Computer Science 8

Curriculum Guide 2021

Education

Newfoundland Labrador

Department of Education and Early Childhood Development Mission Statement

The Department of Education and Early Childhood Development will improve provincial early childhood learning and the K-12 education system to further opportunities for the people of Newfoundland and Labrador.

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Section One: Newfoundland and Labrador Curriculum

Introduction

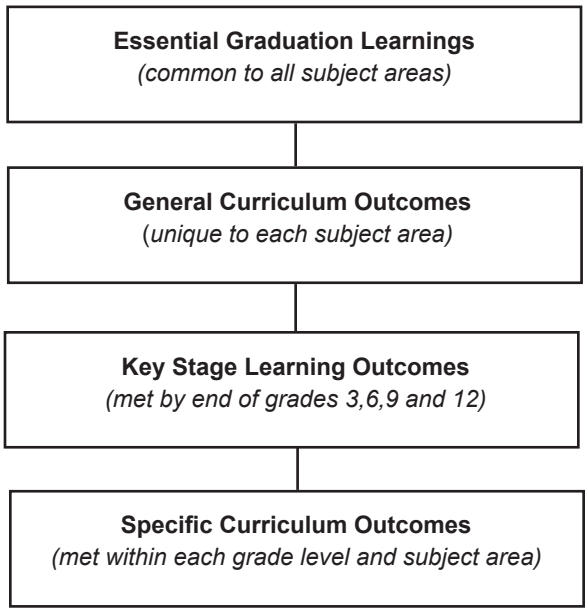
There are multiple factors that impact education: technological developments, increased emphasis on accountability, and globalization. These factors point to the need to consider carefully the education students receive.

The Newfoundland and Labrador Department of Education believes that curriculum design with the following characteristics will help teachers address the needs of students served by the provincially prescribed curriculum:

- Curriculum guides must clearly articulate what students are expected to know and be able to do by the time they graduate from high school.
- There must be purposeful assessment of students' performance in relation to the curriculum outcomes.

Outcomes Based Education

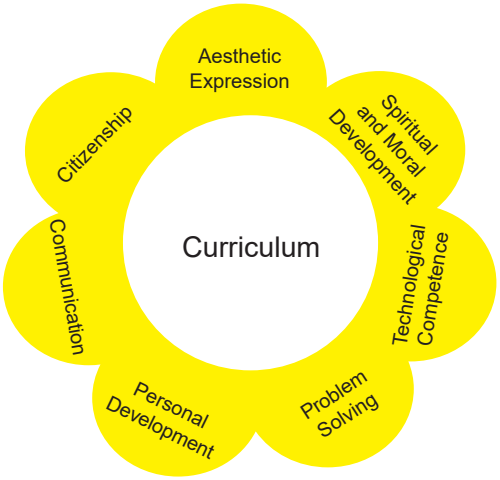
The K-12 curriculum in Newfoundland and Labrador is organized by outcomes and is based on *The Atlantic Canada Framework for Essential Graduation Learning in Schools* (1997). This framework consists of Essential Graduation Learnings (EGLs), General Curriculum Outcomes (GCOs), Key Stage Curriculum Outcomes (KSCOs) and Specific Curriculum Outcomes (SCOs).



Essential Graduation Learnings

EGLs provide vision for the development of a coherent and relevant curriculum. They are statements that offer students clear goals and a powerful rationale for education. The EGLs are delineated by general, key stage, and specific curriculum outcomes.

EGLs describe the knowledge, skills, and attitudes expected of all students who graduate from high school. Achievement of the EGLs will prepare students to continue to learn throughout their lives. EGLs describe expectations, not in terms of individual subject areas, but in terms of knowledge, skills, and attitudes developed throughout the K-12 curriculum. They confirm that students need to make connections and develop abilities across subject areas if they are to be ready to meet the shifting and ongoing demands of life, work, and study.



Aesthetic Expression – Graduates will be able to respond with critical awareness to various forms of the arts and be able to express themselves through the arts.

Citizenship – Graduates will be able to assess social, cultural, economic, and environmental interdependence in a local and global context.

Communication – Graduates will be able to use the listening, viewing, speaking, reading and writing modes of language(s), and mathematical and scientific concepts and symbols, to think, learn and communicate effectively.

Problem Solving – Graduates will be able to use the strategies and processes needed to solve a wide variety of problems, including those requiring language, and mathematical and scientific concepts.

Personal Development – Graduates will be able to continue to learn and to pursue an active, healthy lifestyle.

Spiritual and Moral Development – Graduates will demonstrate understanding and appreciation for the place of belief systems in shaping the development of moral values and ethical conduct.

Technological Competence – Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

Curriculum Outcomes

Curriculum outcomes are statements that articulate what students are expected to know and be able to do in each program area in terms of knowledge, skills, and attitudes.

Curriculum outcomes may be subdivided into General Curriculum Outcomes, Key Stage Curriculum Outcomes, and Specific Curriculum Outcomes.

General Curriculum Outcomes (GCOs)

Each program has a set of GCOs which describe what knowledge, skills, and attitudes students are expected to demonstrate as a result of their cumulative learning experiences within a subject area. GCOs serve as conceptual organizers or frameworks which guide study within a program area. Often, GCOs are further delineated into KSCOs.

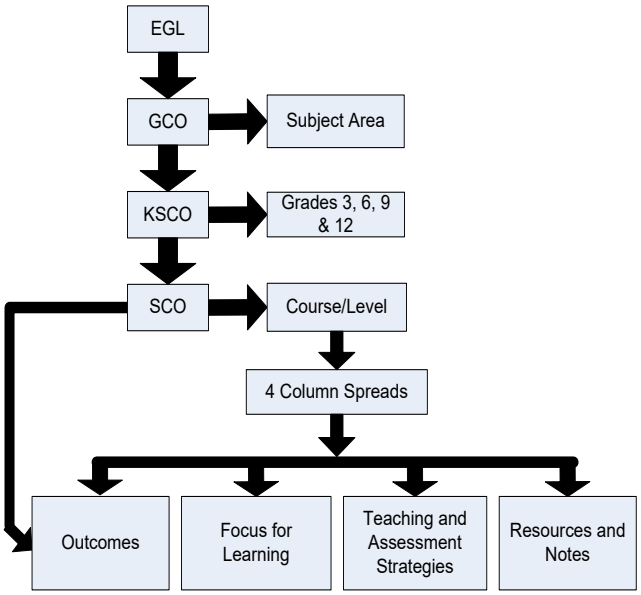
Key Stage Curriculum Outcomes (KSCOs)

Key Stage Curriculum Outcomes (KSCOs) summarize what is expected of students at each of the four key stages of grades three, six, nine, and twelve.

Specific Curriculum Outcomes (SCOs)

SCOs set out what students are expected to know and be able to do as a result of their learning experiences in a course, at a specific grade level. In some program areas, SCOs are further articulated into delineations. *It is expected that all SCOs will be addressed during the course of study covered by the curriculum guide.*

EGLs to Curriculum Guides



Context for Teaching and Learning

Teachers are responsible to help students achieve outcomes. This responsibility is a constant in a changing world. As programs change over time so does educational context. Several factors make up the educational context in Newfoundland and Labrador today: inclusive education, support for gradual release of responsibility teaching model, focus on literacy and learning skills in all programs, and support for education for sustainable development.

Inclusive Education

All students need to see their lives and experiences reflected in their school community. It is important that the curriculum reflect the experiences and values of all genders and that learning resources include and reflect the interests, achievements, and perspectives of all students. An inclusive classroom values the varied experiences and abilities as well as social and ethno-cultural backgrounds of all students while creating opportunities for community building. Inclusive policies and practices promote mutual respect, positive interdependencies, and diverse perspectives. Learning resources should include a range of materials that allow students to consider many viewpoints and to celebrate the diverse aspects of the school community.

Valuing Equity and Diversity

Effective inclusive schools have the following characteristics: supportive environment, positive relationships, feelings of competence, and opportunities to participate. (The Centre for Inclusive Education, 2009)

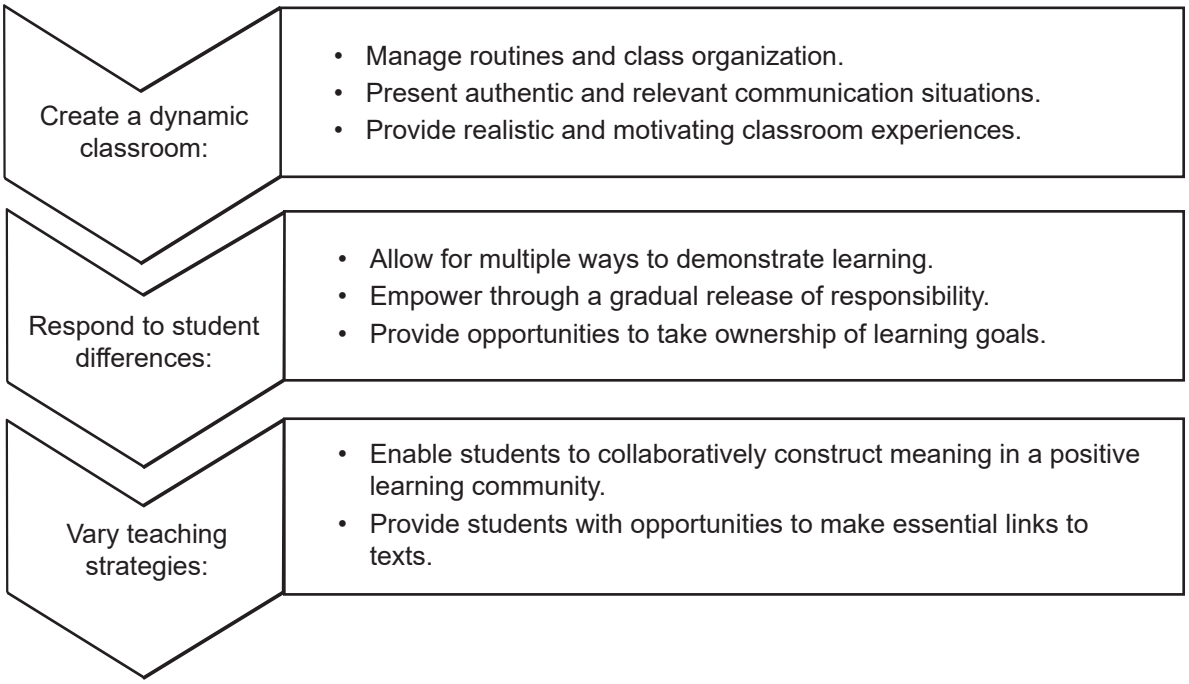
Differentiated Instruction

Differentiated instruction is a teaching philosophy based on the premise that teachers should adapt instruction to student differences. Rather than marching students through the curriculum lockstep, teachers should modify their instruction to meet students' varying readiness levels, learning preferences, and interests. Therefore, the teacher proactively plans a variety of ways to 'get it' and express learning. (Carol Ann Tomlinson, 2008)

Curriculum is designed and implemented to provide learning opportunities for all students according to abilities, needs, and interests. Teachers must be aware of and responsive to the diverse range of learners in their classes. Differentiated instruction is a useful tool in addressing this diversity.

