

Unit 1
Water Systems on Earth's Surface
Suggested Time: 24 Hours

Unit Overview

Introduction

Over two-thirds of the Earth's surface is covered by oceans and freshwater features. Because of this, our planet has been nicknamed the "Blue Planet" due to its appearance from space. A study of the Earth's marine and freshwater systems provides opportunity for students to learn about the relationship between the geomorphology of the Earth, and the dynamics of oceans and freshwater basins. As students develop these understandings, they should be able to explain how these geological features have developed and their impact on society.

In Newfoundland and Labrador, we have considerable shorelines, ranging from towering steep cliffs to flat sandy beaches. In addition, most people in our province live close to the ocean and have many experiences with it. The close proximity of our province to the ocean, as well as the influence the ocean has on our climate, economy, and lifestyles should make this unit particularly relevant to many students.

Focus and Context

The focus of this unit is inquiry. Students should have opportunities to investigate how the ocean and shorelines interact, what relationships exist between ocean currents, wind and climates, and how these abiotic factors impact life in and around the ocean. The context of this unit could include local coastlines as well as how the ocean and local coastlines interact.

Science Curriculum Links

At the elementary level, students were introduced to and explored the effects of wind, water and ice on the landscape and should be able to demonstrate a variety of methods of weathering and erosion. As well, students will have learned about the constant circulation of water on Earth through the processes of evaporation, condensation, and precipitation. In high school, students will investigate heat transfer in the hydrosphere and atmosphere, its effects on ocean currents as well as the development, severity and movement of weather systems. At later grades, students may opt to study Earth systems in which they investigate the major interactions among the hydrosphere, lithosphere, and the atmosphere.

Curriculum Outcomes

STSE	Skills	Knowledge
<p><i>Students will be expected to</i></p> <p>Nature of Science and Technology 109-13 explain the importance of choosing words that are scientifically or technologically appropriate 110-8 describe examples of how technologies have been improved over time</p> <p>Relationships Between Science and Technology 111-3 provide examples of technologies that have enabled scientific research 111-6 apply the concept of systems as a tool for interpreting the structure and interactions of natural and technological systems</p> <p>Social and Environmental Contexts of Science and Technology 112-3 explain how society's needs can lead to developments in science and technology 112-5 provide examples of public and private Canadian institutions that support scientific and technological research and endeavours 112-6 provide examples of Canadian contributions to science and technology 113-2 describe possible positive and negative effects of a particular scientific or technological development, and explain how different groups in society may have different needs and desires in relation to it 113-10 provide examples of problems that arise at home, in an industrial setting, or in the environment that cannot be solved using scientific and technological knowledge</p>	<p><i>Students will be expected to</i></p> <p>Initiating and Planning 208-2 identify questions to investigate arising from practical problems and issues 208-8 select appropriate methods and tools for collecting data and information and for solving problems</p> <p>Performing and Recording 209-1 carry out procedures controlling the major variables 209-4 organize data using a format that is appropriate to the task or experiment 209-5 select and integrate information from various print and electronic sources or from several parts of the same source 209-6 use tools and apparatus safely</p> <p>Analyzing and Interpreting 210-3 identify strengths and weaknesses of different methods of collecting and displaying data 210-4 predict the value of a variable by interpolating or extrapolating from graphical data 210-6 interpret patterns and trends in data, and infer and explain relationships among the variables 210-11 state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea</p> <p>Communication and Teamwork 211-2 communicate questions, ideas, intentions, plans, and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language, and other means 211-4 evaluate individual and group processes used in planning, problem solving, decision making, and completing a task</p>	<p><i>Students will be expected to</i></p> <p>306-3 describe interactions between biotic and abiotic factors in an ecosystem 311-7 describe processes that lead to the development of ocean basins and continental drainage systems 311-8 analyse factors that affect productivity and species distribution in marine and fresh water environments 311-9 describe the interactions of the ocean currents, winds, and regional climates 311-10 explain how waves and tides are generated and how they interact with shorelines 311-11 describe processes of erosion and deposition that result from wave action and water flow 311-12 describe factors that affect glaciers and polar icecaps, and describe their consequent effects on the environment 332-3 describe major interactions among the hydrosphere, lithosphere, and atmosphere</p>

Water Cycle's Vital Role

Outcomes

Students will be expected to

- describe major interactions among the hydrosphere, lithosphere, and atmosphere (332-3)
- define water cycle

- label a diagram of the water cycle

Elaborations—Strategies for Learning and Teaching

To begin this unit, teachers should review the distribution of water on Earth and the vital role that the water cycle plays. Teachers could make a 10 by 10 block grid and shade 97 blocks to represent the percentage of salt water, 2 blocks to represent the percentage of frozen water and 1 block to represent the percentage of available fresh water on Earth. Teachers could have students complete a K-W-L Chart (Appendix B). Teachers should note that the water cycle was previously introduced in the grade 5 Weather unit, in which students related the constant circulation of water on Earth to the processes of evaporation, condensation and precipitation. These topics will also be covered in greater depth in high school science courses.

Students should be able to label a diagram of the water cycle. While teachers could have students draw a diagram of the water cycle, it is more important that they be able to identify the various components of the cycle, how the water is cycled between the oceans, atmosphere and freshwater sources (land). When discussing the water cycle, teachers should introduce the terms “hydrologist” and “oceanographer” to indicate the specialities of scientists who study water at the various parts of the water cycle.

Teachers should clarify that the interactions between the atmosphere, land, and water bodies, are much more complex than indicated in a diagram of the water cycle. For example, freshwater from rivers can lower the salt content where the river empties into the ocean. As a result, certain species of marine life will not be able to survive there while others thrive. When water flows over land, it picks up or dissolves minerals, chemicals, etc. When it empties into another body of water (lake or sea) those substances may be harmful or helpful to the organisms living there.

