Science 7

Curriculum Guide

NOVA SCOTIA
NOUVELLE-ÉCOSSE

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Prepared by the Department of Education and Early Childhood Development

This is the most recent version of the current curriculum materials as used by teachers in Nova Scotia.

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Background

An important and universal goal of science education is to equip learners with an understanding of the roles that science and technology play in society. The Nova Scotia science curriculum aims to develop learners' Scientific Literacy and their ability to problem solve and apply the principles of scientific inquiry to real-world situations and familiar problems. In so doing, learners will develop skills and competencies. Additionally, Science 7 seeks to develop scientific literacy through designing and building for technological innovation, writing for scientific communication and data analysis.

Learners in grade 7 will have opportunities to design scientific inquiries, evaluate evidence, use evidence for argumentation and use technology to solve problems. They will explore fundamental concepts of the Nature of Science such as:

- Scientific Reasoning
- Patterns
- Cause and Effect
- Systems and Models
- Energy and Matter
- Structure and Function
- Change and Stability
- Stewardship and Sustainability
- Similarity and Diversity

Learning in Context:
The nature of science asks learners to question the phenomena of the world around them, then test those questions in controlled environments. Themes create authentic purpose for learning and facilitate cross curricular, project-based learning opportunities. Learners will see the context for what they are learning which will improve transfer of skills and knowledge. It is important that learners view themselves as scientists and as an integral part of the learning process. Teaching through themes is one way to make the learning meaningful for all learners. Each of the themes in Science 7 provide opportunities for learners to engage with inquiry based learning in a hands-on way that is crucial to science literacy and the development of critical thinking skills.

Science 7 Themes:

- *Environmental Action* - Learners explore concepts related to particle theory, solutions, and mixtures in the context of pollution in the environment. Learners will examine the impacts of pollution in the environment while exploring ecosystem components and adaptation of organisms for survival and evolution.
- *Engineering Structures* - Learners explore concepts related to engineering, forces and the design process through applications to the construction of structures. Learners make connections between manufactured structures and those found in nature.

- *Geological Evolution* - Learners explore concepts of plate tectonics and geographical formations in the context of change over time and they will explore evidence of geological evolution and its implications

Learning through the lens of Competencies and Skills

In 2015 the Council of Atlantic Ministers of Education and Training (CAMET) released their findings to a review of the Atlantic Canada Essential Graduation Learnings which had been developed in 1995 as a framework for curriculum development. The review questioned whether the existing model responded to the changing demands of work and life in the 21st century. This review resulted in an updated document, the Essential Graduation Competencies, placed emphasis on the importance of articulating clear statements of what learners are expected to know, be able to do, and reflect on by the time they graduate from high school. These competencies describe expectations, not in terms of individual curricular areas but in terms of attitudes, skills, and knowledge developed throughout the curricula.

What are competencies?

Competencies are an interrelated set of attitudes, skills and knowledge that is drawn upon and applied in a particular context for learning and living. Competencies are developed over time through engagement in learning experiences and a supportive learning environment.

Citizenship (CZ)

Learners are expected to contribute to the quality and sustainability of their environment, communities, and society. They analyse cultural, economic, environmental, and social issues, make decisions, judgment, solve problems, and act as stewards in a local, national, and global context.

Personal-Career Development (PCD)

Learners are expected to become self-aware and self-directed individuals who set and pursue goals. They understand and appreciate how culture contributes to work and personal life roles. They make thoughtful decisions regarding health and wellness, and career pathways.

Communication (COM)
Learners are expected to interpret and express themselves effectively through a variety of media. They participate in critical dialogue, listen, read, view, and create for information, enrichment, and enjoyment.

Creativity and Innovation (CI)
Learners are expected to demonstrate openness to new experiences, engage in creative processes, to make unexpected connections, and to generate new and dynamic ideas, techniques, and products. They value aesthetic expression and appreciate the creative and innovative work of others.

Critical Thinking (CT)
Learners are expected to analyse and evaluate evidence, arguments, and ideas using various types of reasoning and systems thinking to inquire, make decisions, and solve problems. They reflect critically on thinking processes.

Technological Fluency (TF)
Learners are expected to use and apply technology to collaborate, communicate, create, innovate, and solve problems. They use technology in a legal, safe, and ethically responsible manner to support and enhance learning.

The renewed curriculum outcomes are comprised of skills, concepts, and opportunities for engagement with the competencies. Each outcome has suggested indicators to assist in developing those concepts and skills to demonstrate achievement. The design reflects an opportunity for a natural cross curricular approach.

- Indicators have been identified for each outcome; the indicators are aligned with competencies and are suggested ways to scaffold skill development through conceptual exploration in order to provide a depth of understanding in relation to the outcome.
- Concepts are the key ideas, information, and theories that learners come to know through the aligned skill. Guiding questions are offered as possible ways to approach learning associated with the skill and concept.

Competencies are listed at the end of each indicator. These are closely aligned with the combination of skill and concept that are found in the indicator. The competencies can be used by teachers to frame learning experiences. This framing provides opportunities for learners to engage with and develop the related competency.

Course Delivery
Learning will be enhanced through an inquiry-based approach. Inquiry-based learning requires learners to meaningfully engage in the experience/activity while reflecting upon the learning and the competencies and skills they are developing.

By delivering the curriculum through an integrated approach, higher level thinking and active participation are encouraged. This approach supports learners in a deeper understanding of content and offers expanded opportunities for achievement of outcomes in a meaningful way.

Inquiry Based Learning

Inquiry-based learning is an approach that promotes inquiry, the creation of ideas, and observation. The process typically involves investigations, aimed at answering a big question or solving a problem. These investigations require that students learn how to develop questions, look for information, and to identify possible solutions or conclusions.

Project Based Learning

Using "big ideas" as a starting point, students learn through practical projects that require them to acquire a thorough understanding of the subject that they can apply in the real world. This approach engages students in formulating questions, investigating for answers, building new understandings, communicating their learning to others, while developing critical thinking skills, collaboration, communication, reasoning, synthesis skills, and resilience. Project Based Learning typically is concluded with a final product that is presented to a school and/or a community-based audience.

How inquiry based learning benefits learners:

- Makes learning relatable and relevant for learners
- Provides motivation through contextual learning
- Helps learners integrate and practice concepts and theories learned in the classroom
- Creates opportunities for development of skills and success in learning

What could it look like in the classroom?

Learners will:

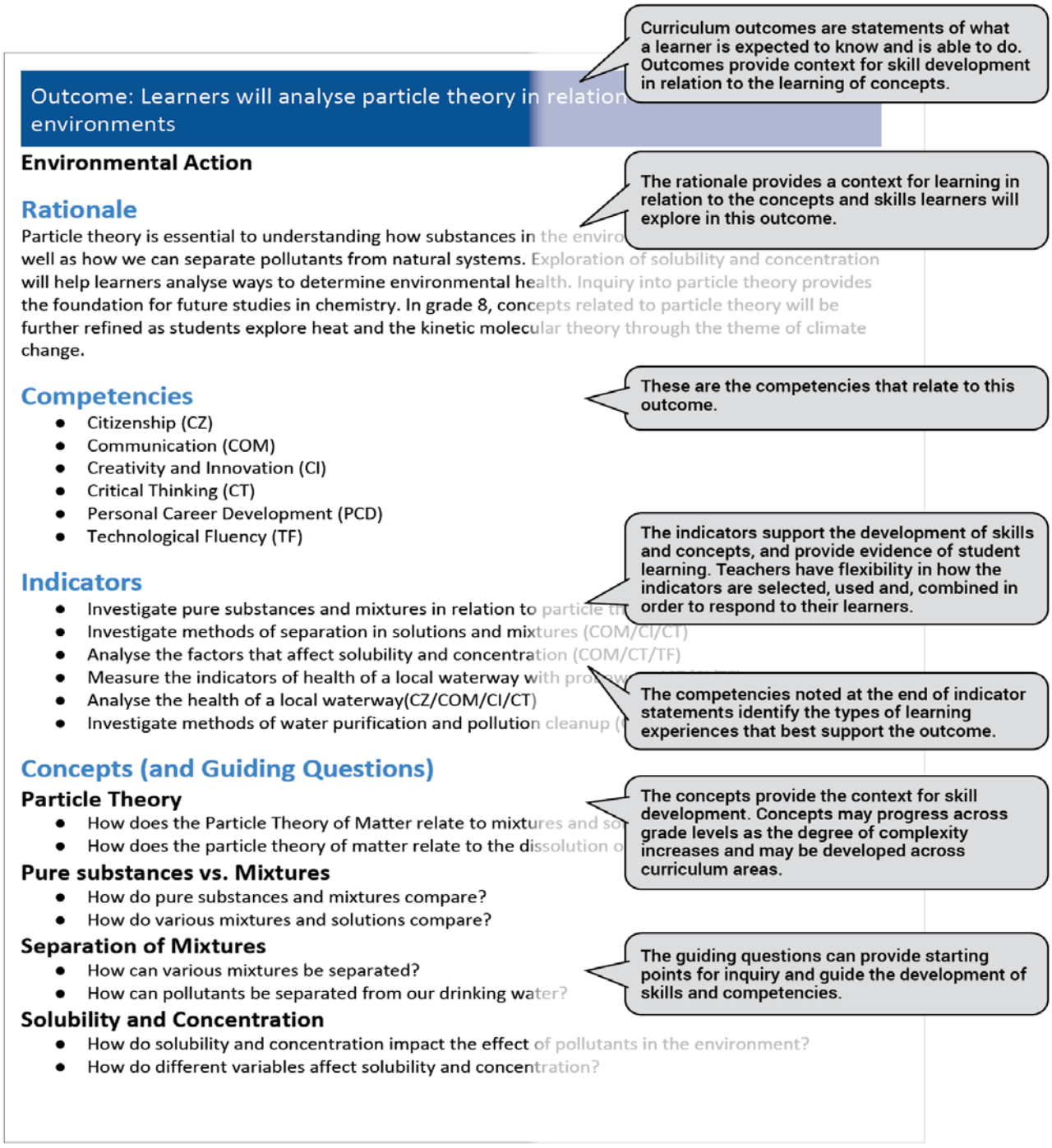
- Seek and pursue opportunities for innovation
- Introduce and test ideas
- Assess opportunities
- Set goals and action plans
- Demonstrate self-awareness
- Engage in ongoing reflection
- Take risks

How do I know it's working?

