Area of Learning: Mathematics	**Foundations of Mathematics 12**
Big Ideas	Elaborations

• **Probabilistic thinking** informs decision making in situations involving chance and uncertainty.	• **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** data requires an understanding of a variety of functions.	• **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?

• Mathematical analysis informs financial **decisions**.	• **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?

• Through **explorations** of spatial relationships, we can develop a geometrical appreciation of the world around us.	• **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?

Learning Standards			
Curricular Competencies	Elaborations	Content	Elaborations

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 context**s
• **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-solving experiences
	• **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
		Students are expected to know the following:
		• geometric explorations:
		  ○ **constructions**
		  ○ **conics**
		  ○ **fractals**
		• graphical **representations** of polynomial, logarithmic, exponential, and sinusoidal functions
		• **regression analysis**
		• **combinatorics**
		• **odds, probability**, and expected value
		• **financial planning**
			• **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,

connected with place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures
 	
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
	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
			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

	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 appropriate 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		

Comment [ANE1]: Carpe Diem: Possible to embed link in "First Peoples Principles of Learning" rather than showing the URL?

	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 (http://www.csus.edu/indiv/o/oreyd/ACP.htm_files/abishop.htm) ○ Aboriginal Education Resources (www.aboriginaleducation.ca) ○ *Teaching Mathematics in a First Nations Context*, FNESC (http://www.fnesc.ca/resources/math-first-peoples/)		