Area of Learning: Mathematics	**History of Mathematics 11**
Big Ideas:	Elaborations:

• Mathematics has **developed** over many centuries and continues to evolve.	• **developed:**
	• *Sample questions to support inquiry with students:*
	  ○ What is the connection between the development of mathematics and the history of humanity?
	  ○ How have mathematicians overcome discrimination in order to advance the development of mathematics?
	  ○ Where have similar mathematical developments occurred independently because of geographical separation?

• Mathematics is a global **language** used to understand the world.	• **language:**
	• *Sample questions to support inquiry with students:*
	  ○ How universal is the language of mathematics?
	  ○ How is learning a language similar to learning mathematics?
	  ○ How does oral language influence our conceptual understanding of mathematics?

• **Societal needs** across cultures have influenced the development of mathematics.	• **Societal needs:**
	• *Sample questions to support inquiry with students:*
	  ○ Have societal needs always had a positive impact on mathematics?
	  ○ How have politics influenced the development of mathematics?
	  ○ How might mathematics influence decisions regarding social justice issues?

• **Tools and technology** are catalysts for mathematical development.	• **Tools and technology:**
	• *Sample questions to support inquiry with students:*
	  ○ Did tools and technology affect mathematical development or did mathematics affect the development of tools and technology?
	  ○ What does technology enable us to do and how does this lead to deeper mathematical understanding?

• Notable **mathematicians** in history nurtured a sense of play and curiosity that led to the development of many areas in mathematics.	• **mathematicians:**
	• *Sample questions to support inquiry with students:*
	  ○ What drives a mathematician to solve the seemingly unsolvable?
	  ○ What do you wonder about in the mathematical world?
	  ○ What are some examples of mathematical play that led to practical applications?

Learning Standards	

Curricular Competencies:	Elaborations:	Content:	Elaborations:

Students are expected to do the following:
 	
Reasoning and modelling
• Develop **thinking strategies** to solve historical puzzles and play games
• Explore, **analyze**, and apply historical mathematical ideas using **reason**, **technology**, and **other tools**
• **Think creatively** and with **curiosity and wonder** when exploring problems
 	
Understanding and solving
• Critique multiple strategies used to solve mathematical problems throughout history
• 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 **connected** with place, story and cultural practices, including local First Peoples
 	
Communicating and representing
• **Explain and justify** mathematical ideas and **decisions** in **many ways**
• Use historical symbolic representations
	• **thinking strategies:**
	  ○ using reason to determine winning strategies
	  ○ generalizing and extending
	• **analyze:**
	  ○ examine the structure of and connections between mathematical ideas from historical contexts
	• **reason:**
	  ○ inductive and deductive reasoning
	  ○ predictions, generalizations, conclusions drawn from experiences
	• **technology:**
	  ○ historically appropriate tools
	  ○ 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
	  – presenting historical solutions or mathematical ideas from a current perspective
	• **other tools:**
	  ○ manipulatives such as rulers, compass, abacus, and other historically appropriate tools
	• **Think creatively:**
	  ○ by being open to trying different
		Students are expected to know the following:
		
		• **number and number systems:**
		  ○ written and oral numbers
		  ○ zero
		  ○ rational and irrational numbers
		  ○ pi
		  ○ prime numbers
		• **patterns and algebra:**
		  ○ early algebraic thinking
		  ○ variables
		  ○ early uses of algebra
		  ○ Cartesian plane
		  ○ notation
		  ○ Fibonacci sequence
		• **geometry:**
		  ○ of lines, angles, triangles
		  ○ Euclid's five postulates
		  ○ geometric constructions
		  ○ developments through time
		• **probability and statistics:**
		  ○ Pascal's triangle
		  ○ games involving probability
		  ○ **early beginnings** of statistics and probability
		• **tools and technology:** development over time, from clay tablets to modern-day calculators and computers
		• **cryptography:**
		  ○ use of ciphers, encryption, and decryption throughout history
			• **number and number systems:**
			  ○ Egyptian, Babylonian, Roman, Greek, Arabic, Mayan, Indian, Chinese, First Peoples
			  ○ exploring the idea of different bases, different forms of arithmetic
			  ○ infinity
			  ○ problems from the Rhind Mathematical Papyrus
			  ○ Eratosthenes
			• **patterns and algebra:**
			  ○ Al-Khwarizmi's *Algebra*
			  ○ Indian mathematics
			  ○ Islamic mathematics
			  ○ Descartes
			  ○ the golden ratio
			  ○ patterns in art
			• **geometry:**
			  ○ problems from the Rhind Mathematical Papyrus, Moscow Mathematical Papyrus
			  ○ Pythagoras
			  ○ Hippocrates and construction problems of antiquity
			  ○ geometry in Euclid's *Elements*, Archimedes, Apollonius, Pappus's *Book III*
			  ○ Indian and Arabic contributions
			  ○ Descartes and Fermat
			• **probability and statistics:**
			  ○ Pascal, Cardano, Fermat, Bernoulli, Laplace

to explore mathematics • 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, with other areas, and with personal interests • Reflect on the consequences of mathematics culturally, socially, and politically • Use **mistakes** as **opportunities to advance learning** • **Incorporate** First Peoples worldviews, perspectives, **knowledge**, and **practices** to make connections with mathematical concepts	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 problems (e.g., guess and check, model, solve a simpler problem, use a chart, use diagrams, role-play, historical representations) • **solve problems:**	○ modern uses of cryptography in war and digital applications	○ ancient games such as dice and the Egyptian game Hounds and Jackals ○ Egyptian record keeping ○ Graunt and the development of statistics through the need for merchant insurance policies • **early beginnings:** ○ forms of tabulating information, leading to the beginnings of probability and statistics • **tools and technology:** ○ papyrus, stone tablet, bone, compass and straightedge, abacus, scales, slide rule, ruler, protractor, calculator, computer • **cryptography:** ○ cuneiform ○ Spartan military use of ciphers ○ first documentation of ciphers in the Arab world ○ John Wallis ○ World War II and the Enigma machine ○ barcodes ○ modular arithmetic ○ RSA coding ○ current coding techniques and security in digital password encryption

	○ 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 and persevering through struggles (e.g., struggles of mathematicians and how their persistence led to mathematical discoveries) ○ 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 argument 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
	• **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		

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	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/)		