Teachers could have students engage in a Two-minute Review (Appendix B) of the material they have covered to this point.

Water Cycle's Vital Role

Suggested Assessment Strategies

Journal

- Describe a personal experience in which you have been affected by waves or currents while in the water. (332-3)

Performance

- Create a song or jingle to help remember the parts of the water cycle. (332-3)
- Create a model of the water cycle. (332-3)

Paper and Pencil

- Describe a situation where you have witnessed an exceptional tide or wave event. (332-3)
- Compare and contrast the work of a hydrologist and an oceanographer. (109-13)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 8-11

TR AC #24

BLM 1-7, 1-8

ST pp. 9, 10, 20

BLM 1-7, 1-8

TR AC #6

Conventions used in Resources Column

ST = Student Text

TR = Teacher Resource

TR AC = Assessment Checklist

TR PS = Process Skills Rubric

TR AR = Assessment Rubric

BLM = Black Line Master

BLM 8 Activity # = Additional
BLM's for each grade level

Comparing Ocean Water and Fresh Water

Outcomes

Students will be expected to

- describe major interactions among the hydrosphere, lithosphere, and atmosphere (332-3)

(continued)

- distinguish between ocean water and fresh water.

Include:

- salinity
- density
- freezing point

- carry out procedures in order to investigate how salinity effects density (209-1)
- use tools and apparatus safely (209-6)
- interpret trends in data, and explain relationships among the variables (210-6)
- communicate questions, and results using notes, and drawings (211-2)
- state a conclusion about the effect of salinity on density (209-4, 210-11)

Elaborations—Strategies for Learning and Teaching

Teachers could use a table, such as the one below, when addressing this outcome. Students should distinguish between fresh water and ocean water qualitatively. Quantitative values have been included in the table for information purposes only. Students are not expected to memorize these values.

	Ocean Water	Fresh Water
Salinity	More salt (~35 g/L)	Less salt (~0 g/L)
Density	More dense (1.022 kg/L)	Less dense (1.000 kg/L)
Freezing Point	Lower (-1.9°C)	Higher (0°C)

Core Laboratory Activity: Salinity’s Effect on Water Density

The laboratory outcomes 209-1, 209-4, 209-6, 210-6, 210-11, and 211-2, are addressed, in whole or in part, by completing CORE LAB 1-2B “The Effect of Salinity on Water Density”.

This laboratory activity will investigate the relationship between salinity and water density. Varying the salinity of the water represents fresh water and ocean water. The laboratory activity explores how they interact when mixed. Students should extend their learnings to environments on Earth where fresh water and ocean water would meet.

Comparing Ocean Water and Fresh Water

Suggested Assessment Strategies

Performance

- Create a poster that distinguishes between salt water and freshwater. (332-3)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 14-17

BLM 1-9

Core Lab #1: Salinity's Effect on Water Density, p. 18

TR pp. 1.10-1.11

BLM 1-10

BLM 8 Activity 3

TR AC #4

ST pp. 475-475 (Science Skills)

Sources of Fresh Water

Outcomes

Students will be expected to

- describe major interactions among the hydrosphere, lithosphere, and atmosphere (332-3)

(continued)

- identify sources of fresh water. Include:
 - (i) drainage basins
 - (ii) ground water
 - (iii) glaciers

- describe how periods of climate change affect glaciers and describe the consequent effects on the environment (311-12)

Elaborations—Strategies for Learning and Teaching

Using maps of the area, teachers could have students research local sources of fresh water.

Teachers could have students begin a “water systems” mind map (Appendix B) to summarize the information they have covered to this point.

Students could complete a K-W-L Chart (Appendix B) to introduce this topic and to activate their prior knowledge.

In a time of debate about climate change, students should explore the topic and speculate about the effects climate change would have on glaciers and polar ice caps (advancing or retreating), availability of fresh water resources, permafrost, ocean water levels and our coastal communities. Periods of global warming and global cooling should be explored. Teachers should highlight that extended periods of global cooling are referred to as ice ages.

Students could also engage in discussions of everyday examples of liquids expanding when heated, such as water in a radiator or gasoline in a gas tank on a warm day. This could lead to predictions about the volume of ocean water if heated.

Sources of Fresh Water

Suggested Assessment Strategies

Performance

- Create a poster or collage that describes the various sources of fresh water. (332-3)

Presentation

- Students will be given the following role:
You have just been elected as president of the Worldwide Glacial Conservation Society and your job is to convince people around the world that glaciers need to be protected and preserved. You will create a visual display which conveys this message for your organization. Your display may be a poster, a brochure, a web page, or even a short video. (311-12)

Pencil and Paper

- Create a graph or poster illustrating the extent of sea ice in the Canadian Arctic over the past decade. (311-12)
- Write a newspaper article about the effects a rise in sea level would have on cities or towns in our province. (311-12)
- Construct a flow chart which shows how climate change affects glaciers and consequently, the environment. (311-12)
- Research and construct a time line of the periodic ice ages. (311-12)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 22-24, 26-27

ST pp. 24-25, 30

BLM 1-12

BLM 8 Activity 4

BLM 8 Activity 12

TR AC #24

Water Systems and Species Distributions

Outcomes

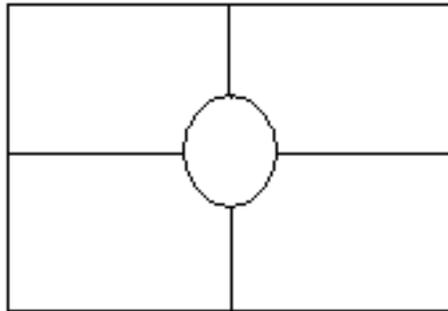
Students will be expected to

- analyze factors that affect productivity and species distribution in freshwater and marine environments (311-8)

Elaborations—Strategies for Learning and Teaching

As they are introduced to freshwater and marine (salt water) environments, students should be introduced to the species found in each environment and the factors that will affect water quality. Examples of freshwater environments that can be discussed include: lakes and ponds; wetlands; rivers and streams; and estuaries. Although students will recognize the organisms in the macro-environment, such as worms, trout, and beaver, they should be made aware of organisms with which they may be unfamiliar, such as invertebrates and plant species. Categories of species should include: invertebrates, vertebrates, microorganisms and plants.

