# GRADE 9 MATHEMATICS at a glance

***Grade 9 Mathematics at a Glance*** can be used in designing, planning, and assessing student learning for the year. It can be used as a planning tool to preview the content of the Grade 9 Mathematics curriculum.

It is organized by **strands** and sorts learning outcomes into categories or **learning targets**. The learning targets can be used to connect learning by integrating strands, learning outcomes, and other subject areas.

This document can be used with the ***Glance Across the Grades*** document to plan clear and concise expectations for student learning by using big ideas (the why behind what we are learning).

## Mathematical PROCESSES

The seven interrelated **mathematical processes** are intended to permeate teaching and describe the critical aspects of learning, doing, and understanding mathematics. These processes allow students to engage in thinking about mathematics, and support the acquisition and the use of mathematical knowledge and foundational skills that develop conceptual understanding.

These processes are outlined in detail in *Grades 9 to 12 Mathematics: Manitoba Curriculum Framework of Outcomes (2014)*.

- **[C] COMMUNICATION**
- **[CN] CONNECTIONS**
- **[ME] MENTAL MATHEMATICS AND ESTIMATION**
- **[PS] PROBLEM SOLVING**
- **[R] REASONING**
- **[T] TECHNOLOGY**
- **[V] VISUALIZATION**

## NUMBER Strand

- **Representation of Whole Numbers and Operations with Whole Numbers**
  Powers and the order of operations
  N.1 N.2 N.4
- **Representation of Rational Numbers and Operations with Rational Numbers**
  Rational numbers N.3
  Square roots N.5 N.6

## PATTERNS AND RELATIONS Strand

### Patterns
- **Patterning and Algebraic Thinking**
  Generalization PR.1
  Problems involving graphs of linear relations PR.2

### Variables and Equations
- **Algebraic Representations with Expressions**
  Polynomials PR.5
  Operations of polynomials PR.6 PR.7
- **Algebraic Representations with Equations**
  Problems involving linear equations PR.3
  Linear inequalities PR.4

## SHAPE AND SPACE Strand

### Measurement
- **Length and Angles**
  Problems involving circle properties SS.1
  Similarity of polygons SS.3
- **Area**
  Problems involving surface area SS.2

### 3-D Objects and 2-D Shapes
- **Identifying, Sorting, Comparing, and Constructing**
  Problems involving surface area SS.2
  Similarity of polygons SS.3

### Transformations
- **Position and Motion**
  Scale diagrams SS.4
  Line and rotation symmetry SS.5

## STATISTICS AND PROBABILITY Strand

### Data Analysis
- **Collection, Organization, and Analysis of Data**
  Elements affecting data collection SP.1
  Sample and population SP.2
  Project plan SP.3

### Chance and Uncertainty
- **Probability**
  Role of probability SP.4

**Substrands**
- **Learning Targets**

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# GRADE 9 MATHEMATICS

## Curriculum Overview

## NUMBER Strand

- **Representation of Whole Numbers and Operations with Whole Numbers**
  Demonstrate an understanding of powers with integral bases (excluding base 0) and whole-number exponents by representing repeated multiplication, by using patterns, and by solving problems. Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole-number exponents. ➡ N.1 N.2

  Explain and apply the order of operations, including exponents, with and without technology. ⬅ N.4

- **Representation of Rational Numbers and Operations with Rational Numbers**
  Demonstrate an understanding of rational numbers by comparing and ordering them and by solving problems involving arithmetic operations. ⬅ N.3

  Determine the square root of positive rational numbers that are perfect squares, and the approximate square roots of positive rational numbers that are non-perfect squares. ⬅ N.5 N.6

## PATTERNS AND RELATIONS Strand

### Patterns

- **Patterning and Algebraic Thinking**
  Generalize a pattern arising from a problem-solving context using linear equations, and verify by substitution. Graph linear relations, analyze the graph, and interpolate or extrapolate to solve problems. ⬌ PR.1 PR.2

### Variables and Equations

- **Algebraic Representations with Expressions**
  Demonstrate an understanding of polynomials (limited to polynomials of degree less than or equal to 2). ➡ PR.5

  Model, record, and explain the operations of addition and subtraction of polynomial expressions, and the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials. ➡ PR.6 PR.7

- **Algebraic Representations with Equations**
  Model and solve problems using linear equations of the form
  - $ax = b$
  - $ax + b = c$
  - $a(x + b) = c$

  ⬅

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

  ■

  where $a$, $b$, $c$, $d$, $e$, and $f$ are rational numbers. PR.3

  Explain and illustrate strategies to solve single variable linear inequalities with rational number coefficients within a problem-solving context. ➡ PR.4

## SHAPE AND SPACE Strand

### Measurement

- **Length and Angles**
  Solve problems and justify the solution strategy using circle properties. ■ SS.1

  Demonstrate an understanding of similarity of polygons. ■ SS.3

- **Area**

  Determine the surface area of composite 3-D objects to solve problems. ⬌ SS.2

### 3-D Objects and 2-D Shapes

- **Identifying, Sorting, Comparing, and Constructing**
  Determine the surface area of composite 3-D objects to solve problems. ⬌ SS.2

  Demonstrate an understanding of similarity of polygons. ■ SS.3

### Transformations

- **Position and Motion**
  Draw and interpret scale diagrams of 2-D shapes. ➡ SS.4

  Demonstrate an understanding of line and rotation symmetry. ⬅ SS.5

## STATISTICS AND PROBABILITY Strand

### Data Analysis

- **Collection, Organization, and Analysis of Data**
  Describe the effect of bias, use of language, ethics, cost, time and timing, privacy, and cultural sensitivity on the collection of data. ■ SP.1

  Select and defend the choice of using either a population or a sample of a population to answer a question. ■ SP.2

  Develop and implement a project plan for the collection, display, and analysis of data. ■ SP.3

### Chance and Uncertainty

- **Probability**
  Demonstrate an understanding of the role of probability in society. ■ SP.4

■ Concept/learning outcomes are taught in this grade only and will be applied in future grades.