Learners are developing as:

- Flexible collaborators
- Reflective leaders
- Calculated risk takers
- Adaptive and resilient problem solvers
- Effective communicators
- Self-aware learner

How to Use This Guide



Curriculum outcomes are statements of what a learner is expected to know and is able to do. Outcomes provide context for skill development in relation to the learning of concepts.

Outcome: Learners will analyse particle theory in relation environments

Environmental Action

Rationale

The rationale provides a context for learning in relation to the concepts and skills learners will explore in this outcome.

Particle theory is essential to understanding how substances in the enviro well as how we can separate pollutants from natural systems. Exploration of solubility and concentration will help learners analyse ways to determine environmental health. Inquiry into particle theory provides the foundation for future studies in chemistry. In grade 8, concepts related to particle theory will be further refined as students explore heat and the kinetic molecular theory through the theme of climate change.

Competencies

These are the competencies that relate to this outcome.

- Citizenship (CZ)
- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

The indicators support the development of skills and concepts, and provide evidence of student learning. Teachers have flexibility in how the indicators are selected, used and, combined in order to respond to their learners.

- Investigate pure substances and mixtures in relation to particle th
- Investigate methods of separation in solutions and mixtures (COM/CI/CT)
- Analyse the factors that affect solubility and concentration (COM/CT/TF)
- Measure the indicators of health of a local waterway with pro
- Analyse the health of a local waterway(CZ/COM/CI/CT)
- Investigate methods of water purification and pollution cleanup (

The competencies noted at the end of indicator statements identify the types of learning experiences that best support the outcome.

Concepts (and Guiding Questions)

The concepts provide the context for skill development. Concepts may progress across grade levels as the degree of complexity increases and may be developed across curriculum areas.

Particle Theory

- How does the Particle Theory of Matter relate to mixtures and so
- How does the particle theory of matter relate to the dissolution o

Pure substances vs. Mixtures

- How do pure substances and mixtures compare?
- How do various mixtures and solutions compare?

Separation of Mixtures

The guiding questions can provide starting points for inquiry and guide the development of skills and competencies.

- How can various mixtures be separated?
- How can pollutants be separated from our drinking water?

Solubility and Concentration

- How do solubility and concentration impact the effect of pollutants in the environment?
- How do different variables affect solubility and concentration?

Determining Environmental Health

- How can the health of an environment be determined?
- How can water be kept clean for drinking and as a habitat?
- How does pollution enter the environment?

Skills

The first skill defined is the outcome skill and the others are the skills found in the indicators.

Analyse

Gather and select appropriate information; determine accuracy, validity, and relevance of the information; identify perspectives; communicate findings.

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Measure

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Some courses include a table that describes the scope and sequence of the skills and concepts for this outcome.

Grade 4	Grade 5	Grade 7
Learners will have investigated a variety of local natural habitats. Concepts included habitat components and characteristics, survival needs of organisms, how habitats can change over seasons and with time.	Learners will have tested how physical and chemical changes affect the properties of matter. Concepts included physical and chemical properties of matter, physical and chemical changes as well as conservation of mass.	Learners will analyse particle theory in relation to substances in environments. Learners will explore the following concepts: particle theory, pure substances vs. mixtures, separation of mixtures, solubility and concentration, determining environmental health.

The background knowledge provides an overview of the learners' experiences in relation to the skills and concepts of the outcome.

Pollution provides the context for learning about particle theory in this outcome. Learners will explore the impact of various concentrations of substances in the environment. A concept of pollution and an understanding of particle theory will support scientific knowledge that underpins the concept of pollution. An understanding learners make decisions about what is safe or harmful for the environment.
Data logging sensors (probeware) can be used to collect data from local environments. This provides opportunities to connect with the mathematics curriculum as well as careers in environmental management. Using probeware allows for the collection of a lot of data in a short period of time so the effort can be placed in designing controlled experiments and analyzing the data for real-life implications. Learners have had probeware available to them as early as grade 4.

Learning Experiences

The suggested indicators are organized in a way to scaffold learning. [illegible] exploration of skills and concepts for this outcome can be done in any or[illegible] based on the progression of learning. The experience described below is [illegible] the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *analyse the factors [illegible] concentration* when *measuring the indicators of health of a local wate[illegible]*

For each outcome you will find one sample learning experience relating to the skills, concepts, and competencies for a specific indicator.

Guiding questions and learning experiences can be used to launch inquiry into the concept.

Indicators

- Investigate pure substances and mixtures in relation to particle theory (COM/PCD/CI/TF)
- Investigate methods of separation in solutions and mixtures (COM/CI/CT)
- **Analyse the factors that affect solubility and concentration (COM/CT/TF)**
- Measure the indicators of health of a local waterway with probeware (CZ/CI/TF)
- Analyse the health of a local waterway(CZ/COM/CI/CT)
- Investigate methods of water purification and pollution cleanup (CZ/COM/PCD/CI/CT)

Overview

The teacher presents learners with the task of designing an experiment t[illegible] solubility and/or concentration. Depending on where learners are in th[illegible] may provide questions in the form of a design challenge: How do you dissolve the most sugar in 100mL of water? What is the fastest method to dissolve a sugar cube?

This provides a quick description of the learning experience outlined in detail below.

Evidence of Learning for the indicator:

Analyse the factors that affect solubility and concentration

Evidence of learning can be gathered as learners design and conduct an e[illegible] information about factors that affect solubility and concentration. Furth[illegible] through conversations about the validity and reliability of the data learn[illegible]

This section provides an overview of how assessment is embedded within the learning experience. The evidence of learning corresponds to the acquisition of skills and the understanding of concepts related to the outcome.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicat[illegible]

Analyse the factors that affect solubility and concentration

This section details the steps for the sample learning experience and identifies the indicator in focus.

Potential Guiding Questions

- How do different variables affect solubility and concentration[illegible]

Guiding questions that relate to the concepts of the sample learning experience are listed here to help launch student inquiry.

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Gather and select appropriate information

Learners can carry out their experiments and gather data. This may be done in small groups or pairs. Alternatively, learners may be placed into groups to discuss the various experimental designs and one design can be chosen to be conducted. Another option is to refine the experimental designs as a group to include elements from several members of the group into one design. This refined design can then be carried out. A discussion or mini lesson on how to effectively record data might help learners organize the experimental information that they will be gathering.

Along with the steps for the learning experience, competencies have been identified that best align with the steps as described.

Essential Graduation Competencies

Technological Fluency
This provides learners the opportunity to use technology in a re... and...

A description of the competency that could be developed through this learning experience.

The teacher should provide feedback with respect to lab safety, throughout the experiment.

Evidence of Learning (Observations)

While students are collecting experimental data, the teacher can pr... **gathering information** for analysis.

Evidence of learning is gathered throughout the learning experience. Suggested opportunities are found in these boxes.

Determining importance of information and Communicate Findings

Learners can share their findings by exploring the following questions:

- How do the results of different experiments compare?
- What do the results mean in relation to pollutants in the environment?
- How is the factor that you inquired about important for pollution management?

Essential Graduation Competencies

Communication
This provides learners the opportunity to listen and interact purposefully and respectfully in formal and informal contexts.

Evidence of Learning (Conversations)

Learners **communicate** and discuss the **importance of the findings**.

Evidence of Learning (Products)

Learners **communicate their findings** on the factors that affect solubility and concentration.

Moving Forward

How are the variables you investigated relevant to substances in the...

The next steps are scaffolded towards learner independence and application of the skill as it relates to the outcome

Outcome: Learners will analyse particle theory in relation to substances in environments

Environmental Action

Rationale

Particle theory is essential to understanding how substances in the environment impact living things as well as how we can separate pollutants from natural systems. Exploration of solubility and concentration will help learners analyse ways to determine environmental health. Inquiry into particle theory provides the foundation for future studies in chemistry. In grade 8, concepts related to particle theory will be further refined as students explore heat and the kinetic molecular theory through the theme of climate change.

Competencies

- Citizenship (CZ)
- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

- Investigate pure substances and mixtures in relation to particle theory (COM/PCD/CI/TF)
- Investigate methods of separation in solutions and mixtures (COM/CI/CT)
- Analyse the factors that affect solubility and concentration (COM/CT/TF)
- Measure the indicators of health of a local waterway with probeware (CZ/CI/TF)
- Analyse the health of a local waterway(CZ/COM/CI/CT)
- Investigate methods of water purification and pollution cleanup (CZ/COM/PCD/CI/CT)

Concepts (and Guiding Questions)

Particle Theory

- How does the Particle Theory of Matter relate to mixtures and solutions?
- How does the particle theory of matter relate to the dissolution of substances?

Pure substances vs. Mixtures

- How do pure substances and mixtures compare?
- How do various mixtures and solutions compare?

Separation of Mixtures

- How can various mixtures be separated?
- How can pollutants be separated from our drinking water?

Solubility and Concentration

- How do solubility and concentration impact the effect of pollutants in the environment?
- How do different variables affect solubility and concentration?

Determining Environmental Health

- How can the health of an environment be determined?
- How can water be kept clean for drinking and as a habitat?
- How does pollution enter the environment?

Skills

Analyse

Gather and select appropriate information; determine accuracy, validity, and relevance of the information; identify perspectives; communicate findings.

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Measure

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 4	Grade 5	Grade 7	Grade 8
Learners will have investigated a variety of local natural habitats. Concepts included habitat components and characteristics, survival needs of organisms, how habitats can change over seasons and with time.	Learners will have tested how physical and chemical changes affect the properties of matter. Concepts included physical and chemical properties of matter, physical and chemical changes as well as conservation of mass.	Learners will analyse particle theory in relation to substances in environments. Learners will explore the following concepts: particle theory, pure substances vs. mixtures, separation of mixtures, solubility and concentration, determining environmental health.	Building on these skills and concepts, learners will investigate heat in relation to particle theory.

Pollution provides the context for learning about particle theory in this outcome. Learners will explore the impact of various concentrations of substances in the environment. Learners are familiar with the concept of pollution and an understanding of particle theory will support their understanding of the scientific knowledge that underpins the concept of pollution. An understanding of solubility will help learners make decisions about what is safe or harmful for the environment.

