Mathematical Process Expectations

Problem Solving

8m1 • develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;

Reasoning And Proving

8m2 • develop and apply reasoning skills (e.g., recognition of relationships, generalization through inductive reasoning, use of counter-examples) to make mathematical conjectures, assess conjectures and justify conclusions, and plan and construct organized mathematical arguments;

Reflecting

8m3 • demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);

Selecting Tools and Computational Strategies

8m4 • select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;

Connecting

8m5 • make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);

Representing

8m6 • create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Communicating

8m7 • communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

Number Sense and Numeration

Overall Expectations

8m8 • represent, compare, and order equivalent representations of numbers, including those involving positive exponents;

8m9 • solve problems involving whole numbers, decimal numbers, fractions, and integers, using a variety of computational strategies;

8m10 • solve problems by using proportional reasoning in a variety of meaningful contexts.

Quantity Relationships

8m11 – express repeated multiplication using exponential notation (e.g., $2 \times 2 \times 2 \times 2 = 2^4$);

8m12 – represent whole numbers in expanded form using powers of ten (e.g., $347 = 3 \times 10^2 + 4 \times 10^1 + 7$);

8m13 – represent, compare, and order rational numbers (i.e., positive and negative fractions and decimals to thousandths);

8m14 – translate between equivalent forms of a number (i.e., decimals, fractions, percents) (e.g., 3/4 = 0.75);

8m15 – determine common factors and common multiples using the prime factorization of numbers (e.g., the prime factorization of 12 is 2 x 2 x 3; the prime factorization of 18 is 2 x 3 x 3; the greatest common factor of 12 and 18 is 2 x 3 or 6; the least common multiple of 12 and 18 is 2 x 2 x 3 x 3 or 36).

Operational Sense

8m16 – solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., graphs, calculators) and strategies (e.g., estimation, algorithms);

8m17 – solve problems involving percents expressed to one decimal place (e.g., 12.5%) and whole-number percents greater than 100 (e.g., 115%) (Sample problem: The total cost of an item with tax included [115%] is $23.00. Use base ten materials to determine the price before tax.);

8m18 – use estimation when solving problems involving operations with whole numbers, decimals, percents, integers, and fractions, to help judge the reasonableness of a solution;

8m19 – represent the multiplication and division of fractions, using a variety of tools and strategies (e.g., use an area model to represent 1/4 multiplied by 1/3);

8m20 – solve problems involving addition, subtraction, multiplication, and division with simple fractions;

8m21 – represent the multiplication and division of integers, using a variety of tools [e.g., if black counters represent positive amounts and red counters represent negative amounts, you can model 3 x (–2) as three groups of two red counters];

8m22 – solve problems involving operations with integers, using a variety of tools (e.g., two-colour counters, virtual manipulatives, number lines);

8m23 – evaluate expressions that involve integers, including expressions that contain brackets and exponents, using order of operations;

8m24 – multiply and divide decimal numbers by various powers of ten (e.g., "To convert 230 000 cm^3 to cubic metres, I calculated in my head $230000 \div 10^6$ to get 0.23 m^3.") (Sample problem: Use a calculator to help you generalize a rule for dividing numbers by 1 000 000.);

8m25 – estimate, and verify using a calculator, the positive square roots of whole numbers, and distinguish between whole numbers that have whole-number square roots (i.e., perfect square numbers) and those that do not (Sample problem: Explain why a square with an area of 20 cm^2 does not have a whole-number side length.).

Proportional Relationships

8m26 – identify and describe real-life situations involving two quantities that are directly proportional (e.g., the number of servings and the quantities in a recipe, mass and volume of a substance, circumference and diameter of a circle);

8m27 – solve problems involving proportions, using concrete materials, drawings, and variables (Sample problem: The ratio of stone to sand in HardFast Concrete is 2 to 3. How much stone is needed if 15 bags of sand are used?);

8m28 – solve problems involving percent that arise from real-life contexts (e.g., discount, sales tax, simple interest) (Sample problem: In Ontario, people often pay a provincial sales tax [PST] of 8% and a federal sales tax [GST] of 7% when they make a purchase. Does it matter which tax is calculated first? Explain your reasoning.);

8m29 – solve problems involving rates (Sample problem: A pack of 24 CDs costs $7.99. A pack of 50 CDs costs $10.45. What is the most economical way to purchase 130 CDs?).

