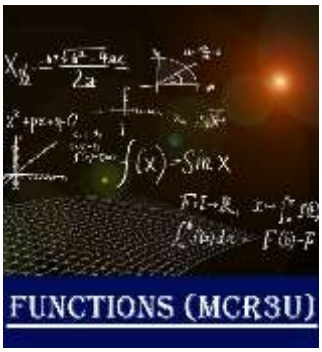


# INUKSHUK ACADEMY

Course code: **Functions (MCR3U)**
Total Hours: **110 hours** and Credit: **1.0**
Prerequisite: **MPM2D, Grade 10 Principles of Mathematics**
Curriculum basis: **Ontario Curriculum, Grades 11–12: Science (Revised 2008)**
Last Update: **Inukshuk Academy 2026**

## Table of Contents

## Course Description

This course introduces the mathematical concept of the function by extending students' experiences with linear and quadratic relations. Students will investigate properties of discrete and continuous functions, including trigonometric and exponential functions; represent functions numerically, algebraically, and graphically; solve problems involving applications of functions; investigate inverse functions; and develop facility in determining equivalent algebraic expressions. Students will reason mathematically and communicate their thinking as they solve multi-step problems.

## 1. Course Rationale

Functions provides the theoretical and mathematical framework for understanding relationships, patterns, and change. MCR3U strengthens students' ability to represent functions, analyze mathematical models, and construct logical arguments using multiple representations. Through inquiry, problem solving, and modelling, students:

- Develop a deeper understanding of functions and how they describe relationships in real-world contexts;
- Explore quadratic, exponential, trigonometric, and discrete functions;
- Refine algebraic and graphical skills essential for senior mathematics and STEM disciplines;
- Learn to analyze patterns, solve multi-step problems, and communicate mathematical reasoning clearly;
- Recognize the role of functions in finance, science, technology, and everyday decision-making.

The course fosters mathematical literacy, critical thinking, and problem-solving fluency, skills essential for success in university-level programs and careers in mathematics, science, engineering, business, and technology.

## 2. Overall Curriculum Expectations

The Ontario Curriculum organizes MCR3U into four major strands. The following expectations are paraphrased for clarity and alignment with Inukshuk Academy's course design.

### a. Characteristics of Functions

Students will:

- Demonstrate an understanding of functions, their representations, and their inverses;
- Make connections between algebraic and graphical representations using transformations;
- Analyze quadratic functions, including zeros, maximum and minimum values, and real-world applications;
- Simplify polynomial, radical, and rational expressions and determine equivalence.

### b. Exponential Functions

Students will:

- Evaluate powers with rational exponents and simplify expressions involving exponents;
- Describe and compare exponential functions using tables, graphs, equations, and verbal descriptions;
- Solve problems involving exponential growth and decay in real-world contexts.

### c. Discrete Functions

Students will:

- Represent recursive sequences in a variety of ways;
- Analyze arithmetic and geometric sequences and series;
- Make connections between sequences, series, compound interest, and ordinary annuities;
- Apply discrete functions to financial and practical problem-solving situations.

### d. Trigonometric Functions

Students will:

- Determine trigonometric ratios for angles less than 360°;
- Prove simple trigonometric identities;
- Solve problems using primary trigonometric ratios, the sine law, and the cosine law;
- Analyze periodic and sinusoidal functions using numerical, graphical, and algebraic representations;
- Model and solve real-world problems involving sinusoidal behaviour.

## 3. Learning Goals for Students

By the end of MCR3U, students will be able to:

- Analyze functions using algebraic, graphical, numerical, and verbal representations;
- Apply transformations to parent functions and interpret their effects on graphs and equations;
- Solve problems involving quadratic, exponential, trigonometric, and discrete functions;
- Simplify and manipulate polynomial, radical, rational, and exponential expressions;
- Model real-world relationships involving growth, decay, periodic behaviour, sequences, series, and financial applications;
- Communicate mathematical reasoning clearly using appropriate notation, terminology, graphs, and technology.
- Analyze complex physical systems using vector-based mathematics and scientific models;
- Conduct investigations using proper experimental design and error analysis;
- Apply conservation laws, field theory, wave models, and modern physics concepts to solve problems;

- Interpret physical data using graphs, equations, and scientific notation;
- Evaluate the impact of physics-related technologies on society and the environment;
- Communicate scientific reasoning clearly, using appropriate diagrams, terminology, and units.

