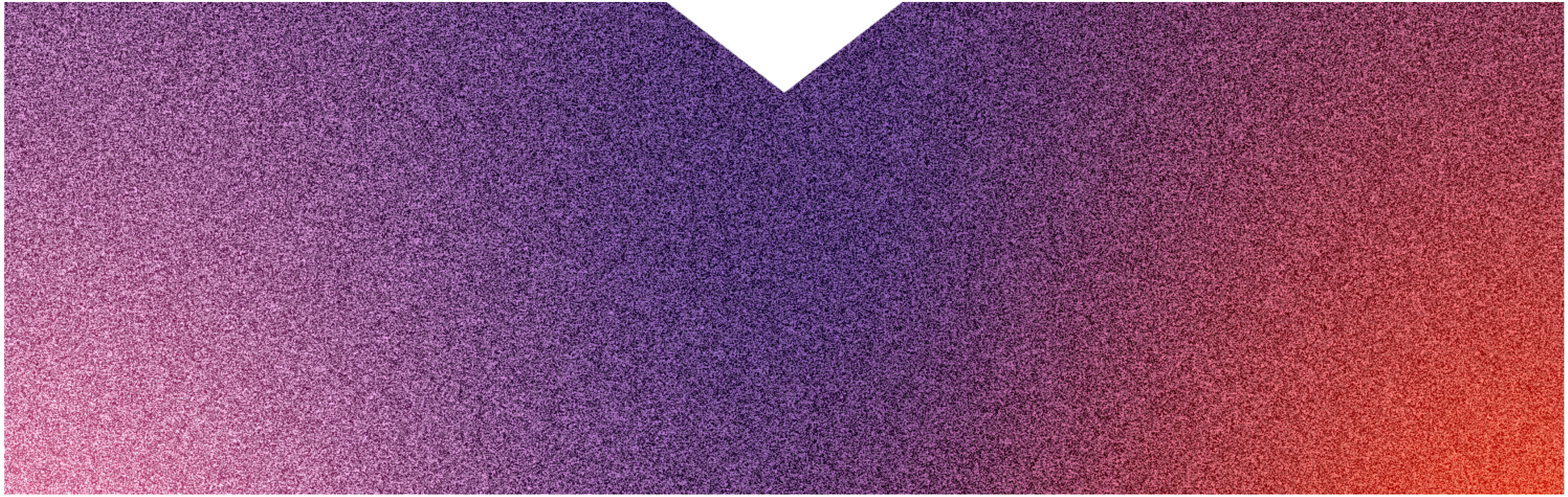


ontario elementary curriculum

science & technology in primary/junior division

unpacking
the ontario elementary curriculum
of science and technology

ronel alvarez
february 2024

contents

foreword

THE IMPORTANCE OF INDIGENOUS PERSPECTIVES IN STEM

Join Joseph Pitawanakwat of Creators Garden and Haley Higdon of Natural Curiosity as they explore the value of Indigenous perspectives in STEM. Explore Indigenous science, including Anishinaabe plant-based medicine, and its relationship with western knowledge systems. Learn how meaningful relationships between educators, students and the natural world can facilitate understanding of Indigenous perspectives.

read here >>

part i

curriculum context for science & technology

THE ONTARIO CURRICULUM SCIENCE AND TECHNOLOGY 2022
access here >>

The Ontario Curriculum, Grades 1–8: Science and Technology, 2022 focuses on fundamental science and technology concepts and on science, technology, engineering, and mathematics (STEM) skills. It supports students in making connections between skills and concepts, and the practical applications of science and technology in their lives, and in learning about life systems, matter and energy, structures and mechanisms, and Earth and space systems. This curriculum is designed to help students prepare for deeper levels of science and technology learning in secondary school and beyond.

SUPPORTING STEM ACHIEVEMENT IN ONTARIO

To ensure students have the skills they need to compete and succeed in the global economy, the Ontario government has revised the Grades 1 to 8 Science and Technology curriculum and is developing a new de-streamed Grade 9 Science course. These changes are being implemented for the 2022-23 school year, with major changes from the 2007 curriculum, as part of the government's commitment to modernizing education and preparing students for success beyond the classroom.

read more >>

preface

Key Changes	2007 curriculum	2022 curriculum
Coding	No coding expectations	Coding expectations in Grades 1 to 9 as students write and execute code when modelling concepts. Expectations related to the impact of coding from Grades 1 to 9.
Engineering Design Processes	No explicit expectations	Engineering design processes (with accompanying models provided in the curriculum context).
Emergent Technologies	No explicit expectations	Expectations related to the impact of emerging technologies from Grades 1 to 9.
Skilled Trades	No explicit learning related to skilled trades	In Grades 4 to 9, students learn about the impacts of coding and of emerging technologies on skilled trades and skilled trades-related careers.
The Environment	Limited learning	Learning about environmental protection, climate change, and reducing greenhouse gases at a developmentally appropriate level is found throughout the curriculum. It is part of the learning expectations for each grade and spans across each of the strands.
Food literacy	Some learning about food literacy throughout grades	Additional learning related to food literacy throughout grades and every strand.
Indigenous Perspectives and Ways of Knowing	Expectations related to Indigenous perspectives and use of plants appears in Life Systems learning	Enhanced and new learning across multiple strands related to students connecting Indigenous ways of knowing and perspectives to explore real-world issues.