Data logging sensors (probeware) can be used to collect data from local environments. This provides opportunities to connect with the mathematics curriculum as well as careers in environmental management. Using probeware allows for the collection of a lot of data in a short period of time so the effort can be placed in designing controlled experiments and analyzing the data for real-life implications. Learners have had probeware available to them as early as grade 4.

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *analyse the factors that affect solubility and concentration* when *measuring the indicators of health of a local waterway.*

Indicators

- Investigate pure substances and mixtures in relation to particle theory (COM/PCD/CI/TF)
- Investigate methods of separation in solutions and mixtures (COM/CI/CT)
- **Analyse the factors that affect solubility and concentration (COM/CT/TF)**
- Measure the indicators of health of a local waterway with probeware (CZ/CI/TF)
- Analyse the health of a local waterway (CZ/COM/CI/CT)
- Investigate methods of water purification and pollution cleanup (CZ/COM/PCD/CI/CT)

Overview

The teacher presents learners with the task of designing an experiment to analyse the factors that affect solubility and/or concentration. Depending on where learners are in their skill development, the teacher may provide questions in the form of a design challenge: How do you dissolve the most sugar in 100mL of water? What is the fastest method to dissolve a sugar cube?

Evidence of Learning for the indicator:

Analyse the factors that affect solubility and concentration

Evidence of learning can be gathered as learners design and conduct an experiment to gather and select information about factors that affect solubility and concentration. Further evidence can be collected through conversations about the validity and reliability of the data learners gather.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Analyse the factors that affect solubility and concentration

Potential Guiding Questions

- How do different variables affect solubility and concentration?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Gather and select appropriate information

Teachers can begin by engaging learners in a discussion about pollution in the environment. Suggested questions might include:

- What is pollution?
- How do you measure pollution?
- What makes something a pollutant?

It is important to help learners see the connection between what they will be learning about concentration and solubility and the relevance to various forms of pollution in the environment.

Next, the teacher may ask what learners already know about concentration and solubility or what experiences they have had with dissolving. As a follow up, the teacher should also ask learners which factors they think might be relevant or have an impact on concentration and solubility. Suggestions for prompts might include:

- What factors might speed up or slow down the rate of dissolving?
- What factors might impact how much of a substance can be dissolved?
- How can a more concentrated solution be created?

Through this sharing and brainstorming, learners will gather and select information about factors that might be relevant, and they can determine the specific factors that they would like to explore in an experiment.

Essential Graduation Competencies

Communication

This provides an opportunity for learners to listen and interact purposefully and respectfully in formal and informal contexts.

Evidence of Learning (Conversations)

Through discussion of the factors that impact solubility and concentration, learners **gather and select information** that will be the focus of their experiment. The teacher can guide this discussion if certain factors are left out in order to provide learners with multiple options to consider for their inquiry.

Using the guiding question at the beginning of this experience, as well as the information they gathered about possible factors (through discussion or research), learners generate a more specific, testable question about solubility and concentration. If this is done early in the school year, it is likely that learners will need explicit instruction about what makes a 'testable' question.

Essential Graduation Competencies

Critical Thinking

This provides learners the opportunity to ask critical and purposeful questions.

Determining relevance and accuracy of information

To support the design of their inquiry, the teacher may want to conduct a mini lesson on how to measure concentration, how to assess dissolution of solids, or how to determine the rate of dissolving. This would also be an excellent time to introduce *independent, dependent, and controlled variables.*

- *What are you testing?*
- *What are you measuring?*
- *What are you keeping constant?*

Discuss as a class what steps can be taken to ensure the collected data is accurate and valid and how this might apply to the design of the experiments. A mini lesson about repeated trials and control samples might be appropriate if these concepts are new to learners.

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Essential Graduation Competencies

Critical Thinking
This provides learners the opportunity to ask critical and purposeful questions; formulate decisions based on evidence.

Evidence of Learning (Conversations)

As learners discuss how to determine relevant independent, dependent, and controlled variables the teacher can provide feedback on how to ensure the data is **relevant, valid, and accurate**.

In designing their experiment, learners may also want to consider the following:

- What equipment will be needed to carry out the experiment?
- How will you gather evidence?
- How will you ensure a fair test?
- How will you design a procedure keeping safety in mind?

Learners should prepare and share their experimental design with the teacher prior to conducting the experiment.

Essential Graduation Competencies

Critical Thinking
This provides learners the opportunity to ask critical and purposeful questions; formulate decisions based on evidence; analyse and evaluate evidence.

Evidence of Learning (Product)

Experimental designs can show how **valid and accurate** data can be collected. The teacher can provide feedback with regards to safety and feasibility of the experimental designs.

Gather and select appropriate information

Learners can carry out their experiments and gather data. This may be done in small groups or pairs. Alternatively, learners may be placed into groups to discuss the various experimental designs and one design can be chosen to be conducted. Another option is to refine the experimental designs as a group to include elements from several members of the group into one design. This refined design can then be carried out. A discussion or mini lesson on how to effectively record data might help learners organize the experimental information that they will be gathering.

Essential Graduation Competencies

Technological Fluency
This provides learners the opportunity to use technology in a responsible manner to create and represent new knowledge.

The teacher should provide feedback with respect to lab safety, throughout the experiment.

Evidence of Learning (Observations)

While learners are collecting experimental data, the teacher can provide feedback to help them refine strategies used to **gather evidence** for analysis.

Determining importance of information and Communicate Findings

Learners can share their findings by exploring the following questions:

- How do the results of different experiments compare?
- What do the results mean in relation to pollutants in the environment?
- How is the factor that you inquired about important for pollution management?

Essential Graduation Competencies

Communication
This provides learners the opportunity to listen and interact purposefully and respectfully in formal and informal contexts.

Evidence of Learning (Conversations)

Learners **communicate** and discuss the **importance of the findings**.

Evidence of Learning (Products)

Learners **communicate their findings** on the factors that affect solubility and concentration.

Moving Forward

How are the variables you investigated relevant to substances in the environment?

Outcome: Learners will analyse the interconnectiveness of living things and the environment, in relation to the concept of Netukulimk.

Environmental Action

Rationale

Netukulimk, provides the perspective for a study of ecosystems. The interconnectiveness of biotic and abiotic components in ecosystems will lead to an understanding of energy input and matter cycling through food webs. Analysis of the impact of humans on ecosystems further demonstrates the interconnectiveness of living things.

Competencies

- Citizenship (CZ)
- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Technological Fluency (TF)

Indicators

- Analyse the interactions of various organisms within an ecosystem (CZ/CT/COM)
- Analyse the impact of humans on ecosystems, including pollution and green technologies (CZ/CT/TF)
- Analyse choices about resource management and sustainability in relation to Netukulimk (CZ/COM/CI/CT)
- Investigate energy input and matter recycling in an ecosystem (COM/CT)
- Analyse the interconnectiveness of biotic and abiotic components in nature, inclusive of a Mi'kmaw perspective (COM/CZ/CT)
- Investigate biological indicators of environmental health (COM/CT/TF)

Concepts (and Guiding Questions)

Ecosystems

- What are some characteristics that different ecosystems have in common?
- How is the size of an ecosystem determined?

Biotic and abiotic components

- How can the impacts of abiotic components be determined?
- How do abiotic and biotic components compare?

Interconnectiveness

- What are some of the interconnections that can be observed in various ecosystems?
- How do abiotic and biotic components interact in various ecosystems?
- How can biological indicators be used as a marker for environmental health?

Energy input and matter recycling

- How does the flow of energy and the flow of matter in an ecosystem compare?
- How can we design a sustainable biosphere?

Food Webs

- How do organisms interact within an ecosystem?
- How do producer populations impact consumer populations?

Netukulimk

- How can natural resources be used in a sustainable way?
- How does environmental racism impact various local and global communities?
- How have human relationships with the environment changed over time?

Human Impact

- How are humans impacting ecosystems?
- How has the impact of humans on ecosystems changed over time?
- How are green technologies changing the impact of humans on ecosystems?

Skills

Analyse

Gather and select appropriate information; determine accuracy, validity, and relevance of the information; identify perspectives; communicate findings.

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 4	Grade 6	Grade 7	Grade 8
Learners will have investigated a variety of local, natural habitats including habitat components and survival needs of organisms. Additionally, learners analysed interconnectiveness of and within local habitats, including basic human impacts and food webs.	Learners will have analysed the variety of organisms that live in various ecosystems. Learners explored concepts such as characteristics of living things, and ecological relationships.	Learners will analyse the interconnectiveness of living things and the environment, in relation to the concept of Netukulimk. Learners will explore the following concepts: ecosystems, interconnectiveness, biotic and abiotic, energy input and matter recycling, food webs, Netukulimk, human impact.	Learners will build from their analysis of human impacts to an evaluation of the role of humans in climate change and climate science. Additionally, learners will evaluate oceanographic and other evidence of climate change including impacts on biotic aspects of ecosystems.

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *analyse interconnectiveness, inclusive of a Mi'kmaw perspective* by *investigating biological indicators of environmental health.*

Indicators

- Analyse the interactions of various organisms within an ecosystem (CZ/CT/COM)
- Analyse the impact of humans on ecosystems, including pollution and green technologies (CZ/CT/TF)
- Analyse choices about resource management and sustainability in relation to Netukulimk (CZ/COM/CI/CT)
- Investigate energy input and matter recycling in an ecosystem (COM/CT)
- **Analyse the interconnectiveness of biotic and abiotic components in nature, inclusive of a Mi'kmaw perspective (COM/CZ/CT)**
- Investigate biological indicators of environmental health (COM/CT/TF)

Overview

A trip to observe a local ecosystem would engage learners in ecological field work where they can learn skills such as quadrat sampling, transect lines and the construction of ethograms to represent ecosystem components. Alternatively, images of ecosystems can be used for observation and data collection.

Evidence of Learning for the indicator:

Analyse the interconnectiveness of biotic and abiotic components in nature, inclusive of a Mi'kmaw perspective

Evidence of learning can be gathered as learners make observations about biotic and abiotic components. Further evidence can be gathered as they engage in conversations about interconnectiveness.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Analyse the interconnectiveness of biotic and abiotic components in nature, inclusive of a Mi'kmaw perspective

Potential Guiding Questions

- What are some of the interconnections that can be observed in various ecosystems?
- How do abiotic and biotic components interact in various ecosystems?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Introduction

Engage learners by having them view (either as a class or in small groups) the video for exploration 1 on the Science Moodle site. This introduces the concepts of biotic and abiotic components and the idea of making careful observations of the natural world. Learners discuss the question presented at the end of the video "How do you connect to the web of life?". As learners engage in small or large group discussions and conversations, encourage them to identify different perspectives as they communicate their ideas.

