Queen Elizabeth
college of Canada

SECONDARY COURSE OUTLINE

Course Title:	Physics
Grade:	12
Course Developer(s)	Victor Lee
Development/Revision Date:	September, 2022
Ministry Course Code:	SPH4U
Course Type:	University Preparation
Credit Value:	1
Credit Hours:	110
Policy Document:	The Ontario Curriculum, Grades 11 and 12, Science, 2008 Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, *First Edition*. 2010.
Prerequisite(s) and/or Co-requisite(s)	Physics, Grade 11, University Preparation
Resources:	Physics 12. Nelson. Publishing, 2020. By D. Bruni et. al.

PHYSICS, GRADE 12, UNIVERSITY PREPARATION

SPH4U

Course Outline

COURSE DESCRIPTION

This course enables students to deepen their understanding of physics concepts and theories. Students will continue their exploration of energy transformations and the forces that affect motion, and will investigate electrical, gravitational, and magnetic fields and electromagnetic radiation. Students will also explore the wave nature of light, quantum mechanics, and special relativity. They will further develop their scientific investigation skills, learning, for example, how to analyse, qualitatively and quantitatively, data related to a variety of physics concepts and principles. Students will also consider the impact of technological applications of physics on society and the environment.

PREREQUISITE: Physics, Grade 11, University Preparation, SPH3U

OVERALL CURRICULUM EXPECTATIONS

There are six strands in SPH4U and the overall expectations for each strand are as follows:

Scientific Investigation Skills and Career Exploration

1. Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analyzing and interpreting, and communicating);
2. Identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields.

Dynamics

3. Analyse technological devices that apply the principles of the dynamics of motion, and assess the technologies social and environmental impact;
4. Investigate, in qualitative and quantitative terms, forces involved in uniform circular motion and motion in a plane, and solve related problems;
5. Demonstrate an understanding of the forces involved in uniform circular motion and motion in a plane.

Energy and Momentum

6. Analyse and propose ways to improve technologies or procedures that apply principles related to energy and momentum and assess the social and environmental impact of these technologies or procedures;
7. Investigate, in qualitative and quantitative terms, through laboratory inquiry or computer simulation, the relationship between the laws of conservation of energy and conservation of momentum and solve related problems;
8. Demonstrate an understanding of work, energy, momentum and the laws of conservation of energy and conservation of momentum, in one and two dimensions.

Gravitational, Electric, and Magnetic Fields

9. Analyse the operation of technologies that use gravitational, electric or magnetic fields and assess the technology's social and environmental impact;
10. Investigate, in qualitative and quantitative terms, gravitational, electric and magnetic fields and solve related problems;
11. Demonstrate an understanding of the concepts, properties, principles, and laws related to gravitational, electric and magnetic fields and their interactions with matter.

The Wave Nature of Light

12. Analyse technologies that use the wave nature of light, and assess their impact on society and the environment;
13. Investigate, in qualitative and quantitative terms, the properties of waves and light, and solve related problems;
14. Demonstrate an understanding of the properties of waves and light in relation to diffraction, refraction, interference and polarization.

Revolutions in Modern Physics: Quantum Mechanics and Special Relativity

15. Analyse, with reference to quantum mechanics and relativity, how the introduction of new conceptual models and theories can influence and/or change scientific thought and lead to the development of new technologies;
16. Investigate special relativity and quantum mechanics, and solve related problems;
17. Demonstrate an understanding of the evidence that supports the basic concepts of quantum mechanics and Einstein's theory of special relativity.

COURSE CONTENT OUTLINE

Unit 1: Dynamics: Students will review concepts essential to their success in the course: scientific notation, significant digits, vector operations, and fundamental mathematical tools. Principles of kinematics and free body diagrams will also be reviewed and extended. By the end of the unit, students will demonstrate an understanding of the forces involved in uniform circular motion and motion in a plane. They will have investigated forces involved in these modes of motion and have solved related problems. They will analyse technological devices that apply the principles of dynamics of motion, with particular respect to the effect of g-forces on the human body.

