

Grade 11/Grade 12 30S/40S Applied Mathematics

mRLC
Essential Learning



Manitoba Rural Learning Consortium 30S/40S Applied Mathematics Essential Learning Document

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Introduction

A. What is mathematical literacy?

- Mathematical literacy is an evolving combination of recognizing describing, and working with numerical and non-numerical patterns, having an intuitive number sense, interpreting and reflecting on the physical environment and making predictions;
- Mathematically literate individuals demonstrate fluency with mental mathematics and estimation, develop and apply new mathematical knowledge through problem solving and mathematical reasoning;
- Mathematically literate individuals can effectively communicate in order to learn and express their understanding, connect mathematical ideas to other concepts in mathematics, to everyday experiences, and to other disciplines;
- Students need to select and use technologies as tools for learning and solving problems as well as develop visualization skills to assist in processing information and making connections.

B. Why 'Enduring Understandings'?

In the new provincial report card, there are no categories in the senior years mathematics courses for which student progress must be tracked and reported. So, unlike the documents developed by the mRLC for grades 1-8 where there is a distinct correlation to report card subject categories, we have chosen to identify enduring understandings in each topic area, and have connected them to essential questions, skills and specific learning outcomes from Manitoba's mathematics curriculum. If our aim is to develop mathematically literate persons, we must shift our focus from the content of math to using the content as a tool to develop the processes and critical thinking skills that define mathematical literacy. Our assessment practices must shift from being point-in-time snapshots to tracking a student's progress over time by providing multiple opportunities for them to demonstrate their learning.

C. Goals of Applied Mathematics

The primary goals of Applied Mathematics are to have students develop critical-thinking skills through problem solving and model real-world situations mathematically to make predictions.

These goals may be attained in a number of ways. Students may collect data in experiments and activities and then develop mathematical concepts by analyzing that data. They are encouraged to learn and demonstrate effective communication skills through a variety of media. Students are expected to become proficient in both oral and written communication skills.

Applied Mathematics is designed to promote student flexibility and responsibility. Flexibility is encouraged by having students work on non-routine problems and projects. Responsibility is encouraged as students work individually and in cooperative groups to explore connections with other mathematical areas, school subjects, and real-life applications.

Technology is an integral part of both learning and assessment in Applied Mathematics. Graphing calculators, spreadsheets, or other computer software will be used by students for mathematical explorations, modeling, and problem solving.

D. The Templates

It is important to note that the attached templates are intended to serve as an example of how teachers might identify essential questions and cluster specific learning outcomes. Therefore, the templates may be viewed as a guide and support document to help teachers in implementing the mathematics curriculum and the Manitoba Report Card.

This document should be considered alongside the Manitoba Curriculum Framework of Outcomes for Mathematics, as well as grade-specific support documents. In addition, teachers are encouraged to consider the following issues:

- On each template, essential vocabulary has been included in the Vocabulary category. This vocabulary has been identified through an examination of the specific learning outcomes for each strand. These are terms that teachers and students will be using as they explore the mathematical concepts related to each strand.
- Although the templates have been organized by specific strands of the Mathematics curriculum, the overall program is intended to be presented as a spiral curriculum. Using this approach, enduring understandings are interwoven and explored throughout the school year.

Grade 11 Applied Mathematics (30S)

Topic: Relations & Functions

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<i>Students will understand how to model and solve real life scenarios by applying systems of linear inequalities.</i>	<p>How can graphical representations be used to model and solve scenarios involving linear inequalities?</p> <p>What characteristics (e.g. implied restrictions, sensible solutions) must be considered when solving systems of inequalities?</p>	<p>Construct two-variable linear inequalities.</p> <p>Represent linear inequalities graphically.</p> <p>Determine and explain the solution which satisfies a linear inequality.</p> <p>Solve optimization problems.</p>	11A.R.1	<p>Boundary Line</p> <p>Discrete Variable(s)</p> <p>Domain & Range</p> <p>Inequalities</p> <p>Linear</p> <p>Linear Programming</p> <p>Objective Function</p> <p>Optimal Solution(s)</p> <p>Restriction(s) / Constraint(s)</p> <p>Solution Set / Feasible Region</p> <p>Systems of Equations</p>
<i>Students will understand how to model and solve real life scenarios by applying quadratic functions.</i>	<p>How do quadratic equations add to the understanding of functions?</p> <p>How can quadratic functions be used to model scenarios?</p>	<p>Identify quadratics on the basis of defining characteristics.</p> <p>Identify the characteristics of a quadratic function given its graphical and/or algebraic representations.</p> <p>Represent a quadratic function graphically and/or algebraically given its characteristics.</p> <p>Apply and communicate an understanding of quadratics to scenarios.</p>	11.A.R.2	<p>Axis of Symmetry</p> <p>Degree</p> <p>Domain & Range</p> <p>Factored form and Standard form</p> <p>Maximum/Minimum</p> <p>Parabola</p> <p>Quadratic Formula</p> <p>Quadratic Function</p> <p>Regression</p> <p>Roots, X Intercepts, & Zeroes</p> <p>Vertex</p> <p>Y Intercept</p>

