Queen Elizabeth
college of Canada

SECONDARY COURSE OUTLINE

Course Title:	Calculus and Vectors 12, University Preparation
Grade:	12
Course Developer(s)	Victor Lee
Development/Revision Date:	September, 2024
Ministry Course Code:	MCV4U
Course Type:	University Preparation
Credit Value:	1
Credit Hours:	110
Policy Document:	The Ontario Curriculum, Grades 11 and 12, Mathematics, 2007. Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, *First Edition*. 2010.
Prerequisite(s) and/or	The new Advanced Functions course (MHF4U)
Co-requisite(s) must be taken prior to or concurrently with	Calculus and Vectors
Resources:	*Calculus and Vectors 12*, Nelson, 2020.

CALCULUS AND VECTORS

GRADE 12, UNIVERSITY PREPARATION

MCV4U

Course Outline

COURSE DESCRIPTION

This course builds on students' previous experience with functions and their developing understanding of rates of change. Students will solve problems involving geometric and algebraic representations of vectors and representations of lines and planes in three dimensional space; broaden their understanding of rates of change to include the derivatives of polynomial, sinusoidal, exponential, rational, and radical functions; and apply these concepts and skills to the modelling of real-world relationships. Students will also refine their use of the mathematical processes necessary for success in senior mathematics. This course is intended for students who choose to pursue careers in fields such as science, engineering, economics, and some areas of business, including those students who will be required to take a university-level calculus, linear algebra, or physics course.

Note: The new Advanced Functions course (MHF4U) must be taken prior to or concurrently with Calculus and Vectors (MCV4U).

MATHEMATICAL PROCESS EXPECTATIONS

The mathematical processes are to be integrated into student learning in all areas of this course. Throughout this course, students will:

Problem Solving

Develop, select, apply, compare, and adapt a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;

Reasoning and Proving

Develop and apply reasoning skills (e.g., use of inductive reasoning, deductive reasoning, and counter-examples; construction of proofs) to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments;

Reflecting

Demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);

Selecting Tools and Computational Strategies

Select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;

Connecting

Make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);

Representing

Create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

Communicating

Communicate mathematical thinking orally, visually, and in writing, using precise mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

OVERALL CURRICULUM EXPECTATIONS

There are three strands in MCV4U and the overall expectations for each strand are as follows:

Rate of Change:

1. demonstrate an understanding of rate of change by making connections between average rate
of change over an interval and instantaneous rate of change at a point, using the slopes of secants and tangents and the concept of the limit;
2. graph the derivatives of polynomial, sinusoidal, and exponential functions, and make connections between the numeric, graphical, and algebraic representations of a function and its derivative;
3. verify graphically and algebraically the rules for determining derivatives; apply these rules to determine the derivatives of polynomial, sinusoidal, exponential, rational, and radical functions, and simple combinations of functions; and solve related problems

Derivatives and Their Applications:

4. make connections, graphically and algebraically, between the key features of a function and its first and second derivatives, and use the connections in curve sketching;
5. solve problems, including optimization problems, that require the use of the concepts and procedures associated with the derivative, including problems arising from real-world applications and involving the development of mathematical models.

Geometry & Algebra of Vectors:

6. demonstrate an understanding of vectors in two-space and three-space by representing them algebraically and geometrically and by recognizing their applications;
7. perform operations on vectors in two-space and three-space, and use the properties of these operations to solve problems, including those arising from real-world applications;
8. distinguish between the geometric representations of a single linear equation or a system of two linear equations in two-space and three-space, and determine different geometric configuration of lines and planes in three-space;
9. represent lines and planes using scalar, vector, and parametric equations, and solve problems involving distances and intersections.

COURSE CONTENT OUTLINE

Unit 1: Limits
Students graphically and through technology.

Unit 2: Derivatives
Students will learn the will explore the concept of limits, its derivation and the conditions to evaluate limits algebraically, concepts of rates of change and to evaluate the various forms of derivatives.

Unit 3: Derivatives and Applications
Students will explore the topics of Related Rates, Optimizations and Velocity problems, developing solutions using derivatives.

Unit 4: Geometric and Cartesian Vectors
Students will explore the concepts of vectors along with its operations, and how to apply in various applications such as force and velocity

Unit 5: Vector in 3 Dimensions
Students will explore the concepts and operations of vectors in 3 dimensions, including dot products, cross products and their related applications

Unit 6: Equations in Lines and Planes
Students will learn the corresponding equations of lines and planes in 3-space. This includes developing solutions for the intersection of lines and planes.

