Area of Learning: MATHEMATICS — Foundations of Mathematics

BIG IDEAS

- **Probabilistic thinking** informs decision making in situations involving chance and uncertainty.
- **Modelling** data requires an understanding of a variety of functions.
- **Mathematical analysis** informs financial decisions.
- Through **explorations** of spatial relationships, we can develop a geometrical appreciation of the world around us.

Learning Standards

<table>
<thead>
<tr>
<th>Curricular Competencies</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students are expected to do the following:</strong></td>
<td><strong>Students are expected to know the following:</strong></td>
</tr>
<tr>
<td><strong>Reasoning and modelling</strong></td>
<td>• geometric explorations:</td>
</tr>
<tr>
<td>• Develop <strong>thinking strategies</strong> to solve puzzles and play games</td>
<td>• <strong>constructions</strong></td>
</tr>
<tr>
<td>• Explore, <strong>analyze</strong>, and apply mathematical ideas using <strong>reason</strong>, <strong>technology</strong>, and <strong>other tools</strong></td>
<td>• <strong>conics</strong></td>
</tr>
<tr>
<td>• <strong>Estimate reasonably</strong> and demonstrate <strong>fluent, flexible, and strategic thinking</strong> about number</td>
<td>• <strong>fractals</strong></td>
</tr>
<tr>
<td>• <strong>Model</strong> with mathematics in <strong>situational contexts</strong></td>
<td>• graphical <strong>representations</strong> of polynomial, logarithmic, exponential, and sinusoidal functions</td>
</tr>
<tr>
<td>• <strong>Think creatively</strong> and with <strong>curiosity and wonder</strong> when exploring problems</td>
<td>• <strong>regression analysis</strong></td>
</tr>
<tr>
<td><strong>Understanding and solving</strong></td>
<td>• <strong>combinatorics</strong></td>
</tr>
<tr>
<td>• Develop, demonstrate, and apply conceptual understanding of mathematical ideas through play, story, <strong>inquiry</strong>, and problem solving</td>
<td>• <strong>odds, probability</strong>, and expected value</td>
</tr>
<tr>
<td>• <strong>Visualize</strong> to explore and illustrate mathematical concepts and relationships</td>
<td>• <strong>financial planning</strong></td>
</tr>
<tr>
<td>• Apply <strong>flexible and strategic approaches</strong> to <strong>solve problems</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Curricular Competencies

**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

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

<table>
<thead>
<tr>
<th>MATHEMATICS – Foundations of Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 12</td>
</tr>
</tbody>
</table>

#### Probabilistic thinking:

*Sample questions to support inquiry with students:*
- How do we make decisions involving probabilities?
- How reliable is a test that is 98% accurate?
- What is the difference between reliability and accuracy?
- What information is needed when considering the likelihood of an event?

#### Modelling:

*Sample questions to support inquiry with students:*
- How do we know what type of regression best models a given set of data?
- What factors would affect the reliability of a regression analysis?
- What are the limitations associated with regression models?

#### Decisions:

*Sample questions to support inquiry with students:*
- How do we make decisions regarding our financial options?
- What are the repercussions of our financial decisions (e.g., in the short term versus the long term)?
- What factors influence our willingness to take financial risks?

#### Explorations:

*Sample questions to support inquiry with students:*
- What can we construct using a straightedge and compass?
- What properties change and stay the same when we vary a square, parallelogram, triangle, and so on?
- How are circles, ellipses, parabolas, and hyperbolas related?
- Where are conics found in the world around us?
- How does nature exhibit fractal properties?
- What patterns do we see in fractals?
• thinking strategies:
  – using reason to determine winning strategies
  – generalizing and extending
• analyze:
  – examine the structure of and connections between mathematical ideas (e.g., conic sections, functions, financial planning)
• 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., regression analysis and combinatorics calculations)
• fluent, flexible and strategic thinking:
  – includes using known facts and benchmarks; partitioning; applying whole number strategies to graphing; regression choice; probability
• 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
Curricular Competencies – Elaborations

• 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
Curricular Competencies – Elaborations

• 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

• 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
### Content – Elaborations

<table>
<thead>
<tr>
<th>MATHEMATICS – Foundations of Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade 12</strong></td>
</tr>
</tbody>
</table>

- **constructions:**
  - perpendicular bisector, tangents, polygons, tessellations, geometric art

- **conics:**
  - locus definition and constructions, conic sections, applications

- **fractals:**
  - understanding fractals as an iteration of a simple instruction
  - constructing and analyzing models of fractals, such as Cantor’s dust, Serpinski’s triangle, Koch’s snowflake
  - connecting fractals with nature

- **representations:**
  - using technology only
  - using characteristics of a graph to identify these functions

- **regression analysis:**
  - polynomial, exponential, sinusoidal, logarithmic
  - applying the appropriate regression model

- **combinatorics:**
  - permutations, combinations, pathways, Pascal’s Triangle

- **odds, probability:**
  - mutually exclusive, non–mutually exclusive, conditional probability, binomial probability
  - Venn diagrams

- **financial planning:**
  - developing a personal financial portfolio
  - mortgages
  - risk
  - changing interest rates and/or payments
  - credit cards
  - exploring banking options and financial markets