goals

01.

to develop the skills and make the connections needed for scientific and technological investigation

02.

to relate science and technology to our changing world, including society, the economy, and the environment

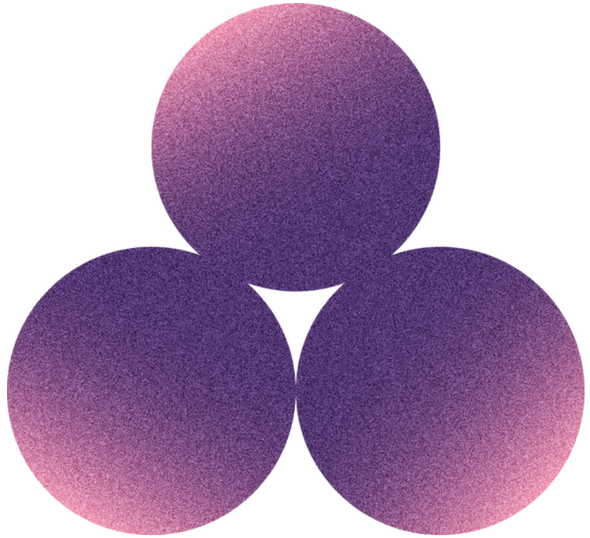
03.

to explore and understand science and technology concepts

QUICK FACTS:

Results from the province-wide consultation in fall of 2018 showed that only 21 per cent of survey respondents believed that Ontario's schools were doing enough to promote STEM education in elementary school and 65 per cent of telephone townhall participants felt students should be learning more about STEM topics at an earlier age.

read more >>



vision

- apply research, experimentation, and engineering design skills to help find solutions to complex problems in their own lives and in the lives of those in their communities;
- understand the cross-curricular and cross-disciplinary nature of problem solving within the STEM fields;
- appreciate the wonder and awe of the world and be optimistic and realistic about the power and limitations of science and technology to solve environmental and social problems;
- consider carefully the intended and unintended consequences of scientific and technological progress;

vision

- develop scientific literacy and technological skills that will allow them to be discerning citizens and find answers to scientific and technological questions;
- see themselves as future contributing members of STEM fields or skilled trades sectors;
- see themselves as confident, effective science and technology learners, with rich social and cultural backgrounds that can help them to contribute to scientific discovery and technological innovation;

NEW SCIENCE CURRICULUM FOR ONTARIO STUDENTS

Ontario's Education Minister announces a new science curriculum for students aimed at emphasizing technology and the skilled trades. The curriculum will be implemented in September 2022.

watch here >>

The vision of the elementary science and technology curriculum is for students to develop the skills and knowledge they need to thrive in today's rapidly changing world.

- discover effective, equitable, inclusive, and sustainable solutions to scientific and technological problems that impact their lives and the lives of those in their communities;
- recognize the importance of Indigenous knowledges and ways of knowing, and how diverse perspectives benefit current challenges within STEM fields.

STEM EDUCATION: DEVELOPING 21ST CENTURY PROBLEM SOLVERS

National Teacher of the Year Finalist, Rob Stephenson, presents instructional strategies and the integration of STEM education challenges in his third grade classroom. He articulates why STEM education needs to become a part of every child's learning experience at home, at school, and within the community. Mr. Stephenson gives stakeholders practical advice on how adults can foster and protect children's natural desire to discover and invent in order to stimulate the next generation of perseverant problem-solvers.

watch here >>

STEM education in Ontario integrates themes and components into the curriculum to cultivate innovators and leaders for societal and workforce change, promote integrative thinking, and develop problem-solving skills. It aims to enhance scientific and technological literacy in students for better understanding and navigation of the world.

the importance of stem education

unpacking the elementary curriculum for science & technology ontario 2022

curiosity and wonder

LEARNING IS A CULTURE

Children are always shaped and directed in their learning by the cultural groups in which they participate, and they build their own, rapidly developing internalized understanding about how those groups work, how to participate in them, and the ways of doing and being they value and marginalize. And as children participate in multiple cultural groups, they develop competency within a broad range of practices that, in turn, promote variation in how they participate in and make meaning of their communities' activities

read more >>

THE CASE FOR CURIOSITY-DRIVEN RESEARCH

Seemingly pointless scientific research can lead to extraordinary discoveries, says physicist Suzie Sheehy. In a talk and tech demo, she shows how many of our modern technologies are tied to centuries-old, curiosity-driven experiments -- and makes the case for investing in more to arrive at a deeper understanding of the world.

watch here >>

curriculum expectations

The Ontario Curriculum, Grades 1–8: Science and Technology, 2022 identifies the expectations for each grade and describes the skills and knowledge that students are expected to acquire, demonstrate, and apply in their class work and investigations, and in various other activities on which their achievement is assessed and evaluated.