COURSE ORGANIZATION

Unit 1	Limits	14 hours – 5 classes
Unit 2	Derivatives	20 hours – 7 classes
Unit 3	Derivatives and Applications	15 hours – 5 classes
Unit 4	Geometric & Cartesian Vectors	20 hours – 7 classes
Unit 5	Vectors in Three Dimensions	13 hours – 4 classes
Unit 6	Equations of Lines and Planes	23 hours – 7 classes
	Review and Exam	5 hours – 2 classes

Total 110 hours

ONLINE / OFFLINE COMPONENTS

Class hours:

Tues 3.30-5.30	Online Synchronous Learning	2 hours
Tues 5.30-6.30	Offline Asynchronous Learning	1 hours
Thurs 3.30-4.30	Online Synchronous Learning	2 hours
Thurs 4.30-5.30	Offline Asynchronous Learning	1 hours

Weekly: 6 hours (online + offline)
# of weeks: 18
Total hours: 111 hours

ONLINE CLASS - ACTIVITIES

A list of activities dedicated for online class

- online class lectures
- Classwork period where students will be doing class assignments with the teacher's observation.
- Conversation between teacher and individual student, on discussion in class topics
- Conversation between teacher and the group of students, on discussion of class topics
- Evaluation by Observation: Students conduct presentations of their solutions to problems. This is conducted in individual zoom video chat.
- Evaluation by Conversation: Students conduct presentations of their solutions, with the teacher asking questions and converse the solution with the student.

OFFLINE IN PERSON CLASS - ACTIVITIES

A list of activities dedicated for offline / in person classes

- In class Lectures
- Classwork period in working on assignments with supervision from the teacher
- Class time to work on Assignments
- Conversation between teacher and the group of students, on discussion of class topics
- Evaluation by Observation: Students conduct presentations of their solutions to problems.
- Evaluation by Conversation: Students conduct presentations of their solutions, with the teacher asking questions and converse the solution with the student.

TEACHING/LEARNING STRATEGIES

- Whole-class, small group, and individual instruction;
- Electronic technology – use of dynamic software, calculators, the Internet, spreadsheets and multi-media in activities, demonstrations and investigations;
- Encourage maximum student participation in classroom activities;
- Share the rubrics for culminating activities at the beginning of the unit, so expectations are clear
- Encourage inquiry – questioning, investigating, communicating in a variety of ways;

- Provide opportunities to acquire knowledge and apply that knowledge in a variety of contexts;
- Identify & address different learning styles throughout the course;
- Use self- and peer assessments;
- Encourage brainstorming, exchange of ideas, debating;
- Encourage students to take responsibility for learning;
- Encourage students to apply individual/group learning skills;
- Respect cultural differences of international students.

ADDITIONAL TEACHING/LEARNING STRATEGIES FOR INTERNATIONAL STUDENTS

- Provide reference notes, outlines of critical information, models of charts, timelines, or diagrams;
- Organize information in chart/graph format;
- Provide handout sheets with sample calculations and specific skill instructions;
- Provide students with clear directions for improvement;
- Pair written instructions with verbal instructions. Provide visual or auditory cues;
- Simplify instructions. Highlight key formulas and mathematical rules;
- Provide opportunities for students to practise oral presentation skills;
- Encourage repetition, clarification, and restatement;
- Permit a wide variety of options for recording and reporting their work, e.g., diagrams, flow charts, concept maps;
- Think/pair/share peer assessment;
- Student conferences.

ASSESSMENT & EVALUATION COMPONENTS

Assessment is the process of gathering information from a variety of sources (including assignments, demonstrations, projects, performances and tests) that accurately reflects how well students are achieving the curriculum expectations.

Evaluation is the process of judging the quality of a student's work on the basis of established achievement criteria, and assigning a value to represent that quality.

The term score will be divided into 4 categories:
- Knowledge (30-35%)
- Applications (20-25%)
- Thinking / Inquiry (15-20%)
- Communications (15-20%)

There are four levels of achievement for students who are passing this course:

- Level 1 (50-59%)
- Level 2 (60-69%)

- Level 3 (70-79%)
- Level 4 (80-100%)

Level 3 is the provincial standard for student achievement.

A wide range of assessment strategies (tests, portfolios, journals, essays, presentations, observation, conferencing and projects), combined with an array of instrument tools (including detailed marking schemes, checklists, rubrics and exemplars), is used in order to measure student achievement of overall course expectations.

ASSESSMENT AND EVALUATION POLICY

The student's final grade for this course will be determined as outlined in Program Planning and Assessment 2000 (pg. 15)

Seventy per cent (70%) of the grade will be based on evaluations conducted throughout this course. This portion of the grade should reflect the students' ***most consistent level of achievement*** throughout the course, although special consideration should be given to the more recent evidence of achievement.

Thirty per cent (30%) of the grade will be based on a final evaluation in the form of an examination, performance, essay and/or other method of evaluation suitable to the course content and administered towards the end of the course.