Differentiated instruction responds to different readiness levels, abilities, and learning profiles of students. It involves actively planning so that the process by which content is delivered, the way the resource is used, and the products students create are in response to the teacher's knowledge of whom he or she is interacting with. Learning environments should be flexible to accommodate various learning preferences of the students. Teachers continually make decisions about selecting teaching strategies and structuring learning activities that provide all students with a safe and supportive place to learn and succeed.

Planning for Differentiation



Differentiating the Content

Differentiating content requires teachers to pre-assess students to identify those who require prerequisite instruction, as well as those who have already mastered the concept and may therefore apply strategies learned to new situations. Another way to differentiate content is to permit students to adjust the pace at which they progress through the material. Some students may require additional time while others will move through at an increased pace and thus create opportunities for enrichment or more indepth consideration of a topic of particular interest.

Teachers should consider the following examples of differentiating content:

- Meet with small groups to reteach an idea or skill or to extend the thinking or skills.
- Present ideas through auditory, visual, and tactile means.
- Use reading materials such as novels, websites, and other reference materials at varying reading levels.

Differentiating the Process

Differentiating the process involves varying learning activities or strategies to provide appropriate methods for students to explore and make sense of concepts. A teacher might assign all students the same product (e.g., presenting to peers) but the process students use to create the presentation may differ. Some students could work in groups while others meet with the teacher individually. The same assessment criteria can be used for all students.

Teachers should consider flexible grouping of students such as whole class, small group, or individual instruction. Students can be grouped according to their learning styles, readiness levels, interest areas, and/or the requirements of the content or activity presented. Groups should be formed for specific purposes and be flexible in composition and short-term in duration.

Teachers should consider the following examples of differentiating the process:

- Offer hands-on activities for students.
- Provide activities and resources that encourage students to further explore a topic of particular interest.
- Use activities in which all learners work with the same learning outcomes but proceed with different levels of support, challenge, or complexity.

Differentiating the Product

Differentiating the product involves varying the complexity and type of product that students create to demonstrate learning outcomes. Teachers provide a variety of opportunities for students to demonstrate and show evidence of what they have learned.

Teachers should give students options to demonstrate their learning (e.g., create an online presentation, write a letter, or develop a mural). This will lead to an increase in student engagement.

Differentiating the Learning Environment

The learning environment includes the physical and the affective tone or atmosphere in which teaching and learning take place, and can include the noise level in the room, whether student activities are static or mobile, or how the room is furnished and arranged. Classrooms may include tables of different shapes and sizes, space for quiet individual work, and areas for collaboration.

Teachers can divide the classroom into sections, create learning centres, or have students work both independently and in groups. The structure should allow students to move from whole group, to small group, pairs, and individual learning experiences and support a variety of ways to engage in learning. Teachers should be sensitive and alert to ways in which the classroom environment supports their ability to interact with students.

Teachers should consider the following examples of differentiating the learning environment:

- Develop routines that allow students to seek help when teachers are with other students and cannot provide immediate attention.
- Ensure there are places in the room for students to work quietly and without distraction, as well as places that invite student collaboration.
- Establish clear guidelines for independent work that match individual needs.
- Provide materials that reflect diversity of student background, interests, and abilities.

The physical learning environment must be structured in such a way that all students can gain access to information and develop confidence and competence.

Meeting the Needs of Students with Exceptionalities

All students have individual learning needs. Some students, however, have exceptionalities (defined by the Department of Education) which impact their learning. The majority of students with exceptionalities access the prescribed curriculum. For details of these exceptionalities see www.gov.nl.ca/edu/k12/studentsupportservices/exceptionalities.html

Supports for these students may include

1. Accommodations
2. Modified Prescribed Courses
3. Alternate Courses
4. Alternate Programs
5. Alternate Curriculum

For further information, see Service Delivery Model for Students with Exceptionalities at www.cdli.ca/sdm/

Classroom teachers should collaborate with instructional resource teachers to select and develop strategies which target specific learning needs.

Meeting the Needs of Students who are Highly Able
(includes gifted and talented)

Some students begin a course or topic with a vast amount of prior experience and knowledge. They may know a large portion of the material before it is presented to the class or be capable of processing it at a rate much faster than their classmates. All students are expected to move forward from their starting point. Many elements of differentiated instruction are useful in addressing the needs of students who are highly able.

Teachers may

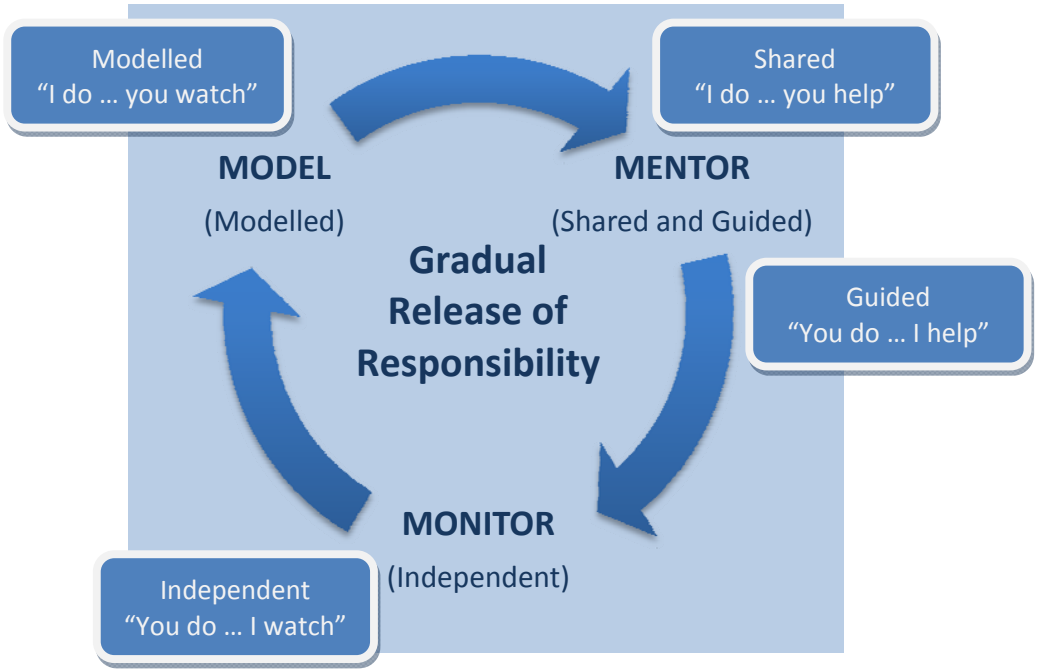
- assign independent study to increase depth of exploration in an area of particular interest;
- compact curriculum to allow for an increased rate of content coverage commensurate with a student's ability or degree of prior knowledge;
- group students with similar abilities to provide the opportunity for students to work with their intellectual peers and elevate discussion and thinking, or delve deeper into a particular topic; and
- tier instruction to pursue a topic to a greater depth or to make connections between various spheres of knowledge.

Highly able students require the opportunity for authentic investigation to become familiar with the tools and practices of the field of study. Authentic audiences and tasks are vital for these learners. Some highly able learners may be identified as gifted and talented in a particular domain. These students may also require supports through the Service Delivery Model for Students with Exceptionalities.

Gradual Release of Responsibility

Teachers must determine when students can work independently and when they require assistance. In an effective learning environment, teachers choose their instructional activities to model and scaffold composition, comprehension, and metacognition that is just beyond the students' independence level. In the gradual release of responsibility approach, students move from a high level of teacher support to independent work. If necessary, the teacher increases the level of support when students need assistance. The goal is to empower students with their own learning strategies, and to know how, when, and why to apply them to support their individual growth. Guided practice supports student independence. As a student demonstrates success, the teacher should gradually decrease his or her support.

Gradual Release of Responsibility Model



Literacy

"Literacy is the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve their goals, to develop their knowledge and potential, and to participate fully in their community and wider society". To be successful, students require a set of interrelated skills, strategies and knowledge in multiple literacies that facilitate their ability to participate fully in a variety of roles and contexts in their lives, in order to explore and interpret the world and communicate meaning. (The Plurality of Literacy and its Implications for Policies and Programmes, 2004, p.13)

Literacy is

- a process of receiving information and making meaning from it; and
- the ability to identify, understand, interpret, communicate, compute, and create text, images, and sounds.

Literacy development is a lifelong learning enterprise beginning at birth that involves many complex concepts and understandings. It is not limited to the ability to read and write; no longer are we exposed only to printed text. It includes the capacity to learn to communicate, read, write, think, explore, and solve problems. Individuals use literacy skills in paper, digital, and live interactions to engage in a variety of activities:

- Analyze critically and solve problems.
- Comprehend and communicate meaning.
- Create a variety of texts.
- Make connections both personally and inter-textually.
- Participate in the socio-cultural world of the community.
- Read and view for enjoyment.
- Respond personally.

These expectations are identified in curriculum documents for specific subject areas as well as in supporting documents, such as *Cross-Curricular Reading Tools* (CAMET).

With modelling, support, and practice, students' thinking and understandings are deepened as they work with engaging content and participate in focused conversations.

Reading in the Content Areas

The focus for reading in the content areas is on teaching strategies for understanding content. Teaching strategies for reading comprehension benefits all students as they develop transferable skills that apply across curriculum areas.

When interacting with different texts, students must read words, view and interpret text features, and navigate through information presented in a variety of ways including, but not limited to

Advertisements	Movies	Poems
Blogs	Music videos	Songs
Books	Online databases	Speeches
Documentaries	Plays	Video games
Magazine articles	Podcasts	Websites

Students should be able to interact with and comprehend different texts at different levels.

There are three levels of text comprehension:

- Independent level – Students are able to read, view, and understand texts without assistance.
- Instructional level – Students are able to read, view, and understand most texts but need assistance to fully comprehend some texts.
- Frustration level – Students are not able to read or view with understanding (i.e., texts may be beyond their current reading level).

Teachers will encounter students working at all reading levels in their classrooms and will need to differentiate instruction to meet their needs. For example, print texts may be presented in audio form, physical movement may be associated with synthesizing new information with prior knowledge, or graphic organizers may be created to present large amounts of print text in a visual manner.

When interacting with information that is unfamiliar to students, it is important for teachers to monitor how effectively students are using strategies to read and view texts:

- Analyze and think critically about information.
- Determine importance to prioritize information.
- Engage in questioning before, during, and after an activity related to a task, text, or problem.
- Make inferences about what is meant but not said.
- Make predictions.
- Synthesize information to create new meaning.
- Visualize ideas and concepts.