Measurement

Overall Expectations

8m30 • research, describe, and report on applications of volume and capacity measurement;

8m31 • determine the relationships among units and measurable attributes, including the area of a circle and the volume of a cylinder.

Attributes, Units, and Measurement Sense

8m32 – research, describe, and report on applications of volume and capacity measurement (e.g., cooking, closet space, aquarium size) (Sample problem: Describe situations where volume and capacity are used in your home.).

Measurement Relationships

8m33 – solve problems that require conversions involving metric units of area, volume, and capacity (i.e., square centimetres and square metres; cubic centimetres and cubic metres; millilitres and cubic centimetres) (Sample problem: What is the capacity of a cylindrical beaker with a radius of 5 cm and a height of 15 cm?);

8m34 – measure the circumference, radius, and diameter of circular objects, using concrete materials (Sample Problem: Use string to measure the circumferences of different circular objects.);

8m35 – determine, through investigation using a variety of tools (e.g., cans and string, dynamic geometry software) and strategies, the relationships for calculating the circumference and the area of a circle, and generalize to develop the formulas [i.e., Circumference of a circle $=\pi$ x diameter; Area of a circle $= \pi$ x $(\text{radius})^2$] (Sample problem: Use string to measure the circumferences and the diameters of a variety of cylindrical cans, and investigate the ratio of the circumference to the diameter.);

8m36 – solve problems involving the estimation and calculation of the circumference and the area of a circle;

8m37 – determine, through investigation using a variety of tools and strategies (e.g., generalizing from the volume relationship for right prisms, and verifying using the capacity of thin-walled cylindrical containers), the relationship between the area of the base and height and the volume of a cylinder, and generalize to develop the formula (i.e., Volume = area of base x height);

8m38 – determine, through investigation using concrete materials, the surface area of a cylinder (Sample problem: Use the label and the plastic lid from a cylindrical container to help determine its surface area.);

8m39 – solve problems involving the surface area and the volume of cylinders, using a variety of strategies (Sample problem: Compare the volumes of the two cylinders that can be created by taping the top and bottom, or the other two sides, of a standard sheet of paper.).

Geometry and Spatial Sense

Overall Expectations

8m40 • demonstrate an understanding of the geometric properties of quadrilaterals and circles and the applications of geometric properties in the real world;

8m41 • develop geometric relationships involving lines, triangles, and polyhedra, and solve problems involving lines and triangles;

8m42 • represent transformations using the Cartesian coordinate plane, and make connections between transformations and the real world.

Geometric Properties

8m43 – sort and classify quadrilaterals by geometric properties, including those based on diagonals, through investigation using a variety of tools (e.g., concrete materials, dynamic geometry software) (Sample problem: Which quadrilaterals have diagonals that bisect each other perpendicularly?);

8m44 – construct a circle, given its centre and radius, or its centre and a point on the circle, or three points on the circle;

8m45 – investigate and describe applications of geometric properties (e.g., properties of triangles, quadrilaterals, and circles) in the real world.