Teachers could have student groups of four take part in a “place mat activity”. Divide a large sheet of paper (for example, ledger paper or flip chart paper) into four equal parts with a centre circle.



Each student is assigned one of the four blocks. In these blocks, students will individually record the answer to this question: List the species found in freshwater environments. Then, the group will collaborate and agree on a group answer which will be recorded in the centre circle.

Students could then repeat the activity for a saltwater environment. Examples of marine (saltwater) environments include: pelagic zone (areas not close to the bottom) and benthic zone (ocean bottom). The ecological region of the benthic zone includes the sediment surface and some sub-surface layers.

When describing life in marine environments, teachers should include the relationships between life found in the zone, water temperature, and the penetration of sunlight. Categories of species should include: invertebrates, vertebrates, microorganisms, and plants.

Wildlife biologists could be invited to elaborate on the types of organisms found in the various environments.

Water Systems and Species Distributions

Suggested Assessment Strategies

Performance

- Create a poster or collage that shows the types of plants and animals that are found at various areas of a marine or freshwater environment. (311-8)
- Create a song, poem, or rap that describes the types of plants and animals that are found at various areas of a marine or freshwater environment. (311-8)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 90-94

BLM 1-34, 1-35

TR AR #3

Water Systems and Species Distributions (continued)

Outcomes

Students will be expected to

- identify the effects of abiotic factors on plant and animal distributions in marine and freshwater ecosystems.
(208-2, 306-3) Include:
 - (i) temperature
 - (ii) dissolved oxygen
 - (iii) phosphates
 - (iv) increased acidity
 - (v) turbidity
 - (vi) pollution
 - (vii) upwelling (marine)

Elaborations—Strategies for Learning and Teaching

Students will have identified biotic and abiotic factors and investigated and their relationships within Newfoundland and Labrador ecosystems in grade 7.

Teachers could consider completing the Core Lab 3-3B prior to addressing this outcome or addressing them concurrently.

The abiotic factors identified for our marine and freshwater environments have an impact on the types of organisms that inhabit our waters. Students could investigate how factors such as salinity, ocean currents, pollution and upwelling affect productivity and species distribution in marine and fresh water environments.

Upwelling should be described as the vertical motion of water in the ocean, whereby subsurface water of lower temperature and greater density moves toward the surface of the ocean. Upwelling occurs most commonly along the western coastlines of continents, but may occur anywhere in the ocean. Upwelling can result when strong winds blowing near continental coastlines transport the light surface water away from the coast. The upwelled water contains an abundance of nutrients which support plant life near the surface. These plants, in turn, attract animal life. Upwelling is an important mechanism for producing nutrient-rich ocean water.

As enrichment, teachers could mention two other abiotic factors that affect marine species distribution: salinity and ocean currents. Ocean currents can be warm or cold and each plant and animal species has a specific tolerance level relating to water temperatures. The same applies to salinity which refers to the dissolved salt content of a water body. The salinity level of a body of water can also affect the salt content in nearby air and can influence the plants and animals that inhabit land adjacent to such bodies of water.

Teachers could have students take part in a Quiz-Quiz-Trade activity (Appendix B) to review these concepts.

Students could add a “species distribution” branch to their mind map and add this information.

Water Systems and Species Distributions (continued)

Suggested Assessment Strategies

Paper and Pencil

- Choose one abiotic factor which affects a body of water, such as temperature, pollution, upwelling, salinity, or ocean currents, and construct a flow chart showing how these may affect plant and animal distribution.

Example:

Ocean temperature increases--> ocean holds less gas such as oxygen--> fish may have to move to more oxygen-rich waters--> local fisheries may be affected (111-6, 210-6, 306-3, 311-8)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 58, 90-97, 100-104

BLM 1-36, 1-39, 1-41

BLM 8 Activity 14

Water Systems and Species Distributions (continued)

Outcomes

Students will be expected to

- select appropriate methods and tools for collecting data and information and for solving problems (208-8)
- interpret patterns and trends in data, and infer and explain relationships among the variables (210-6)
- prepare a presentation or report on the effect of abiotic factors on the distribution of species in freshwater and marine environments and evaluate processes used in planning and completing the task (211-2, 211-4)
- predict and interpret trends in populations of a marine species from graphical data by interpolating and extrapolating data (210-4, 210-6)

Elaborations—Strategies for Learning and Teaching

Core Laboratory Activity: Water Health Test: LAB A – Freshwater Environment

The laboratory outcomes 208-2, 208-8, 210-6, 210-11, 211-2, 211-4 and, in part, 306-3 are addressed by completing CORE LAB 3-3B “Water Health Test: LAB A – Freshwater Environment”.

Teachers should focus on the abiotic ranges that support life. For example, dissolved oxygen levels should be 5 mg/L or greater, phosphate levels should be less than 10 µg/L, and pH should be in the range of 5 to 8.5. Teachers should ensure that student recognize that as factors change, the suitability of an ecosystem to support particular plants and animals also changes.