The overall expectations describe in general terms the skills and knowledge that students are expected to demonstrate by the end of each grade.

The specific expectations describe the expected skills and knowledge in greater detail and are organized under numbered subheadings, each of which indicates the strand and the overall expectation to which the group of specific expectations corresponds.

teacher supports

Specific expectations are accompanied by examples and/or instructional tips.

The examples are meant to clarify the requirement specified in the expectation, illustrating the kind of skill or knowledge, the specific area of learning, the depth of learning, and/or the level of complexity that the expectation entails.

The instructional tips suggest instructional strategies and authentic contexts for the effective modelling, practice, and application of science and technology concepts.

"... they must be inclusive and, wherever possible, reflect the diversity of the student population and the population of the province."

ONTARIO SCIENCE CENTER - TEACHER RESOURCES

The Science Centre is dedicated to creating content that will support teachers in the classroom —no matter what that classroom might look like.

access here >>

the program

fundamental concepts

Sustainability and Stewardship	Sustainability is the concept of meeting the needs of the present without compromising the ability of future generations to meet their needs. Stewardship involves understanding that we need to use and care for the natural environment in a responsible way and making the effort to pass on to future generations no less than what we have access to ourselves. Values that are central to responsible stewardship are as follows: using non-renewable resources with care; reusing and recycling what we can; and switching to renewable resources where possible.
Change and Continuity	Change is the process of becoming different over time, and can be quantified. Continuity represents consistency and connectedness within and among systems over time. Interactions within and among systems result in change and variations in consistency.

Fundamental Concepts	
Matter	Matter is anything that has mass and occupies space. Matter has particular structural and behavioural characteristics.
Energy	Energy comes in many forms, and can change forms. Energy is required to make things happen (to do work). Work is done when a force causes movement.
Systems and Interactions	A system is a collection of living and/or non-living things and processes that interact to perform some function. A system includes inputs, outputs, and relationships among system components. Natural and human systems develop in response to, and are limited by, a variety of environmental factors.
Automation	Automation involves implementing technologies to make systems run on their own, without further human intervention. Automation can facilitate and accelerate functions that are otherwise difficult, repetitive, or dangerous for human beings to perform. Coding and emerging technologies play an increasingly important role in controlling automated systems.
Structure and Function	This concept focuses on the interrelationship between the function or use of a natural or human-made object and the form that the object takes.

The fundamental concepts in science and technology provide a framework for the acquisition of all scientific and technological knowledge. They also help students to integrate scientific and technological knowledge with knowledge in other subject areas, such as mathematics and social studies.

“big ideas”

In this curriculum, “big ideas” describe the aspects of the fundamental concepts that are addressed at each grade level. Developing an understanding of the big ideas requires students to consider and apply STEM skills as they engage in investigative processes and make connections between related science and technology concepts, between science and technology and other disciplines, and between science and technology and everyday life.

LONG RANGE PLANS

Long range plans outline a year-long set of activities for teaching and learning science and technology. Long range plans are living documents that are revised as educators become increasingly aware of the abilities, strengths, needs, and interests of their students.

“Big ideas” are incorporated in these plans to ensure application of STEM skills in investigatory processes and connection in the real world.

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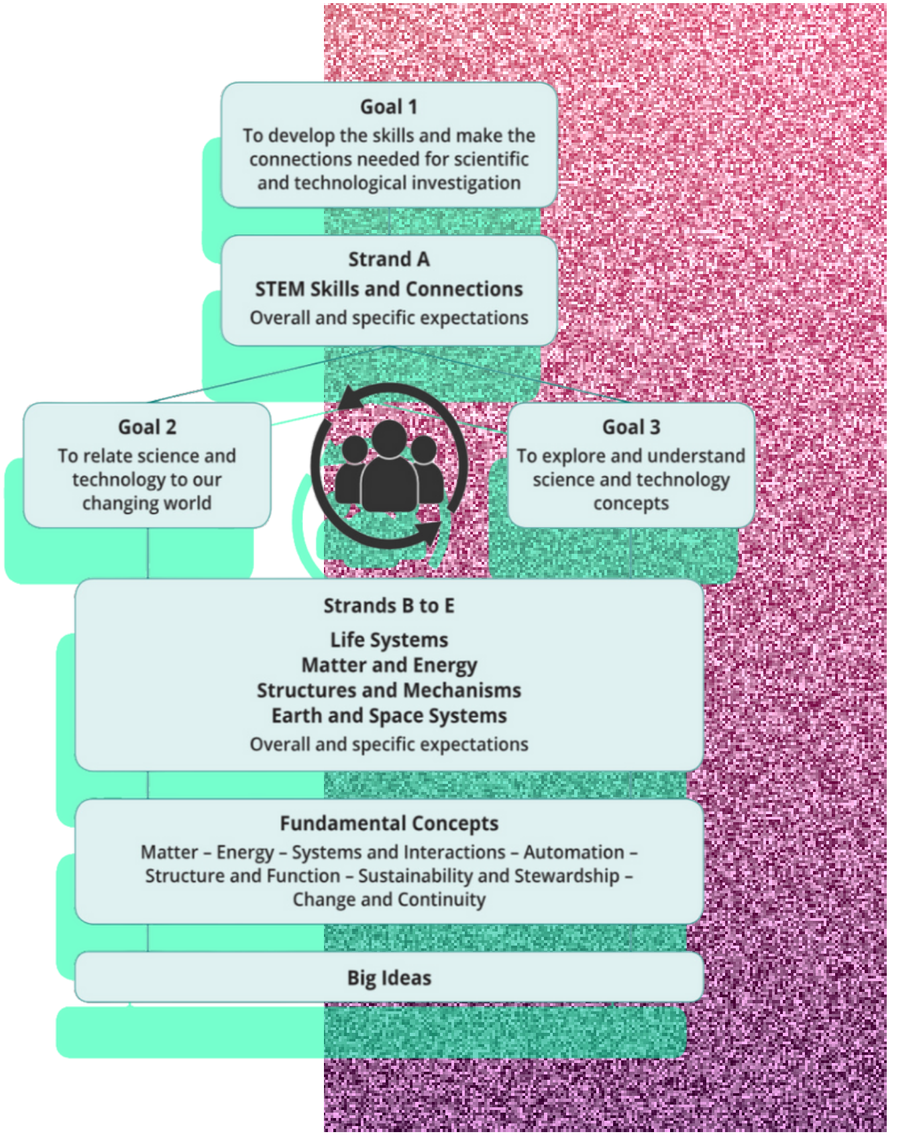