### Course Structure and Instructional Units

| Unit | Description | Hours |
|---|---|---|
| **Unit 0: Prerequisite Skills and Algebra Review** | Linear relations, factoring, exponent laws, equation solving, graphing skills, function notation readiness | 5 hours |
| **Unit 1: Characteristics of Functions** | Function notation, domain and range, transformations, inverses, graphical and algebraic representations | 18 hours |
| **Unit 2: Quadratic Functions** | Quadratic models, zeros, vertex, maximum/minimum values, completing the square, real-world applications | 18 hours |
| **Unit 3: Equivalent Algebraic Expressions** | Polynomial, radical, and rational expressions; simplifying, factoring, restrictions, and equivalence | 15 hours |
| **Unit 4: Exponential Functions** | Rational exponents, exponential graphs, growth and decay, applications and comparisons with other functions | 15 hours |
| **Unit 5: Trigonometric Functions** | Trigonometric ratios, unit circle, sine law, cosine law, identities, sinusoidal functions, periodic modelling | 20 hours |
| **Unit 6: Discrete Functions and Financial Applications** | Recursive sequences, arithmetic and geometric sequences and series, compound interest, ordinary annuities | 17 hours |
| **Culminating Task** | Mathematical investigation or applied modelling project | 5 hours |
| **Final Exam** | Proctored examination | 2 hours |

## 4. Course Structure, Unit Overview and Instructional Plan

## 1. Unit 0: Prerequisite Skills and Algebra Review

**Approx. Hours:** 5

### a. Unit Overview

This introductory unit strengthens the foundational algebraic and graphing skills students require for success in Grade 11 Functions. Students review linear relations, factoring, exponent laws, equation solving, and graphing techniques while reinforcing mathematical communication and problem-solving strategies. Emphasis is placed on developing fluency with algebraic manipulation, proper notation, and interpreting multiple representations of relations and functions.

### b. Key Learning Goals

Students will:

- Simplify algebraic expressions using exponent laws and factoring techniques;
- Solve linear and quadratic equations using multiple strategies;
- Interpret and construct graphs, tables, and equations of linear and quadratic relations;
- Apply proper mathematical notation and communicate reasoning clearly;
- Use graphing technology to verify algebraic and graphical solutions.

### c. Sample Learning and Assessment Activities

- Algebra review exercises and diagnostic assessments;
- Graphing investigations using technology;
- Equation-solving tasks and factoring practice;
- Review of function notation and coordinate geometry.
- Diagnostic quiz, algebra problem sets, graphing activities.

## 2. Unit 1: Characteristics of Functions

**Approx. Hours:** 18

### a. Unit Overview

In this unit, students investigate the mathematical concept of the function and distinguish functions from general relations. Students represent functions numerically, graphically, algebraically, and verbally while exploring domain, range, function notation, and inverses. Emphasis is placed on transformations of parent functions and the connections between algebraic and graphical representations.

Students analyze how translations, reflections, stretches, and compressions affect the graphs of functions and apply these concepts to real-world modelling situations. Technology is used extensively to visualize and compare transformations and inverses.

### b. Key Learning Goals

Students will:

- Identify and represent functions using multiple representations;
- Determine domain and range using graphs, equations, and tables;
- Apply and interpret transformations of parent functions;
- Determine and analyze inverses of functions;
- Model real-world relationships using transformed functions.

### c. Sample Learning and Assessment Activities

- Graphing investigations using dynamic graphing software;
- Function transformation mapping activities;
- Real-world modelling tasks involving functions;
- Inverse function exploration using tables and graphs.
- Graphing assignments, transformation tasks, quizzes, unit test.

## 3. Unit 2: Quadratic Functions

**Approx. Hours:** 18

### a. Unit Overview

Students extend their understanding of quadratic relations through algebraic and graphical analysis. They investigate the properties of quadratic functions, including zeros, vertex, axis of symmetry, maximum and minimum values, and rates of change. Multiple methods for solving quadratic equations are explored, including factoring, completing the square, and the quadratic formula.

Students model real-world situations involving quadratic relationships and interpret the significance of key features of quadratic graphs within contextual applications.

