 Sol made a scale drawing of his rectangular vegetable garden, so he could plan how to plant it. Two sides of the garden are 10 m and 12 m and they form an angle of 50°. He drew a 50° angle on paper and made a triangle by marking off 20 cm and 24 cm on the sides of the angle and connecting them. He measured this side to be 19 cm. What is the length of the third side of this garden? 8.4 Shandra said that two triangles drawn on a page “looked” similar. How can she find out for sure if they are, or are not, similar? Find two different ways she can do this, and explain your reasoning.
	9. Recognize when, and explain why, two triangles are congruent, and use the properties of congruent triangles to solve problems. [C, CN, PS, R, T]	9.1 Heidi thought that two triangles looked congruent. To make sure, she cut them out and placed one on top of the other. – If she couldn’t cut them out, how else could she be sure? – Find two different ways she could do this, and explain your reasoning.
	10. Relate congruence to similarity in the context of triangles. [CN, R]	10.1 Explain, giving examples, whether each of the following statements is true or false. – All similar triangles are congruent. – All congruent triangles are similar.

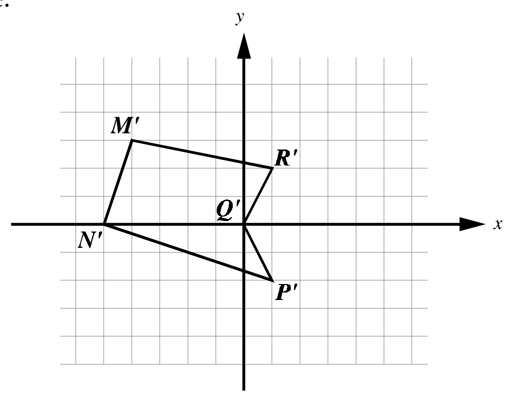
Grade 9
Strand: Shape and Space (3-D Objects and 2-D Shapes)
Students will:
- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

General Outcome	Specific Outcomes	Illustrative Examples
Use spatial problem solving in building, describing and analyzing geometric shapes.	11. Draw the plan and elevations of a 3-D object from sketches and models. [C, R, T, V]	11.1 Six cubes were used to build this model.  Using isometric dot paper, draw the overview plan, front elevation, and the left and right elevations. 11.2 Draw and label the plan, front, right and left elevations of this sketch. 
	12. Sketch or build a 3-D object, given its plan and elevation views. [C, PS, T, V]	12.1 Build the object that follows the plan and the front and side views.  plan front side 12.2 Use isometric dot paper to sketch the object illustrated by the following views.  overview plan front elevation side elevation

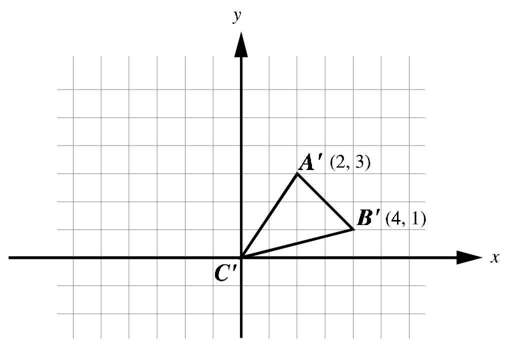
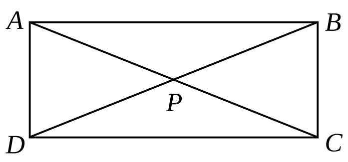
Grade 9
Strand: Shape and Space (3-D Objects and 2-D Shapes)
Students will:
- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

