

Protecting the Oceans

TEACHER'S GUIDE

In its Sustainable Development Goals for 2030, the United Nations states that a healthy Earth requires healthy oceans—and that life below water must be protected. Protecting the Oceans is a timely series that explains the threats to our oceans and explores ocean action being taken around the world. Each book includes basic concepts and factors relating to current ocean conditions. At the same time, it encourages readers to develop a sense of self-awareness about the way in which their actions impact Earth's oceans and foster a sense of urgency about what needs to happen on an individual, regional, national, and global scale to help preserve Ocean life. Readers will learn how we depend on oceans and what sustainable use of ocean resources looks like. They will also discover the effects of climate change and pollution on oceans and how this subsequently impacts social and environmental factors of human health and living.

The Protecting the Ocean Teacher's Guide contains lessons that showcase efforts being made to protect and preserve oceans and inspires readers to contribute to a global movement for change. The lesson plans in this guide are specifically focused on grades 4-5 but could be tailored up to a grade 8 level. With a focus on developing scientific inquiry, reading, critical thinking, and research skills, lessons require students to explore the importance of the ocean's resources and to acknowledge how pollution and global warming contribute to a loss of ocean resources and impact ocean ecology. Students will participate in three diverse activities that maintain the same overarching goal: to understand that a healthy Earth requires healthy oceans and that each system has a direct impact on the other. Students will learn how to use the information in the texts to support their understanding.

The lessons in this guide are designed to be taught in sequential order as they work to scaffold student understanding from lesson to lesson. Reproducible worksheets and assessment tools accompany each lesson plan. The titles in Protecting the Ocean's include:

Why are Oceans Important?

Preventing Ocean Pollution

Ocean Climate Change

Using Ocean Resources Sustainably

PACING CHART AND VOCABULARY

Lesson Plan Title	Pacing	Vocabulary
Diving into Climate Change	3-4 periods	acidification cause climate change consequence global warming sustainable The Great Barrier Reef
A Pool of Pollution	3 periods	environmental impacts gyre pollution social impacts
"Sea"ing things Sustainably	5-6 periods	environmental stewardship federal government local government provincial or state government sustainability

* 1 class period = 40 to 60 minutes

ACCOMMODATION STRATEGIES

Accommodations provide equal access to learning and equal opportunity to demonstrate what is learned. Accommodations allow a student access to the subject or course without any changes to the knowledge and skills the student is expected to demonstrate.

Educators are encouraged to adapt the instructional approach, activities, and assessments included in this guide to best meet the diverse interests, needs, and abilities of their students.

Possible accommodation may include:

Instructional Strategies

- Break tasks into parts with accompanying timelines
- Provide extra time for processing of oral information
- Pair oral instructions with visual ones (writing or symbols)
- Pre-teach new vocabulary and regularly review previously taught vocabulary
- Provide model of completed work
- Frequently check with the student to get him/her started
- Provide oral and visual instructions and examples
- Provide a checklist or tasks for the student

Environmental Strategies

- Proximity to teacher
- Strategic seating
- Flexible or mixed-ability grouping
- Provide an alternative setting for learning that is free from visual and auditory distractions

Assessment Strategies

- Build in extra time to allow students to process questions asked and answers given
- Provide written instructions and rubrics for assignments
- Offer a choice of assessment activities so that the student can choose one suited to their strengths
- Space out or extend assignments to prevent student feeling overwhelmed
- Reduce the number of tasks used to assess skill or concept
- Allow students to use assistive devices or technology

LESSON 1

Diving into Climate Change

Curriculum Correlations

Common Core State Standards

RI.4.4, RI.5.4, RI.4.1, RI.5.3

Next Generation Science Standards

5-ESS2-1.

Ontario Science and Technology Standards

Grade 4. Habitats and Communities

Overall expectation 3

3.8

Ontario Language Arts Standards

Grade 4 Reading

Overall expectation 1

1.4

Materials

- *The Effects of Climate Change on the Oceans*
- White board or chalkboard
- White board markers or chalk
- Markers, pens, or pencils
- Computers
- Blank paper
- Images of The Great Barrier Reef
- Projector for videos
- *Climate Change and the Ocean Pamphlet Instructions*
- *Climate Change and the Ocean Rubric*
- *Exit Card*

Objectives

Students will be able to:

- Identify and explain how climate change impacts oceans.
- Explain why changes in the ocean affect ocean species.

Setting the Stage

Begin the lesson by explaining to students that they will be embarking on a new unit that explores the human impact on the world's oceans. They will explore the consequences of climate change and pollution on ocean ecology and explore options and resources for sustainability and recovery.

Show students before and after images of the Great Barrier Reef and the bleaching that occurs. Using the popcorn protocol to generate answers, ask the following questions:

- What ecosystem are these two images representing?
- What do you think is happening in the photos?
- What do you think is causing this drastic change?
- What is the process that is happening to the Reef called?
- Take away concepts:
 - The images depict The Great Barrier Reef, which is the largest reef on Earth. Coral bleaching is being caused by warmer ocean temperatures, which are occurring due to climate change.
 - Explain to students that the Great Barrier Reef is also being damaged by **acidification**. This is a process whereby the increased carbon dioxide levels in the water cause the PH levels in the water to decrease, making the water more acidic. The extra acidity in the water makes it more difficult for coral to create protective shells, subsequently causing coral to die. The increased carbon dioxide comes from human emissions, which oceans absorb.