Learning Skills for Generation Next

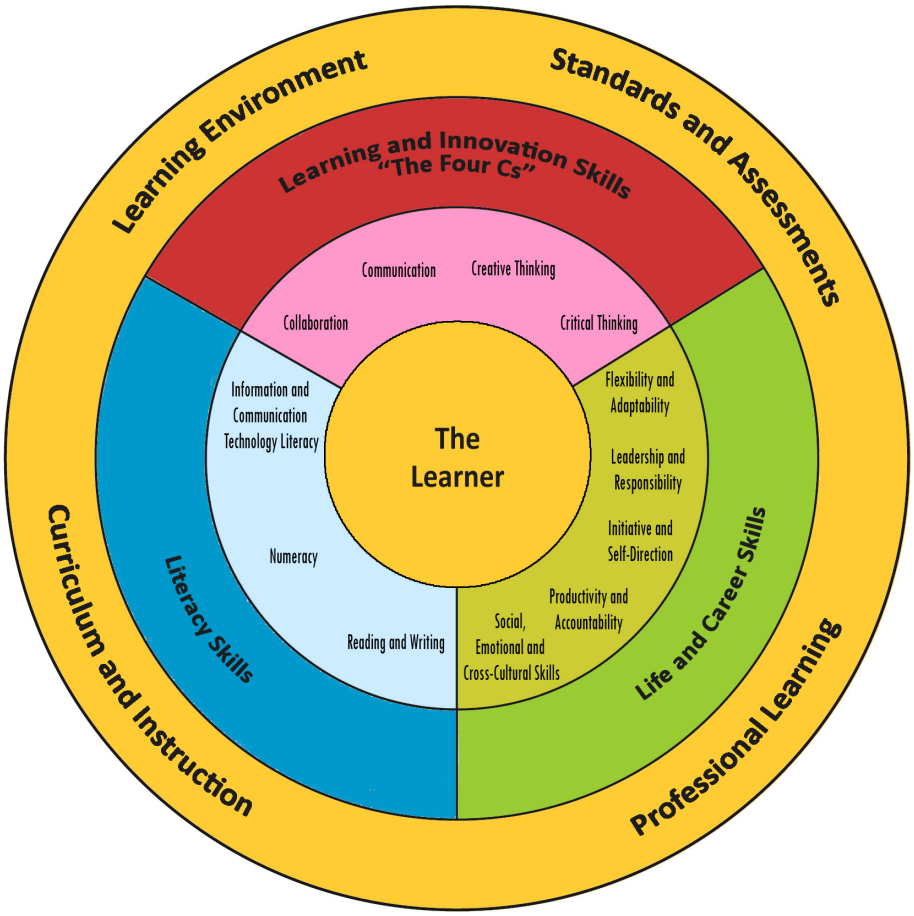
Generation Next is the group of students who have not known a world without personal computers, cell phones, and the Internet. They were born into this technology. They are digital natives.

Students need content and skills to be successful. Education helps students learn content and develop skills needed to be successful in school and in all learning contexts and situations. Effective learning environments and curricula challenge learners to develop and apply key skills within the content areas and across interdisciplinary themes.

Learning Skills for Generation Next encompasses three broad areas:

- Learning and Innovation Skills enhance a person's ability to learn, create new ideas, problem solve, and collaborate.
- Life and Career Skills address leadership, and interpersonal and affective domains.
- Literacy Skills develop reading, writing, and numeracy, and enhance the use of information and communication technology.

The diagram below illustrates the relationship between these areas. A 21st century curriculum employs methods that integrate innovative and research-driven teaching strategies, modern learning technologies, and relevant resources and contexts.



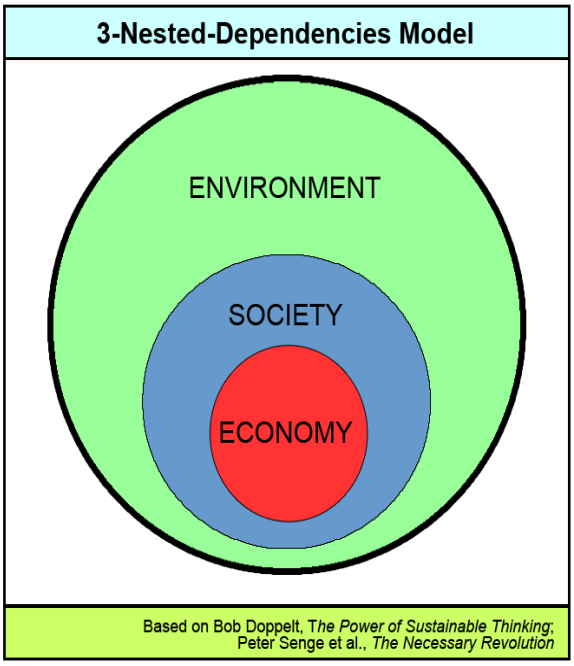
Support for students to develop these abilities and skills is important across curriculum areas and should be integrated into teaching, learning, and assessment strategies. Opportunities for integration of these skills and abilities should be planned with engaging and experiential activities that support the gradual release of responsibility model. For example, lessons in a variety of content areas can be infused with learning skills for Generation Next by using open-ended questioning, role plays, inquiry approaches, self-directed learning, student role rotation, and Internet-based technologies.

All programs have a shared responsibility in developing students' capabilities within all three skill areas.

Education for Sustainable Development

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". (Our Common Future, 43)

Sustainable development is comprised of three integrally connected areas: economy, society, and environment.



As conceived by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) the overall goal of Education for Sustainable Development (ESD) is to integrate the knowledge, skills, values, and perspectives of sustainable development into all aspects of education and learning. Changes in human behaviour should create a more sustainable future that supports environmental integrity and economic viability, resulting in a just society for all generations.

ESD involves teaching *for* rather than teaching *about* sustainable development. In this way students develop the skills, attitudes, and perspectives to meet their present needs without compromising the ability of future generations to meet their needs.

Within ESD, the knowledge component spans an understanding of the interconnectedness of our political, economic, environmental, and social worlds, to the role of science and technology in the development of societies and their impact on the environment. The skills necessary include being able to assess bias, analyze consequences of choices, ask questions, and solve problems. ESD values and perspectives include an appreciation for the interdependence of all life forms, the importance of individual responsibility and action, an understanding of global issues as well as local issues in a global context. Students need to be aware that every issue has a history, and that many global issues are linked.

Assessment and Evaluation

Assessment

Assessment is the process of gathering information on student learning.

How learning is assessed and evaluated and how results are communicated send clear messages to students and others about what is valued.

Assessment instruments are used to gather information for evaluation. Information gathered through assessment helps teachers determine students' strengths and needs, and guides future instruction.

Teachers are encouraged to be flexible in assessing student learning and to seek diverse ways students might demonstrate what they know and are able to do.

Evaluation involves the weighing of the assessment information against a standard in order to make a judgement about student achievement.

Assessment can be used for different purposes:

1. Assessment *for* learning guides and informs instruction.
2. Assessment *as* learning focuses on what students are doing well, what they are struggling with, where the areas of challenge are, and what to do next.
3. Assessment *of* learning makes judgements about student performance in relation to curriculum outcomes.

1. Assessment for Learning

Assessment *for* learning involves frequent, interactive assessments designed to make student learning visible. This enables teachers to identify learning needs and adjust teaching accordingly. Assessment *for* learning is not about a score or mark; it is an ongoing process of teaching and learning:

- Pre-assessments provide teachers with information about what students already know and can do.
- Self-assessments allow students to set goals for their own learning.
- Assessment *for* learning provides descriptive and specific feedback to students and parents regarding the next stage of learning.
- Data collected during the learning process from a range of tools enables teachers to learn as much as possible about what a student knows and is able to do.

2. Assessment as Learning

Assessment *as* learning involves students' reflecting on their learning and monitoring their own progress. It focuses on the role of the student in developing metacognition and enhances engagement in their own learning. Students can

- analyze their learning in relation to learning outcomes,
- assess themselves and understand how to improve performance,
- consider how they can continue to improve their learning, and
- use information gathered to make adaptations to their learning processes and to develop new understandings.

3. Assessment of Learning

Assessment *of* learning involves strategies designed to confirm what students know in terms of curriculum outcomes. It also assists teachers in determining student proficiency and future learning needs. Assessment *of* learning occurs at the end of a learning experience and contributes directly to reported results. Traditionally, teachers relied on this type of assessment to make judgements about student performance by measuring learning after the fact and then reporting it to others. Used in conjunction with the other assessment processes previously outlined, assessment *of* learning is strengthened. Teachers can

- confirm what students know and can do;
- report evidence to parents/guardians, and other stakeholders, of student achievement in relation to learning outcomes; and
- report on student learning accurately and fairly using evidence obtained from a variety of contexts and sources.

Involving Students in the Assessment Process

Students should know what they are expected to learn as outlined in the specific curriculum outcomes of a course as well as the criteria that will be used to determine the quality of their achievement. This information allows students to make informed choices about the most effective ways to demonstrate what they know and are able to do.

It is important that students participate actively in assessment by co-creating criteria and standards which can be used to make judgements about their own learning. Students may benefit from examining various scoring criteria, rubrics, and student exemplars.

Students are more likely to perceive learning as its own reward when they have opportunities to assess their own progress. Rather than asking teachers, "What do you want?", students should be asking themselves questions:

- What have I learned?
- What can I do now that I couldn't do before?
- What do I need to learn next?

Assessment must provide opportunities for students to reflect on their own progress, evaluate their learning, and set goals for future learning.

Assessment Tools

In planning assessment, teachers should use a broad range of tools to give students multiple opportunities to demonstrate their knowledge, skills, and attitudes. The different levels of achievement or performance may be expressed as written or oral comments, ratings, categorizations, letters, numbers, or as some combination of these forms.

The grade level and the activity being assessed will inform the types of assessment tools teachers will choose:

Anecdotal Records	Photographic Documentation
Audio/Video Clips	Podcasts
Case Studies	Portfolios
Checklists	Presentations
Conferences	Projects
Debates	Questions
Demonstrations	Quizzes
Exemplars	Role Plays
Graphic Organizers	Rubrics
Journals	Self-assessments
Literacy Profiles	Tests
Observations	Wikis

Assessment Guidelines

Assessments should measure what they intend to measure. It is important that students know the purpose, type, and potential marking scheme of an assessment. The following guidelines should be considered:

- Collect evidence of student learning through a variety of methods; do not rely solely on tests and paper and pencil activities.
- Develop a rationale for using a particular assessment of learning at a specific point in time.
- Provide descriptive and individualized feedback to students.
- Provide students with the opportunity to demonstrate the extent and depth of their learning.
- Set clear targets for student success using learning outcomes and assessment criteria.
- Share assessment criteria with students so that they know the expectations.

Evaluation

Evaluation is the process of analyzing, reflecting upon, and summarizing assessment information, and making judgements or decisions based on the information gathered. Evaluation is conducted within the context of the outcomes, which should be clearly understood by learners before teaching and evaluation take place. Students must understand the basis on which they will be evaluated and what teachers expect of them.

During evaluation, the teacher interprets the assessment information, makes judgements about student progress, and makes decisions about student learning programs.

Section Two: Curriculum Design

Rationale

Technological competence is one of the Essential Graduation Learnings common to all curricular areas in the Newfoundland and Labrador curriculum. The International Society for Technology in Education (ISTE) outlines Empowered Learner, Knowledge Constructor, Innovative Designer and Creative Communicator as four of its seven standards for students. In addition, the Conference Board of Canada Employability Skills Profile lists the ability to communicate, manage information, use numbers and think and solve problems as fundamental employability skills. Technology has become increasingly ubiquitous in the day to day lives of students and learning how to manage information through technology is an essential form of communication.