Grade 11 Applied Mathematics (30S)

Topic: Geometry

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will understand how reasoning may be used as a strategy to conceptualize geometric relationships that are used in mathematical processes.</i></p>	<p>How can inductive and deductive reasoning be used to determine the properties of angles and polygons?</p> <p>What strategies are used to prove or disprove conjectures?</p> <p>How can proofs be used to solve properties of angles and polygons?</p>	<p>Use inductive and deductive reasoning to derive relationships among angles formed by parallel lines and/or polygons.</p> <p>Solve contextual problems using angle properties.</p> <p>Apply angle properties to determine whether lines are parallel.</p>	<p>11A.G.1. 11A.G.2.</p>	<p>Angles Convex polygon Corresponding angle Exterior alternate Exterior angle Interior alternate Interior angle Transversals Vertically opposite</p>
<p><i>Students will understand how cosine law and sine law are used to solve problems in real life.</i></p>	<p>When should cosine law and/or sine law be used to solve problems?</p> <p>How are cosine law and sine law related to the primary trigonometric ratios?</p> <p>What are the characteristics of a problem that yields zero, one, or two solutions?</p>	<p>Demonstrate an understanding of cosine law and sine law.</p> <p>Solve contextual problems involving cosine law and/or sine law using visual representations and written explanations.</p> <p>Solve problems with ambiguous case.</p>	<p>11A.G.3.</p>	<p>Acute Triangle Ambiguous case Cosine law Oblique Triangle Sine Law</p>

Grade 11 Applied Mathematics (30S)

Topic: Measurement

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will understand that proportional reasoning is a way of estimating and applying rates and scale.</i></p>	<p>How can real life scenarios be represented through rates?</p> <p>How is proportional reasoning impacted by scale factors?</p>	<p>Use multiple representations to communicate rates.</p> <p>Apply proportional reasoning to solve contextual problems.</p> <p>Use scale diagrams to solve problems involving proportional reasoning.</p> <p>Use scale factor to estimate and calculate the dimensions of 2D shapes and 3D objects.</p>	<p>11A.M.1 11A.M.2 11A.M.3</p>	<p>Area Independent Variable Dependent Variable Proportion Rate Scale diagram Scale factor Slope Surface area Unit Rate Volume</p>

Grade 11 Applied Mathematics (30S)

Topic: Statistics

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will understand how to demonstrate and interpret normal distribution data sets.</i></p>	<p>How can graphical representations be used to model and solve scenarios involving data sets?</p> <p>How can statistical analysis be used to compare data sets?</p> <p>What inferences can be made about a population based on sample data?</p>	<p>Organize raw data into frequency tables, histograms and frequency polygons.</p> <p>Analyze examples from media in terms of normal distribution.</p> <p>Determine and explain statistical measures including standard deviation and z-scores using technology.</p> <p>Demonstrate an understanding of statistical measures including confidence intervals and margin of error.</p>	<p>11A.S.1 11A.S.2</p>	<p>Confidence Interval Confidence Level Deviation Dispersion Frequency Distribution Table Frequency polygon / Line plot Margin of error Normal Curve / Bell Curve Normal Distribution (68%-95%-99% rule) Outlier Standard Deviation Standard Normal Distribution Z-score Z-score table</p>

Grade 11 Applied Mathematics (30S)

