**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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**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 |

| **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? |

| **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 |

| **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 |