the strands

strand b

In this strand, students investigate the needs, characteristics, and interconnectedness of living things in the natural environment. In all grades, students assess the impact of human activity and technology on society and the environment.

strand c

In this strand, students develop their understanding of matter as they explore the properties and physical and chemical changes of matter. Throughout the grades, students examine the environmental and social impacts associated with the use of various materials and electrical energy.

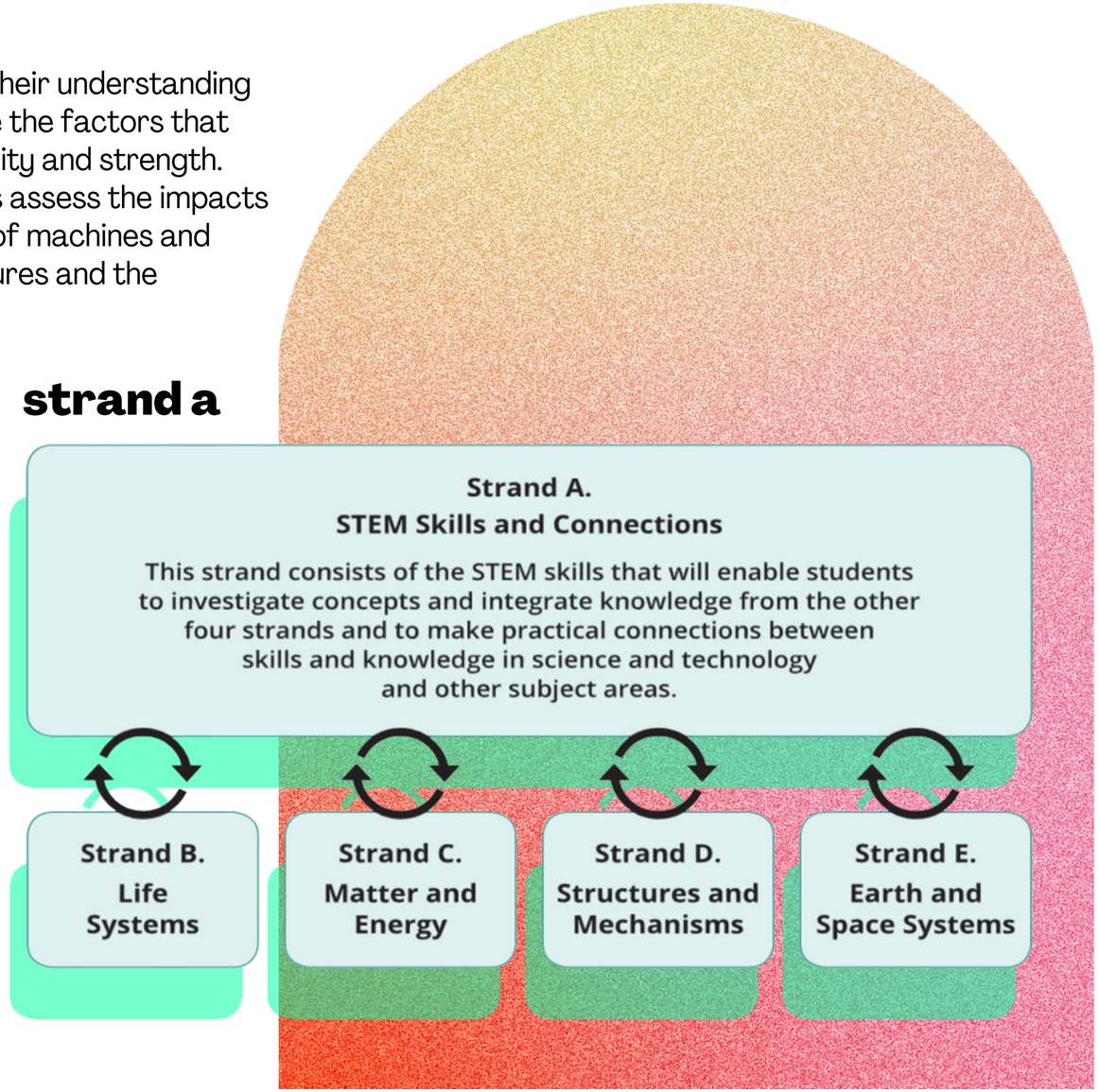
strand d

In this strand, students develop their understanding of structures as they investigate the factors that contribute to a structure's stability and strength. Throughout the grades, students assess the impacts on society and the environment of machines and their mechanisms, and of structures and the materials used to make them.

strand e

In this strand, students investigate the cyclical nature of days and seasons and the importance of the Sun, air, and water to life on Earth. In all grades, students assess the impact of human activity and technology on society and the environment.

strand a



	STEM Skills and Connections STEM Investigation and Communication Skills Coding and Emerging Technologies Applications, Connections, and Contributions			
Grade	Life Systems	Matter and Energy	Structures and Mechanisms	Earth and Space Systems
1	Needs and Characteristics of Living Things	Energy in Our Lives	Everyday Materials, Objects, and Structures	Daily and Seasonal Changes