If time and circumstances permit, students could conduct LAB B – Saltwater Environment to determine the water quality of a marine environment.

Teachers could provide students with population graphs of certain species over time to interpolate and extrapolate marine populations.

Teachers could have students compare population graphs with graphs of water temperature and salinity, and suggest possible relationships. This activity could be carried out throughout the rest of this unit.

Water Systems and Species Distributions (continued)

Suggested Assessment Strategies

Performance

Observation checklist for core lab activity (208-8, 210-6, 211-4)

	Rarely			Always
	1	2	3	4
Follows procedure carefully				
Works collaboratively with partners				
Interprets trends in data				
Explains relationships among variables				
Actions promote safety of self and others				

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

Core Lab #2: Water Health

Test: LAB A - Freshwater Environment, p. 108

ST pp. 108-111

BLM 1-43, 1-44, 1-45, 1-46

BLM 8 Activity 3

TR pp. 1.48-1.50

TR AC #4

ST pp. 474-475, 483-487

(Science Skills)

Exploration of Ocean Basins

Outcomes

Students will be expected to

- describe processes that lead to the development of ocean basins and continental drainage systems. (311-7)
Include:
 - (i) volcanic action
 - (ii) plate tectonics
 - (iii) erosion
 - (iv) glaciation

- using a diagram, illustrate a typical oceanic basin from coastal shoreline to mid-ocean ridge. Include:
 - (i) continental shelf
 - (ii) continental slope
 - (ii) abyssal plain
 - (iv) mid-ocean ridge

- provide examples of public and private Canadian institutions that support scientific and technological research involving the oceans. (112-5, 112-6) Include:
 - (i) Environment Canada
 - (ii) Federal Fisheries
 - (iii) Ocean Sciences Centre
 - (iv) Centre for Cold Ocean Research C-CORE at Memorial University

Elaborations—Strategies for Learning and Teaching

Students have been introduced to some of these concepts in grade 7 science when the theory of plate tectonics was discussed.

Teachers should ensure that students are able to explain how volcanoes helped to form the Earth's oceans. In the description of these processes, teachers should ensure that students recognize the role of volcanoes and the role of glaciation. The discussion of glaciation should be limited to its role as a force of erosion in developing continental drainage systems.

Teachers should ensure students understand that as sediments are created from weathered rocks, they are carried by rivers into oceans and eventually to continental shelves and abyssal plains. The continental slope is the steeply sloping area on the edge of the continental shelf. Mid-ocean ridges are a chain of volcanic mountains rising in the middle of oceans.

Students should be able to label a diagram of the components of an oceanic basin.

Teachers could provide students with maps that illustrate the continental shelf and continental slope that surround our province.

References to, and investigation of, Canadian institutions involved with research of the oceans and the ocean floor could be made throughout the unit.

Environment Canada (weather), the Federal Department of Fisheries, and Memorial University's Ocean Sciences Centre, C-CORE, Oceanography Department and Fisheries and Marine Institute are only a few of the many institutions and groups which research ocean related topics. While teachers could encourage students to inquire about the general focus at these institutions and organizations, it is only required that students are aware that these agencies exist.

Teachers could use a "Quiz-Quiz-Trade" activity to review the topics covered to this point.

Teachers could have students add an "ocean exploration" branch to their "water systems" mind map.

Exploration of Ocean Basins

Suggested Assessment Strategies

Journal

- Explain how new ocean floor is formed at mid-ocean ridges. (311-7)

Pencil and Paper

- Students will draw a cross section of a typical continental margin from coastline to mid-ocean ridge. Label your diagram with the following (210-3, 311-7):
 - continental shelf
 - continental slope
 - abyssal plain
 - mid-ocean ridge

Performance

- Create a song, rap, or poem that describes the movement of a particle of sediment as it is carried from land to an ocean basin. Remind students that forces such as glaciation, water and wind erosion and even gravity provide the means by which particles move. (311-7)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 38-43, 50

BLM 1-15

ST pp. 41-43, 48-49

BLM 1-16, 1-17, 1-18

ST p. 62

Exploration of Ocean Basins (continued)

Outcomes

Students will be expected to

- investigate technologies that have assisted scientists to research ocean basins. (111-3, 209-5) Include:
 - (i) sonar
 - (ii) satellites
 - (iii) underwater photography/videography
 - (iv) deep sea submersibles
 - (v) diving
- provide examples of how technologies, used to investigate the ocean floor, have improved over time (110-8)
- identify some strengths and weaknesses of technologies used to investigate the ocean floor (210-3)
 - recognize that no single data collection method provides a complete picture of the ocean floor

Elaborations—Strategies for Learning and Teaching

The **CORE STSE** component of this unit incorporates a broad range of grade 8 science outcomes. More specifically, it targets, in whole or in part, 110-8, 111-3, 209-5 and 210-3. The STSE component, “Undersea Adventure” can be found in Appendix A.

The STSE component for this unit explores the use of deep sea submersibles. Teachers could have students explore these technologies with a jigsaw activity (Appendix B).

The investigation and study of the processes that lead to the development of ocean basins and continental drainage systems are often based on evidence and data collected from indirect observations (e.g. sonar, satellites). Investigating the utility of these technologies would help students to better appreciate the interconnectedness of various science disciplines as well as how we learn from indirect observations.

Teachers could highlight examples of recent underwater explorations including the discovery of the Titanic and other shipwrecks. Teachers could have students research underwater exploration technologies to rate significant changes and improvements from past to present. Research could include diving versus submersibles and wire line depth probes versus sonar. Local diving club members or fishers could be invited to give presentations about how technology has changed over the years.

Teachers should ensure students understand that all technologies have their own particular strengths and weaknesses. This could be accomplished using investigation, research and/or discussion.