Curriculum Outcomes Framework

Technology Education engages students directly in constructing technological solutions to everyday, real-world problems.Technology Education employs a wide variety of hands-on activities. Students are exposed to a broad range of technological issues, systems, and problem situations in a systemic, systematic fashion. They employ a wide range of technological resources and processes to design, fabricate, and test solutions to familiar and unfamiliar problems. Outcomes, learning experiences, and evaluation of student achievement are designed for engagement. Technology Education provides a naturally integrative function that helps students identify contextual relationships between technological activity and principles, and the underlying scientific, mathematical, and other concepts, principles, laws, and theories.

Computer Science 8

Computer Science is the study of computational systems. While the discipline does deal with some hardware concepts, Computer Science primarily covers programming and software solution development for a vast list of applications including artificial intelligence, networks, and security. Computer Science 8 introduces students to the fundamental concepts of computer programming. Students will have the opportunity to explore the world of computers and emerging opportunities in the technology sector. They will plan, design and create block-based programs for specific tasks. Students will use these programming skills to control physical devices such as LEDs and motors. The module culminates with an innovation challenge where students will develop solutions to authentic problems using skills developed throughout the module.

Key Stage Curriculum Outcomes

The key stage curriculum outcomes, based on the general curriculum outcomes, identify what students are expected to know and be able to do at the end of the primary/elementary, intermediate and high school grades in order to meet the essential graduation learnings. Key stage outcomes are identified for each of the dimensions. These key stage curriculum outcomes serve as the basis for the development of specific programs and courses for Technology Education.

Specific Curricular Outcomes

The specific curriculum outcomes are statements that describe what students will know, value, and be able to do as a result of study in a specific course or program at a grade level. These are found in the curriculum guides for each program or course

General Curriculum Outcomes (GCOs)	Key Stage Curriculum Outcomes (KSCOs) By the end of grade 9, students will be expected to:
GCO 1: Technological Problem Solving Students will be expected to design, develop, evaluate, and articulate technological solutions.	[1.301] articulate problems that may be solved through technological means • examine problem situations • construct simple design briefs that include the problem statement and conditions affecting the solution [1.302] conduct design studies to identify a technological solution to a problem • investigate related solutions • document a range of options to solve the problem • determine and justify the best option • create a plan of action that includes technical sketches [1.303] develop (prototype, fabricate, make) technological solutions to problems • identify appropriate tools and resources • employ safe practices and resource conservation • develop the solution with redesign as necessary to ensure the design brief is satisfied • document all activities and decisions [1.304] critically evaluate technological solutions and report their findings • use established and their own criteria to evaluate the effectiveness of both their own and others' technological solutions • assess solution components and incorporate the required changes during the design activity • document and report their changes, the rationale for change, and conclusions

General Curriculum Outcomes (GCOs)	Key Stage Curriculum Outcomes (KSCOs) By the end of grade 9, students will be expected to:
	[1.305] communicate ideas and information about technological solutions through appropriate technical means • create more sophisticated orthographic and isometric views • create alternate representations, such as computer animations • and physical models
GCO 2: Technological Systems Students will be expected to operate and manage technological systems.	[2.101] operate components of a variety of familiar technological systems [2.102] manage technological resources when engaged in an activity [2.103] operate familiar control systems [2.104] recognize and identify common technological systems, and determine what they do and what keeps them working (e.g., a fridge cools food and it uses electricity to operate) [2.105] follow a process to determine how systems work
GCO 3: History and Evolution of Technology Students will be expected to demonstrate an understanding of the history and evolution of technology, and of its social and cultural implications.	[3.301] examine the historical evolution of technologies and predict future developments [3.302] investigate ways that science activities depend on technology and that inventions in technology depend on science [3.303] examine technological literacy and capability in modern society and their effects on citizenship and education [3.304] evaluate the effects of rapid change in technological systems on people in their schools and communities [3.305] account for effects of cultural diversity on technological solutions • examine the effects of culture on traditional products, and vice versa • explore how products are designed differently for different markets • apply their understanding of cultural preferences when developing technological solutions
GCO 4: Technology and Careers Students will be expected to demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.	[4.401] assess and evaluate employability profiles for a variety of workplaces and careers and determine the level of technological literacy and capability they would need to achieve for job entry [4.402] employ design and invention as tools to create entrepreneurial activity [4.403] envision their short- and longer-term future and develop a plan for acquiring the technological literacy/capability required to achieve their vision

General Curriculum Outcomes (GCOs)	Key Stage Curriculum Outcomes (KSCOs) By the end of grade 9, students will be expected to:
GCO 5: Technological Responsibility Students will be expected to demonstrate an understanding of the consequences of their technological choices.	[5.301] demonstrate an understanding of the nature and purpose of legal and ethical rules and principles [5.302] develop personal rules of conduct that ensure healthy and safe practices [5.303] develop and demonstrate risk-management strategies for a variety of technological activities

Course Overview

Computer Science 8 explores the fundamental concepts of computer programming. Students will have the opportunity to explore the world of computers and emerging opportunities in the technology sector. They will plan, design and create block-based programs for specific tasks. Students will use these programming skills to control physical devices such as LEDs and motors. The module culminates with an innovation challenge where students will develop solutions to authentic problems using skills developed throughout the module.

Unit 1: Big Ideas

Unit 2: Basic Skills

Unit 3: Innovation Challenge

Suggested Yearly Plan

Computer Science 8 is a 26 hour module that is intended to be offered in one semester. It is recognized however, that its integration into the school year will depend mostly on the school's schedule. There are no prerequisites for this course and it is designed for students who are beginning to explore the area of Computer Science and programming.

Unit one is the big ideas unit for the module. It covers three subtopics. It is recommended that no more than five hours of instruction be alotted for this unit. Suggested time allocations for each subtopic are provided below.

Subtopic	# of hours
Careers	2
Technological Responsibility	2
History and Background	1

Suggested Yearly Plan

Unit two is a basic skills unit. and introduces students to the fundamentals of programming in a block-based environment. Students will explore the basic structures of computer programming and then create programs to control physical devices.

Subtopic	# of hours
Planning and Troubleshooting	3
Block Based Coding	2

Unit three represents the culminating activity for the module. Students will use their new knowledge from unit one and their new skills from unit two to complete an innovation challenge in unit three.

Subtopic	#of hours
Getting Organized	2
Getting Started	6
Developing the Solution	8

How to Use the Four Column Curriculum Layout

Outcomes

Column one contains specific curriculum outcomes (SCO) and accompanying delineations where appropriate. The delineations provide specificity in relation to key ideas.

Outcomes are numbered in ascending order.

Delineations are indented and numbered as a subset of the originating SCO.

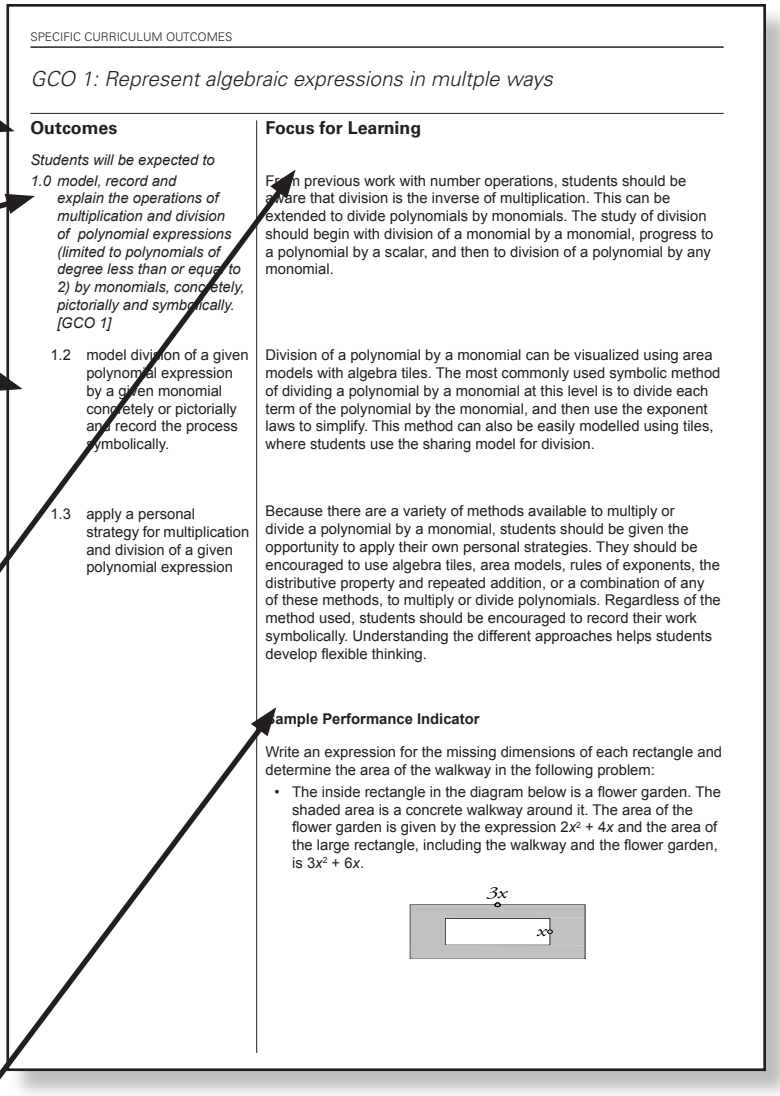
All outcomes are related to general curriculum outcomes.

Focus for Learning

Column two is intended to assist teachers with instructional planning. It also provides context and elaboration of the ideas identified in the first column.

This may include

- cautionary notes
- clarity in terms of scope
- common misconceptions
- depth of treatment
- knowledge required to scaffold and challenge student's learning
- references to prior knowledge



SPECIFIC CURRICULUM OUTCOMES

GCO 1: Represent algebraic expressions in multple ways

Outcomes	Focus for Learning
Students will be expected to	
1.0 model, record and explain the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials, concretely, pictorially and symbolically. [GCO 1]	From previous work with number operations, students should be aware that division is the inverse of multiplication. This can be extended to divide polynomials by monomials. The study of division should begin with division of a monomial by a monomial, progress to a polynomial by a scalar, and then to division of a polynomial by any monomial.
1.2 model division of a given polynomial expression by a given monomial concretely or pictorially and record the process symbolically.	Division of a polynomial by a monomial can be visualized using area models with algebra tiles. The most commonly used symbolic method of dividing a polynomial by a monomial at this level is to divide each term of the polynomial by the monomial, and then use the exponent laws to simplify. This method can also be easily modelled using tiles, where students use the sharing model for division.
1.3 apply a personal strategy for multiplication and division of a given polynomial expression	Because there are a variety of methods available to multiply or divide a polynomial by a monomial, students should be given the opportunity to apply their own personal strategies. They should be encouraged to use algebra tiles, area models, rules of exponents, the distributive property and repeated addition, or a combination of any of these methods, to multiply or divide polynomials. Regardless of the method used, students should be encouraged to record their work symbolically. Understanding the different approaches helps students develop flexible thinking.