Unit 2: Energy and Momentum: Students will demonstrate an understanding of work, energy, momentum. Drawing from Grade 10 concepts of the laws of conservation of energy, they will extend these ideas to conservation of momentum in one and two dimensions. Through computer simulation and other modes of inquiry they will investigate these phenomena and solve related problems. They will conduct analyses and propose improvements to technologies and procedures that apply principles related to energy and momentum, and assess the social and environmental impact of these.

Unit 3: Gravitational, Electric and Magnetic Fields: By the end of this unit, students will demonstrate an understanding of the concepts, properties, principles and laws related to gravitational, electric and magnetic fields, particularly with respect to their interactions with matter. They will investigate these phenomena graphically and through use of other electronic models. They will analyse the operation of technologies that use these fields, and discuss the social and environmental impact of these technologies.

Unit 4: The Wave Nature of Light: Building upon concepts developed during Grade 10, students will study light with particular respect to its wave nature. Properties of waves will be discussed in a general sense, and the principles of diffraction, refraction, interference and polarization will be investigated theoretically and through simulation. Technologies that make use of the knowledge of the wave nature of light, and their social and environmental impacts, will be discussed.

Unit 5: Revolutions in Modern Physics: Quantum Mechanics and Special Relativity: In this unit, some of the most exciting and counterintuitive concepts in physics, including Einstein's ideas about relativity, photoelectric effect, and particle physics, will be examined. Quantum mechanics and special relativity will be investigated mathematically and related problems will be solved. In light of the revolutionary ideas studied in this unit, students will discuss how the introduction of new conceptual models can influence and change scientific thought, and lead to the development of new technologies.

COURSE ORGANIZATION

Unit 1	Dynamics	20 hours
Unit 2	Energy and Momentum	20 hours
Unit 3	Gravitational, Electric and Magnetic Fields	20 hours
Unit 4	The Wave Nature of Light	20 hours
Unit 5	Revolutions in Modern Physics: Quantum Mechanics and Special Relativity	20 hours
	Final Assessment Tasks	10 hours

Total Hours 110 hours

ONLINE / OFFLINE COMPONENTS

Class hours:

Tues 3.30-6.30	Online Synchronous Learning	3 hours
Thurs 3.30-6.30	Offline In person Meeting	3 hours

Weekly: 6 hours (online + offline)
# of weeks: 18
Total hours: 114 hours (including 4 hours dedicated to substitute break time)

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 (10-15%)

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 judgement 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: Physics **Grade/Level: 12**

Course and Code: SPH4U

Teacher:

Planning the Time

Unit	Unit Title (Description)	Time
Unit 1	Dynamics	20 hours
Unit 2	Energy and Momentum	20 hours
Unit 3	Gravitational, Electric and Magnetic Fields	20 hours
Unit 4	The Wave Nature of Light	20 hours
Unit 5	Revolutions in Modern Physics: Quantum Mechanics and Special Relativity	20 hours
Unit 6	ISU	10 hours
Total		**110 hours**

Planning for the Final Grade

	Components	A/E	Strand	Categories K	A	T/I	C	Eval. by P. O. C.	Ex
1	Lab 1	A	A, B	X	X		X	P. O.	1.
	Presentation 1	A	A, B	X			X	O. C.	1.
	Unit Test 1	E	B	X	X	X	X	P.	1.
2	Lab 2	A	A, C	X				P.	1.
	Presentation 2	A	A, C	X			X	O. C.	1.
	Unit Test 2	E	C	X	X	X	X	P.	1.
3	Assignment	A	A, D	X	X			P.	2.
	Presentation 3	A	A, D	X			X	O. C.	2.
	Unit Test 3	E	D	X	X	X	X	P.	2.
4	Assignment 4	A	A, E	X	X		X	P.	1.
	Unit Test 4	E	E	X	X	X	X	P.	1.
	Presentation	A	A, E	X			X	O. C.	2.

