MCR3U: Course Outline

Department:	Mathematics
Course Title:	Functions
Grade Level:	11
Course Type:	University Preparation
Course Code:	MCR3U
Credit Value:	1.00
Prerequisite(s):	Principles of Mathematics, Grade 10, Academic
Policy Document:	The Ontario Curriculum Grades 11 and 12: Mathematics; Revised 2007
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OVERALL CURRICULUM EXPECTATIONS
By the end of this course, students will:
A. Characteristics of Functions
1. demonstrate an understanding of functions, their representations, and their inverses, and make connections between the algebraic and graphical representations of functions using transformations;
2. determine the zeros and the maximum or minimum of a quadratic function, and solve problems involving quadratic functions, including problems arising from real-world applications;
3. demonstrate an understanding of equivalence as it relates to simplifying polynomial, radical, and rational expressions.

Activity Based Strategies	Arts Based Strategies	Cooperative Strategies
Game		Collaborative
	Graphic organizer	
Simulation		Discussion

Interview

Jigsaw

Peer Practice

Peer Teaching

Think/Pair/Share

Direct Instruction Strategies	Independent Learning Strategies	Technology and Media Based Applications
Demonstration		
Activities		
Lecture		
Reciprocal teaching	Homework	Internet Technologies
Review	Independent Study	Media Presentation
Seminar/Tutorial	Memorization	Multimedia Applications
Task Cards	Note Making	On-line Public Access Catalogues
Visual Stimuli	Response Journal	
Visualization		
Workbook/Worksheets		

Assessment for Learning	Assessment as Learning	Assessment of Learning
Student Product	Student Product	Student Product
• Journals • Pre-tests • Exit tickets • Whiteboard Quizzes	• Pre-tests • Whiteboard Quizzes • Graphic Organizers • Peer feedback	• Assignment • Tests • Exam

- Graphic Organizers

Observation

- Class discussions
- PowerPoint presentations

Conversation

- Student teacher conferences
- Small Group Discussions
- Pair work

Observation

- Class discussions
- PowerPoint presentations

Conversation

- Student teacher conferences
- Small Group Discussions

Observation

- Presentations

Conversation

- Student teacher conferences
- Question and Answer Sessions

Categories of the Achievement Chart	Description	Wt.
Knowledge & Understanding	Subject-specific content acquired (knowledge), and the comprehension of its meaning and significance (understanding)	25%
Thinking	The use of critical and creative thinking skills and/or processes.	25%
Communication	The conveying of meaning and expression through various art form	25%
Application	The use of knowledge and skills to make connections within and between various contexts.	25%
Total		100%

Categories	50-59%	60-69%	70-79%	80-100%
	Level 1	Level 2	Level 3	Level 4
Knowledge/Understanding	The student:			
Knowledge of content (e.g., facts, terms, procedural skills, use of tools)	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
Understanding of mathematical concepts	demonstrates limited understanding of concepts	demonstrates limited understanding of concepts	demonstrates limited understanding of concepts	demonstrates limited understanding of concepts
Thinking	The student:			
Use of planning skills - understanding the problem (e.g., formulating and interpreting the problem, making conjectures) - making a plan for solving the problem	uses planning skills with some effectiveness	uses planning skills with some effectiveness	uses planning skills with considerable effectiveness	uses planning skills with a high degree of effectiveness
Use of processing skills - carrying out a plan (e.g., collecting data, questioning, testing, revising, modeling, solving, inferring, forming conclusions) - looking back at the solution (e.g., evaluating reasonableness, making convincing arguments, reasoning, justifying, proving, reflecting)	uses processing skills with limited effectiveness	uses processing skills with some effectiveness	uses processing skills with considerable effectiveness	uses processing skills with a high degree of effectiveness
Use of critical/creative thinking processes (e.g., problem solving, inquiry)	uses critical/creative thinking processes with	uses critical/creative thinking processes with	uses critical/creative thinking processes with	uses critical/creative thinking processes with