Essential Graduation Competencies

Communication
This provides the opportunity for learners to listen and interact purposefully and respectfully in formal and informal contexts

Gather and select appropriate information

As learners observe an ecosystem (behind the school, on a field trip or with images in the classroom), learners can make observations about the connections they notice. The teacher can encourage learners to find a variety of types of connections such as biotic to biotic, biotic to abiotic and abiotic to abiotic and to make field drawings of their observations. The teacher might provide direct instruction about strategies for collecting ecological data such as using quadrats, ethogram templates, graphic organizers, etc. Using the information they have gathered and selected, learners can begin to sketch a visual representation of this ecosystem and the examples of interconnectiveness they observed.

Essential Graduation Competencies

Citizenship
This allows learners to develop skills and practices that support environmental sustainability; recognize the complexity and interconnectedness of factors in analyzing issues

Evidence of Learning (Observations)

As learners **gather information**, observe their data collection and visual representations and provide feedback on the relevance of the information they include.

Determine accuracy, validity, and relevance of the information

After learners have completed making their observations and collecting data, they can share their findings with other groups. Learners could be prompted with questions such as:

- What similarities or differences do you notice in observations made by different groups?
- Is there conflicting information?
- How can the accuracy of the information be determined if there are conflicting observations?
- What additional information do you need in order to have a complete representation of the ecosystem and its interconnectiveness?

Have learners ask questions to expand their research and understanding of the ecosystem that they studied and its interconnectiveness.

Essential Graduation Competencies

Communication
This provides learners an opportunity to listen and interact purposefully and respectfully in formal and informal contexts; engage in constructive and critical dialogue

Evidence of Learning (Conversations)

Learners can discuss what they have observed and how they can be sure of the **accuracy** of their observations. The teacher can provide feedback on the strategies used to determine accuracy and the examples of interconnectiveness that are described.

Gather and select appropriate information

Learners can be invited to gather additional information about interconnectiveness in the ecosystem using the questions they created. Learners can also think about the interconnectiveness they can not readily see through observing an ecosystem for only a short period of time. They may conduct interviews with an Elder, observe a different part of the ecosystem, or make inferences based on prior knowledge. Learners might also search for images of the ecosystem under varying conditions, such as at night, in a different season, etc.

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to ask critical and purposeful questions.

Evidence of Learning (Observations)

As learners work to **gather additional information** the teacher can encourage learners to share their process. The teacher can provide feedback about data collection and research strategies.

Determine accuracy, validity, and relevance of the information

As learners are gathering information and conducting research, they can make inferences about interconnectiveness based on their observations. Working in small groups or with the teacher, learners can share their inferences and explain the reasoning and evidence for those inferences (For example: the trees are deciduous and will lose leaves in the winter, this will change the types of animals that rely on the tree for food because...). Learners can provide feedback to one another about the relevance of their inferences and add to each other's findings. This can help create a more complete picture of interconnectiveness in the ecosystem.

Essential Graduation Competencies

Critical Thinking
This provides learners the opportunity to recognize that experiences shape points of view

Evidence of Learning (Conversations)

Evidence of learning can be gathered as learners discuss the **accuracy, validity and relevance** of the connections they inferred.

Learners can be engaged in one-on-one conversations where they **communicate** their reasoning and inferences they made from observing ecosystems and identifying interconnectiveness.

Identify perspectives

If learners have not already explored human impacts with respect to interconnectiveness, they can be prompted with the following questions:

- How do humans fit into this ecosystem?
- What impacts are humans having on and within this ecosystem?
- Do all peoples see the role of humans the same way?
- What is the relationship between humans and nature?

Essential Graduation Competencies

Citizenship
This provides learners the opportunity to recognize the complexity and interconnectedness of factors in analyzing issues

Evidence of Learning (Conversations)

As learners engage in conversations relating to how humans are connected to and within ecosystems, the teacher can provide feedback about **identifying varying perspectives** on interconnectiveness.

Communicate findings

Learners can consolidate what they have learned by creating a visual representation (mural, diorama, eco-calendar, etc.) of interconnectiveness within the ecosystem they explored. To properly address the wholistic nature of interconnectiveness, the representation will be more complex than just feeding relationships. Learners can communicate their findings using a method of their choice such as a gallery walk, small group discussions or a presentation to the community.

Essential Graduation Competencies

Communication
This provides learners an opportunity to express and respond to learnings through multiple media forms

Evidence of Learning (Product)

Learners **communicate their findings** by creating a representation of interconnectiveness within ecosystems

Evidence of Learning (Conversations)

Learners **communicate their findings** by sharing their representations with others.

Moving Forward

What are some ways that interconnectiveness is being disrupted or changed near you or in your community?

Outcome: Learners will investigate factors that affect species adaptation and evolution

Environmental Action

Rationale

An exploration of various systems of classification demonstrates the diversity of life, which provides an avenue to explore adaptations and how species have evolved over time. Investigating evidence for evolution will allow learners to understand how environmental pressures and species interactions lead to natural selection and affect biodiversity.

Competencies

- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)

Indicators

- Investigate multiple ways that species can be classified (COM/CI/CT)
- Hypothesize ways in which organisms may adapt in response to environmental and predation factors (COM/CT)
- Investigate the concept of natural selection and its role in evolution (COM/CT)
- Investigate evidence of evolution (COM/CT)

Concepts (and Guiding Questions)

Classification

- How can organisms be grouped?
- How does classification help us learn about organisms?

Adaptation

- How do organisms adapt to survive?
- How have local organisms adapted to their specific environmental demands?

Evolution

- Why do living things change over time?
- How can we see evidence of species evolution?

Natural Selection

- How do livings things change over time?
- Why can’t a single organism evolve?

Evidence of evolution

- How can we observe geological evidence of evolution in the local environment?
- How can we infer information about the past in the absence of direct evidence?

Skills

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Hypothesize

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 4	Grade 6	Grade 7	Grade 11, 12
Learners will have analysed interconnectiveness and explored how habitat components help organisms survive.	Learners will have analysed diversity of life and began their exploration of classifying living things based on general characteristics. They also investigated applications of taxonomy.	Learners will investigate factors that affect species adaptation and evolution. Learners will explore the following concepts: Classification, Adaptation, Evolution, Natural Selection, Evidence of Evolution.	Learners explore classification systems and taxonomy in detail. Learners construct dichotomous keys. Learners investigate mechanisms of natural selection and look at DNA evidence of evolution.

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *hypothesize ways in which organisms may adapt in response to environmental and predation factors* while *investigating multiple ways that species can be classified*.

Indicators

- **Investigate multiple ways that species can be classified (COM/CI/CT)**
- Hypothesize ways in which organisms may adapt in response to environmental and predation factors (COM/CT)
- Investigate the concept of natural selection and its role in evolution (COM/CT)
- Investigate evidence of evolution (COM/CT)

Overview

Learners examine a selection of organisms and propose a methodology for classification based on characteristics.

Evidence of Learning for the indicator:

Investigate multiple ways that species can be classified

Evidence of learning can be gathered as learners engage in conversations about classification of species in new ways.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Investigate multiple ways that species can be classified

Potential Guiding Questions

- How can organisms be grouped?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Identify relationships, recognize represented perspectives

Learners may already be familiar with basic sorting and classification. Teachers can engage with this prior knowledge by showing an image of three groups of items or alternatively with physical items. This may be done as a whole class or in small groups. The items should be grouped in a way so that there are multiple possible sorting rules that could have been applied to these groups. The teacher can encourage careful observations and distinctions to be made while learners engage in this experience. Learners can discuss suggestions for the general sorting rule as well as suggestions for additional possibilities for sorting rules as a way to explore multiple perspectives about sorting and classification. Learners can be provided the opportunity to share their thinking process and evidence for their suggestions. A whole class or small group discussion can be initiated about where a new item might fit and why. Learners can also be given the following question as the discuss:

- When would a new category be needed?

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to formulate decisions based on evidence

Evidence of Learning (Conversation)

Learners engage in small or large group discussions to **identify** potential sorting rules and classification options to describe **relationships**.

Learners **recognise perspectives** of their classmates in order to refine their own classifications.

Ask and revise questions

Learners will have opportunities to ask questions about groupings and classification while making observations of living organisms (or images of living organisms). These organisms can be found in the local ecosystem, or other locations in response to student interest. Whole class or small group discussions can be facilitated by the teacher as they offer questions to consider about the learners' observations.

Questions might include:

- Why is it helpful to classify living organisms?
- How do scientists classify these organisms?
- How would I classify them? Are there multiple ways?
- Which characteristics of the organisms are important or relevant for classification?
- Which characteristics are not relevant?
- How do scientists make decisions about the classification of a newly discovered organism?
- What questions do scientists ask when classifying newly discovered organisms?
- Do the classification systems ever change?
- What questions do scientists answer using classification?

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to: ask critical and purposeful questions

Evidence of Learning (Conversations)

As learners engage in small or large group discussions about their **questions** about classification, provide feedback on questions that can sustain inquiry versus those that are less likely to sustain inquiry. The teacher can provide feedback that will help them to **revise their questions**

Evidence of Learning (Product)

Learners can record and share their **questions** about grouping and classifying living organisms

Locate, organize and compare several relevant and dependable details to support an answer

Learners will seek to respond to their questions by acting like taxonomists and creating their own classification systems and rules. Answers to their questions may be possible by reasoning while performing a classification (i.e. which characteristics are relevant, which are not). Learners will make careful observations of the characteristics of the organisms in a collection of living organisms in order to sort them. Collections could be images provided by the teacher or found by learners. Learners can research and organize relevant and dependable information to support their classification system. This can be enacted through small groups working with different collections in centres.

Essential Graduation Competencies

Creativity and Innovation
This provides learners an opportunity to use constructive feedback, reflect, and learn from trial and error; think divergently, embrace complexity and ambiguity

Evidence of Learning (Observations)

As learners develop their classification schemes, the teacher can observe the types of details, organization and comparisons that learners are using.