Sample Performance Indicator

Write an expression for the missing dimensions of each rectangle and determine the area of the walkway in the following problem:

- The inside rectangle in the diagram below is a flower garden. The shaded area is a concrete walkway around it. The area of the flower garden is given by the expression $2x^2 + 4x$ and the area of the large rectangle, including the walkway and the flower garden, is $3x^2 + 6x$.

Sample Performance Indicator(s)

This provides a summative, higher order activity, where the response would serve as a data source to help teachers assess the degree to which the student has achieved the outcome.

Performance indicators are typically presented as a task, which may include an introduction to establish a context. They would be assigned at the end of the teaching period allocated for the outcome.

Performance indicators would be assigned when students have attained a level of competence, with suggestions for teaching and assessment identified in column three.

SPECIFIC CURRICULUM OUTCOMES

GCO 1: Represent algebraic expressions in multple ways

Sample Teaching and Assessment Strategies	Resources and Notes

Teachers may use the following activities and/or strategies aligned with the corresponding assessment tasks:

Modeling division using the sharing model provides a good transition to the symbolic representation. For example, $\frac{3x+12}{3} = \frac{3x}{3} + \frac{12}{3}$. To model this, students start with a collection of three *x*-tiles and 12 unit tiles and divide them into three groups.

For this example, $x + 4$ tiles will be a part of each group, so the quotient is $x + 4$.

Activation

Students may

- Model division of a polynomial by a monomial by creating a rectangle using four x^2-tiles and eight *x*-tiles, where $4x$ is one of the dimensions.

Teachers may

- Ask students what the other dimension is and connect this to the symbolic representation.

Connection

Students may

- Model division of polynomials and determine the quotient
  - (i) $(6x^2 + 12x - 3) \div 3$
  - (ii) $(4x^2 - 12x) \div 4x$

Consolidation

Students may

- Draw a rectangle with an area of $36a^2 + 12a$ and determine as many different dimensions as possible.

Teachers may

- Discuss why there are so many different possible dimensions.

Extension

Students may

- Determine the area of one face of a cube whose surface area is represented by the polynomial $24s^2$.
- Determine the length of an edge of the cube.

Authorized

- *Math Makes Sense 9*
- Lesson 5.5: Multiplying and Dividing a Polynomial by a Constant
- Lesson 5.6: Multiplying and Dividing a Polynomial by a Monomial
- ProGuide: pp. 35-42, 43-51
- CD-ROM: Master 5.23, 5.24
- See It Videos and Animations:
- Multiplying and Dividing a Polynomial by a Constant, Dividing
- Multiplying and Dividing a Polynomial by a Monomial, Dividing
- SB: pp. 241-248, 249-257
- PB: pp. 206-213, 214-219

Resources and Notes

Column four references supplementary information and possible resources for use by teachers.

These references will provide details of resources suggested in column two and column three.

Suggestions for Teaching and Assessment

This column contains specific sample tasks, activities, and strategies that enable students to meet the goals of the SCOs and be successful with performance indicators. Instructional activities are recognized as possible sources of data for assessment purposes. Frequently, appropriate techniques and instruments for assessment purposes are recommended.

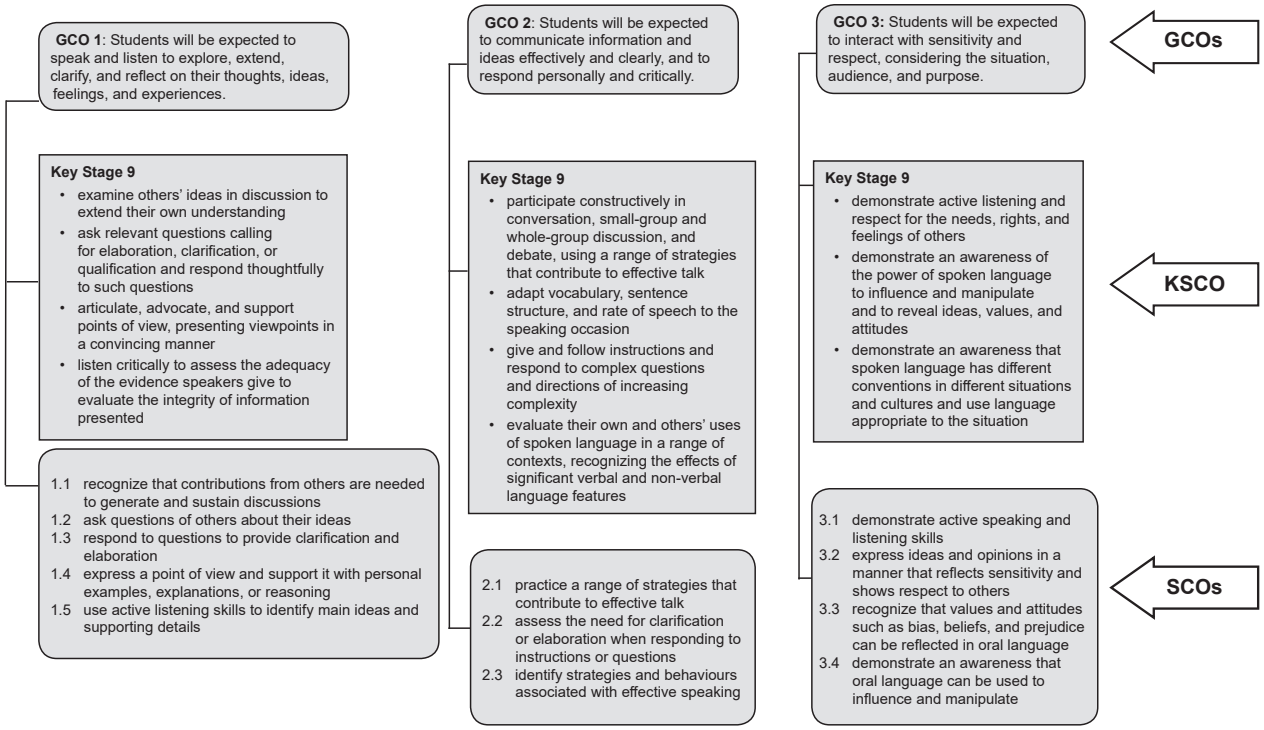
Suggestions for instruction and assessment are organized sequentially:

- Activation – suggestions that may be used to activate prior learning and establish a context for the instruction
- Connection – linking new information and experiences to existing knowledge inside or outside the curriculum area
- Consolidation – synthesizing and making new understandings
- Extension – suggestions that go beyond the scope of the outcome

These suggestions provide opportunities for differentiated learning and assessment.

How to use a Strand overview

At the beginning of each strand grouping there is explanation of the focus for the strand and a flow chart identifying the relevant GCOs, KSCOs and SCOs.



The SCOs Continuum follows the chart to provide context for teaching and assessment for the grade/ course in question. The current grade is highlighted in the chart.

Previous Grade | Current Grade | Next Grade

GCO: GCO 1: Students will be expected to speak and listen to explore, extend, clarify, and reflect on their thoughts, ideas, feelings, and experiences.

SCOs:

Grade 6	Grade 7	Grade 8
1.0 examine how sharing experiences, explanations or reasoning with others clarifies and extends thinking	1.1 recognize that contributions from others are needed to generate and sustain discussions	1.1 reflect upon the contribution of others' ideas during discussion
2.0 use active listening strategies for a variety of purposes	1.2 ask questions of others about their ideas	1.2 ask questions of others for clarification
3.0 assess how thinking may be affected as a result of listening to others	1.3 respond to questions to provide clarification and elaboration	1.3 respond to questions to provide accuracy, relevancy, and validity
	1.4 express a point of view and support it with personal examples, explanations, or reasoning	1.4 express a point of view and support it with personal examples and evidence from various sources
	1.5 use active listening skills to identify main ideas and supporting details	1.5 use active listening skills to interpret main ideas and the relevancy of supporting details

Section Three:

Specific Curriculum Outcomes

Unit 1: Big Ideas

Focus

In this Big Ideas unit students will explore knowledge-based introductory topics of the course. They will first explore the technology and innovation sector in Newfoundland and Labrador and Atlantic Canada and discuss some of the career opportunities in that sector of the economy. Students will then explore themes associated with the responsible use of technological devices and the significance of being a responsible digital citizen. In the final subtopic of the Big Ideas unit students will explore the inner workings of a computing system and discuss the origins of programming languages.

Outcomes Framework

GCO 2: Technological Systems: Students will be expected to operate and manage technological systems.

5.0 identify the elements of the Universal Systems Model

GCO 3: History and Evolution of Technology: Students will be expected to demonstrate an understanding of the history and evolution of technology and if its social and cultural implications.

6.0 trace the evolution of computer hardware
7.0 discuss the evolution of computer programming tools

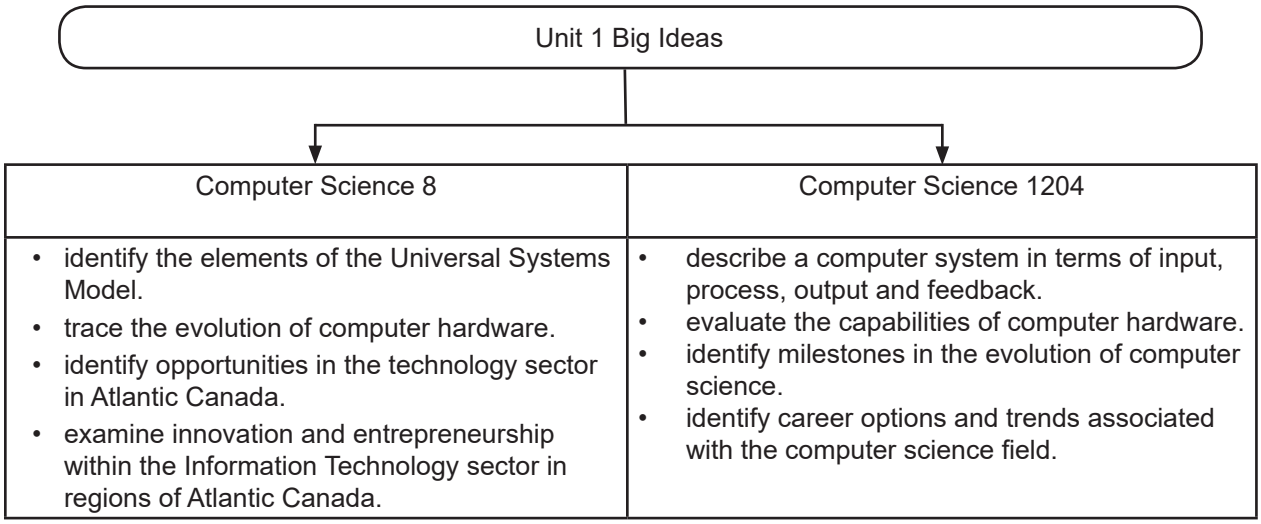
GCO 4: Technology and Careers: Students will be expected to demonstrate an understanding of current and evolving careers and the influence of technology on the nature of work.

1.0 identify opportunities in the technology sector in Atlantic Canada
2.0 examine innovation and entrepreneurship within the Information Technology sector in regions of Atlantic Canada

GCO 5: Technological Responsibility: Students will be expected to demonstrate an understanding of the consequences of their technological choices.