2	Growth and Changes in Animals	Properties of Liquids and Solids	Simple Machines and Movement	Air and Water in the Environment
3	Growth and Changes in Plants	Forces and Motion	Strong and Stable Structures	Soils in the Environment
4	Habitats and Communities	Light and Sound	Machines and Their Mechanisms	Rocks, Minerals, and Geological Processes
5	Human Health and Body Systems	Properties of and Changes in Matter	Forces Acting on Structures	Conservation of Energy and Resources
6	Biodiversity	Electrical Phenomena, Energy, and Devices	Flight	Space
7	Interactions in the Environment	Pure Substances and Mixtures	Form, Function, and Design of Structures	Heat in the Environment
8	Cells	Fluids	Systems in Action	Water Systems

the topics

CURRICULUM-ALIGNED STEM RESOURCES AND LESSONS

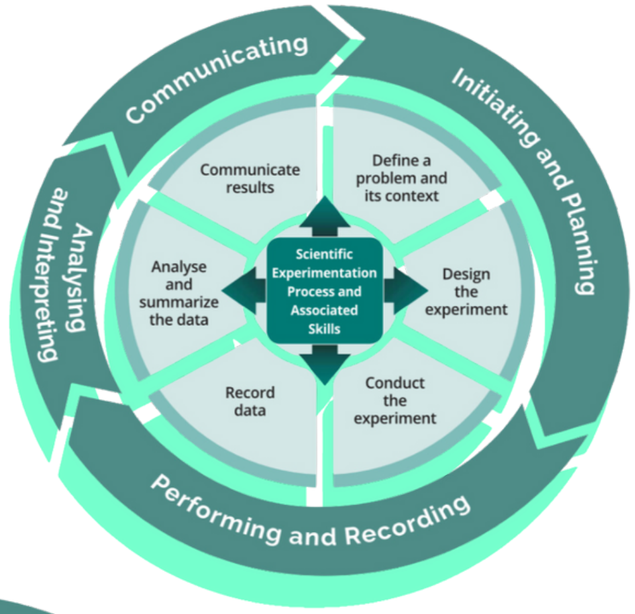
Including space projects, engineering design process, coding, emerging technology, climate science, and careers.

access here >>

let's talk science
est 1993

unpacking the elementary curriculum for science & technology ontario 2022

scientific processes



scientific research

Scientific research includes both primary research, which is done through first-hand, direct observation of objects, living things, phenomena, and systems; and secondary research, which is done by reviewing the work and the findings of others.

scientific experimentation

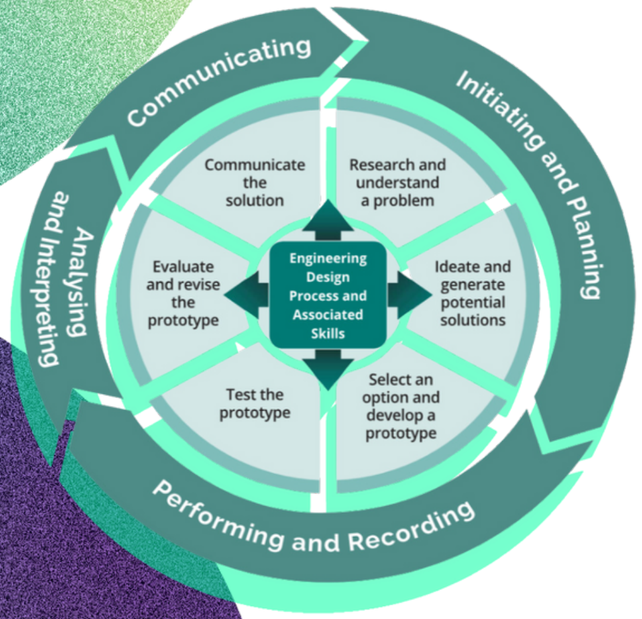
Experimentation involves performing various steps to test and validate or reject a hypothesis, as well as manipulating different variables in order to observe the results. It involves experiential, hands-on learning that engages and empowers students as they develop their investigation skills.

