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

**BIG IDEAS**

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| Mathematics has **developed** over many centuries and continues to evolve. |  | Mathematics is a global **language** used to understand the world. |  | **Societal needs** across cultures have influenced the development of mathematics. |  | **Tools and technology** are catalysts for mathematical development. |  | Notable **mathematicians** in history nurtured a sense of play and curiosity that led to the development of many areas in mathematics. |

**Learning Standards**

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| **Curricular Competencies** | **Content** |
| *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
 | *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
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**Area of Learning: MATHEMATICS — History 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**
* Use historical symbolic representations 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
 | * **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
	+ modern uses of cryptography in war and digital applications
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|  **MATHEMATICS – History of Mathematics Big Ideas – Elaborations Grade 11** |
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| * **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?
* **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:**

*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:**

*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?
* **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?
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|  **MATHEMATICS – History 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 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 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:**
	+ 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 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 – History of Mathematics Content – Elaborations Grade 11** |
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| * **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
	+ 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
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