Evidence of Learning (Conversations)

Teachers can provide feedback on effective **research** strategies.

Communicate Findings

Learners can share their classification schemes and discuss what they have investigated about classification. Collectively, this will provide a fulsome picture of classification and taxonomy.

Essential Graduation Competencies

Communication
This provides learners an opportunity to listen and interact purposefully and respectfully in formal and informal contexts

Evidence of Learning (Product)

Learners can share their classification scheme and **communicate** their research findings using a method of their choosing.

Moving Forward

- Learners can create a new organism and see how it would be classified.

Question for further inquiry

- Can you develop a new way to classify living organisms?

Outcome: Learners will implement an environmental stewardship plan.

Environmental Action

Rationale

This outcome is the application of concepts explored throughout the environmental action theme. Learners will evaluate and plan ways to mitigate environmental harm as well as how they can have a positive impact on their community and environment.

Competencies

- Citizenship (CZ)
- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

- Select strategies for conservation and sustainability (CZ/CT)
- Investigate community environmental stewardship initiatives (CZ/COM/PCD/CT)
- Formulate an environmental stewardship plan to mitigate environmental harm in relation to the concept of Netukulimk (CZ/PCD/CI/CT)

Concepts (and Guiding Questions)

Netukulimk, Sustainability and Conservation

- How can we live according to Netukulimk?
- Why is it important to care for the environment?

Environmental Stewardship

- How can it be determined whether a local environment needs to be protected?
- How can the impact of local environmental initiatives be determined?
- How do people in my community take care of the environment?
- How can I take care of the environment?

Mitigating Environmental Harm

- How can more green space be created?
- How can you determine if conservation and sustainability strategies are effective?

Skills

Implement

Select: Locate several relevant and dependable details to support an answer; **Plan:** Formulate Identify a topic of interest; brainstorm ideas; choose, prioritize, and refine ideas; evaluate choices. Devise a process to solve the problem. **Evaluate:** Review processes and results from an inquiry. Consider and communicate varying perspectives and alternative solutions or findings. Identify potential new problems

and/or issues. Justify decisions and/or findings. **Apply:** Carry out, use, or complete a procedure/ technique.

Select
Locate several relevant and dependable details to support an answer

Investigate
Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Formulate
Identify a topic of interest; brainstorm ideas; choose, prioritize, and refine ideas; evaluate choices.

Background Knowledge
The following chart provides an alignment of related concepts between grade levels:

Grade 4	Grade 6	Grade 7	Grade 8
Learners will have investigated a variety of local, natural habitats and analysed interconnectiveness of and within local habitats, including basic human impacts, inclusive of a Mi'kmaw perspective	Learners will have investigated significant ecological relationships within the natural world.	Learners will implement an environmental stewardship plan. Learners will explore the following concepts: Netukulimk, sustainability and conservation, environmental stewardship, mitigating environmental harm	Learners will build from their analysis of human impacts to an evaluation of the role of humans in climate change and climate science. Learners will formulate a plan to mitigating and/or adapting to the effects of climate change

Learning Experiences
The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *select strategies for conservation and sustainability* while *formulating an environmental stewardship plan to mitigate environmental harm in relation to the concept of Netukulimk.*

Indicators
- Select strategies for conservation and sustainability (CZ/CT)
- Investigate community environmental stewardship initiatives (CZ/COM/PCD/CT)
- **Formulate an environmental stewardship plan to mitigate environmental harm in relation to the concept of Netukulimk (CZ/PCD/CI/CT)**

Overview

It is suggested that this indicator be explored after learners have investigated community environmental stewardship initiatives. This will help learners identify areas of interest for brainstorming and developing their plans, based on what they have learned. Providing learners with several opportunities for voice and choice to explore a topic of interest is crucial to engaging in meaningful, enduring learning. With that in mind, the learning experience outlined below specifically addresses the skill development for formulate rather than describing a specific activity.

Evidence of Learning for the indicator:

Formulate an environmental stewardship plan to mitigate environmental harm in relation to the concept of Netukulimk

Evidence of learning can be gathered as learners brainstorm, prioritize, and refine ideas to mitigate environmental harm and evaluate the choices made in these plans in relation to the teachings of Netukulimk.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Formulate an environmental stewardship plan to mitigate environmental harm in relation to the concept of Netukulimk

Potential Guiding Questions

- How can I take care of the environment?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Identify a topic of interest

Topics of interest can be found in areas explored in earlier outcomes and/or suggested indicators. The following questions might prompt learners to identify a topic of interest:

- Are there environmental areas not being protected currently?
- Are there gaps in community initiatives?
- Are there gaps in awareness of environmental stewardship?
- Where do you want to make a difference?
- What matters to you?

Small groups can be created based on learner interest so that they can work together to learn how to formulate a plan on a topic that is personally relevant.

Essential Graduation Competencies

Citizenship
This provides learners an opportunity to recognize the principles and actions of citizens that impact society

Evidence of Learning (Conversations)

As learners engage in small or large group discussions about **topics of interest**, the teacher can take note of the various strategies that are being used.

Brainstorm ideas

Using a topic of interest, small groups of learners can brainstorm ideas for their environmental stewardship plan. Learners can be prompted with questions such as:

- How can you make a difference?
- What are things that you would like to take on?
- What do you like to do?
- How can you leverage your skills and interests in your plan (sports, fundraising, singing, writing, filmmaking, etc...)?
- Who is your target audience?
- How does that impact the strategies you undertake?
- How can your plan involve the core values of Netukulimk: Respect, Responsibility, Relationship and Reciprocity?

Essential Graduation Competencies

Creativity and innovation
This provides learners an opportunity to collaborate to create and innovate.

Evidence of Learning (Conversations)

As learners engage in small or large group **brainstorming**, take note of the various strategies that they are using.

Evidence of Learning (Products)

Learners will provide evidence of their **brainstorming**. This evidence can take the form of notes, word bubbles, drawings, diagrams, recordings, videos, etc.

Choose, prioritize, and refine ideas

Learners will now narrow down the list of ideas that they brainstormed. They will choose their area of focus and refine their ideas. While refining their ideas, learners could keep the following questions in mind: Which option might have the biggest impact? What resources will you need? Will resource availability impact your decision about which ideas to choose? Who might be available to help with the plan (i.e. organizations, friends, elders, community members, teachers, etc.)? What additional information do you need and where/how can you get it? How does your idea relate to the teaching of Netukulimk?

Learners may need support in prioritising and refining their ideas to form a plan that is feasible, since this indicator is ultimately building to the outcome that involves implementing an environmental stewardship plan.

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to ask purposeful questions

Evidence of Learning (Conversations)

As learners engage in small or large group discussions about **prioritizing and refining their ideas**, take note of the various strategies that they are using.

Evidence of Learning (Products)

Learners can provide notes, drawings, video etc. of their **priority areas that includes ideas that are more refined** than their original brainstorm.

Evaluate choices

Learners will now evaluate their list of priority areas and refined ideas to help them make a judgement about the formulation of their plan. Learners should proceed through the skill components for Evaluate. Learners can be prompted with questions such as:

- Why might one choice be better than the other?
- Is one plan more sustainable than another?
- What is doable?
- What might have the biggest impact?
- What factors are important in making this evaluation?
- How are the core values of Netukulimk represented in the plan?
- What problems might arise with your choice?
- How can you mitigate those problems?
- Are there other perspectives that I need before making a choice?
- Can I justify the reasons for my choice?

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to ask purposeful questions in order to analyse and evaluate evidence.

Evidence of Learning (Conversations)

As learners engage in small or large group discussions to **evaluate their choices**, the teacher can note how they are engaging with the key components of *evaluate,* and that their choices are made in relation to the incorporation of the teachings of Netukulimk in their stewardship plan.

Evidence of Learning (Conversations/Products)

Learners can share their final choices with their classmates and discuss their reasoning. This can be done using a product (such as a poster, a gallery walk, or a video) or learners might engage in asking critical and purposeful questions of their classmates about their plans and choices during small or large group conversations.

Moving Forward

How can the teaching of Netukulimk be practiced everyday?

What examples of the four core values of Netukulimk (respect, responsibility, relationship, reciprocity) do you see in your everyday interactions and decisions?

How can your plan be put into action?

Outcome: Learners will test the strength and efficiency of shapes and materials used in construction.

Engineering Structures

Rationale

Different materials are more efficient for building particular structures. Similarly, by modifying the shapes used in construction, strength and efficiency can be adjusted according to the criteria, goal or design. Comparing manufactured structures and those found in nature demonstrates the properties of various shapes and materials.

Competencies

- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

- Evaluate the strength of a variety of shapes and materials (COM/CI/CT/TF)
- Evaluate the applications of shapes and materials used in construction (CT/PCD/TF)
- Investigate properties of materials used in construction (CT/TF)
- Compare features of manufactured and natural structures (COM/CT)

Concepts (and Guiding Questions)

Features of natural structures

- How do various natural structures compare?
- How are natural structures reflected in manufactured structures?

Features of manufactured structures

- How do engineers use different shapes to improve strength?
- How have structures changed over time and across cultures?

Shapes used in construction

- How do shapes impact strength and stability of structures?
- How can I test the strength and efficiency of shapes used in construction?

Properties of construction materials

- How can advantages and disadvantages of construction materials be determined?
- How does geographic location impact the materials used to build structures?

Skills

Test

Formulate a testable question and a reasonable hypothesis; Identify dependent and independent variables; Identify variables to intentionally control; Design an experiment; Execute the steps; Collect and record, evidence; Conduct data analysis; Develop conclusions based on evidence; Communicate findings and possible limitations.

Evaluate

Review processes and results from an inquiry; Consider and communicate varying perspectives and alternative solutions or findings; Identify potential new problems and/or issues; Justify decisions and/or findings.

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Compare

Make observations; identify similarities and differences; identify relationships and offer an interpretation; communicate the findings.

