**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 |