### b. Key Learning Goals

Students will:

- Analyze and graph quadratic functions in multiple forms;
- Determine zeros and vertices using algebraic and graphical methods;
- Solve quadratic equations using factoring, completing the square, and the quadratic formula;
- Apply quadratic models to solve real-world problems;
- Interpret maximum and minimum values in applied contexts.

### c. Sample Learning and Assessment Activities

- Projectile motion modelling investigations;
- Completing-the-square activities;
- Technology-based graph analysis;
- Quadratic optimization problems.
- Problem sets, graphing tasks, modelling assignment, unit test.

## 4. Unit 3: Equivalent Algebraic Expressions

**Approx. Hours:** 15

### a. Unit Overview

This unit focuses on determining and verifying equivalence among polynomial, radical, and rational expressions. Students simplify, expand, factor, and manipulate expressions while identifying restrictions and maintaining equivalence throughout algebraic operations.

Students develop fluency with symbolic manipulation and use algebraic reasoning to justify solutions and communicate mathematical arguments clearly.

### b. Key Learning Goals

Students will:

- Simplify polynomial, radical, and rational expressions;
- Factor expressions using a variety of techniques;
- Identify restrictions on rational expressions;
- Demonstrate equivalence through algebraic manipulation;
- Apply algebraic reasoning to solve problems accurately.

### c. Sample Learning and Assessment Activities

- Polynomial and rational expression investigations;
- Radical simplification activities;
- Algebraic proof and equivalence tasks;
- Collaborative factoring challenges.
- Algebra quizzes, simplification tasks, assignments, unit test.

## 5. Unit 4: Exponential Functions

**Approx. Hours:** 15

### a. Unit Overview

Students investigate exponential functions and compare their characteristics to linear and quadratic functions. They evaluate powers with integer and rational exponents, simplify exponential expressions, and analyze exponential growth and decay models.

Real-world applications such as population growth, depreciation, compound interest, and radioactive decay are used to demonstrate the importance of exponential relationships in science, business, and technology.

### b. Key Learning Goals

Students will:

- Simplify expressions involving integer and rational exponents;
- Identify and graph exponential functions;
- Compare exponential functions to linear and quadratic relations;
- Solve problems involving exponential growth and decay;
- Interpret exponential models in real-world contexts.

### c. Sample Learning and Assessment Activities

- Exponential growth simulations;
- Compound interest modelling tasks;
- Graphing investigations using technology;
- Real-world data analysis activities.
- Exponential modelling assignment, quizzes, unit test.

## 6. Unit 5: Trigonometric Functions

**Approx. Hours:** 20

### a. Unit Overview

In this unit, students investigate trigonometric ratios, periodic relationships, and sinusoidal functions. Students extend their understanding of trigonometry through the unit circle, special triangles, and the sine and cosine laws. They examine the properties of sinusoidal functions and apply transformations to model periodic behaviour.

Applications involving sound, motion, seasonal variation, and wave phenomena provide meaningful contexts for interpreting trigonometric models.

### b. Key Learning Goals

Students will:

- Determine trigonometric ratios for angles less than 360°;
- Solve problems using the sine law and cosine law;
- Analyze and graph sinusoidal functions;
- Apply transformations to sine and cosine functions;
- Model periodic behaviour using trigonometric functions.

### c. Sample Learning and Assessment Activities

- Unit circle investigations;
- Trigonometric modelling tasks;

- Sinusoidal graphing activities using technology;
- Real-world applications involving periodic motion.
- Trigonometry assignments, graphing investigations, quizzes, unit test.

## 7. Unit 6: Discrete Functions and Financial Applications

**Approx. Hours: 17**

### a. Unit Overview

Students investigate recursive sequences, arithmetic and geometric sequences and series, and their applications in financial mathematics. Emphasis is placed on identifying patterns, developing formulas, and solving problems involving compound interest and annuities.

Students apply discrete mathematics to practical financial situations involving investments, loans, and long-term financial planning.

### b. Key Learning Goals

Students will:

- Represent recursive sequences in multiple forms;
- Analyze arithmetic and geometric sequences and series;
- Solve problems involving compound interest and annuities;
- Apply discrete functions to financial decision-making;
- Use technology to model financial growth and payments.