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 3	Grade 5	Grade 7	Grade 8
Learners will have explored the properties of materials used in building simple structures. Learners also investigated simple shapes used in structure design to respond to design challenges.	Learners will have constructed effective simple and compound machines. In doing so, they investigated forces in simple machines and tested machines for effectiveness.	Learners will test the strength and efficiency of shapes and materials used in construction. Learners will explore the following concepts: features of natural structures, features of manufactured structures, shapes used in construction, properties of construction materials	Learners will construct a device that uses hydraulics or pneumatics and evaluate these devices for efficiency and effectiveness

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *investigate properties of materials used in construction* while *comparing features of manufactured and natural structures.*

Indicators

- Evaluate the strength of a variety of shapes and materials (COM/CI/CT/TF)
- Evaluate the applications of shapes and materials used in construction (CT/PCD/TF)
- Investigate properties of materials used in construction (CT/TF)
- **Compare features of manufactured and natural structures (COM/CT)**

Overview

Learners review a collection of images showing a variety of natural and manufactured structures. They identify similarities and differences, and research examples of biomimicry by looking at manufactured structures that are inspired by structures in nature.

Evidence of Learning for the indicator:

Compare features of manufactured and natural structures

Evidence of learning can be gathered as learners identify similarities and differences in the features of natural and manufactured structures in order to offer an interpretation of the relationships between various structures.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Compare features of manufactured and natural structures

Potential Guiding Questions

- How do various natural structures compare?
- How are natural structures reflected in manufactured structures?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Engage learners by having them view the video for Engineering Structures, Exploration 1 on the Science 7 Moodle site. The video explores examples of biomimicry. Learners can have an opportunity to discuss the final question presented in the video: "What natural structures that you have seen could become manufactured structures with a specific use for humans?"

Essential Graduation Competencies

Communication
This provides learners an opportunity to listen and interact purposefully and respectfully in formal and informal contexts.

Make observations, identify similarities and differences

To provide an opportunity for learners to observe and distinguish between natural and manufactured structures they can be present with a collection of images. These images would show a variety of natural and manufactured structures. To further connect this learning to their lived experiences, learners could also be asked to go on a photo hunt to capture images of natural and manufactured structures around their school or neighbourhood to add to the collection.

Working in small groups, learners can compare several images from the collection. Learners can design a graphic organizer that can be used to identify similarities and differences from their images. Alternatively, teachers may provide a graphic organizer or other support that engages the skill components of identifying similarities and differences. If desired, images could be grouped to draw learner's attention to specific attributes (for example natural - natural; natural - manufactured; manufactured - manufactured)

Essential Graduation Competencies

Communication
This provides learners an opportunity to engage in constructive and critical dialogue.

Evidence of Learning (Conversation)

Learners **make observations and identify similarities, differences, and relationships** between natural and manufactured structures.

Identify relationships and offer an interpretation

Learners could now have an opportunity to research an example of a manufactured structure in detail, independently or with a partner and identify relationships and offer an interpretation to explain how it was inspired by a natural structure.

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to synthesize information from relevant and reliable sources.

Evidence of Learning (Conversations)

As learners discuss their **observations** of the structures, the teacher can engage in one-on-one conversations to gather evidence and support learners in **identifying relationships** between different types of structures.

Communicate the findings

Learners can communicate their findings using a method of their choice. The collective sharing brings up opportunities to notice comparisons, including similarities and differences, between the findings of classmates. This allows for a fulsome exploration of biomimicry.

Essential Graduation Competencies

Communication
This provides learners an opportunity to listen and interact purposefully and respectfully in formal and informal contexts.

Evidence of Learning (Products)

Learners can **communicate their findings** and summarize and share their **interpretations** using an audio, visual, or written method.

Evidence of Learning (Conversation)

Once learners have shared their findings with others, encourage them to **identify similarities and differences** and discuss **relationships** between the structures selected by their peers.

Moving Forward

Which structures in nature inspire you to design a manufactured structure?

Outcome: Learners will test various forces affecting structures.

Engineering Structures

Rationale

Structures are impacted by various forces that hold them together and those that lead to structural failure. Understanding how to balance these forces is best done through hands-on inquiry. Testing structures also allows learners to apply the scientific skills of controlling variables and scientific reasoning.

Competencies

- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

- Investigate forces that act on and within structures (CT/ TF)
- Test structures to determine failure points (COM/PCD/CI/CT)
- Analyse forces that lead to structural failure (COM/CT)
- Compare static and dynamic forces that impact structures (CT/TF)

Concepts (and Guiding Questions)

Internal and External Forces

- How do internal forces affect structures?
- How do external forces affect structures?
- How are joints strengthened?
- How can the direction of forces be controlled?
- What natural forces threaten local manufactured structures?

Static and Dynamic Forces

- How can structural forces be assessed?
- How do static and dynamic forces compare?

Loading

- How can loading forces be used to effectively test a structure?
- How does adding a load to a structure affect its integrity?

Balance and unbalanced forces

- Why do structures fail?
- How are the concepts of balanced and unbalanced forces incorporated in construction?
- How do engineers use unbalanced forces to destroy structures?

Skills

Test

Formulate a testable question and a reasonable hypothesis; Identify dependent and independent variables; Identify variables to intentionally control; Design an experiment; Execute the steps; Collect and record, evidence; Conduct data analysis; Develop conclusions based on evidence; Communicate findings and possible limitations.

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Analyse

Gather and select appropriate information; determine accuracy, validity, and relevance of the information; identify perspectives; communicate findings.

Compare

Make observations; identify similarities and differences; identify relationships and offer an interpretation; communicate the findings.

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 3	Grade 5	Grade 7	Grade 8
Learners will have investigated invisible forces such as static electricity, magnetism and factors that affect the strength of magnets. Learners also explored simple structure design to respond to design challenges.	Learners will have constructed effective simple and compound machines. In doing so, they investigated forces in simple machines and tested machines for effectiveness.	Learners will test various forces affecting structures. Learners will explore the following concepts: internal and external forces, static and dynamic forces, loading, balanced and unbalanced forces.	Learners will test various properties of fluids and explore forces that are involved in hydraulic and pneumatic systems that provide mechanical advantage.

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *investigate forces that act on and within structures* while *analysing forces that lead to structural failure*.

Indicators

- **Investigate forces that act on and within structures (CT/ TF)**
- Test structures to determine failure points (COM/PCD/CI/CT)
- Analyse forces that lead to structural failure (COM/CT)
- Compare static and dynamic forces that impact structures (CT/TF)

Overview

As a way to begin an investigation of forces that act on and within structures, learners can be presented with several images of structures that have been damaged by forces. These could include: broken bicycle wheel, a building that has fallen, a shoe that is scuffed, a roller coaster falling off the tracks etc. Alternatively, learners could bring in images or structures of their own that have been damaged or impacted by forces.

Evidence of Learning for the indicator:

Investigate forces that act on and within structures

Evidence of learning can be gathered as learners engage in the investigation of forces that act on and within structures by examining evidence of those forces.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Investigate forces that act on and within structures

Potential Guiding Questions

- How do internal forces affect structures?
- How do external forces affect structures?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Locate several relevant and dependable details to support an answer, Identify relationships

Learners can locate or be provided with images of structures that have been damaged or impacted by forces. Learners should be encouraged to examine the images/structures in detail to locate several relevant and dependable details about the forces that acted on these structures.

The teacher can engage learners in small or large group discussions about which forces may have led to the damage shown in the images or in the structures. Learners should be encouraged to explain their reasoning and how they identified the relationships between the appearance of the structure and the forces acting on/within the structure.

Forces that might affect structures include:

- Friction,
- Gravity,
- Magnetism,
- wind,
- waves,
- etc..

Essential Graduation Competencies

Critical Thinking

This provides learners an opportunity to ask critical and purposeful questions and formulate decisions based on evidence.

Evidence of Learning (Conversations)

As learners engage in small or large group discussions, the teacher can provide feedback on selecting **relevant details** to support the **relationships** they infer.

Organize and compare details, Identify relationships

Learners can be encouraged to use what they already know and have experienced when describing what might have caused the damage shown. For example, a learner might describe damage to a shoe as being from scuffing or rubbing. This is an opportunity to discuss friction in more detail. Learners will make connections and identify relationships between the effects of a force on a structure and what might have caused those effects. As learners organize and compare details about the impacts of forces, they will have an opportunity to become more systematic in recognizing the types of forces that act on and within structures.

Essential Graduation Competencies

Technological Fluency

This provides learners an opportunity to examine how technology and society impact and advance one another

Evidence of Learning (Observations)

Learners identify forces that act on and within structures and discuss **relationships** between forces and their impact on structures.

Moving Forward

Which forces have the biggest impact on structures in your community?

Outcome: Learners will construct a structure in response to a design challenge.

Engineering Structures

Rationale

Design challenges encourage inquiry and problem solving. Learners will be able to apply what they have learned about materials, shapes, strength, stability efficiency and forces in solving a real-world problem.

Competencies

- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

- Apply concepts of shapes, forces, strength, stability and efficiency to a design challenge (CI/CT/TF)
- Evaluate materials in relation to a design challenge (COM/CT)
- Implement a plan for a structural design challenge (COM/PCD/CI/CT)
- Test a constructed structure according to design challenge criteria (CT/CI/TF)

Concepts (and Guiding Questions)

Forces affecting structures

- How can a structure be built to withstand forces?
- Which forces need to be considered in construction?

Shape/Form

- How can aesthetics influence construction?
- How does form/shape impact function?

Construction materials

- How can the features of construction materials be determined?
- How can the efficient use of resources be incorporated in construction?

Design Process

- How can the design process be used in construction?
- How can the structure's stability be assessed during the design process?

Stability

- How can the stability of a structure be affected by various factors?
- How can the structure's stability be tested?

Skills

Construct

identify a purpose; brainstorm ideas; gather and select information to support a plan; identify and choose options within the plan; offer reasons to support choices; build a model; test and revise, modify as necessary; evaluate the results at each stage of the process; consider alternative options.

Apply

Carry out, use, or complete a procedure/ technique

Evaluate

Review processes and results from an inquiry; Consider and communicate varying perspectives and alternative solutions or findings; Identify potential new problems and/or issues; Justify decisions and/or findings.

Implement

Select: Locate several relevant and dependable details to support an answer; Plan: Formulate Identify a topic of interest; brainstorm ideas; choose, prioritize, and refine ideas; evaluate choices. Devise a process to solve the problem. Evaluate: Review processes and results from an inquiry. Consider and communicate varying perspectives and alternative solutions or findings. Identify potential new problems and/or issues. Justify decisions and/or findings. Apply: Carry out, use, or complete a procedure/ technique.

