

Grade 9 Mathematics – Course II (DRAFT)

Course Code	3014
Course Credit	1.0

ENGLISH Program

Discipline Overview

The Kindergarten to Grade 12 mathematics curriculum in the English Program is designed to meet learners' interests, skills, and needs so they can realize that mathematics is a way of building their understanding of the world and that it is part of their everyday lives.

The learning outcomes of this program of study are divided into four areas:

- Number
- Patterns and relations
- Shape and space
- Statistics (starting in Grade 2) and probability (starting in Grade 5)

These areas reflect the [nature of mathematics](#) from Kindergarten to Grade 12.

The study of mathematics promotes the development of global competencies and supports learners' cultivation of enduring understandings. It also fosters the development of logical thinking, problem-solving, and data analysis skills.

Learning experiences and evaluation in the mathematics classroom are based on a problem-based learning approach that allows learners to make connections between their conceptual understanding and various [mathematical processes](#). Integrating these processes into learning helps learners to understand the nature of mathematics, and to make sense of it so they can learn and use mathematics in and out of school throughout their lives.

Course Overview

Grade 9 learners develop an understanding of square roots, powers with integer exponents, and exponential notation, as well as operations with rational numbers by applying the order of operations. They analyze exponential patterns, model and solve linear equations and inequalities, and develop an understanding of operations with polynomial expressions. Learners determine the surface area of three-dimensional objects; explore similarity of polygons, symmetry, and

transformations; and interpret scale diagrams. They design and carry out statistical investigations, analyze data, and explore probability situations, including dependent events. Finally, they develop their financial literacy by studying career choices, borrowing options, the use of credit, as well as saving and investing.

Global Competencies in Mathematics



Critical Thinking

Critical thinking in mathematics involves the ability to compare, evaluate, critique, justify, test, and validate ideas, representations, plans, or solutions, using logical arguments, relevant criteria, and evidence. It also requires a metacognitive approach, enabling learners to solve mathematical problems and situations, communicate their reasoning effectively, and make informed and ethical decisions.

When critical thinking as a competency is applied in mathematics, learners

- research, use, and think about a variety of ideas and information strategically, efficiently, and effectively to make informed decisions and choices
- evaluate their own and others' ideas, as well as possible solutions, by considering different perspectives, potential biases, and the validity and relevance of supporting sources
- use inductive reasoning to explore and record results, analyze mathematical ideas, problems, and situations, identify patterns, formulate generalizations, and test them based on criteria and evidence
- recognize that certain math beliefs influence how they perceive themselves as math learners in this discipline
- demonstrate a willingness to reconsider their ways of thinking and to take into account perspectives different from their own regarding mathematical ideas, problems, or situations
- ask relevant and clarifying questions to further learning and enhance comprehension of mathematical ideas, concepts, problems, and situations
- make judgments based on thoughtful criteria, enabling them to make decisions, solve mathematical problems and situations, and act in an informed manner
- use deductive reasoning to solve mathematical problems and situations, draw new conclusions based upon what is already known or accepted, and make ethical decisions



Creativity

Creativity in mathematics involves the adoption of flexible thinking, curiosity, risk-taking, and making connections to prior knowledge, enabling learners to formulate new hypotheses or view mathematical problems and situations from a new perspective in order to arrive at innovative solutions.

When creativity as a competency is applied in mathematics, learners

- embrace a learning environment that is based on trust and respect, and that encourages them to make choices, take risks, and think flexibly—allowing them to make decisions and take action
- wonder, ask questions, and contemplate different mathematical ideas and concepts
- solve mathematical problems and situations using different ways to arrive at innovative solutions
- enrich and refine their reasoning by considering others' ideas
- formulate, adjust, and refine their plans for solving mathematical problems and situations by looking at them from a new angle
- validate and adapt plans, ideas, strategies, or solutions, while persevering through obstacles, so they can improve at solving mathematical problems and situations
- seek and use feedback from others to develop and consolidate their conceptual understanding, deepen their reasoning, and reflect on their processes for solving mathematical problems and situations



Citizenship

Citizenship in mathematics involves the development of mathematical literacy that enables the application of ideas and concepts in a variety of everyday contexts, awakening learners' curiosity about their role as citizens who can actively contribute to society, think critically about the world, make informed decisions, and propose solutions to issues from a variety of perspectives.