5	Lab 5	A	A, F	X			X	P.	1.
	Unit Test 5	E	F	X	X	X	X	P.	2.
	Presentation	A	A, F	X	X	X	X	P.	
6	Research Project Presentations	E	A, B, C, D, E, F	X	X	X	X	P. O. C.	
	Final Exam	E	A, B, C, D, E, F	X	X	X	X		
	Grand Total								

Strands:

A. Scientific skills and career exploration
B. Dynamics
C. Energy and Momentum
D. Gravitational, Electric and Magnetic Fields
E. The Wave Nature of Light
F. Revolutions in Modern Physics: Quantum Mechanics and Special Relativity

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

CONSIDERATIONS ON PROGRAM PLANNING

When planning a program in science, teachers must take into account considerations in a number of important areas, including those discussed below:

INSTRUCTIONAL APPROACHES:

Students come to secondary school with a natural curiosity developed throughout the elementary grades. They also bring with them individual interests and abilities as well as diverse personal and cultural experiences, all of which have an impact on their prior knowledge about science, technology, the environment, and the world they live in. Effective instructional approaches and learning activities draw on students' prior knowledge, capture their interest, and encourage meaningful practice both inside and outside the classroom. Students will be engaged when they are able to see the connection between the scientific concepts they are learning and their application in the world around them and in real-life situations.

Students in a science 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 hands-on experiences, and through examples followed by practice. In science, students are required to learn concepts and procedures, acquire skills, and learn and apply scientific processes, and they become competent in these various areas with the aid of instructional and learning strategies that are suited to the particular type of learning. The approaches and strategies teachers use will vary according to both the object of the learning and the needs of the students.

In order to learn science and to apply their knowledge and skills effectively, students must develop a solid understanding of scientific concepts. Research and successful classroom practice have shown that an inquiry approach, with emphasis on learning through concrete, hands-on experiences, best enables students to develop the conceptual foundation they need. When planning science programs, teachers will provide activities and challenges
that actively engage students in inquiries that honour the ideas and skills students bring to them, while further deepening their conceptual understandings and essential skills.

HEALTH AND SAFETY IN SCIENCE:

Teachers must model safe practices at all times and communicate safety expectations to students in accordance with school board and Ministry of Education policies and Ministry of Labour regulations. Teachers are responsible for ensuring the safety of students during classroom activities and also for encouraging and motivating students to assume responsibility for their own safety and the safety of others. Teachers must also ensure that students have the knowledge and skills needed for safe participation in science activities.

Various kinds of health and safety issues can arise when learning involves field trips. Out-of-school field trips can provide an exciting and authentic dimension to students' learning experiences. They also take the teacher and students out of the predictable classroom environment and into unfamiliar settings. Teachers must preview and plan these activities carefully to protect students' health and safety

PLANNING SCIENCE 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 resource 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.

In any given classroom, students may demonstrate a wide range of strengths 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,5 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 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.

If a student requires "accommodations only" in science 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.

PROGRAM CONSIDERATIONS FOR ENGLISH LANGUAGE LEARNERS:

Ontario schools have some of the most multilingual student populations in the world. The first language of approximately 20 per cent of the students in Ontario's English-language schools is a

language other than English. Ontario's linguistic heritage includes several Aboriginal languages and many African, Asian, and European languages. It also includes some varieties of English – also referred to as dialects – that differ significantly from the English required for success in Ontario schools. Many English language learners were born in Canada and have been raised in families and communities in which languages other than English, or varieties of English that differ from the language used in the classroom, are spoken. Other English language learners arrive in Ontario as newcomers from other countries; they may have experience of highly sophisticated educational systems, or they may have come from regions where access to formal schooling was limited.

When they start school in Ontario, many of these students are entering a new linguistic and cultural environment. All teachers share in the responsibility for these students' English language development.

English language learners (students who are learning English as a second or additional language in English-language schools) bring a rich diversity of background knowledge and experience to the classroom. These students' linguistic and cultural backgrounds not only support their learning in their new environment but also become a cultural asset in the classroom community. Teachers will find positive ways to incorporate this diversity into their instructional programs and into the classroom environment.

ENVIRONMENTAL EDUCATION:

As noted in Shaping Our Schools, Shaping Our Future: Environmental Education in Ontario Schools, environmental education "is the responsibility of the entire education community. It is a content area and can be taught. It is an approach to critical thinking, citizenship, and personal responsibility, and can be modelled. It is a context that can enrich and enliven education in all subject areas, and offer students the opportunity to develop a deeper connection with themselves, their role in society, and their interdependence on one another and the earth's natural systems" (p. 10).