Test

Formulate a testable question and a reasonable hypothesis; Identify dependent and independent variables; Identify variables to intentionally control; Design an experiment; Execute the steps; Collect and record, evidence; Conduct data analysis; Develop conclusions based on evidence; Communicate findings and possible limitations.

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 3	Grade 5	Grade 7	Grade 8
Learners will have explored the properties of materials used in building simple structures. Learners also investigated simple shapes used in structure design to respond to design challenges.	Learners will have constructed effective simple and compound machines. In doing so, they investigated forces in simple machines and tested machines for effectiveness.	Learners will construct a structure in response to a design challenge. Learners will also explore the following concepts: features of natural structures, features of manufactured structures, shapes used in construction, properties of construction materials to support constructing a structure	Learners will construct a device that uses hydraulics or pneumatics and evaluate these devices for efficiency and effectiveness

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners might *apply concepts of shapes, forces, strength, stability and efficiency to a design challenge* while *testing a constructed structure according to design challenge criteria.*

Indicators

- Apply concepts of shapes, forces, strength, stability and efficiency to a design challenge (CI/CT/TF)
- Evaluate materials in relation to a design challenge (COM/CT)
- Implement a plan for a structural design challenge (COM/PCD/CI/CT)
- Test a constructed structure according to design challenge criteria (CT/CI/TF)

Overview

Prior to this learning experience, learners would have had opportunities to investigate the concepts of forces affecting structures, the impact of shape, form and choice of materials in construction as well as stability in relation to structural design.

In this experience, learners will also be working through several components of the construct skill: identifying a purpose for their structure; brainstorming ideas of what they could construct; gathering and selecting information to support their plan for a structure; identifying and choosing options within

the plan; offering reasons to support their choices; building their structure.

The learning experience described here specifically deals with co-constructing success criteria prior to designing and testing the structures for a design challenge.

Evidence of Learning for the indicator:

Test a constructed structure according to design challenge criteria

For this indicator, teachers will gather evidence of learning through the collaborative construction and application of success criteria for a design challenge.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Test a constructed structure according to design challenge criteria

Potential Guiding Questions

- How can success or failure be defined for this challenge?
- What is important when testing a design?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Introduction

Providing learners with choices and options when selecting a type of structure to design is a central part of engaging in meaningful, learner-centred experiences. Suggestions for design challenges might include: a shelter, a structure that can withstand strong winds, a structure that could withstand an earthquake, a structure that can float, etc. With this in mind, the learning experience described here specifically deals with co-constructing success criteria prior to designing and testing the structures.

Success criteria for this challenge should not be limited to the data collected relating to a relevant independent variable (for example wind speed). Learners should be encouraged to recognize how creative processes are vital to innovation and to determine how well their design responds to the challenge for their selected audience. They should also be prompted to consider how they use their data to revise and modify their designs and how to incorporate suggestions and ideas from peers where appropriate.

Brainstorm ideas

If possible, learners can be presented with examples or images of strong and weak designs to support learners in identifying success criteria. This may be teacher constructed or come from previous learning experiences. Learners can share their ideas in small groups and record each idea in some way to keep ideas organized and can allow subsequent clustering of ideas.

Learners can suggest ways to sort the ideas that have common themes. A checklist or rubric can be created from the lists to then be used as a guiding tool while they are working on completing the challenge.

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to analyse information and evidence, suspending judgement and accepting ambiguity.

Evidence of Learning (Conversations)

As learners brainstorm and share initial ideas in relation to success criteria the teacher can provide feedback on how to organize and cluster the ideas.

The following suggested questions might be a starting place to prompt learners to consider factors that will be important when testing their design. These can be helpful in determining the success of their design relative to the chosen challenge:

- "To have a successful design, our structure should…"
- "To have a successful test, we need to…"

Essential Graduation Competencies

Creativity and Innovation
This provides learners an opportunity to recognize how creative processes are vital to innovation.

Responses might include (but would not be limited to)

Successful Design	*Successful Test*
... demonstrate concepts such as shapes, forces, strength, stability and efficiency in design ... address possible limitations ... be revised based on evidence collected during testing	... design a test suitable for the structure and execute the steps ... make careful observations and record relevant data (evidence) ... select and record units of measurement ... select an appropriate way to display and communicate results

* Additional success criteria should be appropriate for the specific design challenge.

For example, a structure could:

- Float for a minimum number of seconds/minutes and should...
- Support a mass for a given length of time
- etc.

Evidence of Learning (Product)

Learners co-create a rubric of success criteria to be applied to the **testing** of their designs.

When learners have decided on the success criteria for the design challenge, they can begin constructing and testing their structure.

As learners are constructing and testing their designs, they can be encouraged to refer back to the success criteria.

Essential Graduation Competencies

Technological Fluency
This provides learners an opportunity to implement technology effectively as appropriate to the learning experience.

Evidence of Learning (Observation)

As learners are constructing and testing their designs, the teacher can observe how they use the co-constructed criteria.

Moving Forward

How would you modify your structure if the design criteria changed?

For example, to span twice the distance, support twice the load, etc.

Outcome: Learners will analyse how geographic features are formed and changed.

Geological Evolution

Rationale

An understanding of plate tectonics and an exploration of observable geographic features, like mountains and ocean basins, informs the big questions in science around change versus stability and how scientists can use models to gain understanding. Using a Nova Scotia context will allow learners to explore erosion and deposition in an authentic and personal way.

Competencies

- Communication (COM)
- Critical Thinking (CT)
- Technological Fluency (TF)

Indicators

- Analyse the relationship between geographic features and plate boundaries (COM/CT)
- Analyse the evidence for plate movement (COM/CT/TF)
- Investigate erosion and deposition (COM/CT)
- Investigate technologies used to measure geological change (COM/CT/TF)

Concepts (and Guiding Questions)

Plate Tectonics

- How does the movement of Earth's tectonic plates cause observable changes and effects?
- How do we know plates are moving?

Geographic Features

- How have the geographic features of Nova Scotia changed over time?
- How quickly does/can geological change happen?

Seismology

- How can we prepare for seismic events?
- How does human development in areas with dramatic geologic change impact communities?

Erosion and Deposition

- How do human activities impact geological change?
- How have local landforms been impacted by erosion and deposition?

Skills

Analyse

Gather and select appropriate information; determine accuracy, validity, and relevance of the information; identify perspectives; communicate findings.

Investigate

Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Background Knowledge

The following chart provides an alignment of related concepts between grade levels:

Grade 3	Grade 4	Grade 7	Grade 8
Learners will have analysed soil in the environment including how water interacts with soil in the environment and concepts such as erosion, water absorption and drainage.	Learners will have investigated how the Earth's surface changes over time, including concepts such as the rock cycle and erosion.	Learners will analyse how geographic features are formed and changed. Learners will explore the following concepts: plate tectonics, geographic features, Seismology, erosion and deposition	Learners will evaluate oceanographic and other evidence of climate change

Learning Experiences

The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *investigate technologies used to measure geological change* while *investigating erosion and deposition.*

Indicators

- Analyse the relationship between geographic features and plate boundaries (COM/CT)
- Analyse the evidence for plate movement (COM/CT/TF)
- **Investigate erosion and deposition (COM/CT)**
- Investigate technologies used to measure geological change (COM/CT/TF)

Overview

One way to begin an investigation of erosion and deposition is to model the forces involved. Learners design a model (for example using a fan to model wind erosion, pouring water could represent water erosion, etc.) then use their representation to make observations about erosion and deposition in the environment.

Evidence of Learning for the indicator:

Investigate erosion and deposition

Evidence of learning can be gathered as learners select relevant details about erosion and deposition using a model and then identify relationships between their model and local landforms.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Investigate erosion and deposition

Potential Guiding Questions

- How have local landforms been impacted by erosion and deposition?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

The question that will begin this investigation is: How can erosion and deposition be modelled?

Locate several relevant and dependable details to support an answer

Models of erosion and deposition can be created using a stream table or a metal pan. A pile of sand and gravel can be placed in the pan and learners can be challenged to move the sediment without touching the particles with their hands. Learners can be challenged to model aspects of erosion such as landslides, wind erosion, water erosion, deposition.

Learners might develop the following strategies:

- using a fan to model wind erosion
- tapping, shaking and tilting the pan to represent earthquakes
- pushing with a tool might represent glacier movement
- pouring water to represent water erosion
- sprinkling water to represent rain

Essential Graduation Competencies

Critical Thinking

This provides learners an opportunity to develop curiosity, inquisitiveness and creativity, flexibility, and persistence.

Evidence of Learning (Observations)

As learners begin to **locate relevant details** about how erosion and deposition work to move sediment, the teacher can provide feedback on their models and strategies.

Organize and compare details

Learners can record their methods for moving the sediment along with the results. Learners can measure the movement using a method of their choosing or they may draw, take a photo, or capture a video of their trials.

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to formulate decisions based on evidence.

Evidence of Learning (Products/Observations)

As learners are recording their methods and **organizing and comparing** the details of their modelling, the teacher can provide feedback about the procedures and systems utilized by learners.

Identify relationships

Learners can be prompted to explore how models help geological scientists learn about erosion and deposition. Learners can be encouraged to relate their model to features that are found in Nova Scotia and around the world. They can be offered an opportunity to identify how local landforms might have been impacted by erosion and deposition. This can be explored through small or large group discussions. This will likely lead to more questions about erosion and deposition in the local landscape which can serve as the basis for learner-directed investigations of erosion and deposition.

Essential Graduation Competencies

Communication
This provides learners an opportunity to engage in constructive and critical dialogue.

Evidence of Learning (Conversations)

Learners engage in small or large group discussions about the **relationships** between their models and features they see in real-life.

Moving Forward

What evidence of erosion and deposition do you see in your community?

Outcome: Learners will analyse factors that affect coastline change.

Geological Evolution

Rationale

The study of tides and waves provides real-time evidence that geological changes affect how and where we live. Learners also explore the impact of humans on geographic formations as well as the technologies and strategies that can mitigate coastal degradation.