When citizenship as a competency is applied in mathematics, learners

- use mathematics as a means of developing their understanding of a range of complex social, cultural, economic, and political issues, and to help them reflect on them
- mobilize their mathematical knowledge and skills to analyze and understand issues related to discrimination, equity, and human rights by investigating or proposing solutions to a variety of mathematical problems or situations related to these issues

- mobilize their mathematical knowledge and skills to explore, analyze, and understand the impact of the interconnectedness of self, others, and the natural world by investigating or proposing solutions to a variety of mathematical problems and situations related to this issue
- show interest in others' approaches to mathematics and to different points of view, experiences, and world views, allowing them to better understand and solve mathematical problems and situations
- empathize with others whose ideas are different from their own and appreciate solutions to mathematical problems or situations proposed by others
- interact and learn with others in person or online in a responsible, respectful, and inclusive manner by welcoming and valuing diverse viewpoints, and by considering a range of ideas and perspectives when contributing to mathematical exchanges
- realize that their mathematical knowledge and skills will serve not only to improve their own quality of life but also that of others
- engage in meaningful mathematical inquiries, individually and in collaboration, in which they ask themselves and others questions so they can find equitable solutions and make ethical decisions
- appreciate how mathematics can be used to make and justify ethical decisions that lead to responsible and sustainable actions that affect themselves, their community, and the world



Connection to Self

Connection to self in mathematics encompasses the learners' confidence in their ability to undertake and complete tasks, solve mathematical problems and situations, and engage positively in reflective practices that enable them to set goals and make progress.

When connection to self as a competency is applied in mathematics, learners

- believe in their ability to learn and understand the world of mathematics and its impact on their daily lives
- recognize the elements that shape their identity as math learners, and they see themselves as mathematicians
- allow themselves the time they need, and they implement strategies that foster a growth mindset to develop a positive relationship with mathematics
- view reflection on their decisions, efforts, experiences, and feedback as a learning opportunity that helps them progress in mathematics
- reflect on their mathematical learning to set goals and make informed decisions that affect their well-being
- believe that their ability to learn, their talents, and their skills in mathematics will continue to improve throughout their lives through their hard work, perseverance, and effort

- are willing to take risks, ask for help, and persevere, despite obstacles
- demonstrate the ability to make changes and adapt to new mathematical contexts, knowing that they will learn from their mistakes and build on their personal strengths
- develop their autonomy, value their voice, and commit to their role in becoming lifelong mathematics learners



Collaboration

Collaboration in mathematics involves adopting a culture of exchanging ideas and perspectives, in which learners learn from and with each other in order to progress individually and collectively, develop their mathematical reasoning, and implement new ideas to solve problems.

When collaboration as a competency is applied in mathematics, learners

- collaborate with others, value diverse points of view, and consider a range of ideas and perspectives when participating in mathematical exchanges
- participate actively in learning experiences by sharing thinking and learning strategies with others to confirm or extend understandings of mathematical ideas; they respectfully voice their opinions, ideas, and conjectures
- recognize the value of others' contributions, allowing diverse perspectives to enrich mathematical exchanges
- practise active listening, question their own and others' mathematical ways of thinking, and ask questions of others to deepen their understanding of mathematical concepts and ideas
- demonstrate openness by agreeing to compromise and change their views when presented with convincing arguments during mathematical exchanges
- make sense of mathematical concepts and ideas by co-constructing their understanding with others
- support their peers and take responsibility for their roles throughout the learning process and in the completion of mathematical tasks



Communication

Communication in mathematics involves the learners' ability to express their mathematical ideas, reasoning, and solutions in a variety of ways, including orally, in writing, concretely, graphically, and symbolically, and in various contexts. It enables learners to clarify and validate their ideas and reasoning, while encouraging them to question their attitudes and beliefs about mathematics.

When communication as a competency is applied in mathematics, learners

- express their mathematical ideas and emotions about mathematics, taking into account non-verbal cues and adapting what they say according to the context
- present their mathematical ideas visually, orally, in writing, graphically, or symbolically, taking into account the conventions related to the mode of communication used, their audience, and the types of communication contexts, while using clear, precise mathematical language
- understand how their words and actions shape their identity as mathematical learners and shape their relationships with others
- look for oral, non-verbal, or visual cues during exchanges to improve their understanding of terminology, what others are saying, ideas presented, and various solutions to mathematical problems and situations
- seek to understand different points of view and different solutions to a mathematical problem or situation by observing, practising active listening, and asking clarifying questions, thereby contributing to a culture of mutual communication
- recognize and accept that the ways they learn and represent their understanding may be different from those of others
- make sense of mathematical ideas, problems, and situations, and deepen their understanding by making connections among their own language, mathematical terminology, and associated conventions
- contribute to mathematical exchanges and express their thoughts and emotions about mathematical ideas in a positive and respectful way, whether in person or online
- defend their points of view and their mathematical reasoning, while welcoming those of others in a constructive and responsible manner, recognizing that these exchanges enrich learning for themselves and other members of their community



Enduring Understandings

Mathematics, a tool for growth

Developing knowledge and skills in mathematics allows for the understanding of processes, theorems, concepts, situations, and their applications. Building mathematical knowledge allows learners to identify as citizens who believe in their ability to complete a task, a lesson, or a challenge successfully—motivating them to take action and persevere throughout their lifetime to achieve their goals.