Classroom activities designed to gather data using indirect observation would permit students to extrapolate their experiences to a greater scale. For example, to simulate “taking soundings”, teachers could place Plasticine™, or other material, on the bottom of a shoebox to create an irregularly shaped surface. The cover on the box should then be sealed. Students then collect data about the surface by making holes in the cover of the box and using a measuring device, such as a calibrated straw. Teachers could then have students graph their data in various ways to create cross-sectional views of the “bottom”.

Teachers should encourage students to identify the strengths and weaknesses of this collection method. Teachers should ensure that students understand that although relative depths can be determined, the composition of the bottom cannot be determined using this method.

Exploration of Ocean Basins (continued)

Suggested Assessment Strategies

Presentation

- Students will be divided into groups and each group will be assigned one of the following investigative ocean technology tools to research: sonar, satellites, core sampling, underwater photography/videography, deep sea submersibles, or diving. For their assigned technology, students will provide the following information:
 - how the technology works
 - what information it gives
 - how the technology has evolved from past to present
 - the strengths and weaknesses of the technology
 - examples of public and private institutions who use this technology, including Canadian examples
 - a picture or diagram.

Each group will then present their findings to the class. This can be done in a variety of ways, for example; multimedia presentation, web page, whole group presentation, poster etc. This can also be done using a paper template and assembled in a booklet form so that each student has a copy. (111-3, 209-5, 110-8, 210-3, 112-5)

- Choose one of the underwater exploration techniques, investigate it, and create an historical time line. Present your findings to the class.

Paper and Pencil

- Develop a graphic organizer on a 11 x 17 piece of paper. Divide the paper into 4 equal sections which will be respectively labelled sonar, satellites, submersibles, and underwater cameras. Draw a picture of each technology while in use and explain how the technology works to provide information about ocean basins. (111-3, 209-5)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

Appendix A

ST pp. 44-47, 52-61

BLM 1-19

TR AC 22

TR AR 3

TR AC 11

BLM 8 Activity 4

Ocean Currents and Waves

Outcomes

Students will be expected to

- describe the interactions of the ocean currents, winds, and regional climates (311-9)
 - define ocean current
 - identify local ocean currents. Include:
 - (i) Labrador Current (cold)
 - (ii) Gulf Stream (warm)

- explain how waves and tides are generated (311-10)
 - define wave
 - identify that waves on the surface of water are the result of a transfer of energy from moving air to the water

Elaborations—Strategies for Learning and Teaching

To introduce waves, tides and water currents, students could be asked if they have ever seen or experienced exceptional events involving waves or tides. Pictures or video of extraordinary local events could be viewed. Surge tides and large waves produced by storms could present a context to set the scene for this topic. Students could also be asked if they have ever felt the force (energy) of waves and/or currents while standing or swimming in a body of water.

Teachers could refer students to Figure 2.13 of the student textbook to illustrate how currents are distributed on Earth.

At this point, teachers should limit treatment of local ocean currents to include where the ocean current originates, direction of flow and relative temperature. The effects these currents have on our regional climate will be further addressed later in the unit.

Students could add an “ocean currents” branch to their mind map.

Most shoreline processes, such as erosion, are either directly or indirectly related to the action of waves. An understanding of waves is very important for the study of shorelines. Waves are generated primarily by the wind. The energy of the wind is transferred across the surfaces of bodies of water. The size of waves is influenced by the speed and duration of the wind as well as the size of the water area it passes over. When the waves come into contact with the shoreline, the energy is then used to erode and reshape the coast.

Teachers should limit treatment to developing the concept that a wave is moving water that transfers energy.

Teachers could point out the difference between ocean waves, swells, breakers, and tsunamis. Teachers could reference the tsunami that hit the south coast of the island of Newfoundland in 1929.

Teachers could have students investigate waves in a basin, sink or large baking pan filled with water. Students could apply forces to the water to generate waves. Students should note the relationship between the strength of the generated waves and the strength of the force used to create them.

Teachers could have students add this information to their mind maps. Teachers could also have students engage in a “numbered heads” review or a Quiz-Quiz-Trade activity (Appendix B) of the information to this point.

Ocean Currents and Waves

Suggested Assessment Strategies

Performance

- Create a poster which describes the local ocean currents that affect Newfoundland and Labrador. (311-9)

Presentation

- Create a poem, song, or rap for each each ocean current that affects Newfoundland and Labrador. (311-9)
- Choose and research a current from Figure 2.13 (ST p. 52). Prepare a brief presentation. Include:
 1. a map indicating where the current exists
 2. the direction of the current
 3. description of affects on regional climate. (311-9)
- Research tsunami occurrences throughout history and present this information in one of the following formats:
 - (i) multimedia
 - (ii) web page
 - (iii) poster
 - (iv) brochureResearch information should include date, location (include a map), cause, destruction, and pictures. (311-10)

Portfolio

- Students will research and collect pictures showing the effect of wind in creating ocean waves. Students should make note of the geographic location of these pictures and make conclusions regarding size of the waves and the impact of the wind in that situation. (311-10)

Pencil and paper

- Research the Newfoundland tsunami of 1929, report its cause and it effects. (311-10)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 52 -53

ST pp. 64-66

BLM 8 Activity 5

Waves and Shorelines

Outcomes

Students will be expected to

- describe the processes of erosion and deposition at shorelines that result from wave action and water flow (311-10, 311-11)
- identify that wave interactions with shorelines depend on:
 - (i) shape of the shoreline
 - (ii) slope of the shoreline
 - (iii) type of rock material
 - (iv) wave energy
- explain how waves affect headlands and bays

Elaborations—Strategies for Learning and Teaching

Teachers could ask students to identify the similarities and differences between a variety of shorelines. This can be presented in the form of photographs, slides or a video. Students can then begin to explore the reasons for the differences and similarities.