3.0 practice safe use of technology
4.0 apply legal and ethical practices when using technology

SCO Continuum



Suggested Unit Plan

The recommended instructional time for the Big Ideas unit is five hours. Approaches to the delivery of the outcomes may vary depending on the teacher's experience and familiarity with the topics. Teachers may want to combine outcomes or treat them in a different order than presented here. It is important that teachers determine students' prior learning in the area of computer science before beginning this unit.

Careers

Outcomes

Students will be expected to

1.0 identify opportunities in the technology sector in Atlantic Canada [GCO 4]

Focus for Learning

Throughout Atlantic Canada there are increased opportunities in technology industries. Students should be aware of the career trends that are currently emerging in their region and the requirements necessary to establish a career in this sector of the labour market.

Teachers may use current labour market resources to compile a list of technology careers within their region and discuss these careers with their students. Teachers may reach out to industry to provide students with authentic learning experiences such as guest speakers and field trips.

While careers are an important component of this unit, teachers should be cognizant of the total amount of time associated with the Big Ideas unit. Refer to the unit plan in the introduction to this unit for suggested time allotments.

Sample Performance Indicator

Provide an example of a career opportunity in the technology sector in your region. Use labour market information to indicate why you think this is a good opportunity.

Careers

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Lead a discussion about changes in the technology sector that will affect future job opportunities.
- Invite a guest speaker from a company in the technology sector.
- Partner with an entrepreneur from a technology startup to mentor their class throughout the course and especially during the innovation challenge.

Connection

Students may

- Interview a family member or community member about the role their job plays in the technology sector, both directly or indirectly.
- Complete an interest inventory to explore technology-related careers.

Consolidation

Students may

- Use a multimedia format of their choice to create a profile of a technology-related occupation. This could include video, audio, or graphic design.

Extension

Students may

- Record a video interview with an employee from an Atlantic Canadian technology company.

Resources and Notes

Supplementary

Computer Science 8
Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html organized by outcome.

Careers

Outcomes

Students will be expected to

2.0 examine innovation and entrepreneurship within the Information Technology sector in regions of Atlantic Canada [GCO 4]

Focus for Learning

There is an increase in the number of companies that are now operating in the technology sector in Newfoundland and Labrador. Many of these companies are being recognized globally.

Innovation to solve modern problems is an essential part of the growing field in the technology sector. Students should be aware of some of the innovative companies and the solutions that are being developed in this province.

Teachers may explore opportunities to partner with industry and to have guest speakers and/or real world demonstrations. Industry involvement would increase student awareness of what is happening in their province.

Sample Performance Indicator

In pairs, select an organization within the province that has developed an innovative product. Research the product and its applications. Analyze the problem this innovation is solving in society.

Careers

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Show students examples of current inventions or innovations within the Atlantic Canadian technology sector.

Connection

Students may

- Develop a timeline of innovations over the past 20 years. Each student is encouraged to contribute to a classroom timeline

Consolidation

Students may

- Research an innovative business within Newfoundland and Labrador and use a multimedia format of their choice to present their findings.

Extension

Students may

- Identify a problem they would like to see resolved. Discuss, or design an innovative solution for that problem.

Resources and Notes

Supplementary

Computer Science 8
Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links, organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html organized by outcome.

Technological Responsibility

Outcomes

Students will be expected to

3.0 practice safe use of technology [GCO 5]

Focus for Learning

As society becomes more dependent on technology in everyday life, students need to be more aware of how to use it safely.

Teachers should discuss

- ergonomic considerations such as design of workstation and repetitive stress injuries;
- information security including sharing personal information, use of credit cards, and password protection;
- physiological effects of extended screen time such as depletion of melatonin, obesity, and high blood pressure; and
- psychological effects of extended screen time with risk factors such as depression, addiction, social anxiety, and irritability.

Teachers should link this topic to social emotional learning (SEL) principals of safe decision making. Students should be encouraged to apply ethical standards, safety concerns, and social norms to decision making.

Sample Performance Indicator

Select one aspect of technological safety and analyze how it affects your daily life. Document your analysis and record your data in your course portfolio. This could include logging screen time and analyzing workspace.

Technological Responsibility

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Lead a class discussion on personal information security, the effects of screen time, and ergonomics.

Connection

Students may

- Find and analyze a current news article on practicing safe use of technology.

Consolidation

Students may

- Write a journal entry discussing their views on technology safety and how it affects their lives.

Extension

Students may

- Perform an ergonomic assessment of their work station.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links, organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html

Technological Responsibility

Outcomes

Students will be expected to

4.0 apply legal and ethical practices when using technology [GCO 5]

Focus for Learning

Students should be aware of legal and ethical issues when using technology. This is especially true in an age where the technology itself makes it very easy to engage in unethical behaviour.

Students should be aware of unethical behaviours.

- Plagiarism is associated with taking someone else's work and using it as their own
- Copyright is a law that gives the owner of a work (e.g., book, movie, picture, song, website or code) the right to say how other people can use it. Copyright laws allow authors to make a profit by selling their work.
- Creating malicious code is the act of creating code to cause undesired effects such as security breaches or damage to a system. Examples include viruses, worms, spyware, and adware.

Teachers should spend some time activating students' prior knowledge from district led Digital Citizenship activities

Sample Performance Indicator

Working in groups, analyze a case study provided by your teacher.

1. Identify and explain the legal and ethical issues in your assigned case study.
2. What is your opinion about the issue? Discuss among your group.
3. Does this issue make you reevaluate your online habits?

Technological Responsibility

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Discuss the definitions of plagiarism, copyright, and malicious code.
- Demonstrate proper ethical practices when using technology.

Connection

Students may

- Refer to and recall content from prior learning on Digital Citizenship.

Consolidation

Students may

- Participate in a classroom discussion on the use and misuse of technology.

Extension

Students may

- Research the outcomes of legal cases dealing with technological issues.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links, organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html

History and Background

Outcomes

Students will be expected to

5.0 identify the elements of the Universal Systems Model [GCO 2]

Focus for Learning

Students will be introduced to the idea that they are surrounded by a variety of technological systems.

Using the Universal Systems Model, students will think critically about the systems they use on a daily basis.

The Universal Systems Model is a fundamental framework that defines systems into four principal elements: input, process, output and feedback. The complete device or system is a group of subsystems that work together in one of the four areas of the Universal Systems Model in order to complete the overall goal. In the context of computer science, the Universal Systems Model is applicable to the design of all software and hardware solutions.

Sample Performance Indicator

Choose a system that you use either at school or at home and identify the following four elements of the Universal Systems Model:

- input
- process
- output
- feedback

History and Background

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Discuss what the Universal System Model is and how it is applied in the daily use of technological systems.
- Discuss how the Universal Systems Model applies to an explanation of artificial intelligence or machine learning.
- Demonstrate computer subsystems in the context of the Universal Systems Model.

Connection

Students may

- Create a log of the devices that they use during a day that operate using the Universal Systems Model.
- Complete an activity identifying the Universal Systems Model. Students will be presented with a scenario or device and then identify input process and output as it applies to that device.

Extension

Students may

- Explore the “Internet of things” and show how it integrates into their everyday life. They can identify the advantages and disadvantages and then relate them back to the Universal Systems Model.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links, organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html

History and Background

Outcomes

Students will be expected to

6.0 trace the evolution of computer hardware [GCO 3]

Focus for Learning

Students will acquire a basic understanding of how computing systems have evolved. In order for students to have an appreciation of current technology, it is necessary to understand the origins of the devices.

Some topics that could be highlighted include

- development of the integrated circuit,
- development of the smartphone,
- emergence of the internet of things(IoT),
- emergence of the personal computer,
- influence of war and the space race,
- invention of the first digital computer, and
- origins of the first computer.

By tracing the evolution of computer technology, students will understand the improvement from the first computers to the newest designs.

Sample Performance Indicator

Create a timeline highlighting some of the major advancements of computers.

History and Background

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Lead a class discussion on the evolution of computer hardware.

Connection

Students may

- Explore the evolution of gaming systems or cell phones.

Consolidation

Students may

- In groups, create a game of their choice highlighting the major advancements in computer hardware.

Extension

Students may

- Investigate some of the developing hardware technologies that will be present in the products of the future.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links, organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html

History and Background

Outcomes

Students will be expected to

7.0 explore the evolution of computer programming tools [GCO 3]

Focus for Learning

Students will develop an understanding of how programming languages have evolved and how compilers and integrated development environments have made coding easier.

Some topics that should be highlighted.

- Punch cards are one of the first forms of encoding instructions for a machine to execute. They were used to control machinery (Jacquard loom) at first then advanced to control the precursor to the modern computer.
- Machine code is a low level language in which the instructions can be directly executed by the computer's microprocessor. These instructions are in the form of binary (1s and 0s). For example the binary code for 13 is 1101.
- Text based coding allows programmers to move from machine code to a more understandable language. Programs have to be compiled, in a process of changing from a programming language to the machine language. Examples of programming languages include Python, C++, and JavaScript
- An integrated development environment(IDE) is a software tool that combines a code editor, compiler, and debugger.
- Blocked based coding is a programming language where instructions are mainly represented as blocks. These blocks are dragged into a development environment to create programs.

Teachers should activate students' prior knowledge of programming by referencing activities such as Hour of Code or coding opportunities in the grade six science curriculum.

Sample Performance Indicator

Select one computer programming tool to research. Present the programming tool to the class highlighting what the tool is usually used for in industry, its strengths and weaknesses and its origins.

History and Background

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Present examples of programming tools and lead a class discussion about how they work.

Connection

Students may

- Relate back to an Hour of Code sessions and coding in the grade 6 science curriculum.

Consolidation

Students may

- Use a multimedia tool of their choice to research and present on the evolution of a programming tool.

Extension

Student may:

- Investigate the instructions needed in machine code to complete a basic mathematical operation.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links, organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-1.html

Section Three:

Specific Curriculum Outcomes

Unit 2: Basic Skills

Focus

The purpose of the Basic Skills unit is to give students the opportunity to develop skills in planning, writing and troubleshooting block-based code. Students will develop skills in troubleshooting others' code and writing their own programs. The overall purpose of this unit is help students build coding skills and then use those new skills to control sensors and actuators. Students will use these newly acquired skills as the basis for the innovation challenge in unit three.

Outcomes Framework

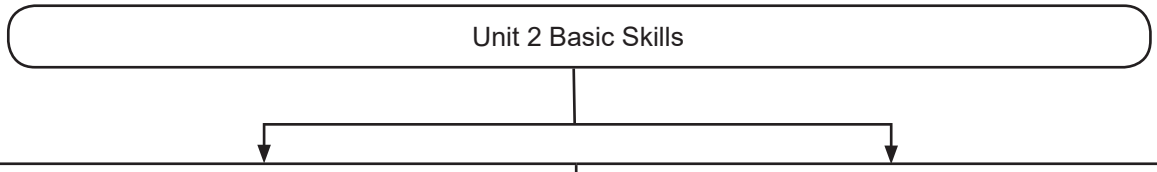
GCO 1: Technological Problem Solving: Students will be expected to design, develop, evaluate and articulate technological solutions.