General Outcome	Specific Outcomes	Illustrative Examples
Use spatial problem solving in building, describing and analyzing geometric shapes.	13. Recognize and draw the locus of points in solving practical problems. [PS, T, V]	13.1 A radio transmitter can send out its programs a distance of 60 km or less. Choose a suitable scale, then mark some points that are 60 km or less. What does the area covered by the transmitter look like?  13.2 This is a plan of a backyard with a fence around it. The grass must be at least 1 m away from the tree and at least 2 m from the fence. Shade the area that will be grass.  13.3 A monkey can reach out 60 cm from the base of his cage. His cage is rectangular and measures 150 cm by 100 cm. Shade the part of the ground outside the cage where the monkey can reach. (The bars go all around the cage.) 13.4 Imagine a smaller circle (A) rolling around a larger circle (B).  What would the path of a specific point on circle A look like? Consider: – the centre of circle A – a point on the circumference of circle A. 13.5 Pasha and Quentin are hiding behind a high wall. Use diagrams to show: – points from which neither person can be seen – points from which Pasha but not Quentin can be seen – points from which both can be seen. 

Grade 9
Strand: Shape and Space (Transformations)
Students will:
- perform, analyze and create transformations.

General Outcome	Specific Outcomes	Illustrative Examples
Apply coordinate geometry and pattern recognition to predict the effects of translations, rotations, reflections and dilatations on 1-D lines and 2-D shapes.	14. Draw the image of a 2-D shape as a result of: • a single transformation • a dilatation • combinations of translations and/or reflections. [PS, T, V] 15. Identify the single transformation that connects a shape with its image. [R] 16. Demonstrate that a triangle and its dilatation image are similar. [R] 17. Demonstrate the congruence of a triangle with its: • translation image • rotation image • reflection image. [R]	14, 16 Draw a triangle with coordinates (2, 3), (4, 6) and (5, 4). Locate the dilatation image of the triangle with the dilatation centre at (0, 0) and a scale factor of 2. Explain how you know that the triangle and its image are similar. 14, 17 Draw a triangle with coordinates (3, 1), (6, 1) and (5, 3). Draw the resulting images for the following: – 90° clockwise rotation with rotation centre at (3, 1) – reflection with y-axis as line of reflection – translation—2 units right and 4 units down. Explain how each image is the same as the original figure and how it is different from the original figure. 14.1 Draw a triangle in the first quadrant. Identify the coordinates. – Perform a translation so that the image is completely in the fourth quadrant. Identify the coordinates of the image. – Perform a reflection of the above image so that its image is completely in the second quadrant. Identify the coordinates of this image. 14.2 This image *M′* (-4, 3), *N′* (-5, 0), *P′* (1, -2), *Q′* (0, 0), *R′* (1, 2) was obtained by subtracting 3 from each *x*-coordinate of the vertices *M*, *N*, *P*, *Q* and *R*. Draw the original figure. 

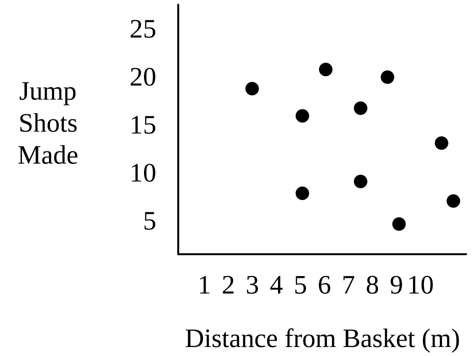
Grade 9
Strand: Shape and Space (Transformations)
Students will:
- perform, analyze and create transformations.

General Outcome	Specific Outcomes	Illustrative Examples
Apply coordinate geometry and pattern recognition to predict the effects of translations, rotations, reflections and dilatations on 1-D lines and 2-D shapes.		14.3 The triangle in the diagram was moved from its original position by adding 1 to its *x*-coordinates and 3 to its *y*-coordinates and then reflect over the *x*-axis. What was the original position of the triangle?  15.1 Rectangle *ABCD* was transformed, and the image lies on top of *ABCD*.  What single rotation is required for a rotation about: – Point *A*? – Point *P*?

Grade 9
Strand: Statistics and Probability (Data Analysis)
Students will:
- collect, display and analyze data to make predictions about a population.