EVALUATION STRATEGIES

Evidence of student achievement for evaluation is collected over time from three different sources – observations, conversations, and student products. Using multiple sources of evidence increases the reliability and validity of the evaluation of student learning. "Student products" may be in the form of tests or exams and/or assignments for evaluation. Assignments for evaluation may include rich performance tasks, demonstrations, projects, and/or essays. To ensure equity for all students, assignments for evaluation and tests or exams are to be completed, whenever possible, under the supervision of a teacher. Assignments for evaluation must not include ongoing homework that students do in order to consolidate their knowledge and skills or to prepare for the next class. Assignments for evaluation may involve group projects as long as each student's work within the group project is evaluated independently and assigned an individual mark, as opposed to a common group mark. The evaluation of student learning is the responsibility of the teacher and must not include the judgment of the student or of the student's peers.

ASSESSMENT STRATEGIES

Teachers use a variety of strategies for students' assessment to elicit information about student learning. These strategies should be coordinated to include observation, student-teacher conversations, and student products. Teachers gather information about learning via:

- designing tasks that provide students with a variety of ways to demonstrate their learning;
- observing students as they perform tasks;
- posing questions to help students make their thinking explicit;
- engineering classroom and small-group conversations that encourage students to articulate what they are thinking and further develop their thinking.

Course Planning

Subject: Calculus and Vectors **Grade/Level: 12**

Course and Code: MCV4U

Teacher:

Planning the Time

Unit	Unit Title (Description)	Time
Unit 1	Limits	14 hours
Unit 2	Derivatives	20 hours
Unit 3	Derivatives and Applications	15 hours
Unit 4	Geometric & Cartesian Vectors	20 hours
Unit 5	Vectors in Three Dimensions	13 hours
Unit 6	Equations of Lines and Planes	23 hours
	Review & Final Exam (3 hours)	5 hours
	Total	**110 hours**

Planning for the Final Grade

Unit	Components	A/E	Strand	Categories K	A	T/I	C	Evaluation by P. O. C.	Expectation	Weight (% worth of final grade)
1	Assignment	A	A	X			X	P.	1.1, 1.2	3
	Unit Test 1	E	A	X	X	X	X	P.	1.1 – 1.9	7
2	Assignment	A	B				X	P.	3.1, 3.2	3
	Unit Test 2	E	B	X	X	X	X	P.	3.1 – 3.5	7
3	Assignment	A	B	X				P.	2.3	3
	Unit Test 3	E	B	X	X	X	X	P.	2.1-2.3	7
4	In class Construct math Models	A	C			X		O. C.	2.6	3
	Unit Test 4	E	C	X	X	X	X	P.	1.1-2.7	7
5	Student	A	C	X			X	O. C.	3.3	3

	Demonstration									
	Unit Test 5	E	C	X	X	X	X	P.	3.1-3.4	7
6	In class Presentations	A	C	X			X	O. C.	1.1, 2.3	3
	Unit Test 6	E	C	X	X	X	X	P.	1.1-3.4	7
7	In class construc Math Models	A	C	X	X		X	O. C.	3.1-3.3	3
	Unit Test 7	E	C	X	X	X	X	P.	1.1-3.3	7
										70
1-7	Final Exam	E	A, B C	X	X	X	X	P.		30
										30
										100

Strands:

A. Rate of Change
B. Derivatives and Their Applications
C. Geometry and Algebra of Vectors

The final grade will be based on the **four knowledge and skill categories** and consistent with the levels of student achievemer identified in the Achievement Chart from the specified Ontario curriculum policy. A level 3 (a grade of 70-79% is the provinci standard.

CONSIDERATIONS FOR PROGRAM PLANNING

Teachers who are planning a program in mathematics must take into account considerations in a number of important areas, including those discussed below.

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.

PROMOTING POSITIVE ATTITUDES TOWARDS LEARNING MATHEMATICS:

Students' attitudes have a significant effect on how students approach problem solving and how well they succeed in mathematics. Students who enjoy mathematics tend to perform well in their mathematics course work and are more likely to enroll in the more advanced mathematics courses.

Students develop positive attitudes when they are engaged in making mathematical conjectures, when they experience breakthroughs as they solve problems, when they see connections between important ideas, and when they observe an enthusiasm for mathematics on the part of their teachers. With a positive attitude towards mathematics, students are able to make more sense of the mathematics they are working on, and to view themselves as effective learners of mathematics. They are also more likely to perceive mathematics as both useful and worthwhile, and to develop the belief that steady effort in learning mathematics pays off.

It is common for people to feel inadequate or anxious when they cannot solve problems quickly and easily, or in the right way. To gain confidence, students need to recognize that, for some mathematics problems, there may be several ways to arrive at a solution. They also need to understand that problem solving of almost any kind often requires a considerable expenditure of time and energy and a good deal of perseverance. To counteract the frustration they may feel when they are not making progress towards solving a problem, they need to believe that they are capable of finding solutions. Teachers can encourage students to develop a willingness to persist, to investigate, to reason, to explore alternative solutions, to view challenges as opportunities to extend their learning, and to take the risks necessary to become successful problem solvers. They can help students develop confidence and reduce anxiety and frustration by providing them with problems that are challenging but not beyond their ability to solve. Problems at a developmentally appropriate level help students to learn while establishing a norm of perseverance for successful problem solving.
Collaborative learning enhances students' understanding of mathematics. Working cooperatively in groups reduces isolation and provides students with opportunities to share ideas and communicate their thinking in a supportive environment as they work together towards a common goal. Communication and the connections among ideas that emerge as students interact with one another enhance the quality of student learning.