The increased emphasis on relating science to technology, society, and the environment (STSE) within this curriculum document provides numerous opportunities for teachers to integrate environmental education effectively into the curriculum. The STSE expectations provide meaningful contexts for applying what has been learned about the environment, for thinking critically about issues related to the environment, and for considering personal action that can be taken to protect the environment. Throughout the courses and strands, teachers have opportunities to take students out of the classroom and into the world beyond the school, to observe, explore, and investigate. One effective way to approach environmental literacy is through examining critical inquiry questions related to students' sense of place, to the impact of human activity on the environment, and/or to systems thinking. This can be done at numerous points within the science curriculum.

The following are some examples: • A sense of place can be developed as students investigate the geological history of their region. • An understanding of the effects of human activity on the environment can be developed as students consider the impact of their actions (e.g., the use of household chemicals, the consumption of electricity, the acquisition of new electronic devices and the disposal of used ones) on the local and global environment. • Systems thinking can be developed as students extend their understanding of various kinds of systems (e.g., bodily systems; our solar system; Earth systems; mechanical systems) and the interdependence of their components.

ANTIDISCRIMINATION EDUCATION:

The implementation of antidiscrimination principles in education influences all aspects of school life. It promotes a school climate that encourages all students to work to attain high standards, affirms the worth of all students, and helps students strengthen their sense of identity and develop a positive self-image. It encourages staff and students alike to value and show respect for diversity in the school and the wider society. It requires schools to adopt measures to provide a safe environment for learning, free from harassment, violence, and expressions of hate.

Antidiscrimination education encourages students to think critically about themselves and others in the world around them in order to promote fairness, healthy relationships, and active, responsible citizenship.

Schools have the responsibility to ensure that school–community interaction reflects the diversity in the local community and wider society. Consideration should be given to a variety of strategies for communicating and working with parents and community members from diverse groups, in order to ensure their participation in such school activities as plays, concerts, and teacher interviews. Families new to Canada, who may be unfamiliar with the Ontario school system, or parents of Aboriginal students may need special outreach and encouragement in order to feel comfortable in their interactions with the school.

CRITICAL THINKING AND CRITICAL LITERACY IN SCIENCE:

Critical thinking is the process of thinking about ideas or situations in order to understand them fully, identify their implications, and/or make a judgement about what is sensible or reasonable to believe or do. Critical thinking includes skills such as questioning, predicting, hypothesizing, analysing, synthesizing, examining opinions, identifying values and issues, detecting bias, and distinguishing between alternatives.

Students use critical thinking skills in science when they assess, analyse, and/or evaluate the impact of something on society and the environment; when they form an opinion about something and support that opinion with logical reasons; or when they create personal plans of action with regard to making a difference. In order to do these things, students need to examine the opinions and values of others, detect bias, look for implied meaning in their readings, and use the information gathered to form a personal opinion or stance.

As they work to achieve the STSE expectations, students are frequently asked to identify the implications of an action, activity, or process. As they gather information from a variety of sources, they need to be able to interpret what they are reading, to look for instances of bias, and to determine why that source might express that particular bias.

LITERACY MATHEMATICAL LITERACY, AND INVESTIGATION (INQUIRY AND RESEARCH) SKILLS:

Literacy, mathematical literacy, and investigation skills are critical to students' success in all subjects of the curriculum and in all areas of their lives. Many of the activities and tasks that students undertake in the science curriculum involve the literacy skills related to oral, written,

and visual communication. Communication skills are fundamental to the development of scientific literacy and fostering students' communication skills is an important part of the teacher's role in the science curriculum.

When reading in science, students need to understand vocabulary and terminology that are unique to science, and must be able to interpret symbols, charts, diagrams, and graphs. In addition, as they progress through secondary school, it becomes critically important for them to have the ability to make sense of the organization of science textbooks, scientific journals, and research papers. To help students construct meaning from scientific texts, it is essential that teachers of science model and teach the strategies that support learning to read while students are reading to learn in science.

