M A T H E M A T I C S 9

Appendix A: Correlation Between Projects and Mathematics 9 Learning Outcomes

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PROBLEM SOLVING	Projects A B C D E
It is expected that students will use a variety of methods to solve real-life, practical, technical, and theoretical problems.	***It is expected that students will:*** • **solve problems that involve a specific content area (e.g., geometry, algebra, trigonometry, statistics, probability, etc.)** • **solve problems that involve more than one content area** • **solve problems that involve mathematics within other disciplines** • **analyse problems and identify the significant elements** • **develop specific skills in selecting and using an appropriate problem-solving strategy or combination of strategies chosen from, but not restricted to, the following:** - **guess and check** - **look for a pattern** - **make a systematic list** - **make and use a drawing or model** - **eliminate possibilities** - **work backward** - **simplify the original problem** - **develop alternative original approaches** - **analyse keywords** • **demonstrate the ability to work individually and co-operatively to solve problems** • **determine that their solutions are correct and reasonable** • **clearly communicate a solution to a problem and the process used to solve it** • **use appropriate technology to assist in problem solving**

NUMBER (Number Concepts) — Projects A B

It is expected that students will:

- **explain and illustrate the structure and the interrelationship of the sets of numbers within the rational number system**
- develop a number sense of powers with integral exponents and rational bases

It is expected that students will:

- give examples of numbers that satisfy the conditions for natural, whole, integral and rational numbers, and show that these numbers comprise the rational number system.
- **describe, orally and in writing, whether or not a number is rational.**
- give examples of situations where answers would involve the positive (principal) square root, or both positive and negative square roots of a number.
- **illustrate power, base, coefficient and exponent, using** rational numbers or **variables as bases or coefficients.**
- explain and apply the exponent laws for powers with integral exponents.

$$x^m \bullet x^n = x^{m+n}$$

$$x^m \div x^n = x^{m-n}$$

$$(x^m)^n = x^{mn}$$

$$(xy)^m = x^m y^m$$

$$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}, y \neq 0$$

$$x^0 = 1, x \neq 0$$

$$x^{-n} = \frac{1}{x^n}, x \neq 0$$

- determine the value of powers with integral exponents, using the exponent laws.

NUMBER (Number Operations) — Projects A B

It is expected that students will:

- **use a scientific calculator or a computer to solve problems involving rational numbers**
- 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.

It is expected that students will:

- document and explain the calculator keying sequences used to perform calculations involving rational numbers.
- **solve problems, using rational numbers in meaningful contexts.**
- understand and use the exponent laws to simplify expressions with variable bases and evaluate expressions with numerical bases.

PATTERNS AND RELATIONS (Patterns) — Projects A B E

It is expected that students will generalize, design and justify mathematical procedures, using appropriate patterns, models and technology.

It is expected that students will:

- use logic and divergent thinking to present mathematical arguments in solving problems.
- **model situations that can be represented by first -degree expressions.**
- write equivalent forms of algebraic expressions, or equations, with rational coefficients.

PATTERNS AND RELATIONS (Variables and Equations) — Projects A B D

It is expected that students will:

- **evaluate, solve and verify linear equations** and inequalities **in one variable.**
- generalize arithmetic operations from the set of rational numbers to the set of polynomials.

It is expected that students will:

- Illustrate the solutions process for a first-degree, single-variable equation, using concrete materials or diagrams.
- **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.
- solve, algebraically, first-degree inequalities in one variable, display the solutions on a number line and test the solutions
- **identify constant terms, coefficients and variables in polynomial expressions**
- **evaluate polynomial expressions, given the value(s) of variables(s)**
- represent and justify the addition and subtraction of polynomial expressions, using concrete materials and diagrams
- perform the operations of addition and subtraction on polynomial expressions.
- represent multiplication, division and factoring of monomials, binomials, and trinomials of the form $x2 + bx + c$, using concrete materials and diagrams.
- find the product of two monomials, a monomial and a polynomial, and two binomials.
- determine equivalent forms of algebraic expressions by identifying common factors and factoring of the form $x^2 + bx + c$.

SHAPE AND SPACE (Measurement) — Projects D E

It is expected that students will:

- **use trigonometric ratios to solve problems involving a right triangle**
- **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.**

It is expected that students will:

- **explain the meaning of sine, cosine and tangent ratios in right triangles**
- **demonstrate the use of trigonometric ratios (sine, cosine and tangent) in solving right triangles**
- **calculate an unknown side or an unknown angle in a right triangle, using appropriate technology**
- **model and then solve given problem situations involving only one right triangle**
- relate expressions for volumes of pyramids to volumes of prisms, and volumes of cones to volumes of cylinders
- **calculate and apply the rate of volume to surface area to solve design problems in three dimensions**
- **calculate and apply the rate of area to perimeter to solve design problems in two dimensions**

SHAPE AND SPACE (3-D Objects and 2-D Shapes) — Projects D E

It is expected that the student will:

- **specify conditions under which triangles may be similar or congruent, and use these conditions to solve problems**
- **use spatial problem solving in building, describing and analyzing geometric shapes**

It is expected that students will:

- **draw the plan and elevation of a 3-D object from sketches and models**
- **sketch or build a 3-D object, given its plan and elevation views**
- recognize and draw the locus of points in solving practical problems
- **recognize when, and explain why, two triangles are similar, and use the properties of similar triangles to solve problems.**
- **recognize when, and explain why, two triangles are congruent, and use the properties of congruent triangles to solve problems.**
- relate congruence to similarity in the context of triangles

SHAPE AND SPACE (Transformation) — Projects A E

It is expected that students will apply coordinate geometry and pattern recognition to predict the effects of translations, rotations, reflections and dilatations on 1-D lines and 2-D shapes.

It is expected that students will:

- draw the image of a 2-D shape as a result of:
  - a single transformation
  - a dilatation
  - a combination of translation and/or reflections
- identify the single transformation that connects a shape with its image
- demonstrate that a triangle and its dilatation image are similar
- demonstrate the congruence of a triangle with its:
  - translation image
  - rotation image
  - reflection image

STATISTICS AND PROBABILITY (Data Analysis) — Projects A B C

It is expected that students will collect and analyze experimental results expressed in two variables, using technology, as required.

It is expected that students will:

- design, conduct and report on an experiment to investigate a relationship between two variables.
- create scatter plots for discrete and continuous variables.
- interpret a scatter plot to determine if there is an apparent relationship.
- determine the lines of best fit from a scatter plot for an apparent linear relationship by:
  - inspection
  - using technology (equations are not expected).
- draw and justify conclusions from the line of best fit.
- assess the strengths, weaknesses and biases of samples and data collection methods.
- critique ways in which statistical information and conclusions are presented by the media and other sources.

STATISTICS AND PROBABILITY (Chance and Uncertainty) — Projects A

It is expected that students will explain the use of probability and statistics in the solution of problems.	***It is expected that students will:*** • **recognize that decisions based on probability may be a combination of theoretical calculations, experimental results and subjective judgements.** • **demonstrate an understanding of the role of probability and statistics in society** • **solve problems involving the probability of independent events**