PLANNING MATHEMATICS PROGRAMS FOR STUDENTS WITH SPECIAL EDUCATION NEEDS:

Classroom teachers are the key educators of students who have special education needs. They have a responsibility to help all students learn, and they work collaboratively with special education teachers, where appropriate, to achieve this goal. Special Education Transformation: The Report of the Co-Chairs with the Recommendations of the Working Table on Special Education, 2006 endorses a set of beliefs that should guide program planning for students with

special education needs in all disciplines. Those beliefs are as follows: All students can succeed.

In any given classroom, students may demonstrate a wide range of learning styles and needs. Teachers plan programs that recognize this diversity and give students performance tasks that respect their particular abilities so that all students can derive the greatest possible benefit from the teaching and learning process. The use of flexible groupings for instruction and the provision of ongoing assessment are important elements of programs that accommodate a diversity of learning needs.

If the student requires either accommodations or modified expectations, or both, the relevant information, as described in the following paragraphs, must be recorded in his or her Individual Education Plan (IEP). More detailed information about planning programs for students with special education needs, including students who require alternative programs and/or courses, can be found in The Individual Education Plan (IEP): A Resource Guide, 2004 (referred to hereafter as the IEP Resource Guide, 2004). For a detailed discussion of the ministry's requirements for IEPs, see Individual Education Plans: Standards for Development, Program Planning, and Implementation, 2000 (referred to hereafter as IEP Standards, 2000). (Both documents are available at http://www.edu.gov.on.ca.)

STUDENTS REQUIRING ACCOMMODATIONS ONLY:

Some students are able, with certain accommodations, to participate in the regular course curriculum and to demonstrate learning independently. Accommodations allow access to the course without any changes to the knowledge and skills the student is expected to demonstrate. The accommodations required to facilitate the student's learning must be identified in his or her IEP (see IEP Standards, 2000, page 11). A student's IEP is likely to reflect the same accommodations for many, or all, subjects or courses.

Providing accommodations to students with special education needs should be the first option considered in program planning. Instruction based on principles of universal design and differentiated instruction focuses on the provision of accommodations to meet the diverse needs of learners.

There are three types of accommodations:

- Instructional accommodations are changes in teaching strategies, including styles of presentation, methods of organization, or use of technology and multimedia.

- Environmental accommodations are changes that the student may require in the class-room and/or school environment, such as preferential seating or special lighting.

- Assessment accommodations are changes in assessment procedures that enable the student to demonstrate his or her learning, such as allowing additional time to complete tests or assignments or permitting oral responses to test questions (see page 29 of the IEP

Resource Guide, 2004, for more examples).

If a student requires "accommodations only" in mathematics courses, assessment and evaluation of his or her achievement will be based on the appropriate course curriculum expectations and the achievement levels outlined in this document. The IEP box on the student's Provincial Report Card will not be checked, and no information on the provision of accommodations will be included.

STUDENTS REQUIRING MODIFIED EXPECTATIONS:

Some students will require modified expectations, which differ from the regular course expectations. For most students, modified expectations will be based on the regular course curriculum, with changes in the number and/or complexity of the expectations. Modified expectations represent specific, realistic, observable, and measurable achievements and describe specific knowledge and/or skills that the student can demonstrate independently, given the appropriate assessment accommodations.

It is important to monitor, and to reflect clearly in the student's IEP, the extent to which expectations have been modified. As noted in Section 7.12 of the ministry's policy document Ontario Secondary Schools, Grades 9 to 12: Program and Diploma Requirements, 1999,the principal will determine whether achievement of the modified expectations constitutes successful completion of the course, and will decide whether the student is eligible to receive a credit for the course. This decision must be communicated to the parents and the student.

When a student is expected to achieve most of the curriculum expectations for the course, the modified expectations should identify how the required knowledge and skills differ from those identified in the course expectations. When modifications are so extensive that achievement of the learning expectations (knowledge, skills, and performance tasks) is not likely to result in a credit, the expectations should specify the precise requirements or tasks on which the student's performance will be evaluated and which will be used to generate the course mark recorded on the Provincial Report Card.