Topic: Logical Reasoning

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will demonstrate an understanding and application of inductive and deductive reasoning.</i></p>	<p>How can inductive and deductive reasoning be applied to contextual problems such as number patterns, geometry, games and puzzles?</p>	<p>Identify the difference between inductive and deductive reasoning.</p> <p>Identify patterns and make conjectures for sets of numbers and geometric shapes.</p> <p>Disprove conjecture through counterexamples.</p> <p>Analyze logical arguments for validity.</p> <p>Apply logical reasoning strategies when solving puzzles and playing games.</p>	<p>11A.L.1 11A.L.2</p>	<p>Conjecture Counterexample Deductive reasoning Inductive reasoning Proof</p>

Grade 11 Applied Mathematics (30S)

Topic: Research Project

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will appreciate the value of mathematics in other disciplines.</i></p>	<p>What connections does mathematics have to areas of interest (mechanics, music, history, science, technology, etc.)?</p> <p>How does mathematics impact day-to-day activities on a personal level?</p>	<p>Gather data (statistical or informational) that relates to or influences the chosen topic.</p> <p>Analyze data for relevance and applicability.</p> <p>Critique mathematical content for clarity and accuracy.</p> <p>Convey mathematical ideas through written, verbal and/or symbolic communication.</p>	<p>11A.RP.1</p>	<p>(dictated by topic)</p>

Grade 12 Applied Mathematics (40S)

Topic: Finance

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<i>Students will understand how to make informed financial decisions.</i>		Use technology to solve financial problems. <i>(Note: Skill Applies to all EQs)</i>		Amortization Appreciate Compound interest Compounding periods Cost and benefit analysis Depreciate Interest rate Investment portfolios Leasing Maturity Mortgage Principal Rate of return Rule of 72 Simple interest
	How does compound interest influence financial decision-making?	Differentiate between compound and simple interest. Solve investment/loan scenarios.	12A.FM.1	
	What are the costs/benefits of renting, buying and leasing assets that appreciate or depreciate?	Differentiate between assets that appreciate and depreciate. Use a cost-and-benefit analysis when considering the option to buy, lease or rent.	12A.FM.2	
	What makes a strong investment portfolio?	Use investment strategies to explain advantages and disadvantages of various types of long or short term portfolios.	12A.FM.3	

Grade 12 Applied Mathematics (40S)

Topic: Design & Management

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<i>Students will understand how to solve cost and design problems.</i>	How do objects and shapes relate to the process of solving cost and design problems? How do budget requirements affect design processes?	Solve complex problems by reframing them into manageable and simplified tasks in order to calculate total costs. Be able to state logical assumptions given real world scenarios. Understand the need for rounding up to whole units. Understand what constitutes a valid answer.	12A.D.1	(dictated by topic)

Grade 12 Applied Mathematics (40S)

Topic: Probability

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will understand and apply counting methods when solving scenarios that involve probability.</i></p>	<p>How can a sample space be used to illustrate an understanding of probability?</p> <p>How can key terms be used to assist in the selection of strategies to solve a variety of probability problems?</p>	Determine the odds for and against an event in a variety of situations	12A.P.1	<p>Combination Complementary Factorial notation Fundamental Counting Principle Independent/Dependent Mutually exclusive Odds for and against Pathways Permutation Sample Space Tree Diagram</p>
		Differentiate between mutually exclusive and non-mutually exclusive events	12A.P.2	
		Differentiate between independent and dependent events	12A.P.3	
		Solve contextual problems that use probability formulae (“and” versus “or”) including conditional probability		
		Apply the fundamental counting principle to solve permutations with restrictions	12A.P.4	
		Determine the number of permutations for scenarios that may include pathways, repetition and grouping techniques	12A.P.5	
Determine the number of combinations for scenarios that may include more than one case	12A.P.6			
		Solve contextual problems that involve probability and fundamental counting principle, permutations, or combinations		

Grade 12 Applied Mathematics (40S)

Topic: Relations & Functions

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will understand how data can be represented as a function in order to solve real world scenarios.</i></p>	<p>What characteristics and/or relationships can be used to analyze different types of functions?</p> <p>Which type of function can be used to model a given scenario?</p>	<p>Identify characteristics of different types of functions</p> <p>Determine, using technology, a regression equation to approximate data and model scenarios</p> <p>Apply and communicate an understanding of characteristics of functions for scenarios</p>	<p>12A.R.1 12A.R.2 12A.R.3</p>	<p>Amplitude Asymptote Baseline Exponential Function Logarithmic Function Period Periodic Function Radians Regression Sinusoidal Function Starting Point/Phase Shift</p>

