BIG IDEAS

Similar shapes and objects have proportional relationships that can be described, measured, and compared.	**Optimization** informs the decision-making process in situations involving extreme values.	**Logical reasoning** helps us discover and describe mathematical truths.	Statistical analysis allows us to notice, wonder about, and answer questions about **variation**.

Learning Standards

Curricular Competencies	Content
Students are expected to do the following: **Reasoning and modelling** • Develop **thinking strategies** to solve puzzles and play games • Explore, **analyze**, and apply mathematical ideas using **reason**, **technology**, and **other tools** • **Estimate reasonably** and demonstrate **fluent, flexible, and strategic thinking** about number • **Model** with mathematics in **situational contexts** • **Think creatively** and with **curiosity and wonder** when exploring problems **Understanding and solving** • Develop, demonstrate, and apply mathematical understanding through play, story, **inquiry**, and problem solving • **Visualize** to explore and illustrate mathematical concepts and relationships • Apply **flexible and strategic approaches** to **solve problems** • Solve problems with **persistence and a positive disposition** • Engage in problem-solving experiences **connected** with place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures	*Students are expected to know the following:* • forms of **mathematical reasoning** • **angle relationships** • **graphical analysis:** – **linear inequalities** – **quadratic functions** – **systems of equations** – **optimization** • **applications** of **statistics** • **scale models** • **financial literacy:** compound interest, investments and loans

Learning Standards (continued)

Curricular Competencies	Content
Communicating and representing • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom • Take risks when offering ideas in classroom **discourse** **Connecting and reflecting** • **Reflect** on mathematical thinking • **Connect mathematical concepts** with each other, other areas, and personal interests • Use **mistakes** as **opportunities to advance learning** • **Incorporate** First Peoples worldviews, perspectives, **knowledge**, and **practices** to make connections with mathematical concepts	

Big Ideas – Elaborations

- **Similar:**

  Sample questions to support inquiry with students:

  - What characteristics make objects similar?
  - How do the properties of 3D objects change in an enlargement or a reduction?
  - How do the properties of 2D objects change in an enlargement or a reduction?
- **Optimization:**
  - a mathematical analysis used to determine the minimum or maximum output for a given situation

  Sample questions to support inquiry with students:

  - Can we think of a story where a conflict can be resolved through optimization?
  - How can mathematics help us make decisions regarding the best course of action?
  - What factors influence the decision-making process when determining an optimal solution?
  - How do graphs aid in understanding a situation that is being optimized?
- **Logical reasoning:**
  - the process of using a strategic, systematic series of steps based on valid mathematical procedures and given statements to form a conclusion

  Sample questions to support inquiry with students:

  - How can logical reasoning help us deal with problems in our everyday lives?
  - How does puzzle and game analysis help us in the world outside the math classroom?
- **variation:**
  - occurs in observation (e.g., reaction to medications, opinions on topics, income levels, graduation rates)

  Sample questions to support inquiry with students:

  - How do we gather data in order to answer questions?
  - How do we analyze data and make decisions?
  - Can we think of a story that involves variation? How would we describe the variation?
  - When analyzing data, what are some of the factors that need to be considered before making inferences?

- **thinking strategies:**
  - using reason to determine winning strategies
  - generalizing and extending
- **analyze:**
  - examine the structure of and connections between mathematical ideas (e.g., quadratics and cubic functions, linear inequalities, optimization, financial decision making)
- **reason:**
  - inductive and deductive reasoning
  - predictions, generalizations, conclusions drawn from experiences (e.g., with puzzles, games, and coding)
- **technology:**
  - graphing technology, dynamic geometry, calculators, virtual manipulatives, concept-based apps
  - can be used for a wide variety of purposes, including:
    - exploring and demonstrating mathematical relationships
    - organizing and displaying data
    - generating and testing inductive conjectures
    - mathematical modelling
- **other tools:**
  - manipulatives such as algebra tiles and other concrete materials
- **Estimate reasonably:**
  - be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., angle size reasonableness, scale calculations and unit choice, optimal solutions)
- **fluent, flexible and strategic thinking:**
  - includes:
    - using known facts and benchmarks, partitioning, applying whole number strategies to rational numbers and algebraic expressions
    - choosing from different ways to think of a number or operation (e.g., Which will be the most strategic or efficient?)
- **Model:**
  - use mathematical concepts and tools to solve problems and make decisions (e.g., in real-life and/or abstract scenarios)
  - take a complex, essentially non-mathematical scenario and figure out what mathematical concepts and tools are needed to make sense of it
- **situational contexts:**
  - including real-life scenarios and open-ended challenges that connect mathematics with everyday life
- **Think creatively:**