Modified expectations indicate the knowledge and/or skills the student is expected to demonstrate and have assessed in each reporting period(IEP Standards, 2000, pages 10 and 11). The student's learning expectations must be reviewed in relation to the student's progress at least once every reporting period, and must be updated as necessary (IEP Standards, 2000, page 11). If a student requires modified expectations in mathematics courses, assessment and evaluation of his or her achievement will be based on the learning expectations identified in the IEP and on the achievement levels outlined in this document. If some of the student's learning expectations for a course are modified but the student is working towards a credit for the course, it is sufficient simply to check the IEP box on the Provincial Report Card.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS:

Young people whose first language is not English enter Ontario secondary schools with diverse linguistic and cultural backgrounds. Some English language learners may have experience of highly sophisticated educational systems, while others may have come from regions where access to formal schooling was limited. All of these students bring a rich array of background knowledge and experience to the classroom, and all teachers must share in the responsibility for their English-language development.

Teachers of mathematics must incorporate appropriate adaptations and strategies for instruction and assessment to facilitate the success of the English language learners in their classrooms. These adaptations and strategies include:

- modification of some or all of the course expectations so that they are challenging but attainable for the learner at his or her present level of English proficiency, given the necessary support from the teacher;

- use of a variety of instructional strategies (e.g., extensive use of visual cues, scaffolding, manipulatives, pictures, diagrams, graphic organizers; attention to clarity of instructions);

- modeling of preferred ways of working in mathematics; previewing of textbooks;

- pre-teaching of key vocabulary; peer tutoring; strategic use of students' first languages);

- use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, materials that reflect cultural diversity);

- use of assessment accommodations (e.g., granting of extra time; simplification of language used in problems and instructions; use of oral interviews, learning logs, portfolios, demonstrations, visual representations, and tasks requiring completion of graphic organizers or cloze sentences instead of tasks that depend heavily on proficiency in English).

When learning expectations in any course are modified for English language learners (whether or not the students are enrolled in an ESL or ELD course), this must be clearly indicated on the student's report card.
Although the degree of program adaptation required will decrease over time, students who are no longer receiving ESL or ELD support may still need some program adaptations to be successful.

ANTIDISCRIMINATION EDUCATION IN MATHEMATICS:

To ensure that all students in the province have an equal opportunity to achieve their full potential, the curriculum must be free from bias, and all students must be provided with a safe and secure environment, characterized by respect for others, that allows them to participate fully and responsibly in the educational experience.

Learning activities and resources used to implement the curriculum should be inclusive in nature, reflecting the range of experiences of students with varying backgrounds, abilities, interests, and learning styles. They should enable students to become more sensitive to the diverse cultures and perceptions of others, including Aboriginal peoples. By discussing aspects of the history of mathematics, teachers can help make students aware of the various cultural groups that have contributed to the evolution of mathematics over the centuries. Finally, students need to recognize that ordinary people use mathematics in a variety of everyday contexts, both at work and in their daily lives.

Connecting mathematical ideas to real-world situations through learning activities can enhance students' appreciation of the role of mathematics in human affairs, in areas including health, science, and the environment. Students can be made aware of the use of mathematics in contexts such as sampling and surveying and the use of statistics to analyse trends. Recognizing the importance of mathematics in such areas helps motivate students to learn and also provides a foundation for informed, responsible citizenship.

Teachers should have high expectations for all students. To achieve their mathematical potential, however, different students may need different kinds of support. Some boys, for example, may need additional support in developing their literacy skills in order to complete mathematical tasks effectively. For some girls, additional encouragement to envision themselves in careers involving mathematics may be beneficial. For example, teachers might consider providing strong role models in the form of female guest speakers who are mathematicians or who use mathematics in their careers.

LITERACY AND INQUIRY/RESEARCH SKILLS:

Literacy skills can play an important role in student success in mathematics courses. Many of the activities and tasks students undertake in mathematics courses involve the use of written, oral, and visual communication skills. For example, students use language to record their observations, to explain their reasoning when solving problems, to describe their inquiries in both informal and formal contexts, and to justify their results in small group conversations, oral presentations, and written reports. The language of mathematics includes special terminology. The study of mathematics consequently encourages students to use language with greater care and precision and enhances their ability to communicate effectively.

The Ministry of Education has facilitated the development of materials to support literacy instruction across the curriculum. Helpful advice for integrating literacy instruction in mathematics courses may be found in the following resource documents:

Think Literacy: Cross-Curricular Approaches, Grades 7–12, 2003
Think Literacy: Cross-Curricular Approaches, Grades 7–12 – Mathematics: Subject-Specific Examples, Grades 10–12, 2005

In all courses in mathematics, students will develop their ability to ask questions and to plan

investigations to answer those questions and to solve related problems. Students need to learn a variety of research methods and inquiry approaches in order to carry out these investigations and to solve problems, and they need to be able to select the methods that are most appropriate for a particular inquiry. Students learn how to locate relevant information from a variety of sources, such as statistical databases, newspapers, and reports. As they advance through the grades, students will be expected to use such sources with increasing sophistication. They will also be expected to distinguish between primary and secondary sources, to determine their validity and relevance, and to use them in appropriate ways.

THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN MATHEMATICS:

Information and communication technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' learning in mathematics. Teachers can use ICT tools and resources both for whole-class instruction and to design programs that meet diverse student needs. Technology can help to reduce the time spent on routine mathematical tasks, allowing students to devote more of their efforts to thinking and concept development. Useful ICT tools include simulations, multimedia resources, databases, sites that give access to large amounts of statistical data, and computer-assisted learning modules.

Applications such as databases, spreadsheets, dynamic geometry software, dynamic statistical software, graphing software, computer algebra systems (CAS), word-processing software, and presentation software can be used to support various methods of inquiry in mathematics. Technology also makes possible simulations of complex systems that can be useful for problem-solving purposes or when field studies on a particular topic are not feasible.

Information and communications technologies can be used in the classroom to connect students to other schools, at home and abroad, and to bring the global community into the local classroom.

Although the Internet is a powerful electronic learning tool, there are potential risks attached to its use. All students must be made aware of issues of Internet privacy, safety, and responsible use, as well as of the ways in which this technology is being abused – for example, when it is used to promote hatred.

Teachers, too, will find the various ICT tools useful in their teaching practice, both for whole class instruction and for the design of curriculum units that contain varied approaches to learning to meet diverse student needs.

CAREER EDUCATION IN MATHEMATICS:

Teachers can promote students' awareness of careers involving mathematics by exploring applications of concepts and providing opportunities for career-related project work. Such

activities allow students the opportunity to investigate mathematics-related careers compatible with their interests, aspirations, and abilities.

Students should be made aware that mathematical literacy and problem solving are valuable assets in an ever-widening range of jobs and careers in today's society. The knowledge and skills students acquire in mathematics courses are useful in fields such as science, business, engineering, and computer studies; in the hospitality, recreation, and tourism industries; and in the technical trades.

THE ONTARIO SKILLS PASSPORT AND ESSENTIAL SKILLS:

Teachers planning programs in mathematics need to be aware of the purpose and benefits of the ***Ontario Skills Passport*** (OSP).The OSP is a bilingual web-based resource that enhances the relevancy of classroom learning for students and strengthens school-work connections. The OSP provides clear descriptions of Essential Skills such as Reading Text, Writing, Computer Use, Measurement and Calculation, and Problem Solving and includes an extensive database of occupation-specific workplace tasks that illustrate how workers use these skills on the job. The Essential Skills are transferable, in that they are used in virtually all occupations. The OSP also includes descriptions of important work habits, such as working safely, being reliable, and providing excellent customer service. The OSP is designed to help employers assess and record students' demonstration of these skills and work habits during their cooperative education placements. Students can use the OSP to identify the skills and work habits they already have, plan further skill development, and show employers what they can do.

The skills described in the OSP are the Essential Skills that the Government of Canada and other national and international agencies have identified and validated, through extensive research, as the skills needed for work, learning, and life. These Essential Skills provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

COOPERATIVE EDUCATION AND OTHER FORMS OF EXPERIENTIAL LEARNING:

Cooperative education and other workplace experiences, such as job shadowing, fieldtrips, and work experience, enable students to apply the skills they have developed in the classroom to real-life activities.
Cooperative education teachers can support students taking mathematics courses by maintaining links with community-based businesses and organizations, and with colleges and universities, to ensure students studying mathematics have access to hands-on experiences that will reinforce the knowledge and skills they have gained in school. Teachers of mathematics can support their

students' learning by providing opportunities for experiential learning that will reinforce the knowledge and skills they have gained in school.

Health and safety issues must be addressed when learning involves cooperative education and other workplace experiences. Teachers who provide support for students in workplace learning placements need to assess placements for safety and ensure students understand the importance of issues relating to health and safety in the workplace. Before taking part in workplace learning experiences, students must acquire the knowledge and skills needed for safe participation. Students must understand their rights to privacy and confidentiality as outlined in the Freedom of Information and Protection of Privacy Act. They have the right to function in an environment free from abuse and harassment, and they need to be aware of harassment and abuse issues in establishing boundaries for their own personal safety. They should be informed about school and community resources and school policies and reporting procedures with regard to all forms of abuse and harassment.

PLANNING PROGRAM PATHWAYS AND PROGRAMS LEADING TO A SPECIALISTHIGH-SKILLS MAJOR:

Mathematics courses are well suited for inclusion in programs leading to a Specialist High-Skills Major (SHSM) or in programs designed to provide pathways to particular apprenticeship or workplace destinations. In an SHSM program, mathematics courses can be bundled with other courses to provide the academic knowledge and skills important to particular industry sectors and required for success in the workplace and postsecondary education, including apprenticeship. Mathematics courses may also be combined with cooperative education credits to provide the workplace experience required for SHSM programs and for various program pathways to apprenticeship and workplace destinations. (SHSM programs would also include sector-specific learning opportunities offered by employers, skills-training centres, colleges, and community organizations.)

