**Area of Learning: MATHEMATICS — Foundations of Mathematics Grade 11**

**BIG IDEAS**

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| **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 analysisallows us to notice, wonder about, and answer questions about **variation**. |

**Learning Standards**

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| **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
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**Area of Learning: MATHEMATICS — Foundations of Mathematics Grade 11**

**Learning Standards (continued)**

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| **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 makeconnections with mathematical concepts
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|  **MATHEMATICS – Foundations of Mathematics Big Ideas – Elaborations Grade 11** |
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| * **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?
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|  **MATHEMATICS – Foundations of Mathematics Curricular Competencies – Elaborations Grade 11** |
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| * **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 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 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](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
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|  **MATHEMATICS – Foundations of Mathematics Content – Elaborations Grade 11** |
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| * **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
* **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
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