8.0 create algorithms using pseudocode and flowcharts
13.0 create programs that sense events and control physical devices

GCO 2: Technological Systems: Students will be expected to operate and manage technological systems.

9.0 employ problem-solving techniques to debug errors
10.0 create programs using a block-based programming language
11.0 create a program using common elements of computer programming
12.0 differentiate between digital and physical interfaces

SCO Continuum



Computer Science 8	Computer Science 1204
• create algorithms using pseudocode and flowcharts • employ problem-solving techniques to debug errors • create programs using a block-based programming language • create a program using common elements of computer programming • differentiate between digital and physical interfaces • create programs that sense events and control physical devices	• design a concept organizer to describe logical sequences and decision making • employ appropriate problem-solving skills to identify and correct block-based programming and logic errors • create a solution to an authentic problem using a block-based programming language • write code that assigns and manipulates variables using a block-based programming language • write code that uses loops in a block-based programming language • write code that uses conditional statements in a block-based programming language • differentiate between hardware and software interfacing • employ coding concepts that detect sensor inputs through a physical interfacing device • employ coding concepts to control outputs through a physical interfacing device • employ coding concepts to control outputs through a physical interfacing device

Suggested Unit Plan

The suggested time for the Basic Skills unit is five hours of instructional time. Approaches to the delivery of the outcomes may vary depending on the teacher's experience and familiarity with the topics. Some of the skill building from unit 2 may continue into preparation for the innovation challenge in Unit 3.

Planning and Troubleshooting

Outcomes

Students will be expected to

8.0 create algorithms using pseudo-code and flowcharts [GCO 1]

Focus for Learning

Students will be introduced to the basics of programming. At its fundamental level, programming is breaking a problem into a series of logical steps. This is called an algorithm.

Algorithms can be expressed in several ways:

- Pseudo-code is the use of plain language to represent an algorithm. Pseudo-code cannot be interpreted by a computer.
- Flowcharts are diagrams that are used to summarize and direct the flow of logic using a set of graphic symbols.
- Computer code varies depending on the language used. Instructions are processed and compiled to execute a computer program.

Coding is best introduced without the use of digital technologies. Students can create a set of instructions which they physically have to follow. This is called kinaesthetic programming. It is highly recommended that introductory coding activities begin with a kinaesthetic component.

These planning strategies are introduced early to reinforce the importance of planning in all coding activities. Planning the logic of a program before beginning to write the code minimizes errors and helps the student understand the various functions of a programming language.

Sample performance Indicator

Assemble and execute a block of code through physical actions. The code should represent and everyday activity. Use pseudo-code to plan the block of code.

Planning and Troubleshooting

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Define and introduce a sample algorithm.
- Discuss what pseudo-code is and how it can be expressed.

Connection

Students may

- Explore the use of pseudo-code in daily life, e.g., recipes, daily routines, or building instructions.

Consolidation

Students may

- Develop a series of instructions for a classmate to carry out a simple task. For example, obtaining water from the fountain, sharpening a pencil, or getting a book from the school library. Students could utilize both the flowchart and pseudo-code in this process.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

The link to MicroBit Makecode and the Brilliant Labs Makecode specifically for the Bboard are located in unit 2 resources.

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-2.html

Planning and Troubleshooting

Outcomes

Students will be expected to

9.0 employ problem solving techniques to debug errors [GCO 2]

Focus for Learning

This outcome will reinforce the importance of problem solving in computer science. As students create a program, errors may occur. This is where using problem-solving and debugging techniques are important.

Debugging is the process of detecting and removing existing and potential errors in code that can cause the code to behave unexpectedly or crash. Debugging is a normal part of solution development. Many software updates for common applications are good examples of how debugging is an ongoing process even in a professional setting.

It is important that teachers use the language of computer programming with students throughout this module. Creating a functional program is essentially developing a solution and while sometimes frustrating, debugging and problem solving are an integral part of solution development.

Sample performance indicator

Examine a block of code provided by your teacher. Identify and debug any errors provided in that block of code.

Planning and Troubleshooting

Sample Teaching and Assessment Strategies

Activation

Teachers may
- highlight the steps to debugging any situation.

Connection

Students may
- Associate debugging with proofreading in Language Arts or error analysis in Mathematics.
- Recognize that software updates are often a method of addressing errors or omissions in programs.

Consolidation

Students may
- Analyze a situation or task provided by their teacher. In this task, students should recognize that the task cannot be completed because there is an error within the code. An example might be directing someone to leave the room, but forgetting to tell them to open the door.

Extension

Students may
- Explore possible solutions to an identified problem or issue that is significant in their daily lives.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

The link to MicroBit Makecode and the Brilliant Labs Makecode specifically for the Bboard are located in Unit 2 resources.

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-2.html

Blocked Based Coding

Outcomes

Students will be expected to

10.0 create programs using a block-based programming language [GCO 2

Focus for Learning

This outcome will introduce students to block-based coding. Block-based coding involves drag and drop blocks that allow programmers to create code without having to know the specific written syntax of the language.

Students will use a block-based programming language to create and execute their own program.

Teachers can introduce a simple program that students can recreate. Once students are introduced to the language, they can then be given time to plan, experiment, debug and create their own program.

It is important that students gain experience with writing and executing some sort of program. Even the most simple programs can help students understand the logic behind coding. Once students get a program working, they can begin to analyze how the elements of a program work together.

Sample Performance Indicator

Create a block-based program to accomplish a simple task.

Blocked Based Coding

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Discuss block-based coding and how it works.

Connection

Students may

- Discuss previous knowledge from other coding experiences such as Hour of Code or robotics clubs.

Consolidation

Students may

- Write a block-based program that displays their name.

Extension

Students may

- Continue to explore block-based coding programs to accomplish more difficult tasks.

Resources and Notes

Supplementary

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Blocked-Based Coding

Outcomes

Students will be expected to

11.0 create a program using common elements of computer programming [GCO 2]

Focus for Learning

For this outcome, students will be expected to learn the functions of common elements of a computer program. These elements include variables, loops and conditional statements.

- Variables are values that can change, depending on conditions or information passed to the program.
- Loops are a sequence of instructions that are continually repeated until a certain condition is reached. Loops can be definite (stop on its own after a certain point) or indefinite (continue forever until a certain condition is met).
- Conditional statements perform different actions depending on whether a condition is true or false.

To understand how a set of digital instructions work in a computing device, students should understand these elements. Every computer program is made up of increasingly complex elements that allow it to perform more complex functions. It would be helpful if students had the opportunity to analyze more complex blocks of code to identify the variables, loops and conditional statements.

Sample Performance Indicator

Write a block-based program that uses a variable, a loop and a conditional statement.

Blocked Based Coding

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Discuss variables, loops and conditional statements in relation of computer programing.

Connection

Students may

- Identify examples of programs that use the elements of computer programing.

Consolidation

Students may

- Write a block-based program that manipulates variables and uses loops and conditional statements.
- Create and maintain a glossary of programming terms.

Resources and Notes

Supplementary

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Blocked Based Coding

Outcomes

Students will be expected to

12.0 differentiate between digital and physical interfaces [GCO 2]

Focus for Learning

An interface is a description of actions that an object can do. Interfaces represent an amalgamation of visual, auditory, and functional components that people see, hear, touch, or talk to as they interact with computers (digital devices). An interface can be digital or physical. Differentiating between physical and digital interfaces is an important part of computer programming.

- A digital interface is the digital medium through which humans interact with computers.
- A physical interface is where a tangible, physical device connects and interacts with a system.

A person can interact with a digital interface through a physical interface. An everyday example is a computer mouse interacting with an operating system of a computer or the touch screen of a smart phone. Physical and digital interfaces are very common and it is helpful to get students to record the interfaces they interact with on a daily basis.

Sample Performance Indicator

In teams of two, design a sorting game that identifies various digital and physical interfaces.

Blocked Based Coding

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Discuss characteristics of digital and physical interfaces, providing examples of each type.

Connection

Students may

- Identify interfaces with which they interact with daily.

Consolidation

Students may

- Label interfaces as either digital or physical.

Extension

Students may

- Research and explain how digital and physical interfaces work together to create an efficient device.
- Explore a device using both digital and physical interfaces. Determine the advantages and disadvantages of the design.

Resources and Notes

Supplementary

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Blocked Based Coding

Outcomes

Students will be expected to

13.0 create programs that sense events and control physical devices [GCO 1]]

Focus for Learning

Students will use block-based code to create a program that interfaces with the physical world.

It is recommended that with guided instruction students explore the options built into an interface board. This may include:

- sensing
  - motion
  - temperature
  - direction
- controlling
  - light emitting diodes (LED)

Once the basic commands have been examined, teachers and students can then expand to

- sensing
  - light
  - temperature
  - movement
- controlling
  - LEDs
  - servo and DC motors

There are similarities within the code for multiple devices. It is important that the teacher demonstrate how a piece of code for one sensor or actuator may be slightly modified to control another sensor or actuator. An example of this is lighting an LED and turning on a DC motor. Both programs are sending voltage to a device to turn the device on and off and therefore will have similarities.

Sample Performance Indicator

Write and execute block-based code that interfaces with an external device. This may include, turning on a light, operating a motor or sensing temperature change.

Blocked Based Coding

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Demonstrate code that controls a variety of interfaces such as switches, passive infrared motion sensor, crash sensor, or DC motors.

Connection

Students may

- Explore devices that are controlled by code.
- Apply the Universal Systems Model of input process output and feedback to a variety of interfaces.
- Identify common elements of code for sensors and actuators

Consolidation

Students may

- Create a block of code that controls a sensor.
- Create a block of code that uses the data from a sensor to control and actuator such as and LED or a motor.

Extension

Students may

- Characterize physical interfaces as devices for either sensing or control.
- Draw diagrams of a system that uses physical and digital interfaces.

Resources and Notes

Authorized

MicroBit Go Kit

Inventor Parts Kit

Brilliant Labs b.Board Kit

Supplementary

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Section Three:

Specific Curriculum Outcomes

Unit 3: Innovation Challenge

Focus

This unit represents the culminating activity of the module. The module is designed so that students spend the first two units gaining the computer science knowledge and skills necessary to complete an innovation challenge in unit three. Students will be challenged to think critically about the world around them to identify an authentic problem that can be solved with the available resources. Working cooperatively in design teams, students will create innovative solutions to identified problems and present prototypes and documentation in a class or school -based innovation fair.

Outcomes Framework

GCO 1: Technological Problem Solving: Students will be expected to design, develop, evaluate and articulate technological solutions.

16.0 investigate authentic problem situations to determine opportunities to develop an innovative solution
17.0 generate a variety of solutions to a chosen problem and select the best solution

GCO 2: Technological Systems: Students will be expected to operate and manage technological systems.

18.0 identify specific tools and materials needed to develop the solution
19.0 test and refine the prototype's design to ensure that it solves the identified problem

GCO 3: History and Evolution of Technology: Students will be expected to demonstrate an understanding of the history and evolution of technology and of its social and cultural implications.

15.0 maintain a design portfolio of documentation for the design activity

GCO 4: Technology and Careers: Students will be expected to demonstrate an understanding of current and evolving careers and of the influence of technology on the nature of work.