Grade 12 Applied Mathematics (40S)

Topic: Logical Reasoning

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will understand how to use sets as a strategy to solve problems.</i></p>	<p>How can data be categorized into sets?</p> <p>How can set theory be applied to contextual problems such as internet searches, games and puzzles?</p>	<p>Demonstrate an understanding of set theory concepts, terminology and notation.</p> <p>Demonstrate an understanding of the relationship between sets using Venn Diagrams.</p> <p>Apply and solve contextual problems that involve sets.</p> <p>Apply logical reasoning strategies when solving puzzles and analyzing games.</p>	<p>12A.L.1 12A.L.2</p>	<p>Complement Disjoint set Elements Empty set Intersection Subsets Union Universal Sets</p>
<p><i>Students will understand logic problems that involve conditional statements.</i></p>	<p>How can conditional statements be analyzed and interpreted?</p>	<p>Understand and interpret conditional statements.</p> <p>Analyze logical arguments using graphic organizers such as truth tables and/or Venn diagrams.</p> <p>Define and determine the truths of the converse, inverse and contrapositive for a conditional statement.</p> <p>Determine if a statement is biconditional.</p>	<p>12A.L.3</p>	<p>Biconditional Contrapositive Converse Inverse Truth tables</p>

Grade 12 Applied Mathematics (40S)

Topic: Research Project

Enduring Understandings	Essential Questions	Skills	Learning Outcomes	Essential Vocabulary
<p><i>Students will appreciate the value of mathematics in other disciplines</i></p>	<p>What connections does mathematics have to areas of interest (mechanics, music, history, science, technology, etc.)?</p> <p>How does mathematics impact day-to-day activities on a personal level?</p>	<p>Gather data (statistical or informational) that relates to or influences the chosen topic.</p> <p>Analyze data for relevance and applicability.</p> <p>Critique mathematical content for clarity and accuracy.</p> <p>Convey mathematical ideas through written, verbal and/or symbolic communication.</p>	<p>12A.RP.1</p>	<p>(dictated by topic)</p>

Appendix 1

Sample Grade Book
Applied Mathematics 40S
Topic: Finance

Enduring Understanding in Finance: <i>Students will understand how to make informed decisions.</i>														
Essential Question					Essential Question					Essential Question				
<i>How does compound interest influence financial decision-making?</i>					<i>What are the costs/benefits of renting, buying and leasing assets that appreciate or depreciate?</i>					<i>What makes a strong investment portfolio?</i>				
Key Performance Skill(s)					Key Performance Skill(s)					Key Performance Skill(s)				
<i>Differentiate between compound and simple interest</i>			<i>Solve investment/loan scenarios</i>		<i>Differentiate between assets that appreciate and depreciate</i>			<i>Use a cost-and-benefit analysis when considering the option to buy, lease or rent</i>		<i>Use investment strategies to explain advantages and disadvantages of various types of long or short term portfolios</i>				
Assessment(s)			Assessment(s)		Assessment(s)			Assessment(s)		Assessment(s)				
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Student A														
Student B														
Student C														
Student D														
Student E														
Student F														

Appendix 2: Essential Learning Terminology

Enduring Understandings

Enduring understandings are statements summarizing important ideas and core processes that are central to a discipline and have lasting value beyond the classroom. They synthesize what students should understand as a result of studying a particular content area. Moreover, they articulate what students should revisit over the course of their lifetimes in relationship to the content area.

Essential Questions

Questions that are not answerable with finality in a brief sentence...their aim is to stimulate thought, provoke inquiry and spark more questions. *(Wiggins/McTighe, 2005)*

Key Performance Skills

Key performance skills draw on a variety of skills. Skills develop within the individual and grow in sophistication over time. Some examples of key performance skills include problem solving, critical thinking and inquiry, design process etc.

Essential Vocabulary

Vocabulary is introduced when needed to clarify experiences and ideas rather than in a list of new terms that start the unit. Essential vocabulary consists of figurative language, nuances in word meaning, roots, affixes, context clues, dictionary, thesaurus, pronunciation, parts of speech. *(Wiggins/McTighe, 2005)*