	limited effectiveness	some effectiveness	considerable effectiveness	a high degree of effectiveness
Communication	The student:			
Expression and organization of ideas and mathematical thinking (e.g., clarify of expression, logical organization), using oral, visual, and written forms (e.g., pictorial, graphic, dynamic, numeric, algebraic forms; concrete materials)	expresses and organizes mathematical thinking with limited effectiveness	expresses and organizes mathematical thinking with some effectiveness	expresses and organizes mathematical thinking with considerable effectiveness	expresses and organizes mathematical thinking with a high degree of effectiveness
Communication of different audiences (e.g., peers, teachers) and purposes (e.g., to present data, justify a solution, express a mathematical argument) in oral, visual, and written forms	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
Use of conventions, vocabulary, and terminology of the discipline (e.g., terms, symbols) in oral, visual, and written forms	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness
Application	The student:			
Application of knowledge and skills in familiar contexts	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills to new contexts	Transfers knowledge and skills to new contexts with	Transfers knowledge and skills to new contexts with	Transfers knowledge and skills to new contexts with	Transfers knowledge and skills to new contexts with a

	limited effectiveness	some effectiveness	considerable effectiveness	high degree of effectiveness
Making connections within and between various contexts (e.g., connections between concepts, representations, and forms within mathematics; connections involving use of prior knowledge and experience; connection between mathematics, other disciplines, and the real world)	makes connections within and between various contexts with limited effectiveness	makes connections within and between various contexts with some effectiveness	makes connections within and between various contexts with considerable effectiveness	makes connections within and between various contexts with a high degree of effectiveness

B. Exponential Functions

1. evaluate powers with rational exponents, simplify expressions containing exponents, and describe properties of exponential functions represented in a variety of ways;

2. make connections between the numeric, graphical, and algebraic representations of exponential functions;

3. identify and represent exponential functions, and solve problems involving exponential functions, including problems arising from real-world applications.

C. Discrete Functions

1. demonstrate an understanding of recursive sequences, represent recursive sequences in a variety of ways, and make connections to Pascal's triangle;

2. demonstrate an understanding of the relationships involved in arithmetic and geometric sequences and series, and solve related problems;

3. make connections between sequences, series, and financial applications, and solve problems involving compound interest and ordinary annuities.

D. Trigonometric Functions

1. determine the values of the trigonometric ratios for angles less than 360^{o}; prove simple trigonometric identities; and solve problems using the primary trigonometric ratios, the sine law, and the cosine law;

2. demonstrate an understanding of periodic relationships and sinusoidal functions, and make connections between the numeric, graphical, and algebraic representations of sinusoidal functions;

3. identify and represent sinusoidal functions, and solve problems involving sinusoidal functions, including problems arising from real-world applications.

TEACHING & LEARNING STRATEGIES

There are seven mathematical processes that support effective learning in mathematics. Attention to the mathematical processes is considered to be essential to a balanced mathematics program. The processes are to be applied in all strands of the mathematics course and are part of the evaluation of student achievement.

The seven mathematical processes are:

Communicating: To improve student success there will be several opportunities for students to share their understanding both in oral as well as written form.

Problem solving: Scaffolding of knowledge, detecting patterns, making and justifying conjectures, guiding students as they apply their chosen strategy, directing students to use multiple strategies to solve the same problem, when appropriate, recognizing, encouraging, and applauding perseverance, discussing the relative merits of different strategies for specific types of problems.

Reasoning and proving: Asking questions that get students to hypothesize, providing students with one or more numerical examples that parallel these with the generalization and describing their thinking in more detail.

Reflecting: Modeling the reflective process, asking students how they know.

Selecting Tools and Computational Strategies: Modeling the use of tools and having students use technology to help solve problems.

Connecting: Activating prior knowledge when introducing a new concept in order to make a smooth connection between previous learning and new concepts, and introducing skills in context to make connections between particular manipulations and problems that require them.

Representing: Modeling various ways to demonstrate understanding, posing questions that require students to use different representations as they are working at each level of conceptual development - concrete, visual or symbolic, allowing individual students the time they need to solidify their understanding at each conceptual stage.

Using a variety of instructional strategies, the teacher will provide numerous opportunities for students to develop skills of inquiry, problem solving, and communication as they investigate and learn fundamental concepts.