20.0 present the project portfolio and prototype in an in-class or school-based technology fair.

GCO 5: Technological Responsibility: Students will be expected to demonstrate an understanding of the consequences of their technological choices

14.0 work cooperatively and collaboratively in design teams

SCO Continuum

Unit 3 Innovation Challenge

Computer Science 8	Computer Science 1204
• work cooperatively and collaboratively in design teams • maintain a design portfolio of documentation for the design activity • investigate authentic problem situations to determine opportunities to develop an innovative solution • generate a variety of solutions to a chosen problem and select the best solution. • identify specific tools and materials needed to develop the solution • test and refine the prototype's design to ensure that it solves the identified problem • present the project portfolio and prototype in an in-class or school-based technology fair	• work cooperatively and collaboratively in design teams • maintain a design portfolio of documentation for the design activity • investigate authentic problem situations to determine opportunities to develop an innovative solution using sensing and control • generate a variety of solutions to a chosen problem and select the best solution • identify specific tools, consumable materials and interfacing devices needed to develop the solution • test and refine the prototype's design to ensure that it solves the identified problem • share the project portfolio and prototype in an in-class or school-based technology fair

Suggested Unit Plan

The suggested time for the Innovation Challenge is 16 hours of instructional time. This unit represents the culminating activity for the module. The knowledge and skills acquired in Units one and two feed into activities in Unit three. While this is not a skill development unit, the acquisition of new knowledge and skills may be necessary to develop a solution for the innovation challenge. The outcomes for this unit are organized in a sequence that student design teams should follow to develop a solution to an authentic problem that is important to them. Providing an opportunity for design teams to showcase projects is critical to the success of this unit.

Getting Organized

Outcomes

Students will be expected to

14.0 work cooperatively and collaboratively in design teams [GCO 5]

Focus for Learning

Students should complete the design project as a team effort. This project should be completed using a cooperative approach.

Before the start of the innovation challenge teachers should outline the following points:

- In industry, design is always done by teams of professionals who bring a variety of skills to the project.
- Effective collaboration is an essential employability skill.
- Design teams are most effective in groups of two or three.

It is important that the teacher review the characteristics of a good team member and principles of good group collaboration.

Teachers should refer to current SEL resources that apply to the development of relationship skills in various environments. Relevant skills may include:

- reflective listening skills,
- communication skills to encourage and affirm,
- offering and accepting constructive criticism, and
- resolving conflicts constructively.

Students should establish a design team structure, determining roles and developing an initial plan of action.

Team members should:

- allow others to take the lead
- assume leadership in their area of expertise and interest
- compromise on some issues
- participate
- share ideas
- share responsibilities
- show respect for the opinions of other group members

Getting Organized

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Introduce students to concepts of effective design teams.

Connection

Students may

- Relate working collaboratively design teams to experiences in other subject area.
- Reflect on how collaboration plays a key role in major design projects in industry.

Consolidation

Students may

- Create a rubric that assess effective teamwork.
- Complete a self-assessment on effective teamwork while solving a design challenge.

Extension

Students may

- Use virtual tools to work collaboratively with classmates.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8.html

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-3.html

Getting Organized

Outcomes

Students will be expected to

15.0 maintain a design portfolio of documentation for the design activity [GCO 1]

Focus for Learning

Each design team should document the design process using a portfolio.

The design portfolio is an essential component of the design process and will make up most of the content of the final team presentation at the end of the project. It should contain:

- an introductory page
- a design team page
- a daily log page
- the design process steps as major headings

Because of time restraints, teachers may wish to provide a design portfolio template. The portfolio can be electronic using a variety of applications.

It is extremely important that students have the opportunity to make their design portfolio reflective of themselves. Students need to feel ownership of the portfolio and the process in general.

Design portfolios are essential to the design process. They are like diaries and need to be constantly maintained to have meaning. They should track all ideas, decisions, actions and activities. Pages may contain but are not limited to:

- any sketches/documents related to the topic,
- notes and questions related to research and group decisions,
- photographs of members working on the various aspects of the project, and
- short videos of prototype development and testing.

Getting Organized

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Provide students with an example of a quality design portfolio.

Connection

Students may

- Review portfolios they create and maintain in English Language Arts or other subject areas.

Consolidation

Students may

- Use a digital medium of their choice to organize and maintain a portfolio.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

https://sites.google.com/nlesd.ca/computerscience8/unit-3

Suggested

K-12 Professional Learning Newfoundland and Labrador, Computer Science 8, Resource Links organized by outcome.

https://www.k12pl.nl.ca/curr/7-9/tech-ed/cs8/links/unit-3.html

Getting Started

Outcomes

Students will be expected to

16.0 Investigate authentic problem situations to determine opportunities to develop an innovative solution [GCO 1)

Focus for Learning

The purpose of this stage of design is to investigate situations that may provide opportunities to design innovative solutions to authentic problems. There are three parts to this section of the process.

- identifying authentic problem opportunities from which they will select a suitable project,
- collecting information and asking questions to clarify the problems, and
- writing a design brief summarizing the problem and general approach to solving it.

Although it may not be realistic to require students to identify their own problem situations, it is not the intent of the design activity to provide students with everything they need to develop a solution from a given set of plans. Design teams should be given every opportunity to question, problem solve and troubleshoot as part of the design activity. Regardless of the method of identifying projects, it is essential that students take ownership of the problem they have chosen to solve.

Students should be drawing on their coding and interfacing skills acquired in Unit 2 two to develop their prototype.

Getting Started

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Present students with examples of problems and solutions that have been created and solved.

Connection

Students may

Reflect on problem-solving techniques used in other subject areas such as Mathematics and Science

Consolidation

Students may

- Research problems and possible solutions to common problems in society.

Resources and Notes

Supplementary

Computer Science 8 Teacher Resource Guide

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Getting Started

Outcomes

Students will be expected to

17.0 generate a variety of solutions to a chosen problem and select the best solution. [GCO 1]

Focus for Learning

Students should engage in brainstorming exercises. It may be useful to ask students to think about solutions in advance and share their ideas with other design team members.

Teachers should ensure that all students have an opportunity to express their ideas. All ideas should be given equal weight. Students should attempt to envision a minimum of 3-4 different ideas or variations of an idea.

Teachers should be familiar with guidelines for generating optional solutions to a design problem. When students are revealing their ideas some basic principals should apply.

1. Defer judgement. Students should resist the instinct to consider or accept a solution until all possibilities are presented.
2. Seek quantity. The more alternatives generated, the better the chance that one of them is a viable solution.
3. Encourage freewheeling. It is important that all group members get the opportunity to get their ideas considered. There should be no censoring.
4. Look for combinations. It is quite common that proposed solutions will have commonalities. Encourage students to look for the best aspects of all the solutions and combine ideas.

Once ideas are generated and presented in the design team, students should use some sort of weighing strategy to select the best possible solution to the problem.

Sample Performance Indicator

Document three to four alternative solutions in the design portfolio and record an assessment strategy used to select the best possible solution.

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Introduce students to the importance of generating multiple solutions.

Connection

Students may

- Relate to the multiple methods used to solve problems in Mathematics.

Consolidation

Students may

- Use block-based coding to develop alternative solutions to a problem.

Resources and Notes

Authorized

MicroBit Go Kit

Inventor Parts Kit

Brilliant Labs b.Board Kit

Supplementary

Computer Science 8 Teacher Resource Guide

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Develop the Solution

Outcomes

Students will be expected to

18.0 identify specific tools and materials needed to develop the solution [GCO 2]

Focus for Learning

Students should develop the solution to the chosen problem including identifying tools, resources, and skills required.

This step is the most time-consuming step of the design process.

Preparation should include

- identification and preparation of appropriate work spaces and tools for the design teams;
- the collection of resources, including consumable items, for the design activity;
- development of a strategy that ensures design work is shared equitably among the design team membership; and
- assurance that students understand and are following the safety rules.

It is important during this part of the design process that students are encouraged to articulate what resources they will need and identify possible sources of these materials. It is sometimes unrealistic for the teacher to provide specific consumable materials for all student teams. Teachers should consider placing parameters on some consumable resources while encouraging students to be creative in the acquisition of other resources. Creativity and resourcefulness are an integral part of the problem-solving process and any innovation challenge.

Develop the Solution

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Present the physical interfaces that can be used to solve the problems.
- Demonstrate the characteristics of a variety of common fabrication materials. e.g., glue, posterboard, corregated plastic, tape.

Connection

Students may

- Use the interfaces and codes that were created in unit two to solve a common problem.
- Consider some of the materials present around their house that could be examples of consumable fabrication materials.

Consolidation

Students may

- Using their Design Portfolio, document the tools and materials needed to create possible solutions.

Resources and Notes

Authorized

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Develop the Solution

Outcomes

Students will be expected to

19.0 test and refine the prototype's design to ensure that it solves the identified problem [GCO 2]

Focus for Learning

Each design team should finish the solution during this phase. Modeling and prototyping of the solution are required to complete the innovation challenge. Once students have completed initial tests on their prototype, they will likely enter into a cycle of tuning and testing their solution.

This section of the design challenge will likely require the most significant amount of time. It is important to ensure that students are using some sort of systematic process to test and improve their prototype. It is critical that students document the changes being made so that the testing process results in a successful prototype.

During this part of the process, teachers will need to work closely with each design team to ensure success.

Sample Performance Indicator

- Sense and control events external to the computer using a coding language physical interface equipment and a computer.
- Modify the prototype so that it solves the problem that was identified earlier in the innovation challenge.

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Provide students with guiding questions to help students critically assess prototypes.
- Provide students with examples of prototypes completed in previous years.

Connection

Students may

- Consider a similar process that is used in skill development in sports or general life skills.

Consolidation

Students may

- Use their Design Portfolios to document test results and debugging of possible solutions.

Resources and Notes

Authorized

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Develop the Solution

Outcomes

Students will be expected to

20.0 present the project portfolio and prototype in an in-class or school-based technology fair. [GCO 4]

Focus for Learning

The design portfolio is the students' opportunity to summarize and present information that was collected during the innovation challenge.

It is important that teachers focus on how students organize and present the material.

The evaluation of the design portfolio should consider:

- completeness of items;
- conciseness;
- evidence of decisions and reasons for them;
- inclusion of authentic information, like sketches, drawings, photos, video, etc.;
- inclusion of components that failed;
- level of detail; and
- organization according to design process headings.

The process that student design teams use to develop a solution is equally as important as the effectiveness of the final prototype. This concept can be challenging for students. It is natural to begin creating something right away and then refine it through trial and error without documenting anything. It is vital that the teachers highlight the documentation as an integral part of the innovation challenge. One way of doing this is to inform students that they will be presenting their documentation to the class or a school-based fair at the end of the innovation challenge.

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Provide students with rubric of what is expected in the presentation of materials.
- Show student presentations from previous years' projects.

Connection

Students may

- Use presentation skills previously acquired in other curriculum areas.

Consolidation

Students may

- Use a digital medium of their choice to present their project portfolio and prototype to the class.

Resources and Notes

Authorized

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Inventor Parts Kit

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