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

**BIG IDEAS**

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

**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 conceptual understanding of mathematical ideas 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-solvingexperiences **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:** **measuring:** using tools with graduated scales; conversions using metric and imperial
* similar **triangles:** including right-angle trigonometry
* 2D and 3D shapes: including area, surface area, volume, and nets
* **3D objects** and their views (isometric drawing, orthographic projection)
* **mathematics in the workplace**
* **financial literacy:** business investments and loans
 |

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

**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 riskswhen 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 makeconnections with mathematical concepts
 |  |

|  **MATHEMATICS – Apprenticeship Mathematics Big Ideas – Elaborations Grade 12** |
| --- |
| * **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?
 |

|  **MATHEMATICS – Apprenticeship Mathematics Curricular Competencies – Elaborations Grade 12** |
| --- |
| * **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 deductivereasoning
	+ 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
* **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](http://www.fnesc.ca/wp/wp-content/uploads/2015/09/PUB-LFP-POSTER-Principles-of-Learning-First-Peoples-poster-11x17.pdf) (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](http://www.csus.edu/indiv/o/oreyd/ACP.htm_files/abishop.htm): counting, measuring, locating, designing, playing, explaining
	+ [Aboriginal Education Resources](http://www.aboriginaleducation.ca/)
	+ [*Teaching Mathematics in a First Nations Context*,](http://www.fnesc.ca/resources/math-first-peoples/) FNESC
 |

|  **MATHEMATICS – Apprenticeship Mathematics Content – Elaborations Grade 12** |
| --- |
| * **measuring:**
	+ unit analysis
	+ precision and accuracy
	+ breaking of units into smaller divisions to get more precise measurements
	+ extension: project or presentation to share measurement concepts and skills used in a field/career of interest
* **triangles:**
	+ situational examples such as stairs and roofs
	+ application of Pythagorean theorem
	+ situations involving multiple right-angle triangles
* **3D objects:**
	+ creating and reading various types of technical drawings
	+ extension: project or presentation to share geometry concepts and skills used in a field/career of interest
* **mathematics in the workplace:**
	+ compare and contrast mathematics used in different workplace contexts
	+ interview someone working in a field of interest
	+ extension: project that includes an element of design and mathematical thinking
* **financial literacy:**
	+ business investments, loans (lease versus buy), graphical representations of financial growth, projections, expenses
	+ extension: project or presentation to share mathematical concepts and skills used in a field/career of interest
 |