Teachers should remind students that weathering is the breakdown of rocks into smaller particles; erosion is the movement of those weathered particles; and deposition is when eroded material is dropped or left behind. These terms were defined in grade 7 science.

The energy of the wave is what causes shorelines to erode and sediments to be deposited on the shore. Tides work together with waves and determine the range of shoreline that can be affected by wave action.

Teachers should have students observe that deposition occurs on shorelines with shallow slopes while erosion occurs on shorelines with steeper slopes. Teachers could use a stream table to demonstrate these processes.

Teachers should have students observe the relationship between the amount of erosion and particle size. Smaller particles are more easily eroded whereas larger particles are left behind. This could be demonstrated using the stream table.

Teachers should ensure students recognize that less resistant rock types, such as sandstone, will erode at a faster rate than more resistant types, such as shale. For example, the red rocks found in St. George's erode faster than the cliffs of Bell Island in Conception Bay.

Teachers should focus treatment on how wave energy is concentrated on headlands and spreads out as it reaches bays. Students should relate the energy of a wave to its power to erode and deposit.

Waves and Shorelines

Suggested Assessment Strategies

Performance

- Teachers can use a large plastic container or wave tank to demonstrate wave generation by wind. Students can investigate trends in the size and energy of waves created by placing a fan or other wind source at a variety of locations relative to the water container. Note: This should be a teacher demonstration due to the potential hazards of water and electricity in close proximity.

Students will draw diagrams and explain the trends they observed.

Extension: Teachers may consider varying the size of the water container and/or the fan speed to show the effect on wave size. (311-10)

Performance

- Create a poster that describes how headlands and bays are created. (311-10, 311-11)
- Create a song, rap, or poem that describes how waves affect headlands and bays differently. (311-10, 311-11)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 66-69, 72-76

BLM 1-24, 1-27, 1-28

ST pp. 67-69

Tides

Outcomes

Students will be expected to

- explain how waves and tides are generated (311-10)
(continued)
 - define tide
 - explain how tides are generated by the gravitational pull of the moon

- distinguish between spring tides and neap tides

Elaborations—Strategies for Learning and Teaching

Students were introduced to this concept in grade 6. They observed and explained how the relative positions of Earth, the moon and the sun are responsible for the moon phases, eclipses and tides.

The daily rise and fall of the oceans is connected to the motion of the moon and the spinning of Earth. Both the sun and the moon affect the pull on Earth's water, but the moon exerts the greater influence due to its closer proximity to Earth.

Teachers should have students illustrate how the gravitational pull of the moon creates a pattern of high and low tides on the surface of the Earth.

Teachers should have students explain that spring tides occur twice monthly when the Earth, moon and sun line up creating a greater gravitational pull. During spring tides the tidal range is greatest. Neap tides also occur twice monthly when the position of the sun and moon creates a lesser gravitational pull. During neap tides the tidal range is smallest.

Teachers could use this as an opportunity to bring in local professionals such as fishermen or engineers, who use tidal information related to their profession.

Teachers could point out that, in various parts of this province, spring tides are also referred to as the "springes" or "springis".

Students could add this information to their mind maps. Teachers could have students engage in a Quiz-Quiz-Trade to review the material to this point.

Tides

Suggested Assessment Strategies

Performance

- Model tides on the surface of the Earth as they are caused by gravitational pull of the moon and to lesser extent, the sun. Each group will be comprised of at least 4 students representing the Earth, the moon, and the bulges of water on the surface, a fifth person may represent the sun. (311-10)
- Construct a graph of the mean high and low tides for several communities in our province. Using this graph predict the mean high and low tides in the neighboring communities. (311-10)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 69-71

ST pp. 69-71

BLM 1-25

Interactions at Shorelines

Outcomes

Students will be expected to

- recognize that landforms result from the processes of erosion and deposition caused by wave action and water flow. (311-11) Include:
 - (i) beaches
 - (ii) shoal
 - (iii) sand bars
 - (iv) sea caves
 - (v) sea arches
 - (vi) sea stacks

- provide examples of various technologies designed to contain damage due to waves and tides (112-3)

Elaborations—Strategies for Learning and Teaching

Teachers could engage students in a Meet and Mingle activity (Appendix B) as an introduction. Instead of using a question/answer format for this activity, teachers could provide cards with a picture on one side and the effects of erosion and deposition on the other side.

Pictures and videos of a variety of different types of shorelines could further stimulate discussion regarding the features of shorelines. A class trip could be taken to survey a shoreline in a local community.

If students live in or by a community that has a harbour that is dredged periodically, questions related to the origin of the material that is dredged could be explored.

Teachers could twin students with another community within the Atlantic provinces or on the west coast of Canada in order to compare and contrast shorelines and/or tidal phenomena.

Students could engage in a Two-minute Review (Appendix B).

Teachers should provide students with opportunities to investigate technological attempts to prevent or reduce damage to coastal areas due to wave action and tides. Teachers should provide examples of these technologies which include: breakwaters, jetties/wharves, and vegetation. Additional examples of technologies that could be discussed are: sea walls, coastline reconfiguration, and use of large boulders placed against wharves. Teachers could show photographs of examples of various methods used to limit the damage due to waves and tides. Teachers could then have students engage in a Think-Pair-Share activity (Appendix B) in which they identify which method shown appears to be the most successful and have the least environmental impact on the ecosystems present.

Wave and tidal action are the two main factors that influence shorelines. Teachers should ensure that students understand the on-going affect these two energy sources have on the shoreline. Examples of intense wave action, such as those produced during winter storms and hurricanes, could help illustrate how shorelines can be changed quickly over a short period of time. Teachers could have students engage in a Think-Pair-Share activity in which they consider which of these two factors, waves or tidal action, have the greatest impact on a local shoreline.