WHAT ARE THE STEPS OF THE SCIENTIFIC METHOD?

Robo and Reem is an edutainment series for children. It revolves around 'Robo and Reem' sharing fun and knowledge together.

watch here >>

engineering design process



engineering design process

An engineering design process (EDP) provides a framework for students and teachers as they plan and build solutions to problems or develop ways to address needs that connect to the curriculum and the world around them. An EDP recognizes that twenty-first-century science and technology problems can be complex and sometimes ambiguous, and provides appropriate, purposeful stages to navigate these challenges.

THE BRILLIANCE OF CHILDREN AND
THE STRENGTHS OF EDUCATORS

Building a solid foundation in science and engineering in preschool through the elementary grades sets the stage for later success—both by sustaining and enhancing children's natural enthusiasm for learning about the world around them and by establishing the knowledge and skills they need to approach the more challenging science and engineering topics intro- duced in later grades.

This report, then, also aims to help educators recognize and foster the brilliance of every child.

access here >>

program planning

food literacy

HANDS-ON TOOLS FOR TEACHING SCIENCE THROUGH FOOD.

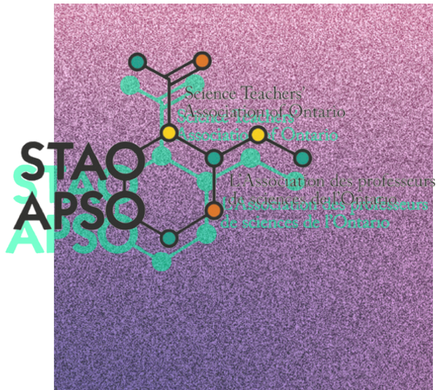
Experiential, evidence-based resources to help educators understand and teach new food literacy learning in Ontario's Science and Technology Curriculum.

access here >>

Skills and knowledge related to food literacy are wide-ranging, from students developing an understanding of where food comes from, including the importance of locally sourced food and how it is grown and prepared, to students investigating the importance of biodiversity in agriculture.

health & safety

Under the Education Act, teachers are required to ensure that all reasonable safety procedures are carried out in the programs and activities for which they are responsible. Teachers should always model safe practices; communicate safety requirements to students in accordance with school board policies, Ministry of Education policies, and any applicable laws; and encourage students to assume responsibility for their own safety and the safety of others.



A SAFETY PLANNING FRAMEWORK - STAO

Used throughout this resource to assist teachers in planning hands-on activities for each strand in the curriculum. The Framework helps teachers to identify hazards, assess risks, and make safety plans.

access here >>

skilled trades

A skilled trade is a career path that requires hands-on work and specialty knowledge. Skilled trades workers apply science and technology concepts as they build and maintain infrastructure like our homes, schools, hospitals, roads, water treatment plants, power stations, farms, and parks.

NEW CURRICULUM TO FOCUS ON LIFE AND JOB SKILLS

By 2026, it is estimated that as many as one in five jobs openings in Ontario will be in the skilled trades. The province is also expected to face a shortfall of 100,000 construction workers over the current decade.

read more >>

integrated learning

coding

CODING CONCEPT AND SKILLS

Strand A, STEM Skills and Connections, includes expectations related to the application of coding concepts and skills that are to be integrated across the other four strands. This allows students to explore a wide variety of science and technology concepts and contexts through coding, while also learning valuable skills related to the automation and control of systems.

THE IMPACT OF CODING & EMERGING TECHNOLOGIES

Strand A includes learning related to the impact of coding and of emerging technologies on everyday life and in STEM-related fields, including skilled trades, that can capture the imagination of students as they consider exciting innovations in science and technology across all strands of the curriculum, and as they imagine a hopeful future. This creates opportunity to critically assess technologies and to consider issues surrounding accessibility, appropriate use, bias, ethical design, and environmental sustainability.