⬅ Concept/learning outcomes introduced in previous grade(s) are further taught in this grade and will be applied in future grades.

➡ Concept/learning outcomes are taught for the first time in this grade and will be taught in future grade(s).

⬌ Concept/learning outcomes introduced in previous grades are taught in this grade and will continue to be taught in future grades.

## REPORT CARD CATEGORIES

"The subject categories are not used for reporting at Grades 9 to 12; however, it is still expected that assessment and reporting at high school be based on curriculum learning outcomes and follow the principles of assessment outlined in this document. For high school, these categories may provide some help for planning instruction and assessment, but reference should be made to the foundations, philosophy, and learning outcomes of the grade-level curriculum."
(*Manitoba Provincial Report Card Policy and Guidelines: Partners for Learning, Grades 1 to 12*)

### KNOWLEDGE AND UNDERSTANDING OF MATHEMATICAL CONCEPTS

The student demonstrates knowledge and understanding of grade-specific mathematical concepts and skills in each strand (number, patterns and relations, shape and space, statistics and probability).

### MENTAL MATH AND ESTIMATION

The student uses math knowledge and number facts to calculate mentally or estimate within each strand (number, patterns and relations, shape and space, statistics and probability). Students apply mental math strategies with efficiency, accuracy, and flexibility. They are able to make reasonable estimates of values or quantities using benchmarks and referents.

### PROBLEM SOLVING

The student applies knowledge, skill, or understanding to solve problems in each strand (number, patterns and relations, shape and space, statistics and probability). By learning to solve problems and by learning through problem solving, students connect mathematical ideas in new contexts. Students think logically, visualize, model, reason, and communicate and justify their solutions.

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# GRADE 9 MATHEMATICS

## Mathematical Processes

The seven interrelated **mathematical processes** are intended to permeate teaching and describe the critical aspects of learning, doing, and understanding mathematics. These processes allow students to engage in thinking about mathematics, and support the acquisition and the use of mathematical knowledge and foundational skills that develop conceptual understanding.

These processes are outlined in detail in *Grades 9 to 12 Mathematics: Manitoba Curriculum Framework of Outcomes (2014)*.

### COMMUNICATION (C)

Reading about, representing, viewing, writing about, listening to, and discussing mathematical ideas allows students to create links among their own language and ideas, the language and ideas of others, and the formal language and symbols of mathematics. Communication enables students to reflect upon, to validate, and to clarify their thinking. Expression of mathematical meaning and ideas can be accomplished orally or in written representations such as journals and learning logs.

### CONNECTIONS (CN)

Mathematics becomes more meaningful when it is contextualized and linked to students' experiences across disciplines. Furthermore, mathematics should be viewed as an integrated whole, rather than as the study of separate strands or units. Within a particular topic, students should see the connections between concrete, pictorial, and symbolic modes of representation. When mathematical ideas are connected to each other or to real-world phenomena, students begin to view mathematics as useful, relevant, and integrated.

### MENTAL MATH AND ESTIMATION (ME)

Mental mathematics is a combination of strategies that enhances flexible thinking and number sense. Estimation is a strategy for determining approximate values or quantities, usually by referring to benchmarks or using referents, or for determining the reasonableness of calculated values. Estimation is often used to make mathematical judgments and to develop useful, efficient strategies for dealing with situations in daily life. Strategies in mental mathematics and estimation enable students to calculate mentally without the use of external aids. In the process, they improve their computational fluency—developing efficiency, accuracy, and flexibility.

### PROBLEM SOLVING (PS)

Students develop understanding of mathematical concepts and procedures when they apply their mathematical knowledge to solve problems in new ways and meaningful contexts. When students encounter new situations and respond to questions of the type *How would you . . . ?* or *How could you . . . ?*, the problem-solving approach is being modelled. Problems are often open-ended, so students may arrive at multiple solutions in different and creative ways. Rich problems allow students in the class to demonstrate their knowledge, skill, or understanding at a level appropriate to them. Learning through problem solving should be the focus of mathematics at all grade levels and should be embedded throughout all topics.

### REASONING (R)

Mathematical reasoning involves generalizing from patterns, conjecturing, validating, and proving. Students need to develop confidence in their abilities to reason and to justify their mathematical thinking. Good reasoning is as important as finding correct answers. The thinking skills developed by a focus on reasoning can be used in life in a wide variety of contexts and disciplines.

### TECHNOLOGY (T)

Technology contributes to and supports the learning of a wide range of mathematical concepts and can increase the focus on conceptual understanding by decreasing the time spent on repetitive procedures. It enables students to explore and create patterns, organize and display data, examine relationships, model situations, generate and test conjectures, solve problems, and reinforce the learning of basic facts. Technology can help to satisfy the curiosity of students and lead to rich mathematical discoveries at all grade levels. The use of technology can enhance, although it should not replace, conceptual understanding, procedural thinking, and problem solving.

### VISUALIZATION (V)

Visual images and visual reasoning are important to a sense of number, space, and measurement. Visualization is fostered through the use of concrete materials, technology, and a variety of visual representations. Visualization can help students gain a concrete understanding of abstract concepts.