Geometric Relationships

8m46 – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, geoboard), relationships among area, perimeter, corresponding side lengths, and corresponding angles of similar shapes (Sample problem: Construct three similar rectangles, using grid paper or a geoboard, and compare the perimeters and areas of the rectangles.);

8m47 – determine, through investigation using a variety of tools (e.g., dynamic geometry software, concrete materials, protractor) and strategies (e.g., paper folding), the angle relationships for intersecting lines and for parallel lines and transversals, and the sum of the angles of a triangle;

8m48 – solve angle-relationship problems involving triangles (e.g., finding interior angles or complementary angles), intersecting lines (e.g., finding supplementary angles or opposite angles), and parallel lines and transversals (e.g., finding alternate angles or corresponding angles);

8m49 – determine the Pythagorean relationship, through investigation using a variety of tools (e.g., dynamic geometry software; paper and scissors; geoboard) and strategies;

8m50 – solve problems involving right triangles geometrically, using the Pythagorean relationship;

8m51 – determine, through investigation using concrete materials, the relationship between the numbers of faces, edges, and vertices of a polyhedron (i.e., number of faces + number of vertices = number of edges + 2) (Sample problem: Use Polydrons and/or paper nets to construct the five Platonic solids [i.e., tetrahedron, cube, octahedron, dodecahedron, icosahedron], and compare the sum of the numbers of faces and vertices to the number of edges for each solid.).

Location and Movement

8m52 – graph the image of a point, or set of points, on the Cartesian coordinate plane after applying a transformation to the original point(s) (i.e., translation; reflection in the x-axis, the y-axis, or the angle bisector of the axes that passes through the first and third quadrants; rotation of 90°, 180°, or 270° about the origin);

8m53 – identify, through investigation, real-world movements that are translations, reflections, and rotations.

Patterning and Algebra

Overall Expectations

8m54 • represent linear growing patterns (where the terms are whole numbers) using graphs, algebraic expressions, and equations;

8m55 • model linear relationships graphically and algebraically, and solve and verify algebraic equations, using a variety of strategies, including inspection, guess and check, and using a "balance" model.

Patterns and Relationships

8m56 – represent, through investigation with concrete materials, the general term of a linear pattern, using one or more algebraic expressions (e.g., "Using toothpicks, I noticed that 1 square needs 4 toothpicks, 2 connected squares need 7 toothpicks, and 3 connected squares need 10 toothpicks. I think that for n connected squares I will need 4 + 3(n – 1) toothpicks, because the number of toothpicks keeps going up by 3 and I started with 4 toothpicks. Or, if I think of starting with 1 toothpick and adding 3 toothpicks at a time, the pattern can be represented as 1 + 3n.");

8m57 – represent linear patterns graphically (i.e., make a table of values that shows the term number and the term, and plot the coordinates on a graph), using a variety of tools (e.g., graph paper, calculators, dynamic statistical software);

8m58 – determine a term, given its term number, in a linear pattern that is represented by a graph or an algebraic equation (Sample problem: Given the graph that represents the pattern 1, 3, 5, 7, …, find the 10th term. Given the algebraic equation that represents the pattern, t = 2n – 1, find the 100th term.).

Variables, Expressions, and Equations

8m59 – describe different ways in which algebra can be used in real-life situations (e.g., the value of $5 bills and toonies placed in a envelope for fund raising can be represented by the equation v = 5f + 2t);

8m60 – model linear relationships using tables of values, graphs, and equations (e.g., the sequence 2, 3, 4, 5, 6, … can be represented by the equation t = n + 1, where n represents the term number and t represents the term), through investigation using a variety of tools (e.g., algebra tiles, pattern blocks, connecting cubes, base ten materials) (Sample problem: Leah put $350 in a bank certificate that pays 4% simple interest each year. Make a table of values to show how much the bank certificate is worth after five years, using base ten materials to help you. Represent the relationship using an equation.);

8m61 – translate statements describing mathematical relationships into algebraic expressions and equations (e.g., for a collection of triangles, the total number of sides is equal to three times the number of triangles or s = 3n);

8m62 – evaluate algebraic expressions with up to three terms, by substituting fractions, decimals, and integers for the variables (e.g., evaluate 3x + 4y = 2z, where x = 1/2, y = 0.6, and z = –1);

8m63 – make connections between solving equations and determining the term number in a pattern, using the general term (e.g., for the pattern with the general term 2n + 1, solving the equation 2n + 1 = 17 tells you the term number when the term is 17);

8m64 – solve and verify linear equations involving a one-variable term and having solutions that are integers, by using inspection, guess and check, and a "balance" model (Sample problem: What is the value of the variable in the equation 30x – 5 = 10?).