### c. Sample Learning and Assessment Activities

- Spreadsheet modelling for investments and loans;
- Sequence pattern investigations;
- Financial literacy case studies;
- Recursive sequence exploration tasks.
- Financial applications assignment, sequence problems, unit test.

## Culminating Task

**Approx. Hours: 5**

Students complete a mathematical investigation or applied modelling project integrating multiple strands of the course. The culminating task emphasizes problem solving, mathematical communication, reasoning, and real-world application.

## Final Exam

**Approx. Hours: 2**

Students complete a proctored final examination evaluating overall expectations from all course strands.

## Instructional Approaches

Teaching and learning in MCR3U at Inukshuk Academy incorporate a wide range of strategies to ensure students develop strong conceptual understanding, analytical thinking, and confidence in applying mathematics to real-world situations. Instruction is guided by the mathematical processes and inquiry-based principles outlined in the Ontario Curriculum.

### a. Inquiry-Based and Experiential Learning

Students learn mathematics most effectively through exploration, investigation, and problem solving. Lessons regularly include modelling activities, guided inquiry tasks, technology-based investigations, and real-world applications that reinforce mathematical concepts.

Examples include:

- Investigating transformations of parent functions using graphing technology;
- Exploring quadratic models through projectile motion and optimization tasks;
- Analyzing exponential growth and decay in financial and scientific contexts;
- Modelling periodic behaviour using trigonometric functions and sinusoidal graphs.

### b. Multiple Representations of Concepts

Students encounter mathematical ideas through a combination of:

- Algebraic expressions and equations;
- Graphs, tables, and diagrams;
- Numerical patterns and data analysis;
- Verbal explanations and mathematical reasoning;
- Technology-based visualizations and dynamic models.

This approach supports deeper conceptual understanding and helps students make connections between different representations of functions and mathematical relationships.

### c. Use of Technology and Digital Tools

Digital tools are integrated throughout the course to enhance learning, support inquiry, and strengthen visualization skills. Technology is used to:

- Graph and analyze functions dynamically;

- Model transformations and inverses;
- Investigate sequences, series, and financial applications;
- Compare multiple representations of functions;
- Analyze real-world data and mathematical models;
- Verify algebraic solutions and explore patterns.

Examples include Desmos, GeoGebra, spreadsheets, graphing calculators, and online simulations.

### d. Collaborative Problem Solving

Mathematical learning is strengthened through collaboration. Students work in pairs or small groups to:

- Solve multi-step problems;
- Compare and justify solution strategies;
- Investigate mathematical patterns and relationships;
- Communicate and critique mathematical reasoning;
- Complete inquiry and modelling activities collaboratively.

Collaborative learning supports communication skills, critical thinking, and confidence in mathematical problem solving.

### e. Differentiated Instruction

Instruction is adapted to support a variety of learning styles, readiness levels, and interests. Strategies include:

- Scaffolded problem sets with increasing complexity;
- Enrichment and extension tasks for advanced learners;
- Visual, numerical, and algebraic representations to support conceptual understanding;
- Guided practice and targeted intervention for students requiring additional support.

### f. Explicit Teaching of Mathematical Processes

Students receive direct instruction and ongoing support in the mathematical processes emphasized in the Ontario Curriculum, including:

- Problem solving;
- Reasoning and proving;
- Reflecting on mathematical thinking;
- Selecting tools and computational strategies;
- Connecting mathematical concepts;
- Representing ideas in multiple ways;
- Communicating mathematical reasoning clearly and accurately.

## Assessment and Evaluation

Assessment in MCR3U aligns with the principles of *Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools* (2010) [1]. Evaluation reflects students' most consistent achievement, with particular emphasis on recent evidence of learning.

Assessment serves three purposes:

### a. Assessment for Learning (Diagnostic)

- Initial algebra and function skills review;
- Diagnostic quizzes to identify prerequisite gaps;
- Informal observations and class discussions;
- Technology-based readiness checks and graphing activities.

### b. Assessment as Learning (Formative)

- Homework and practice problem sets;
- Graphing and modelling investigations with iterative feedback;
- Reflection tasks and self-assessment activities;
- Collaborative inquiry and problem-solving exercises;
- Draft submissions of mathematical investigations.

### c. Assessment of Learning (Summative)

- Unit tests on major strands;
- Mathematical investigations and modelling assignments;
- Performance tasks involving real-world applications;
- Culminating mathematical project;
- Final examination.