Oral communication skills are fundamental to the development of scientific literacy and are essential for thinking and learning. Through purposeful talk, students not only learn to communicate information but also explore and come to understand ideas and concepts; identify and solve problems; organize their experience and knowledge; and express and clarify their thoughts, feelings, and opinions.

Investigations are at the heart of learning in science. In science courses, students will have multiple
opportunities to develop their ability to ask questions and conduct inquiries and research as they plan and carry out investigations. They will practise using a variety of inquiry and research skills that they need to carry out their investigations and will learn how to determine the most appropriate methods to use in a particular inquiry or research activity. Students will also learn how to locate relevant information in a variety of print and electronic sources

THE ROLE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY IN SCIENCE:

Information and communications technology (ICT) provides a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' learning in science. Computer programs can help students collect, organize, and sort the data they gather and to write, edit, and present multimedia reports on their findings. ICT can also be used to connect students to other schools, at home and abroad, and to bring the global community into the local classroom. Technology also makes it possible to use simulations – for instance, when field studies on a particular topic are not feasible or dissections are not acceptable.

Whenever appropriate, therefore, students should be encouraged to use ICT to support and communicate their learning. For example, students working individually or in groups can use computers and portable storage devices, CD-ROM and DVD technologies, and/or Internet websites to gain access to science institutions in Canada and around the world. Students can also use digital or video cameras to record laboratory inquiries or findings on field trips, or for multimedia presentations on scientific issues.

Although the Internet is a powerful learning tool, all students must be made aware of issues of privacy, safety, and responsible use, as well as of the potential for abuse of this technology, particularly when it is used to promote hatred.

THE ONTARIO SKILLS PASSPORT AND ESSENTIAL SKILLS:

Teachers planning programs in science 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 relevance 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 assess, practise, and build their Essential Skills and work habits and transfer them to a job or further education or training.

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. For further information on the OSP and the Essential Skills, visit http://skills.edu.gov.on.ca.

CAREER EDUCATION:

Ongoing scientific discoveries and innovations coupled with rapidly evolving technologies have resulted in an exciting environment in which creativity and innovation thrive, bringing about new career opportunities. Today's employers seek candidates with strong critical-thinking and problem-solving skills and the ability to work cooperatively in a team – traits that are developed through participation in the science program. Through science courses, students will develop a variety of important capabilities, including the ability to identify issues, conduct research, carry out experiments, solve problems, present results, and work on projects both independently and as a team. Students are also given opportunities to explore various careers related to the areas of science under study and to research the education and training required for these careers (see the expectations in the first strand of every course in the program, "Scientific Investigation Skills and Career Exploration").

COOPERATIVE EDUCATION AND OTHER FORMS OF EXPERIENTIAL LEARNING:

Cooperative education and other forms of experiential learning, such as job shadowing, field trips, and work experience, enable students to apply the skills they have developed in the classroom to real-life activities in the world of science and innovation. Cooperative education and other workplace experiences also help to broaden students' knowledge of employment opportunities in a wide range of fields, including laboratory technology and 44THE ONTARIO CURRICULUM, GRADES 11 AND 12 | Science research, health care, veterinary science, and horticulture. In addition, students develop their understanding of workplace practices, certifications, and the nature of employer– employee relationships. Teachers of science can support their students' learning by maintaining links with community-based organizations to ensure that students have access to hands-on experiences that will reinforce the knowledge and skills they have gained in school.

Students who choose a science course as the related course for two cooperative education credits are able, through this packaged program, to meet the OSSD compulsory credit requirements for groups 1, 2, and 3.

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 that 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 respect to all forms of abuse and harassment.

PLANNING PROGRAM PATHWAYS AND PROGRAMS LEADING TO A SPECIALIST HIGH SKILLS MAJOR:

Science courses are well suited for inclusion in some programs leading to a Specialist High Skills Major (SHSM) or in programs designed to provide pathways to particular apprenticeship or workplace destinations. In some SHSM programs, science 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. Science courses may also be combined with cooperative education credits to provide the workplace experience required for some 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.)

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 BEHAVIOR 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+