**Area of Learning: MATHEMATICS — Apprenticeship Mathematics**  
**Grade 12**

### BIG IDEAS

<table>
<thead>
<tr>
<th>Design involves investigating, planning, creating, and evaluating.</th>
<th>Constructing 3D objects often requires a 2D plan.</th>
<th>Transferring mathematical skills between problems requires conceptual understanding and flexible thinking.</th>
<th>Proportional reasoning is used to make sense of multiplicative relationships.</th>
<th>Choosing a tool based on required precision and accuracy is important when measuring.</th>
</tr>
</thead>
</table>

### Learning Standards

<table>
<thead>
<tr>
<th>Curricular Competencies</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are expected to do the following:</td>
<td>Students are expected to know the following:</td>
</tr>
<tr>
<td><strong>Reasoning and modelling</strong></td>
<td>• <strong>measuring</strong>: using tools with graduated scales; conversions using metric and imperial</td>
</tr>
<tr>
<td>• Develop <strong>thinking strategies</strong> to solve puzzles and play games</td>
<td>• similar <strong>triangles</strong>: including right-angle trigonometry</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>2D and 3D shapes</strong>: including area, surface area, volume, and nets</td>
</tr>
<tr>
<td>• <strong>Estimate reasonably</strong> and demonstrate <strong>fluent, flexible, and strategic thinking</strong> about number</td>
<td>• <strong>3D objects</strong> and their views (isometric drawing, orthographic projection)</td>
</tr>
<tr>
<td>• <strong>Model</strong> with mathematics in <strong>situational contexts</strong></td>
<td>• <strong>mathematics in the workplace</strong></td>
</tr>
<tr>
<td>• <strong>Think creatively</strong> and with <strong>curiosity and wonder</strong> when exploring problems</td>
<td>• <strong>financial literacy</strong>: business investments and loans</td>
</tr>
<tr>
<td><strong>Understanding and solving</strong></td>
<td></td>
</tr>
<tr>
<td>• Develop, demonstrate, and apply conceptual understanding of mathematical ideas through play, story, <strong>inquiry</strong>, and problem solving</td>
<td></td>
</tr>
<tr>
<td>• <strong>Visualize</strong> to explore and illustrate mathematical concepts and relationships</td>
<td></td>
</tr>
<tr>
<td>• Apply <strong>flexible and strategic approaches</strong> to solve problems</td>
<td></td>
</tr>
<tr>
<td>• Solve problems with <strong>persistence and a positive disposition</strong></td>
<td></td>
</tr>
<tr>
<td>• Engage in problem-solving experiences <strong>connected</strong> with place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures</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
### Design:

*Sample questions to support inquiry with students:*
- How is a product designed?
- How can the design process be applied to meet a need or solve a problem?

### 3D objects:

*Sample questions to support inquiry with students:*
- What are some limitations that result when 3D objects are represented in 2D?
- Which type of 2D representation would be the most appropriate for a 3D object?
- How does visualization help when solving problems?
- How does visualization help break down a larger problem?

### Transferring mathematical skills:

*Sample questions to support inquiry with students:*
- How does awareness and knowledge of mathematics in the workplace make learning more meaningful?
- What is the mathematics required for a particular trade of interest?

### Proportional reasoning:

- reasoning about comparisons of relative size or scale instead of numerical difference
- ways of showing proportional comparison when analyzing problems in situational contexts
  - scale diagrams
  - rates of change

*Sample questions to support inquiry with students:*
- How are proportions used to solve problems?
- What is the importance of proportional reasoning when making sense of the relationship between two things?

### Measuring:

*Sample questions to support inquiry with students:*
- What skills are required for measuring with accuracy?
- What is the importance of choosing appropriate tools and units when measuring?
- What are the implications of inaccurate measurements?
### thinking strategies:
- using reason to determine winning strategies
- generalizing and extending

### analyze:
- examine the structure of and connections between mathematical ideas (e.g., proportional reasoning, metric/imperial conversions)

### 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 rulers and other measuring tools

### Estimate reasonably:
- be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., reasonableness of measurements)

### fluent, flexible, and strategic thinking:
- including:
  - using known facts and benchmarks, partitioning, applying whole number strategies to expressions involving proportional reasoning, financial analysis, and logic
  - 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
### MATHEMATICS – Apprenticeship Mathematics

#### Curricular Competencies – Elaborations

**Grade 12**

- **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
### Curricular Competencies – Elaborations

**MATHEMATICS – Apprenticeship Mathematics**  
**Grade 12**

- **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
<table>
<thead>
<tr>
<th>Content – Elaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>measuring:</strong></td>
</tr>
<tr>
<td>− unit analysis</td>
</tr>
<tr>
<td>− precision and accuracy</td>
</tr>
<tr>
<td>− breaking of units into smaller divisions to get more precise measurements</td>
</tr>
<tr>
<td>− extension: project or presentation to share measurement concepts and skills used in a field/career of interest</td>
</tr>
<tr>
<td><strong>triangles:</strong></td>
</tr>
<tr>
<td>− situational examples such as stairs and roofs</td>
</tr>
<tr>
<td>− application of Pythagorean theorem</td>
</tr>
<tr>
<td>− situations involving multiple right-angle triangles</td>
</tr>
<tr>
<td><strong>3D objects:</strong></td>
</tr>
<tr>
<td>− creating and reading various types of technical drawings</td>
</tr>
<tr>
<td>− extension: project or presentation to share geometry concepts and skills used in a field/career of interest</td>
</tr>
<tr>
<td><strong>mathematics in the workplace:</strong></td>
</tr>
<tr>
<td>− compare and contrast mathematics used in different workplace contexts</td>
</tr>
<tr>
<td>− interview someone working in a field of interest</td>
</tr>
<tr>
<td>− extension: project that includes an element of design and mathematical thinking</td>
</tr>
<tr>
<td><strong>financial literacy:</strong></td>
</tr>
<tr>
<td>− business investments, loans (lease versus buy), graphical representations of financial growth, projections, expenses</td>
</tr>
<tr>
<td>− extension: project or presentation to share mathematical concepts and skills used in a field/career of interest</td>
</tr>
</tbody>
</table>