### d. Achievement Chart Categories

Student achievement is evaluated across the four categories defined in the Ontario Curriculum for Mathematics:

**Knowledge & Understanding (30 percent):**
Understanding of mathematical concepts, procedures, properties, and relationships involving functions, algebraic expressions, trigonometry, sequences, and financial mathematics.

**Thinking (20 percent):**
Use of critical and creative thinking skills to solve problems, analyze relationships, develop strategies, and justify mathematical reasoning.

**Communication (20 percent):**
Clarity and precision in mathematical explanations, notation, diagrams, graphs, representations, and communication of reasoning.

**Application (30 percent):**
Application of mathematical knowledge and skills to real-world contexts, modelling situations, financial applications, and interdisciplinary problem solving.

### e. Final Evaluation (30 percent)

The final evaluation consists of:

### 1. Culminating Performance Task (10–15 percent)

A multi-step mathematical investigation or applied modelling project. Examples include:

- Modelling real-world phenomena using functions;
- Analyzing financial growth using sequences and exponential models;
- Designing and interpreting sinusoidal models for periodic behaviour;
- Investigating transformations and applications of functions using technology.

### 2. Final Examination (15–20 percent)

A proctored examination assessing conceptual understanding, algebraic fluency, mathematical reasoning, problem-solving skills, and application across all course strands.

### 3. Summary of Achievement Levels and Percentage Grade Ranges

Student achievement in secondary school courses is evaluated according to the Ontario Ministry of Education's four-level achievement scale. Each percentage grade corresponds to a level of achievement, as outlined below.

| Percentage Grade Range | Achievement Level | Summary Description |
|---|---|---|
| **80–100%** | Level 4 | Demonstrates a very high to outstanding level of achievement. Performance exceeds the provincial standard. |
| **70–79%** | Level 3 | Demonstrates a high level of achievement. Performance meets the provincial standard. (This is the provincial expectation for student performance.) |
| **60–69%** | Level 2 | Demonstrates a moderate level of achievement. Performance is below but approaching the provincial standard. |
| **50–59%** | Level 1 | Demonstrates a passable level of achievement. Performance is significantly below the provincial standard. Further improvement is required for continued success. |

| | | |
|---|---|---|
| **Below 50%** | Level 0 | Insufficient achievement. Curriculum expectations have not been met. A credit will not be granted. |

## Academic Honesty and Integrity Policy

Inukshuk Academy is committed to fostering a learning environment based on honesty, responsibility, respect, and academic integrity. Students are expected to submit original work and properly acknowledge all sources of information, ideas, images, data, and wording used in assignments and investigations. Academic honesty is essential to maintaining fairness and trust in the evaluation process.

All submitted work must represent the student's own understanding and effort. Sources must be documented appropriately using MLA or APA citation style, as directed by the teacher. The use of generative artificial intelligence tools (e.g., ChatGPT) or other forms of external assistance must be disclosed and approved by the teacher. Undisclosed or inappropriate use of such tools may be treated as academic dishonesty.

Students may be asked to provide process work, rough drafts, notes, calculations, or planning documents to verify authorship and learning progress. If academic dishonesty occurs, the student and Principal may be notified, and consequences will be applied in accordance with school policy. Repeated incidents may result in escalating consequences.

### 1. Improper Citation

Improper citation occurs when a student fails to use appropriate citation formatting when referencing sources.

| Grade Level | First Instance | Subsequent Instances |
|---|---|---|
| **Grades 9–10** | Warning and opportunity to resubmit | Warning and opportunity to resubmit |
| **Grades 11–12** | Warning and opportunity to resubmit | Opportunity to resubmit, maximum grade of 75% |

### 2. Unaccredited Paraphrasing

Unaccredited paraphrasing occurs when a student rewrites another person's ideas without giving proper credit.

| Grade Level | First Instance | Subsequent Instances |
|---|---|---|
| **Grades 9–10** | Warning and resubmission allowed | Resubmission allowed, maximum grade of 75% |
| **Grades 11–12** | Resubmission allowed, maximum grade of 75% | Resubmission allowed, maximum grade of 50% |

### 3. Unaccredited Verbatim Copying

This occurs when a student copies sentences or passages directly from a source without proper citation.