Along with some of the strategies noted in the assessment for, as and of learning charts below, strategies will include:

STRATEGIES FOR ASSESSMENT & EVALUATION OF STUDENT PERFORMANCE

There are three forms of assessment that will be used throughout this course:

Assessment for Learning: Assessment for Learning will directly influence student learning by reinforcing the connections between assessment and instruction, and provide ongoing feedback to the student. Assessment for Learning occurs as part of the daily teaching process and helps teachers form a clear picture of the needs of the students because students are encouraged to be more active in their learning and associated assessment. Teachers gather this information to shape their classroom teaching.

Assessment for Learning is:

- Ongoing
- Is tied to learning outcomes
- Provides information that structures the teachers planning and instruction
- Allows teachers to provide immediate and descriptive feedback that will guide student learning

The purpose of Assessment for Learning is to create self-regulated and lifelong learners.

Assessment as Learning: Assessment as Learning is the use of a task or an activity to allow students the opportunity to use assessment to further their own learning. Self and peer assessments allow students to reflect on their own learning and identify areas of strength and need. These tasks offer students the chance to set their own personal goals and advocate for their own learning.

The purpose of Assessment as Learning is to enable students to monitor their own progress towards achieving their learning goals.

Assessment of Learning: Assessment of Learning will occur at or near the end of a period of learning; this summary is used to make judgments about the quality of student learning using established criteria, to assign a value to represent that quality and to communicate information about achievement to students and parents.

Evidence of student achievement for evaluation is collected over time from three different sources – observation, conversations, and student products. Using multiple sources of evidence will increase the reliability and validity of the evaluation of student learning.

EVALUATION

Evaluation will be based on the provincial curriculum expectations and the achievement levels outlined in the curriculum document. Student achievement of the learning expectations will be evaluated according to the following breakdown.

FINAL MARK

The percentage grade represents the quality of the student's overall achievement of the expectations for the course and reflects the corresponding level of achievement as described in the achievement chart for the arts.

70% of the grade will be based upon evaluations conducted throughout the course. This portion of the grade will reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.

30% of the grade will be based on a final evaluation. At least 20% of this evaluation will be a formal examination. The other 10% may be any one of a variety of assessment tools that suit the students learning style.

CONSIDERATIONS FOR PROGRAM PLANNING IN MATHEMATICS

Instructional Approaches

To make new learning more accessible to students, teachers build new learning upon the knowledge and skills students have acquired in previous years – in other words, they help activate prior knowledge. It is important to assess where students are in their mathematical growth and to bring them forward in their learning.

In order to apply their knowledge effectively and to continue to learn, students must have a solid conceptual foundation in mathematics. Successful classroom practices engage students in activities that require higher-order thinking, with an emphasis on problem solving. Learning experienced in the primary, junior, and intermediate divisions should have provided students with a good grounding in the investigative approach to learning new mathematical concepts, including inquiry models of problem solving, and this approach continues to be important in the senior mathematics program.

Students in a mathematics class typically demonstrate diversity in the ways they learn best. It is important, therefore, that students have opportunities to learn in a variety of ways – individually, cooperatively, independently, with teacher direction, through investigation involving hands-on experience, and through examples followed by practice. In mathematics, students are required to learn concepts, acquire procedures and skills, and apply processes with the aid of the instructional and learning strategies best suited to the particular type of learning.

The approaches and strategies used in the classroom to help students meet the expectations of this curriculum will vary according to the object of the learning and the needs of the students. For example, even at the secondary level, manipulatives can be important tools for supporting the effective learning of mathematics. These concrete learning tools, such as connecting cubes, measurement tools, algebra tiles, and number cubes, invite students to explore and represent abstract mathematical ideas in varied, concrete, tactile, and visually rich ways. Other representations, including graphical and algebraic representations, are also a valuable aid to teachers. By analysing students' representations of mathematical concepts and listening carefully to their reasoning, teachers can gain useful insights into students' thinking and provide supports to help enhance their thinking.

All learning, especially new learning, should be embedded in well-chosen contexts for learning – that is, contexts that are broad enough to allow students to investigate initial understandings, identify and develop relevant supporting skills, and gain experience with varied and interesting applications of the new knowledge. Such rich contexts for learning open the door for students to see the "big ideas" of mathematics – that is, the major underlying principles or relationships that will enable and encourage students to reason mathematically throughout their lives.