CODING RESOURCES

The resources found on this website have been created to assist Ontario teachers with the implementation of the revised Elementary Science and Technology Curriculum 2022. The resources have all been created by Ontario Certified Teachers to provide examples of best practices in elementary science and technology. This project has been a collaboration between FIRST Robotics Canada and STEM Minds. Funding for these resources was provided by the Ontario Ministry of Education.

access here >>

climate change

CLIMATE CHANGE LEARNING & ACTION IN ONTARIO'S CERTIFIED ECO-SCHOOLS

Climate change education (CCE) is the process of increasing climate change awareness and learning amongst individuals to create climate-responsive societies. Effective CCE is closely related to climate leadership. In this report, climate leadership is defined as the agency of school communities (including individual educators and students) to effect positive change with regard to climate change causes and its widespread impacts.

access here >>

Students will develop the skills and knowledge needed to understand the causes and potential innovative solutions and mitigation strategies related to climate change and other environmental issues, and how they can make the most environmentally responsible decisions possible, given the choices they have.

categories of knowledge and skills

Knowledge and Understanding. Subject-specific content acquired in each grade or course (knowledge), and the comprehension of its meaning and significance (understanding).

Thinking and Investigation. The use of critical and creative thinking skills and/or processes.

Communication. The conveying of meaning and expression through various forms.

Application. The use of knowledge and skills to make connections within and between various contexts.

levels of achievement

Level 1.
Achievement that falls much below the provincial standard.

Level 2.
Achievement that approaches the standard. The student demonstrates the specified knowledge and skills with some effectiveness.

Level 3. The provincial standard for achievement. The student demonstrates the specified knowledge and skills with considerable effectiveness.

Level 4. Achievement that surpasses the provincial standard. The student demonstrates the specified knowledge and skills with a high degree of effectiveness.

Descriptors. Indicate the characteristics of the student's performance, with respect to a particular criterion, on which assessment or evaluation is focused.

Effectiveness.
Assessment that focuses on a quality such as appropriateness, clarity, accuracy, precision, logic, relevance, significance, fluency, flexibility, depth, or breadth, as appropriate for the particular criterion.

criteria & descriptors

Criteria. Identifies the aspects of student performance that are assessed and/or evaluated, and they serve as a guide to what teachers look for.

GROWING SUCCESS, ONTARIO, 2010

read more >>

assessment and evaluation

Knowledge and Understanding – Subject-specific content acquired in each grade (knowledge), and the comprehension of its meaning and significance (understanding)				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Knowledge of content (*e.g., facts, terminology, definitions)*	demonstrates limited knowledge of content	demonstrates some knowledge of content	demonstrates considerable knowledge of content	demonstrates thorough knowledge of content
Understanding of content (*e.g., concepts, ideas, theories, principles, procedures, processes*)	demonstrates limited understanding of content	demonstrates some understanding of content	demonstrates considerable understanding of content	demonstrates thorough understanding of content
Thinking and Investigation – The use of critical and creative thinking skills and inquiry and problem-solving skills and/or processes				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Use of initiating and planning skills and strategies (*e.g., formulating questions, identifying the problem, developing hypotheses, scheduling, selecting strategies and resources, developing plans*)	uses initiating and planning skills and strategies with limited effectiveness	uses initiating and planning skills and strategies with some effectiveness	uses initiating and planning skills and strategies with considerable effectiveness	uses initiating and planning skills and strategies with a high degree of effectiveness
Use of processing skills and strategies (*e.g., performing and recording; gathering evidence and data; examining different points of view; selecting tools, equipment, materials, and technology; observing; manipulating materials; proving)*	uses processing skills and strategies with limited effectiveness	uses processing skills and strategies with some effectiveness	uses processing skills and strategies with considerable effectiveness	uses processing skills and strategies with a high degree of effectiveness
Use of critical/creative thinking processes, skills, and strategies (*e.g., analysing, interpreting, problem solving, evaluating, forming and justifying conclusions on the basis of evidence, developing solutions, considering diverse perspectives)*	uses critical/ creative thinking processes, skills, and strategies with limited effectiveness	uses critical/ creative thinking processes, skills, and strategies with some effectiveness	uses critical/ creative thinking processes, skills, and strategies with considerable effectiveness	uses critical/ creative thinking processes, skills, and strategies with a high degree of effectiveness

Communication – The conveying of meaning through various forms				
Categories	**Level 1**	**Level 2**	**Level 3**	**Level 4**
	The student:			
Expression and organization of ideas and information in oral, visual, and/or written forms *(e.g., diagrams, models, articles, project journals, reports)*	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness
Communication for different audiences *(e.g., peers, adults, community members)* **and purposes** *(e.g., to inform, to persuade)* **in oral, visual, and/or written forms**	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
Use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms *(e.g., symbols, formulae, International System of Units)*	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness
Application – The use of knowledge and skills to make connections within and between various contexts				

the achievement chart

the achievement chart

Making connections within and between various contexts *(e.g., connections between sciences; connections to everyday and real-life situations; connections among concepts within science and technology; connections involving use of prior knowledge and experience; connections among science and technology and other disciplines, including other STEM [science, technology, engineering, and mathematics] subjects)*	makes connections within and between various contexts with limited effectiveness	makes connections within and between various contexts with some effectiveness	makes connections within and between various contexts with considerable effectiveness	makes connections within and between various contexts with a high degree of effectiveness
Proposing courses of practical action to deal with problems relating to our changing world	proposes courses of practical action of limited effectiveness	proposes courses of practical action of some effectiveness	proposes courses of practical action of considerable effectiveness	proposes highly effective courses of practical action