HEALTH AND SAFETY IN MATHEMATICS:

Although health and safety issues are not normally associated with mathematics, they may be important when learning involves fieldwork or investigations based on experimentation. Out-of-school fieldwork can provide an exciting and authentic dimension to students' learning experiences. It also takes the teacher and students out of the predictable classroom environment and into unfamiliar settings. Teachers must preview and plan activities and expeditions carefully to protect students' health and safety.

ENVIRONMENTAL EDUCATION

Environmental education is education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of: the Earth's physical and biological systems; the dependency of our social and economic systems on these natural systems; the scientific and

human dimensions of environmental issues; the positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems.

Ontario Ministry of Education, *Shaping Our Schools, Shaping Our Future: Report of the Working Group on Environmental Education* (June 2007), p. 6 The document *Acting Today, Shaping Tomorrow: A Policy Framework forEnvironmental Education in Ontario Schools* offers school boards and schools an approach to environmental education that recognizes the needs of all Ontario students and promotes environmental responsibility in the operations of all levels of the education system. School boards, in collaboration with their community partners, are expected to revise or develop an environmental education policy that reflects their local circumstances. This policy facilitates the implementation of programs and curriculum initiatives to deepen and broaden student learning about the environment, and will help to guide school boards in their efforts to put environmentally responsible practices in place.

EQUITY AND INCLUSIVE EDUCATION

The Ontario education system is based on a vision of an equitable and inclusive system where all students, parents, and other members of the school community are welcomed and respected; where every student is supported and inspired to succeed in a culture of high expectations for learning; and where all staff and students value diversity and demonstrate respect for others and a commitment to establishing a just, caring society.

All school boards are required to implement and monitor an equity and inclusive education policy in accordance with the requirements set out in PPM No. 119, in the policy document *Realizing the Promise of Diversity: Ontario's Equity andInclusive Education Strategy*, and in the document *Equity and Inclusive Education in Ontario Schools: Guidelines for Policy Development and Implementation*. Ontario's equity and inclusive education strategy is designed to recognize diversity and promote inclusive education in all Ontario schools. It calls for upholding human rights by identifying and eliminating discriminatory biases and systemic barriers to students' learning and development, to enable all students to succeed to their highest potential and contribute to society.

School boards are required to embed the principles of equity and inclusive education in all aspects of their operations, including policy development, programming, and practices related to research, curriculum resources, instruction, and assessment. Schools are expected to provide students and staff with authentic and relevant opportunities to learn about diverse histories, cultures, and perspectives and to enable students and other school community members to see themselves represented in the curriculum, resources, programs, and culture of the school. Students need to feel engaged in and empowered by what they are learning, supported by teachers and staff, and welcomed in their learning environment.

ABORIGINAL EDUCATION

The policies outlined in the *Ontario First Nation, Métis, and Inuit Education Policy Framework* are designed to support learning and achievement for Aboriginal students and to promote

increased awareness in schools about the cultures, histories, and perspectives of First Nation, Métis, and Inuit peoples.

The framework has two areas of focus: targeted strategies and supports for First Nation, Métis, and Inuit students; and strategies to increase knowledge and awareness of Aboriginal histories, cultures, and perspectives among all students,teachers, and school board staff. Implementation requires a holistic approach in order to integrate the framework strategies into all programs, services, and initiatives. School boards will carry out the framework policy through their own school board planning, which will include locally developed targets and voluntary, confidential, Aboriginal student self-identification policies.

The Ontario curriculum includes expectations across all disciplines that school boards can build on to engage First Nation, Métis, and Inuit students and strengthen their pride in the rich heritage of Aboriginal peoples and their contributions to Canadian society. The Ontario curriculum also provides opportunities for all students to learn about Aboriginal cultures, histories, and perspectives, and to study Native languages. These learning opportunities are designed to foster a strengthened sense of cultural identity among Aboriginal students.

ACCEPTABLE USE POLICIES

For security and tracking reasons, it is a requirement of e-Learning Ontario that students using the QEA Online Platform be uniquely identified within each jurisdiction with usernames and passwords. Boards offering e-learning opportunities to their own students or to students outside their area will establish, communicate, and implement board acceptable use policies. Such board acceptable use policies will include clear directions to teachers, students, and parents about the appropriate use of:

- Communication tools, such as e-mail, chat, telephony, videoconferencing, web conferencing, and threaded discussions;
- Student services, such as libraries, the technical help desk, and extracurricular events;
- Hardware, software, and technologies associated with e-learning;
- Orientation materials and opportunities.

Students registered in an e-learning course outside of their home board will follow the acceptable use policies of the board delivering the course. Where a student is taking a course in another board and where the two policies conflict, the acceptable use policies of the board delivering the course would take precedence.

