BIG IDEAS

Working with **diagrams** is essential to geometric thinking.	Geometry is about working with **variation** and invariance.	Working with and on **definitions** is central in geometry.	**Geometry** stories and applications vary across cultures and time.	A written **proof** is the endpoint to the process of proving.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Reasoning and analyzing** • Engage in **spatial reasoning** in a dynamic environment • 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:* • geometric **constructions** • **circle geometry** • **constructing tangents** • transformations of 2D shapes, including the **isometries** and **affine transformations** • **perspective** and **non-Euclidean geometries**

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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 — Geometry Grade 12

diagrams:

- Diagrams are fundamental to investigating, communicating, and discovering properties in geometry.

variation:

- Invariance amidst variation can be experienced using current technology and dynamic diagrams. For example, the sum of the angles in planar triangles being 180° is invariant when all forms of a triangle are considered.

definitions:

- Definitions are seldom the starting points in geometry; rather, we are working with geometry to create, test, and redefine definitions.

geometry:

- Geometry is more than a list of axioms and deductions. Non-Western and modern geometry is concerned with shape and space and is non-axiomatic. It is not about producing a theorem; rather, it is about creating or serving a purpose. Today, geometry is experienced in a multitude of disciplines, including animation, architecture, biology, carpentry, chemistry, and art.

proof:

- Proof is not confined to axiomatic deduction, but also includes explaining, discovery, systemization, justification, and communication.

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Curricular Competencies – Elaborations

spatial reasoning:

- being able to think about shapes (real or imagined) and to mentally transform these shapes in order to notice relationships

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

tools or technology:

- physical and digital tools, including coordinate grids

Model:

- using concrete materials and dynamic interactive technology

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

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Curricular Competencies – Elaborations

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)

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/)

Content – Elaborations

constructions:

- perpendicular, angles, bisectors, triangles, triangle centres, quadrilaterals

circle geometry:

- properties of segments, angles, and tangents

constructing tangents:

- lines tangent to circles, circles tangent to circles, circles tangent to three points (PPP), three lines (LLL)

isometries:

- transformations that maintain congruence (translations, rotations, reflections)

affine transformations:

- transformations that maintain collinearity of points and proportions (dilations and shear)

perspective:

- a type of projective geometry where parallel lines meet at a point

non-Euclidean geometries:

- taxicab, hyperbolic/elliptical

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