Interactions at Shorelines

Suggested Assessment Strategies

Paper and Pencil

- How can costal communities minimize the damage to shoreline property due to waves and tides? (112-3, 311-11)
- Draw the stages in the formation of a sea stack. (209-5, 311-11)

Presentation

- Create 3-D models of structures and technologies used to contain damage due to wave and tidal action. (112-3, 209-5)
- Create a collage of a variety of technologies used to protect shorelines from wave and tidal damage. (112-3)

Performance

- Individually, or as a member of a group, choose one of the following physical features and develop a brochure that describes the feature and explains how it forms. (209-5, 311-1)
 - beach
 - shoal
 - sand bar
 - sea cave
 - sea arch
 - sea stack
- You have just been hired by the Newfoundland and Labrador government to promote tourism within our province. Your job is to create a tourist brochure advertising attractive shoreline features of our province. The shoreline features should include examples of both those created by weathering and erosion, as well as, deposition. Include a brief description of how these features were formed. (209-5, 311-11)
- Compose a poem or a song which describes the effect of storms or tides on a local shoreline. (112-3)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 72-76

TR AR 8

ST p. 75

BLM 1-29

Oceans, Weather and Climate

Outcomes

Students will be expected to

- describe the interactions of the ocean currents, winds, and regional climates (311-9)
 - describe how oceans moderate climate

- describe how convection affects weather

Elaborations—Strategies for Learning and Teaching

The presence of warm or cold water along coastlines plays an important role in affecting the climate of a region. Water takes a relatively long time to heat up and a long time to cool down. As a result, oceans can store large amounts of heat. Additionally, currents can transport that heat to other parts of the world. In this way ocean temperatures can noticeably affect the climate of coastal areas. For example, during the summer months it takes a long time for the ocean to heat up. Once heated, oceans will stay warmer than the surrounding land mass through the fall and winter months. Conversely, oceans take a long time to cool down. Once cooled, oceans will stay cooler than the surrounding land mass through the spring and into the summer. This regulates the temperature of coastal areas. It prevents the area from being extremely hot in the summer and extremely cold during the winter. Teachers could have students research how oceans affect other aspects of coastal climates.

Students will be familiar with the concept of convection from the grade 7 science program. Teachers should ensure that students understand that warm oceans will heat the air above them resulting in thermals. As the warm air rises, cooler, denser air replaces it.

Oceans, Weather and Climate

Suggested Assessment Strategies

Interview

- Interview other students as to how water's ability to hold heat influences the weather and climate in coastal Newfoundland and Labrador? (311-9)

Paper and Pencil

- Explain how water's ability to hold heat plays a part in on-shore and off-shore breezes. (311-9)
- Create a sketch which shows the differences between on-shore and off-shore breezes and how they influence local climate. (311-9)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 82-85, 87

BLM 1-33

ST p. 85

BLM 1-32

Oceans, Weather and Climate (continued)

Outcomes

Students will be expected to

- describe the interactions of the ocean currents, winds, and regional climates (311-9)

(continued)

- recognize how Newfoundland and Labrador's close proximity to the Labrador Current and the Gulf Stream affect our climate. Include:
 - frequency of fog
 - temperature fluctuations within short time frames
- distinguish between the effects of El Niño and La Niña as global climatic influences. Include:
 - causes - trade winds decreasing or increasing
 - effects - warming or cooling of the ocean
 - results - weather patterns and marine productivity

Elaborations—Strategies for Learning and Teaching

Teachers should ensure students recognize that rapidly changing weather patterns in Newfoundland and Labrador are influenced by the interaction of the Labrador Current and the Gulf Stream.

Teachers should ensure that students see the relationship between the temperature of ocean currents and the temperature of the air masses above these currents. Warm surface currents transfer tropical heat to the atmosphere and colder currents remove heat from the atmosphere. When the warm, moist air above the Gulf Stream blows over the colder water of the Labrador Current, it cools and condenses, producing fog.

Temperature fluctuations occur rapidly in Newfoundland and Labrador due to our location between warm, tropical winds moving north and cold, arctic winds moving south. Local atmospheric temperatures depend on which of these prevail.

Teachers should have students identify El Niño and La Niña as examples of how oceans affect climate.

Teachers could use the following graphic organizer to help students distinguish between El Niño and La Niña:

	El Niño	La Niña
Trade Winds	decrease	increase
Ocean Temperature	warming (decreased upwelling)	cooling (increased upwelling)
Marine Productivity	decreases (decreased nutrients)	increases (increased nutrients)

Students should identify upwelling as the mechanism for producing nutrient-rich ocean water. An abundance of nutrients can significantly increase plankton populations on which the entire marine ecosystem depends, leading to increased marine productivity and diversity.

Students should recognize that El Niño and La Niña are responsible for changing patterns of rainfall around the world and creating weather extremes from droughts and fires on some continents to severe storms and floods on others.

Students could add this information to their mind maps.

Oceans, Weather and Climate (continued)

Suggested Assessment Strategies

Presentation

- Research the Labrador Current and Gulf Stream and prepare a brief presentation on one of the following:
 1. Why the island of Newfoundland is often considered the “foggiest place on Earth”?
 2. How have ocean currents affected human settlement patterns? (209-4, 210-11)

Paper and Pencil

- How do the Labrador and Gulf currents affect the climate of our province? (311-9)
- Research how El Niño and La Niña affect global climates. (311-9)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 87-88

ST pp. 85-86

BLM 8 Activity 15

Human Impacts on Marine Systems

Outcomes

Students will be expected to

- describe some positive and negative effects of marine technologies on ocean species (113-2)

- recognize that new technologies have contributed to over-fishing

- discuss how the offshore oil industry impacts marine environments

- recognize that aquaculture technologies can impact marine environments

Elaborations—Strategies for Learning and Teaching

Teachers should allow students to investigate several technologies to determine the potential positive or negative effects on the ocean. These technologies could include the Confederation Bridge between Prince Edward Island and New Brunswick, oil rigs on the east coast, Sable Island gas development, Fundy tidal power, factory/ freezer trawlers, and oil tankers.