General Outcome	Specific Outcomes	Illustrative Examples
Collect and analyze experimental results expressed in two variables, using technology, as required.	1. Design, conduct and report on an experiment to investigate a relationship between two variables. [C, CN, PS] 2. Create scatter plots for discrete and continuous variables. [C, V] 3. Interpret a scatter plot to determine if there is an apparent relationship. [E, R] 4. Determine the lines of best fit from a scatter plot for an apparent linear relationship by: • inspection • using technology (equations are not expected). [E, PS, T] 5. Draw and justify conclusions from the line of best fit. [C, R]	1–5.1 Design, conduct and report on an investigation into one of the following: – spring extension versus mass – mass versus volume for several samples of the same substance – price in Canadian dollars versus price in US dollars for books and magazines – temperature versus time of day over a two day period (nonlinear) – height versus “arm stretch”—distance between fingertips with arms fully extended – any other possible relationship you wish to investigate. 1–5.2 Create a scatter plot to investigate the relationship: – between the distance, in kilometres, that a student lives from school versus the time, in minutes, required to travel to school each morning – the number of cars in our school parking lot at 9:00 a.m. and the day of the week? Examine your scatter plot to: – describe the patterns of the dots – account for the dots that do not lie on the line – state a relationship in words for your plot. Use your ruler. Estimate and draw the line that best fits your dot pattern. Could your line be used to make predictions? Would any point that lies on the line have meaning with respect to the two variables? Explain.

Grade 9
Strand: Statistics and Probability (Data Analysis)
Students will:
- collect, display and analyze data to make predictions about a population.

General Outcome	Specific Outcomes	Illustrative Examples
Collect and analyze experimental results expressed in two variables, using technology, as required.		5.1 – Draw the line of best fit. – What conclusions can be drawn from this data? – Describe the relationship between shots made and distance. 
	6. Assess the strengths, weaknesses and biases of samples and data collection methods. [C, R, T]	6–7 Collect data presented via newspaper, magazine, radio or TV. – How were samples for the data selected? Why do you think they were selected that way? Are they biased? – Were the data collection methods appropriate for the data and the issue? – How would you do it differently? Why? – Are the data presented clearly and honestly? – Do the conclusions follow logically from the data? – What questions are left unanswered? Is this deliberate?
	7. Critique ways in which statistical information and conclusions are presented by the media and other sources. [C, CN]	

Grade 9
Strand: Statistics and Probability (Chance and Uncertainty)
Students will:
- use experimental or theoretical probability to represent and solve problems involving uncertainty.

General Outcome	Specific Outcomes	Illustrative Examples
Explain the use of probability and statistics in the solution of complex problems.	8. Recognize that decisions based on probability may be a combination of theoretical calculations, experimental results and subjective judgements. [PS, R]	8.1 Interview some people to find out how they pick lottery numbers and why they choose particular numbers. 8.2 Jay checked data on how often each number has been drawn in a particular lottery. He chose six numbers that had been drawn the least often. Do they have a greater probability of being drawn the next time? Explain. 8.3 The weather forecast indicates that the probability of precipitation for tomorrow is 60%. Sasha will decide whether or not to go golfing, based on what criteria?
	9. Demonstrate an understanding of the role of probability and statistics in society. [C, CN]	9.1 Find examples from newspapers, radio, TV or other sources that use probability; e.g., marketing of products and services, weather forecasting, opinion polls. Are the data valid? Are they presented in an honest or in a misleading way? What assumptions are made?
	10. Solve problems involving the probability of independent events. [PS, T]	10.1 If you toss three pennies, what is the probability that they will all land heads? What other events are possible? Are all the events equally likely? Explain. What is the probability of getting two heads and one tail? Justify your answer by using pennies to illustrate all possible outcomes. 10.2 Amenu chose three, single digits for her combination lock. What is the probability that someone could make a lucky guess and open her lock? Explain. How could you set up a simulation experiment, using the computer to solve this problem? 10.3 There are two candies each of red, green and blue in a bag. What is the probability of drawing a red one? How many will you have to draw before you are sure of drawing a red one?