Data Management and Probability

Overall Expectations

8m65 • collect and organize categorical, discrete, or continuous primary data and secondary data and display the data using charts and graphs, including frequency tables with intervals, histograms, and scatter plots;

8m66 • apply a variety of data management tools and strategies to make convincing arguments about data;

8m67 • use probability models to make predictions about real-life events.

Collection and Organization of Data

8m68 – collect data by conducting a survey or an experiment to do with themselves, their environment, issues in their school or community, or content from another subject, and record observations or measurements;

8m69 – organize into intervals a set of data that is spread over a broad range (e.g., the age of respondents to a survey may range over 80 years and may be organized into ten-year intervals);

8m70 – collect and organize categorical, discrete, or continuous primary data and secondary data (e.g., electronic data from websites such as E-Stat or Census At Schools), and display the data in charts, tables, and graphs (including histograms and scatter plots) that have appropriate titles, labels (e.g., appropriate units marked on the axes), and scales (e.g., with appropriate increments) that suit the range and distribution of the data, using a variety of tools (e.g., graph paper, spreadsheets, dynamic statistical software);

8m71 – select an appropriate type of graph to represent a set of data, graph the data using technology, and justify the choice of graph (i.e., from types of graphs already studied, including histograms and scatter plots); – explain the relationship between a census, a representative sample, sample size, and a population (e.g., "I think that in most cases a larger sample size will be more representative of the entire population.").

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Data Relationships

8m73 – read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g., election data or temperature data from the newspaper, data from the Internet about lifestyles), presented in charts, tables, and graphs (including frequency tables with intervals, histograms, and scatter plots);

8m74 – determine, through investigation, the appropriate measure of central tendency (i.e., mean, median, or mode) needed to compare sets of data (e.g., in hockey, compare heights or masses of players on defence with that of forwards);

8m75 – demonstrate an understanding of the appropriate uses of bar graphs and histograms by comparing their characteristics (Sample problem: How is a histogram similar to and different from a bar graph? Use examples to support your answer.);

8m76 – compare two attributes or characteristics (e.g., height versus arm span), using a scatter plot, and determine whether or not the scatter plot suggests a relationship (Sample problem: Create a scatter plot to compare the lengths of the bases of several similar triangles with their areas.);

8m77 – identify and describe trends, based on the rate of change of data from tables and graphs, using informal language (e.g., "The steep line going upward on this graph represents rapid growth. The steep line going downward on this other graph represents rapid decline.");

8m78 – make inferences and convincing arguments that are based on the analysis of charts, tables, and graphs (Sample problem: Use data to make a convincing argument that the environment is becoming increasingly polluted.);

8m79 – compare two attributes or characteristics, using a variety of data management tools and strategies (i.e., pose a relevant question, then design an experiment or survey, collect and analyse the data, and draw conclusions) (Sample problem: Compare the length and width of different-sized leaves from a maple tree to determine if maple leaves grow proportionally. What generalizations can you make?).

Probability

8m80 – compare, through investigation, the theoretical probability of an event (i.e., the ratio of the number of ways a favourable outcome can occur compared to the total number of possible outcomes) with experimental probability, and explain why they might differ (Sample problem:Toss a fair coin 10 times, record the results, and explain why you might not get the predicted result of 5 heads and 5 tails.);

8m81 – determine, through investigation, the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases, using class-generated data and technology-based simulation models (Sample problem: Compare the theoretical probability of getting a 6 when tossing a number cube with the experimental probabilities obtained after tossing a number cube once, 10 times, 100 times, and 1000 times.);

8m82 – identify the complementary event for a given event, and calculate the theoretical probability that a given event will not occur (Sample problem: Bingo uses the numbers from 1 to 75. If the numbers are pulled at random, what is the probability that the first number is a multiple of 5? is not a multiple of 5?).