BIG IDEAS

The **concept of a limit** is foundational in developing calculus.	Differential calculus develops the concept of instantaneous **rate of change** of one quantity in relation to another.	Integral calculus develops the concept of finding the **sum of an infinite series**.	Derivatives and integrals have an **inverse relationship**.

Learning Standards

Curricular Competencies	Content
Students are expected to be able 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, 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, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and 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	*Students are expected to know the following:* • concept of the **derivative** • **limits** • **derivatives** • **applications** of derivatives • concept of the **integral** • **integrals** • applications of **integration**

Learning Standards (continued)

Curricular Competencies	Content
Connecting and reflecting • **Reflect** on 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	

Big Ideas – Elaborations

MATHEMATICS — Calculus
Grade 12

concept of a limit:

- Differentiation and integration are defined using limits.

rate of change:

- developing rate of change from average to instantaneous

sum of an infinite series:

- 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.

inverse relationship:

- The fundamental theorem of calculus shows the relationship between integrals and antiderivatives.

reasoning and logic:

- inductive and deductive reasoning
- predicting, generalizing, drawing conclusions through experiences including puzzles, games, and coding

Estimate:

- being able to defend the reasonableness of an estimate across mathematical contexts

fluent and flexible thinking:

- includes using known facts and benchmarks; partitioning; applying whole number strategies to rational numbers and algebraic expressions

Model:

- using concrete materials and dynamic interactive technology
- representing a situation graphically and/or symbolically

conceptual understanding:

- developed through playing with ideas, inquiry, and problem solving

Visualize:

- includes dynamic visualizations such as graphical relationships, simulations

flexible strategies:

- from a repertoire of strategies, choosing an appropriate strategy to solve problems (e.g., guess and check, model, solve a simpler problem, use a chart, use diagrams, role-play)

experiences:

- includes context, strategies and approaches, language across cultures

many ways:

- including oral, written, visual, use of technology

discussions:

- developing a mathematical community in the classroom through discourse — partner talks, small-group discussions, teacher-student conferences

Represent:

- concretely, pictorially, symbolically, including using models, tables, graphs, words, numbers, symbols

Reflect:

- sharing the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions

other areas and personal interests:

- 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, cross-curricular integration)

Curricular Competencies – Elaborations

Incorporate:

- Collaborate with local First Peoples Elders and knowledge keepers.

make connections:

- Bishop's cultural practices: counting, measuring, locating, designing, playing, explaining (http://www.csus.edu/indiv/o/oreyd/ACP.htm_files/abishop.htm)
- www.aboriginaleducation.ca
- *Teaching Mathematics in a First Nations Context,* FNESC (http://www.fnesc.ca/resources/math-first-peoples/)

MATHEMATICS — Calculus
Grade 12

Content – Elaborations

derivative:

- rate of change (slope), average versus instantaneous (secant versus tangent lines)

limits:

- table of values, graphically, algebraically; one-sided versus two-sided; continuity

derivatives:

- history, definition; notation; differentiability; powers, logarithmic, exponential, trigonometric; implicit differentiation; higher-order derivatives; product; quotient and chain rules

applications:

- 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:

- infinite sum, Riemann sum (rectangle approximation method, trapezoidal rule)

integrals:

- fundamental theorem of calculus; integrals of functions (indefinite and definite), substitution, parts

integration:

- area under a curve; volume of solids; differential equations (initial value problems)