Competencies

- Citizenship (CZ)
- Communication (COM)
- Creativity and Innovation (CI)
- Critical Thinking (CT)
- Personal Career Development (PCD)
- Technological Fluency (TF)

Indicators

- Investigate weathering and erosion (COM/CT)
- Analyse the impact of waves and tides on rivers and coastlines (COM/CT)
- Compare possible strategies for mitigating coastal degradation (CZ/PCD/CT/TF)

Concepts (and Guiding Questions)

Waves and Tides

- How do beaches/coastlines change from season to season?
- How do coastlines change naturally over time?

Erosion and Weathering

- How do geological features and processes affect where and how we live?
- How does the shape of coastlines affect erosion?

Mitigating Coastal Degradation

- How do humans interact with the natural processes of coastline erosion?
- How can we control erosion without causing more erosion?

Mitigating Coastal Degradation

- How do humans interact with the natural processes of coastline erosion?
- How can we control erosion without causing more erosion?

Skills

Analyse

Gather and select appropriate information; determine accuracy, validity, and relevance of the information; identify perspectives; communicate findings.

Investigate
Ask and revise questions; locate several relevant and dependable details to support an answer; organize and compare details; identify relationships, recognize represented perspectives, and communicate findings.

Compare
Make observations; identify similarities and differences; identify relationships and offer an interpretation; communicate the findings.

Background Knowledge
The following chart provides an alignment of related concepts between grade levels:

Grade 3	Grade 4	Grade 7	Grade 8
Learners will have analysed soil in the environment including how water interacts with soil in the environment and concepts such as erosion, water absorption and drainage.	Learners will have investigated how the Earth's surface changes over time, including concepts such as the rock cycle and erosion.	Learners will analyse factors that affect coastline change. Learners will explore the following concepts: waves and tides, erosion and weathering, mitigating coastal degradation	Learners will evaluate oceanographic and other evidence of climate change

Learning Experiences
The suggested indicators are organized in a way to scaffold learning in support of the outcome. The exploration of skills and concepts for this outcome can be done in any order, concurrently, or selectively based on the progression of learning. The experience described below is presented independently from the other indicators that support the outcome, however, in practice multiple indicators can be addressed simultaneously. For example, learners may *analyse the impact of waves and tides on rivers and coastlines* while *comparing possible strategies for mitigating coastal degradation.*

Indicators
- Investigate weathering and erosion (COM/CT)
- Analyse the impact of waves and tides on rivers and coastlines (COM/CT)
- **Compare possible strategies for mitigating coastal degradation** (CZ/PCD/CT/TF)

Overview
Learners research and compare different strategies for mitigating coastal degradation. Strategies to explore might include: living coastlines, seawalls, groynes, breakwaters, dams, concrete barriers, natural barriers etc., alternatively, learners may research new potential strategies that use innovative technologies or are in development.

Evidence of Learning for the indicator:

Compare possible strategies for mitigating coastal degradation

Evidence of learning can be gathered as learners identify similarities, differences and relationships between different strategies for mitigating coastal degradation as well as the environmental and social impact of the strategies.

The evidence found through the learning experience for this indicator are suggestions of what teachers can look for in relation to skills and concepts. Regardless of the methods used, it is necessary for teachers to be intentional about collecting evidence of student learning to inform next steps for teaching.

Description of learning experience for the indicator

Compare possible strategies for mitigating coastal degradation

Potential Guiding Questions

- How do humans interact with the natural processes of coastline erosion?
- How can we control erosion without causing more erosion?

*The learning experience below is **one possibility** to engage learners with **this indicator**. It will be necessary to modify this experience to engage learners in a culturally and linguistically responsive way.*

Learners should start by choosing strategies for mitigating coastal degradation to compare. Suggestions might include: living coastlines, seawalls, groynes, breakwaters, dams, concrete barriers, natural barriers etc., alternatively learners may research new, potential strategies that use novel technology or are futuristic.

Make observations

Learners will gather information about the strategies and make observations about their function, their success, what is involved, their drawbacks, etc. This can be accomplished by interviewing Elders, conducting research, speaking to local community groups, interviewing academics working in this field, etc.

Essential Graduation Competencies

Technological Fluency
This provides learners an opportunity to examine how technology and society impact and advance one another

Learners should devise a method for recording their observations and the information they collect. This information may take various forms such as: interview transcripts, diagrams, photos, data tables, maps, recordings, etc. Learners can do this individually or in small groups. Alternatively, learners could collect observations about one strategy and then pair up with other groups for the remaining parts of this learning experience.

Evidence of Learning (Observations)

As learners **make observations** of the various mitigation strategies, the teacher can collect evidence of learning about the process that they use and assist them by asking about details that they have yet to consider.

Identify similarities and differences

Once learners have collected observations about the strategies for mitigating coastal degradation, they should identify similarities and differences between them. Learners can do this in pairs or small groups, depending on the set-up for the observation stage. Learners should record the similarities and differences and may be guided using a graphic organizer such as a Venn diagram.

Essential Graduation Competencies

Critical Thinking
This provides learners an opportunity to analyse information and evidence, suspending judgement and accepting ambiguity.

Evidence of Learning (Products)

Learners summarize their observations and **similarities and differences** using a visual or written method. The teacher can provide feedback to help learners consider outcomes/impact as well as basic characteristics of the strategies.

Identify relationships and offer an interpretation

Using their initial observations and the similarities and differences, learners will identify the relationships between the types of strategies and between the outcomes of the strategies. Learners can offer interpretations of what it would mean - environmentally and socially - to implement each of the strategies.

Essential Graduation Competencies

Citizenship

This provides learners an opportunity to analyse possible consequences of decisions and to develop skills that support environmental sustainability

Evidence of Learning (Conversations)

As learners share their **interpretations** of the strategies and their effectiveness, the teacher can provide feedback on how to use observations to support their interpretations. Additional evidence of learning can be gathered as learners discuss the environmental and social **relationships** and implications of the various strategies.

Moving Forward

Which strategies do you think will have the biggest impact on slowing coastline change due to erosion, weathering and tides?

Appendix

What is scientific reasoning?

The decisions scientists make have far reaching implications on science, technology, society, and the environment. Much of science involves making decisions based on logic and reasoning. The nature of science requires that learners analyse observations and data to draw conclusions that are well articulated and supported with a logical defense. Learners need to be provided with opportunities to practice scientific reasoning in the development of critical thinking and communicative competencies.

At the P-3 level, learners will engage in scientific reasoning by

- Beginning to recognize multiple viewpoints
- Making decisions and effectively articulating reasons
- Beginning to recognize there are multiple options for solutions
- Evaluating implications of decisions
- Demonstrating respect for the decisions of others

At the 4-6 level, learners will engage in scientific reasoning by

- Recognizing the difference between opinions and evidence
- Beginning to identify questions that have conflicting solutions
- Recognizing multiple viewpoints
- Effectively articulating supporting arguments for a decision
- Using analysis of facts/data to make a decision
- Recognizing there are multiple options for solutions
- Evaluating implications of decisions
- Demonstrating respect for the decisions of others

At the 7-9 level, learners will engage in scientific reasoning by

- Differentiating decisions based on opinions from those supported by evidence or logic
- Identifying questions that have conflicting solutions
- Investigating multiple viewpoints
- Effectively articulating a logical explanation for a decision using evidence
- Using systematic thinking (thorough, reasoned analysis of facts/data) to make a decision
- Identifying multiple options for solutions
- Evaluating a decision
- Demonstrating respect for the decisions of others

At the 10-12 level, learners will engage in scientific reasoning by

- Differentiating decisions based on opinions from those supported by evidence or logic
- Identifying questions that have conflicting solutions
- Communicating/Explaining multiple viewpoints
- Effectively articulating a logical explanation for a decision using evidence from multiple sources
- Using systematic thinking (thorough, reasoned analysis of facts/data) to make a decision
- Evaluating multiple options for solution
- Evaluating a decision

- Demonstrating respect for the decisions of others

Science Scope and Sequence - Overview

Gr.	Life Sciences	Physical Sciences	Earth and Space Sciences	Nature of Science – Scientific Processes
P	Living Things	Materials Movement	Sand and Water	Gathering observations using the senses Asking testable questions Investigating cause and effect Fair test Testing variables Controlling variables Using evidence to make conclusions
1	Needs of living things	Materials, objects and devices	Daily and Seasonal Changes	
2	Animal Growth and Changes	Liquids, solids and mixtures Motion	Air and water in the environment	
3	Plants	Invisible forces Structures	Soil	
4	Habitats	Light Sound	Rocks and minerals	Gathering observations using tools Presenting collected data multiple ways Identifying patterns in results and observations Investigating properties and change Designing simple experiments to control variables Using results of experimentation to make claims
5	Healthy body and body systems	Forces and simple machines Chemical and physical properties and changes of matter	Weather	
6	Diversity of life	Electricity Flight	Space components	
7	Environmental Action: Ecosystem components	Engineering Structures Environmental Action: Solutions Chemistry	Geological Evolution	Systematic approach to scientific inquiry Designing more complex experiments to control variables Data collection, processing and analysis Communication of scientific arguments based on evidence Considering multiple perspectives regarding decision-making and the applications of science
8	Cells and Systems	Climate Change: Heat Hydraulics and Pneumatics: Fluids	Climate Change: Ocean Systems	
9	Reproduction	Atoms and Periodic Table Electricity	Space components and discovery	

10	Ecosystems and Sustainability	Motion Chemical Reactions	Weather	Evaluating scientific designs Examining error and conducting statistical analysis of data Application of the Nature of Science cross-cutting concepts Critically thinking about the outcomes and applications of science with consideration of ethics
11	Body Systems Cell components Cell respiration and Photosynthesis Taxonomy and diversity of life Interactions among living things Biomes Population dynamics	Stoichiometry From Structures to Properties - Bonding Organic Chemistry Kinematics Dynamics Momentum and Energy Waves	Ocean structure and motion Marine Biome Coastal Zones	
12	Nervous and endocrine systems Reproduction DNA Genetics Evolution, Change and Diversity	Thermochemistry from Solutions to Kinetics to Equilibrium - rates of reaction and dynamic equilibrium Acids and Bases Electrochemistry force, Motion, Work and Energy Fields - Magnetic, Electric, Gravitational Waves and Modern Physics including quantum physics	Geology and Earth Systems Crystallography, Mineralogy and Petrology Plate Tectonics Forces and Structures of Earth's Interior Surface Processes: Weathering, Erosion and Deposition Fossil record and Geological Time Environmental Geology	