Area of Learning:	**Calculus**
Big Ideas	Elaborations
• The **concept of a limit** is foundational in developing calculus.	• **concept of a limit**: o Differentiation & integration are defined using limits
• Differential calculus develops the concept of instantaneous **rate of change** of one quantity in relation to another.	• **rate of change**: o developing rate of change from average to instantaneous
• Integral calculus develops the concept of finding the **sum of an infinite series**.	• **sum of an infinite series**: o The $\int f(x)dx$ is the infinite sum of infinitesimal pieces $f(x)dx$ and can be related to the graph of $f(x)$ and area associated with its curve.
• Derivatives & integrals have an **inverse relationship.**	• **inverse relationship:** o The fundamental theorem of calculus show the relationship between integrals and antiderivatives.

Curricular Competencies	Elaborations	Content:	Elaborations
Students are expected to do the following: **Reasoning and analyzing** • Use **reasoning and logic** to analyze and apply mathematical ideas • **Estimate** reasonably • Demonstrate **fluent and flexible thinking** of number • Use tools or technology to analyze relationships and test conjectures • **Model** mathematics in contextualized experiences **Understanding and solving** • Develop, demonstrate,	• **reasoning and logic:** o inductive and deductive reasoning**,** predicting, generalizing, drawing conclusions through experiences including puzzles, games, and coding • **Estimate:** o being able to defend the reasonableness of an estimate; across mathematical contexts • **fluent and flexible thinking:** o this includes using known facts, benchmarks, partitioning, applying whole number strategies to rational numbers and algebraic expressions • **Model:** o use concrete materials, dynamic interactive technology, representing a situation graphically and/or symbolically o http://www.nctm.org/Publications/Teaching-Children-Mathematics/Blog/Modeling-with-Mathematics-through-Three-Act-Tasks/ • **conceptual understanding:**	*Students are expected to know the following:* • Concept of the **Derivative** • **Limits** • **Derivatives** • **Applications** of Derivatives • Concept of the **Integral** • **Integrals** • Applications of	• **Derivative:** o Rate of change (slope), average vs instantaneous (secant vs tangent lines) • **Limits:** o Table of values, graphically, and algebraically; one-sided vs. two-sided; continuity • **Derivatives:** o History, definition; notation; differentiability; powers, logarithmic, exponential, and trigonometric; implicit differentiation; higher order derivatives;

and apply **conceptual understanding** of mathematical ideas • **Visualize** to explore and illustrate mathematical concepts and relationships • Apply **flexible strategies** to solve problems in both abstract and contextualized situations • Engage in problem-solving **experiences** that are connected to place, story, and cultural practices and perspectives relevant to local First Peoples communities, as well as other cultures **Communicating and representing** • Communicate mathematical thinking in **many ways** • Use mathematical vocabulary and language to contribute to mathematical **discussions** • **Represent** mathematical ideas in a variety of ways • Explain and justify mathematical ideas **Connecting and reflecting** • **Reflect** upon	o developed through playing with ideas, inquiry, and problem solving • **visualize:** o including dynamic visualizations such as graphical relationships, simulations • **flexible strategies:** o from a repertoire of strategies, choose an appropriate strategy to solve problems (e.g., guess and check, model, solve a simpler problem, use a chart, diagrams, role play) • **experiences:** o includes context, strategies and approaches, language across cultures • **many ways:** o oral, written, pictures, use of technology • **discussions:** o developing a mathematical community in the classroom through discourse-partner talks, small group discussions, teacher-student conferences • **Represent:** o concretely, pictorially, symbolically including using models, tables, graphs, words, numbers and symbols • **Reflect:** o share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions • **other areas and personal interests:** o to develop a sense of how mathematics helps us understand ourselves and the world around us (e.g., daily activities, local and traditional practices, the environment, popular media and news events, social justice, and cross-curricular integration) • **Incorporate:** o Invite local First Peoples Elders and knowledge keepers to share their knowledge • **make connections:** o Bishop's cultural practices: counting, measuring, locating, designing, playing, explaining (http://www.csus.edu/indiv/o/oreyd/ACP.htm_files/abishop.h	**integration**	product; quotient and chain rules • **Applications:** o Relating graph of f(x) to f'(x) and f''(x) (increasing/decreasing, concavity), Newton's method; contextual problems, including related rates and optimization problems • **Integral**: o infinite sum, Riemann sum (rectangle approximation method, trapezoidal rule) • **Integrals:** o Fundamental theorem of calculus**;** integrals of functions (indefinite and definite), substitution, parts? • **integration:** o Area under a curve; volume of solids; differential equations (initial value problems)

mathematical thinking • Use mathematics to support personal choices • Connect mathematical concepts to each other and to **other areas and personal interests** • **Incorporate** First Peoples worldviews and perspectives to **make connections** to mathematical concepts	tm) o FNESC Place-Based Themes and Topics: family & ancestry; travel & navigation; games; land, environment & resource management; community profiles; artwork; nutrition; dwellings o http://www.fnesc.ca/resources/math-first-peoples/		