Teachers could use these examples to illustrate how environmental risks, associated with oceans, are often balanced by economic and societal needs. Teachers could use a cause and effect graphic organizer to help students address this outcome. For example, the cause could be the technology and the effect of the technology could be either positive or negative.

Teachers could have students take part in an Anticipation/Reaction Guide (Appendix B) concerning the issue of over-fishing.

Discussion of over fishing is sure to elicit many factors that are believed to have caused recent declines in stocks. Teachers should limit discussion to the impact of improved fishing technology, such as catch methods, fish finding technology and vessel type.

Teachers could lead a discussion on these effects. Teachers could include in their discussion the effects of pollution including oil spills and the scouring of the ocean floor destroying marine habitats. The introduction of foreign species that can occur when oil tankers release their bilge water endangering native habitats and organisms. Some examples of invasive species include the green crab in Placentia Bay and the violet tunicate in Belleoram.

Teachers could include in their discussion the effects of an accidental release of organisms into native populations, and spread of diseases. For example, teachers could engage students in a discussion concerning some of the negative impacts that may arise as a result of increased organic matter from mussel farms, referred to as detritus rain, which can accumulate on the sea floor.

Teachers could have students use the “What? So what? Now what?” format to create a journal entry related to the impact of humans on marine systems.

Human Impacts on Marine Systems

Suggested Assessment Strategies

Performance

- Interview an individual closely connected with ocean industries, such as: a fisherman, environmentalist, fisheries scientist, conservation officer, or person working in the oil and gas or aquaculture industries. The interview should focus on the individual's perspective on how technologies have impacted marine environments, either positively or negatively. (113-2)

Paper and Pencil

- Describe an ocean related technology that you have seen and discuss the impact that you think this has on an ocean environment. Some examples of these technologies are:
 - oil rigs
 - confederation bridge
 - sable gas development
 - Fundy tidal power
 - factory freezer trawlers
 - oil tankers (113-2)
- Create a chart of positive and negative effects of marine technologies in the oceans. (113-2)
- Select an offshore oil/gas project, such as Hibernia or Sable gas, and investigate the following:
 - What are some economic benefits and costs of the project?
 - What are the uses of the product in our region?
 - What are some environmental considerations of the project? (113-2)
- How have advances in technology, such as boat design, catching methods, or fish finding technology, affected fishing in marine environments such as those here in our province. (210-4, 210-6)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

ST pp. 105-106

ST pp. 104, 112-113

ST pp. 106-107

Human Impacts on Marine Systems (continued)

Outcomes

Students will be expected to

- recognize that problems related to the oceans cannot be completely resolved using scientific and technological knowledge (113-10)

Elaborations—Strategies for Learning and Teaching

This outcome provides an opportunity for teachers to engage students in a discussion of the nature of science. In particular, students should recognize that scientific endeavors are not separate from society and societal needs/wants. Teachers could also lead students in a discussion of general beliefs associated with science/technology. For example, many people have the erroneous concept that any problem can be solved by science if enough time and money are put into it. When students recognize that science cannot answer all questions, or solve all problems, this indicates an attitudinal outcome related to the appreciation of science.

Teachers could also incorporate a discussion of sustainable development into this topic. Students could be challenged to identify the environmental, economic, and social/cultural implications of decisions made related to ocean resource use and development of new technological knowledge. During their debate or discussions, students should recognize that appropriate use of resources often involves compromise in one or more of the three aspects of sustainable development. For example, oil and gas exploration can result in negative environmental impacts (e.g., oil spills killing sea birds or destroying ecosystems), positive economic impacts (e.g., good paying jobs, money for governments to build roads, etc.), negative economic impacts (e.g., price of housing increasing so people can not afford to buy homes), negative social/cultural impacts (e.g., changes in the way of life for many communities, increases in the gap between rich and poor, etc.), and positive social/cultural impacts (e.g., better quality education for everyone, more leisure time for people, etc.).

Students should develop an understanding that decisions to develop any resource has to include discussion of the potential positive and negative effects and a recognition that science and technology can not be relied upon to solve any problems that result. Often the decision to develop, or not develop, a particular resource is made after consideration of the positive and negative effects and a “weighing” of these pros and cons. The final decision is unlikely to satisfy all the stakeholders.

Teachers could have students use the “What? So What? Now what?” format to create a journal entry on the problems related to the development of ocean resources.

Human Impacts on Marine Systems (continued)

Suggested Assessment Strategies

Performance

- Create a visual display that provides examples of the positive and negative consequences of developing a marine-based resource. (113-10, 211-2)
- Organize a debate related to the sustainability of developing ocean resources. (113-2, 113-10)
- Create a poster or collage that examines the development of a particular ocean resource from a sustainable development perspective. (113-2, 113-10, 211-2)

Journal

- How does the continuation of the food fishery for cod affect us on a societal level and on an ecological level. (113-10)
- Write a journal entry which responds to the following statement: “The problem with the cod stocks cannot be solved by scientific knowledge alone.” (113-10)

Resources

www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/index.html

TR AC 9, 10, 11, 21, 22

BLM 8 Activity 1

BLM 8 Activity 2