Mathematics, a tool for seeing things differently

Mathematics is a part of the living world. It develops one's capacity to think fluidly and creatively, and to understand, interpret, and logically represent various phenomena that can be imperceptible or abstract. It also allows them to compare these phenomena and to analyze them from different perspectives.

Mathematics, a vital tool for understanding the world

Mathematics contributes to the analysis, the comprehension, the interpretation, and the description of the world in which we live. It allows one to study quantities, orders, spaces, numbers, and figures, and the links that exist among them.

Mathematics, an essential interdisciplinary tool for advancing society

Mathematics plays an important role in people's quest for innovation and solutions for the various problems encountered in advancing society. It is used in other disciplines to understand, describe, and interpret the phenomena that surround us, and it allows researchers to improve quality of life through innovation and the development of new technology.

Mathematics, an essential tool for all aspects of daily life

Mathematics is everywhere in society. Mathematical knowledge and skills are necessary for critically analyzing information in diverse social, personal, economic, political, cultural, and environmental contexts in order to make informed, ethical, and sustainable decisions in all aspects of daily life.

Learning Outcomes

Legend

Including: compulsory content
Such as: suggestions to support understanding
[C, CN, ME, PS, R, T, V]: mathematical processes
essential to learning outcomes

Learning Outcome Key

Subject Course Number (I or II)
↓ ↓
MAT.9.1.A.1
↑ ↑ ↗ Learning Outcome
Grade Level Strand

Mathematical Processes

There are critical components that learners must encounter in a mathematics program in order to achieve the goals of mathematics education and encourage lifelong learning in mathematics.

Learners are expected to

- **communicate [C]** in order to learn and express their understanding
- **connect [CN]** mathematical ideas to other concepts in mathematics, to everyday experiences, and to other disciplines
- demonstrate fluency with **mental mathematics and estimation [ME]**

- develop and apply new mathematical knowledge through **problem solving [PS]**
- develop mathematical **reasoning [R]**
- select and use **technologies [T]** as tools for learning and solving problems
- develop **visualization [V]** skills to assist in processing information, making connections, and solving problems

The *Common Curriculum Framework* incorporates these seven interrelated mathematical processes that are intended to permeate teaching and learning.

Strand A: Number

Number sense and operations: Different representations of numbers help reveal certain properties and make calculations easier. Regardless of the type of numbers or symbols used, each operation retains the same meaning, operations are interconnected, and there are multiple ways to reach a result, some of which may be more useful depending on the situation or the problem to be solved, including using estimation to assess whether a solution is reasonable.

- MAT.9.2.A.1** Determine the square root of positive rational numbers that are perfect squares.
[C, CN, ME, PS, R, V]
- MAT.9.2.A.2** Determine an approximate square root of positive rational numbers that are non-perfect squares.
[C, CN, ME, PS, R, T, V]



MAT.9.2.A.3 Demonstrate an understanding of powers with bases that are natural numbers and exponents that are integers, by

- using patterns to show why $a^{-n} = \frac{1}{a^n}$
- evaluating expressions of the form
 - $a^{-n} = \frac{1}{a^n}$
 - $\frac{1}{a^{-n}} = a^n$
- applying the laws of exponents
 - $a^m \cdot a^n = a^{m+n}$
 - $\frac{a^m}{a^n} = a^{m-n}$
 - $(a^m)^n = a^{mn}$
 - $(ab)^m = a^m \cdot b^m$
 - $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
 - $a^0 = 1$
 - $a^{-n} = \frac{1}{a^n}$
 - $\frac{1}{a^{-n}} = a^n$

where a and b are natural numbers and m and n are integers.

[C, CN, ME, PS, R]

MAT.9.2.A.4 Demonstrate an understanding of the exponential notation by expressing and interpreting decimal numbers ranging from 0.001 to 1 000 000 using powers of ten, including expanded exponential forms that reflect place value.

[C, CN, R]

MAT.9.2.A.5 Explain and apply the order of operations on rational numbers, including exponents (limited to whole numbers) with and without technology.

[ME, PS, R, T]



Strand B: Patterns and Relations

Patterns: Recognizing and representing patterns helps us understand the world, make generalizations, and solve problems.

MAT.9.2.B.1 Represent and describe exponential patterns and relations using a table of values, graphs, and analyze these relationships to draw conclusions.
[C, CN, R, T, V]

Variables and equations: Symbols, expressions, and equations are used to represent patterns and describe relationships between quantities.