| Grade Level | First Instance | Subsequent Instances |
|---|---|---|
| **Grades 9–10** | Resubmission allowed, maximum grade of 75% | Resubmission allowed, maximum grade of 50% |
| **Grades 11–12** | Resubmission allowed, maximum grade of 50% | Grade of zero. No resubmission permitted |

### 4. Full Plagiarism

Full plagiarism occurs when a student submits work entirely created by another person or source.

| Grade Level | First Instance | Subsequent Instances |
|---|---|---|
| **Grades 9–10** | Grade of zero. No resubmission | Grade of zero. No resubmission |
| **Grades 11–12** | Grade of zero. No resubmission | Grade of zero and possible removal from the course |

### 5. Missed Work

Students are responsible for reviewing lesson materials, completing missed assignments, and meeting established deadlines. Students are expected to remain informed about course expectations, due dates, and assessment requirements.

### 6. Homework Expectations

Students are expected to:

- Complete homework assignments, readings, and practice problems on time;
- Prepare for scheduled lessons, laboratories, discussions, and assessments;
- Participate actively and consistently in course activities and investigations.

If homework is repeatedly incomplete, the teacher may:

- Schedule a meeting with the student;
- Contact parents or guardians;
- Consult with school administration to support student success and progress.

## Inclusion, accommodations & ELL supports

Inukshuk Academy is a small private school with limited accommodation resources. The school is committed to supporting students' access to learning within the scope of available staffing, programming, facilities, and course delivery structures.

Where possible, reasonable accommodations may be provided for students with documented learning needs, including limited support for Individual Education Plans (IEPs). Accommodations are considered on a case-by-case basis in consultation with the student, parents/guardians, teacher, and school administration.

Possible supports may include:

- Clear written instructions and success criteria;
- Guided notes, visual examples, and scaffolded practice;
- Reasonable extended time where appropriate;
- Preferential seating or reduced-distraction work space when available;
- Use of approved assistive technology;
- Check-ins with the teacher to support organization and progress;
- ELL support through simplified instructions, vocabulary support, and additional clarification.

Inukshuk Academy may not be able to provide specialized programming, intensive one-on-one support, modified curriculum expectations, or accommodations requiring resources beyond the school's capacity. Students requiring significant accommodations or specialized services may need additional external support.

## Instructional Philosophy

Teaching and learning in MCR3U emphasize:

- Inquiry-based learning through investigations, modelling tasks, and problem-solving activities;
- Conceptual understanding supported by real-world applications of functions;
- Mathematical modelling of relationships, patterns, and change;
- Multiple representations of functions, including equations, graphs, tables, diagrams, and written explanations;
- Collaboration through group problem solving, discussions, and mathematical investigations;
- Technology integration in graphing, modelling, data analysis, and visualizing function behaviour.

This approach ensures students engage deeply with mathematical concepts while developing transferable problem-solving, reasoning, and STEM skills.

## Course Learning Resources

Students will engage with a variety of mathematics learning materials, both digital and print, selected to support inquiry, modelling, problem solving, and conceptual development.

### a. Primary Resources

- Teacher-created notes, examples, lessons, and practice sets;
- Function investigations, modelling tasks, and problem-solving activities;
- Graphing tools and mathematical visualization resources;
- Scientific calculators and mathematics reference materials.
- *Ontario Curriculum, Grades 11–12:* Mathematics *(2008)* [2]

### b. Digital Tools and Platforms

- Desmos or GeoGebra for graphing, transformations, and modelling;
- Spreadsheet software for data organization and pattern analysis;
- Online graphing calculators and function exploration tools;
- Learning management system resources, videos, and interactive activities;
- Digital assessment, collaboration, and presentation tools.

### c. Supplementary Resources

- Mathematics problem banks and practice exams;
- Real-world case studies involving functions, financial mathematics, and modelling;
- Articles, videos, and multimedia related to mathematical applications;
- Review materials for algebra, functions, trigonometry, sequences, and financial applications.

## References


[1] Ministry of Education, "Growing Sucess," 2010. [Online]. Available: https://www.edu.gov.on.ca/eng/policyfunding/growsuccess.pdf.

[2] Ministry of Education, "Course Descriptions and Prerequisites," August 2024. [Online]. Available: https://www.dcp.edu.gov.on.ca/en/course-descriptions-and-prerequisites.