Application – The use of knowledge and skills to make connections within and between various contexts

Categories	Level 1	Level 2	Level 3	Level 4
	The student:			
Application of knowledge and skills *(e.g., concepts and processes; procedures related to the safe use of tools, equipment, materials, and technology; investigation skills)* **in familiar contexts**	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills *(e.g., concepts and processes, safe use of equipment and technology, investigation skills)* **to new contexts**	transfers knowledge and skills to new contexts with limited effectiveness	transfers knowledge and skills to new contexts with some effectiveness	transfers knowledge and skills to new contexts with considerable effectiveness	transfers knowledge and skills to new contexts with a high degree of effectiveness

part ii

assessment of a long range plan model

LONG RANGE PLANS

A long-range plan outlines possible sequences of instruction for the school year. There are many ways to structure an effective plan for learning. The plans can include clusters of learning that have areas of focus from science and technology, as well as examples of cross-curricular connections that can be made to some expectations in other subject area

read more >>

LONG RANGE PLAN GRADE 6, MODEL 1

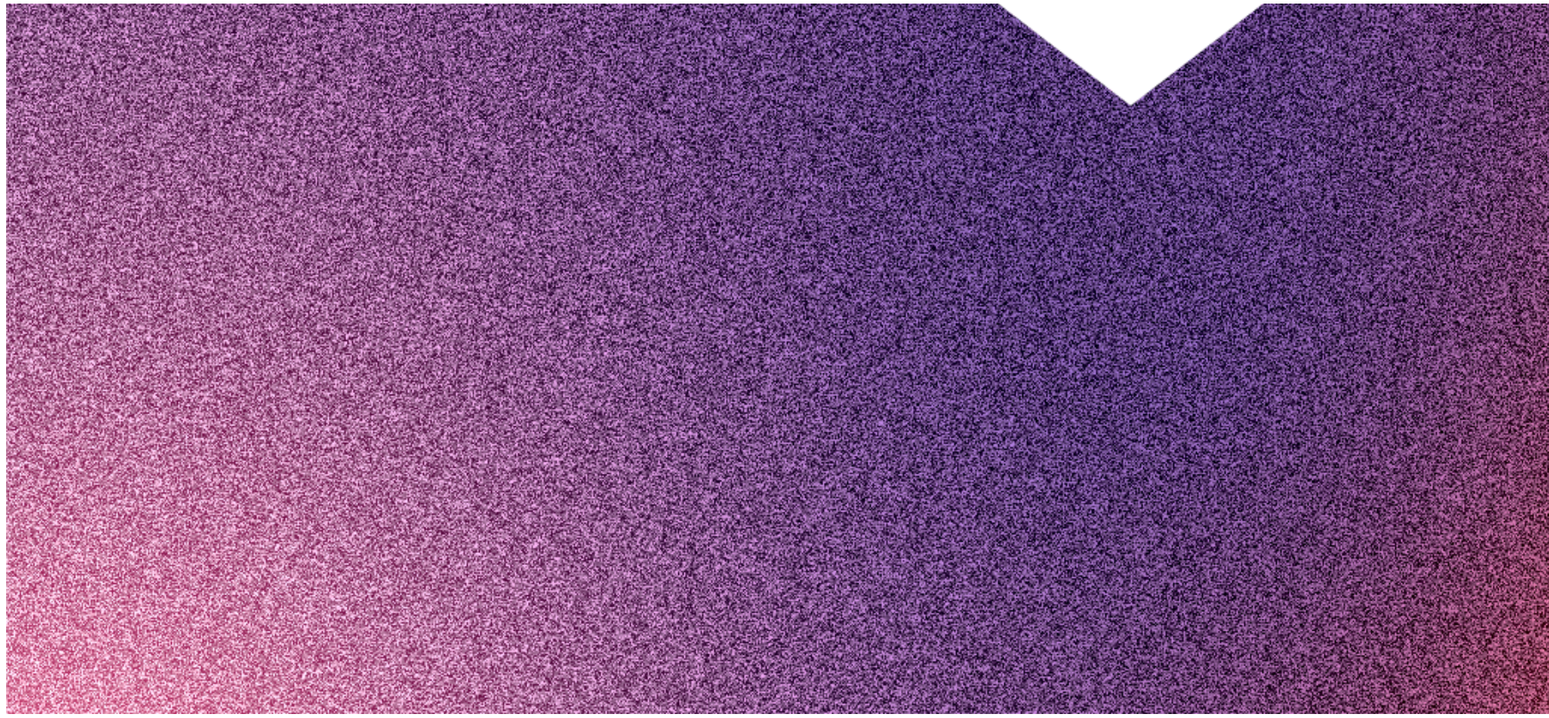
The model details out plans for each suggested month or timeline. Each suggested times corresponds to a focused Big Idea. Term 1 is focused on the impact of the topics on the environment, and Term 2 is focused on the understanding and application of technology in each topic.

access here >>

THE ASSESSMENT OF THE LRP MODEL >>

part iii

evaluation >>
references >>



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