MAT.9.2.B.2 Model and solve problems using linear equations of the form

- $ax = b + cx$
- $ax + b = cx + d$
- $a(x + b) = cx + d$
- $a(bx + c) = d(ex + f)$
- $\frac{a}{x} = b, x \neq 0$

where a, b, c, d, e , and f are rational numbers.

[C, CN, ME, PS, V]

MAT.9.2.B.3 Explain, illustrate, and apply strategies to solve single variable linear inequalities with rational coefficients within a problem-solving context.

[C, CN, ME, PS, R, V]

MAT.9.2.B.4 Model, record, and explain the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials and binomials, concretely, pictorially, and symbolically.

[C, CN, R, V]

Note: The intent is not to factor polynomials, but to relate multiplication of binomials to the division of a polynomial by a binomial through concrete, pictorial, and symbolic representation.



Strand C: Shape and Space

Measurement: Measurement is a useful process for comparing the dimensions of certain attributes of two-dimensional shapes and three-dimensional objects, whether through direct or indirect methods, in order to solve problems in real-world contexts.

There are no outcomes assigned to this sub-domain.

Three-dimensional objects and two-dimensional figures: Two-dimensional figures and three-dimensional objects can be described, classified, and analyzed based on their attributes and the relationships between them.

MAT.9.2.C.1 Determine the surface area of composite 3-D objects to solve problems.
[C, CN, ME, PS, R, T, V]

Note: It is intended that the composite 3-D objects be made up of objects limited to right cylinders, right rectangular prisms, and right triangular prisms.

MAT.9.2.C.2 Demonstrate an understanding of similarity of polygons.
[C, CN, PS, R, T, V]

Transformations: Two-dimensional figures can be moved using transformations and analyzed based on their position in a Cartesian plane. Their positions and movements can be described and modeled using coordinates, geometric representations, and transformations.

MAT.9.2.C.3 Draw and interpret scale diagrams of 2-D shapes.
[CN, R, T, V]

MAT.9.2.C.4 Demonstrate an understanding of line and rotation symmetry.
[C, CN, PS, V]



Strand D: Statistics and Probability

Data analysis: Data can be collected, organized, represented, and interpreted to model situations, support decision-making, and solve problems.

- MAT.9.2.D.1** Develop and implement a project plan for the collection, display, and analysis of data by
- formulating a question for investigation
 - choosing a data collection method that includes social considerations
 - selecting a population or a sample
 - collecting the data
 - displaying the collected data in an appropriate manner
 - drawing conclusions to answer the question
- [C, CN, PS, R, T, V]

Probability and uncertainty: Probability involves determining the likelihood that an event will occur based on past experiences or the analysis of possible outcomes in order to solve problems in uncertain situations.

- MAT.9.2.D.2** Identify the sample space and calculate the theoretical probability for an event in a random experiment involving two dependent events.
- [C, CN, ME, PS, R, T]
- MAT.9.2.D.3** Explore dependent events through experimentation, calculate, and compare the experimental and theoretical probabilities.
- [C, CN, PS, R, T, V]

Strand E: Financial Literacy

Revenue: Understanding different types of income and how effective money management supports the development of essential skills for making informed financial decisions in everyday life.

- MAT.9.2.E.1** Develop an understanding of how education, career choice, and personal goals can influence future income potential and lifestyle, recognizing the connection between individual expectations and long-term financial planning.
- [C, CN, R, T]



Spending and borrowing: By understanding that income forms the foundation for spending decisions and that borrowing carries obligations and risks that must be managed responsibly, individuals are able to make informed financial decisions.

MAT.9.2.E.2 Develop an understanding of available borrowing options, including a short-term loan, student loan, car loan, line of credit, and mortgage, and recognize their impact on personal finances.
[C, PS, R, T]

MAT.9.2.E.3 Demonstrate an understanding of borrowing decisions, the advantages and disadvantages of using credit, including credit cards, and how paying back debt can affect personal finances and influence credit scores over time.
[C, CN, ME, PS, R, T, V]

Saving and investing: Managing personal finances involves saving and investing wisely to prepare for the future, handle unexpected events, and achieve personal goals.

MAT.9.2.E.4 Demonstrate an understanding of different types of investments and recognize how returns, tax implications, volatility, and risk factors, including fraud, scams, and deceptive schemes, differ among investment options.
[C, CN, R, T]

MAT.9.2.E.5 Demonstrate an understanding of how different types of investments can grow or lose value over time by using technology, tables, and graphs to explore simple and compound interest and compare changes across various options.
[C, CN, PS, R, T, V]

Curriculum Implementation Resources

Curriculum implementation resources are frequently added. Please refer to https://www.edu.gov.mb.ca/k12/framework/english/math/resources/grade_9.html.