  - by being open to trying different strategies
  - refers to creative and innovative mathematical thinking rather than to representing math in a creative way, such as through art or music
- **curiosity and wonder:**
  - asking questions to further understanding or to open other avenues of investigation
- **inquiry:**
  - includes structured, guided, and open inquiry
  - noticing and wondering
  - determining what is needed to make sense of and solve problems
- **Visualize:**
  - create and use mental images to support understanding
  - Visualization can be supported using dynamic materials (e.g., graphical relationships and simulations), concrete materials, drawings, and diagrams.
- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem
  - choosing an effective strategy to solve a problem (e.g., guess and check, model, solve a simpler problem, use a chart, use diagrams, role-play)
- **solve problems:**
  - interpret a situation to identify a problem
  - apply mathematics to solve the problem
  - analyze and evaluate the solution in terms of the initial context
  - repeat this cycle until a solution makes sense
- **persistence and a positive disposition:**
  - not giving up when facing a challenge
  - problem solving with vigour and determination
- **connected:**
  - through daily activities, local and traditional practices, popular media and news events, cross-curricular integration
  - by posing and solving problems or asking questions about place, stories, and cultural practices
- **Explain and justify:**
  - use mathematical arguments to convince
  - includes anticipating consequences

- **decisions:**
  - Have students explore which of two scenarios they would choose and then defend their choice.
- **many ways:**
  - including oral, written, visual, use of technology
  - communicating effectively according to what is being communicated and to whom
- **Represent:**
  - using models, tables, graphs, words, numbers, symbols
  - connecting meanings among various representations
- **discussions:**
  - partner talks, small-group discussions, teacher-student conferences
- **discourse:**
  - is valuable for deepening understanding of concepts
  - can help clarify students' thinking, even if they are not sure about an idea or have misconceptions
- **Reflect:**
  - share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions
- **Connect mathematical concepts:**
  - to develop a sense of how mathematics helps us understand ourselves and the world around us (e.g., daily activities, local and traditional practices, popular media and news events, social justice, cross-curricular integration)
- **mistakes:**
  - range from calculation errors to misconceptions
- **opportunities to advance learning:**
  - by:
    - analyzing errors to discover misunderstandings
    - making adjustments in further attempts
    - identifying not only mistakes but also parts of a solution that are correct
- **Incorporate:**
  - by:
    - collaborating with Elders and knowledge keepers among local First Peoples
    - exploring the First Peoples Principles of Learning (e.g., Learning is holistic, reflexive, reflective, experiential, and relational [focused on connectedness, on reciprocal relationships, and a sense of place]; Learning involves patience and time)
    - making explicit connections with learning mathematics
    - exploring cultural practices and knowledge of local First Peoples and identifying mathematical connections

Curricular Competencies – Elaborations

- **knowledge:**
  - local knowledge and cultural practices that are appropriate to share and that are non-appropriated
- **practices:**
  - Bishop's cultural practices: counting, measuring, locating, designing, playing, explaining
  - Aboriginal Education Resources
  - *Teaching Mathematics in a First Nations Context*, FNESC

MATHEMATICS – Foundations of Mathematics
Grade 11

Content – Elaborations

- **mathematical reasoning:**
  - logic, conjecturing, inductive and deductive thinking, proofs, game/puzzle analysis, counter-examples
- **angle relationships:**
  - properties, proofs, parallel lines, triangles and other polygons, angle constructions
- **graphical analysis:**
  - using technology only
- **linear inequalities:**
  - graphing of the solution region
  - slope and intercepts
  - intersection points of lines
- **quadratic functions:**
  - characteristics of graphs, including end behaviour, maximum/minimum, vertex, symmetry, intercepts
- **systems of equations:**
  - including linear with linear, linear with quadratic, and quadratic with quadratic
- **optimization:**
  - using feasible region to optimize objective function
  - maximizing profit while minimizing cost
  - maximizing area or volume while minimizing perimeter

Content – Elaborations

- **applications:**
  - posing a question about an observed variation, collecting and interpreting data, and answering the question
- **statistics:**
  - measures of central tendency, standard deviation, confidence intervals, z-scores, distributions
- **scale models:**
  - enlargements and reductions of 2D shapes and 3D objects
  - comparing the properties of similar objects (length, area, volume)
  - square-cube law
- **financial literacy:**
  - compound interest
  - introduction to investments/loans with regular payments using technology
  - buy/lease