The QEA Online Platform is to be used by teachers, students and parents or legal guardians authorized for use by the district school board. Materials on the QEA Online Platform are to be used for teaching and learning in Ontario district school boards and are not to be redistributed, sold, or posted on other web-sites
that are not password protected. Students using the QEA Online Platform must be enrolled in a provincially-funded school. Students who are home-schooled can become an authorized user of the QEA Online Platform if they apply to their local district school board for a user account.

RIGHTS AND RESPONSIBILITIES

A. Rights and Responsibilities of the Principal of the School Delivering the E-Learning Course

The principal of the school delivering the e-learning course is responsible for:

- managing the enrolment of students in e-learning courses and ensuring they meet provincial and board policies for class size;
- deciding which e-learning courses will be offered;
- giving permission for an eligible student from another board to take an e-learning course;
- providing an orientation program to teachers teaching an e-learning course through the QEA Online Platform;
- providing an orientation program to students taking their e-learning courses to validate the student's suitability for e-learning and to prepare them for this style of learning;
- ensuring that outlines of the courses of study are available for examination;
- assigning teachers to teach the online courses and ensuring the courses are included in the required teacher workload;
- providing disciplinary support/action in alignment with board policies when required;
- ensuring that the teacher of an e-learning course reports information on student achievement to the student's home school for inclusion in the student's Ontario Student Record (OSR) and on the Ontario Student Transcript (OST);
- conducting performance appraisals of e-learning teachers as is current practice within the board;
- monitoring the online behavior of teachers and students;
- ensuring that suspension and expulsion rules as outlined in provincial policy and district school board policies apply to students participating in e-learning.

B. Rights and Responsibilities of the E-learning Teacher

The e-learning teacher is responsible for:

- becoming familiar with and utilizing teaching tools and communication strategies specific to the e-learning environment;
- ensuring that when any modifications are made to an e-learning course, the course continues to meet all requirements of the Ontario provincial curriculum;
- providing the final assessment and/or examination to student's home school principal for completion;
- providing all records and information on student achievement in the course to student's home school for inclusion on the Ontario Student Transcript (OST) and in the Ontario Student Record (OSR);
- communicating information on student progress to parents and students regularly and in accordance with the delivering board policies;
- conducting parent-teacher interviews. Given that face-to-face teacher parent interviews may not be possible alternative means may be used, such as telephone, videoconferencing and email.

C. Rights and Responsibilities of the E-learning Student

The e-learning student is responsible for:

- applying for an e-learning course through his/her home school;
- participating in an e-learning orientation;
- following all delivering school policies with respect to acceptable use and student conduct;
- informing his/her principal and/or guidance counselor if he/she wishes to withdraw from an e-learning course.

GENERAL BEHAVIOUR EXPECTATIONS:

The Ministry of Education reserves the right to implement monitoring software to record and identify inappropriate use of this system.

- As a user of QEA Online Platform, although every effort will be made by the DELC to control access, users should have no expectation of privacy and should behave accordingly.
- Users are expected to conduct themselves in a respectful, responsible and ethical manner while online. Because online communication is "faceless", users sometimes forget that the person they are communicating with is also human;
- Behaviour such as hate mail, harassment, discriminatory remarks, political or derogatory comments to individuals or groups and/or any unethical behaviour will not be tolerated.
- Users are expected to carefully consider the audience for a message and target the message using an appropriate distribution list or individual email account. In replying to messages, consider whether the reply is best sent to an individual, group of individuals or all.
- Hardware, software, and other online resources which make up the QEA Online Platform system are provided for the exclusive educational use of all students, parents and teachers and should not be otherwise copied, used or reused in any way, without the written consent of the Ministry of Education. These resources shall not be used for commercial purposes, product advertising, product/service purchasing, political lobbying, or political campaigning.

For Parents/Guardians of Students in Ontario, in addition to the conditions outlined here it is highly recommended that you become informed of the computer Acceptable Use Policy (AUP) of your daughter's/son's school/board.

HARDWARE AND SOFTWARE REQUIREMENT

Hardware and equipment required:

Hardware / System requirement

- An internet connection – broadband wired or wireless (3G or 4G/LTE)
- Speakers and a microphone – built-in, USB plug-in, or wireless Bluetooth
- A webcam or HD webcam - built-in, USB plug-in, or:
    - An HD cam or HD camcorder with a video-capture card
      Note: See the list of supported devices.

    - Virtual camera software for use with broadcasting software like OBS or IP cameras
      Note: For macOS, Zoom client 5.1.1 or higher is required.

Software / OS requirement

- macOS X with macOS X (10.10) or later
- Windows 11*
  *Note: Windows 11 is supported on version 5.9.0 or higher.
- Windows 10*
  *Note: Devices running Windows 10 must run Windows 10 Home, Pro, or Enterprise. S Mode is not supported.
- Windows 8 or 8.1
- Windows 7

Browser requirement

- Windows: Edge 12+, Firefox 27+, Chrome 30+
- macOS: Safari 7+, Firefox 27+, Chrome 30+
- Linux: Firefox 27+, Chrome 30+