Project the following two short videos:

- How Carbon Dioxide Kills Ocean Life: <https://video.nationalgeographic.com/video/short-film-showcase/00000146-ca3a-de99-ad7f-ebfe8ee20000>
- Ocean Impacts of Climate Change: <https://www.nationalgeographic.org/media/ocean-impacts-climate-change/>

Brainstorm with students all the marine organisms that they think might be affected by the gradual disappearing of The Great Barrier Reef.

Explain to the class that they have learned some ways climate change is impacting Earth's oceans and its reef ecosystems. Have them then consider other impacts climate change has on the oceans. Use Think, Pair, Share method to invite students to share their ideas. Discuss in a large group setting and write some of the ideas on the whiteboard.

Activity

Students will watch the following videos:

- Climate 101: Oceans: <https://www.nationalgeographic.org/video/climate-101-oceans/>
- Global Climate Change Through the Lens of Changing Glaciers: <https://www.nationalgeographic.org/video/global-climate-change-through-lens-changing-glaciers/>

As a class, discuss the following:

- What surprised you about the video Global Climate Change Through the Lens of Changing Glaciers?
- What are some of the social impacts of the rising sea levels? What are some of the impacts of melting glaciers? How are local people adapting to these changes? Do you think the changes will be sustainable?
- Are there any other causes and consequences of global warming on oceans that we learn from these videos?

Students will read *The Effects of Climate Change on the Oceans* as a class or individually. Teachers may choose to have the class participate in choral reading.

Explain to students that they will create a pamphlet that explores one of the major effects of climate change on the oceans. Students will choose one of the following topics: dangerous weather patterns, changing currents, rising sea levels, diminishing coastlines, threat of disease, and changing oxygen levels.

Using the text, in addition to two other reliable sources, students will:

- In their own words, explain what climate change is and what contributes to it (i.e. global warming)
- Explain the **cause** and **consequence** of the effect they have chosen
- Explain how a species is being impacted by the effect (i.e. acidification affects the ability of corals to strengthen their skeletons, making coral much more susceptible to environmental factors)
- Provide information on one person who is bringing awareness to this issue and explain how they are trying to make a change

Discuss rubric requirements as a class and provide copy upon completion.

- Challenge students to integrate information from a third source as they create their pamphlets

Extensions

- Encourage students to think of ways that they might personally be affected by the impact global warming has on oceans. They can write a reflection on this topic or add an additional section to their pamphlets.

Wrap-Up

Students will be divided into small group settings where they will rotate reading each other's pamphlets. Allow students time to discuss the content and ask any questions they might have.

Students will hand in an exit card explaining two details they found interesting after reading their group members' pamphlets.

Assessment

Students' pamphlets will be assessed using the *Climate Change and the Ocean Pamphlet Rubric* and the exit cards should be informally assessed for understanding and completion.

Name: _____

Date: _____

Climate Change and the Ocean

Read the book *The Effects of Climate Change on the Ocean*. In this book, we learn how human activities are contributing to climate change and affecting ocean health.

A healthy planet starts with healthy oceans! You will choose one of the following effects of climate change on oceans and create a pamphlet that brings awareness to it.

- Dangerous Weather Patterns
- Changing Currents
- Sea Level Swells
- Diminishing Coast Line
- Threat of Disease
- Changing Oxygen Levels

Using the book and at least two additional reliable sources, you will include the following information in your pamphlet:

- Title page that brings attention to the issue (i.e. images, bold title, color, etc.)
- An explanation, in your own words, of climate change and what types of human activities cause it.
- An explanation of the **cause** and **consequences** of the topic you have chosen
- Research a particular species and provide information on how it is being affected by the topic you chose.
- Highlight a person or organization that is bringing awareness to this issue and explain how they are making a change
- 2 or more drawings
- Include a chart, graph, diagram, or timeline that speaks to the urgency of this issue
- An explanation of why you chose this topic and why you think it's important to bring awareness to it

Name: _____

Date: _____

Teacher: _____

Climate Change and the Ocean Rubric

Make sure to include your name and use the rubric as a checklist to make sure you include all required information

Rubric	Level 4	Level 3	Level 2	Level 1
Layout	<ul style="list-style-type: none"> • very organized blocks of information • easy to read and interesting to look at • main title is bold and tells readers what the topic is about • thorough evidence of planning of information • information is categorized and contributes to the flow of information • bullets are used consistently throughout for organization • clear and concise headings 	<ul style="list-style-type: none"> • most work is strategic and readable • some evidence of attempt to organize information • neatly printed • bold and clear main title • good use of headings • bullets are used throughout to organize the flow of information • headings are used throughout 	<ul style="list-style-type: none"> • some work is readable • evidence that some effort was taken when laying out the information • bullets are sometimes used in a way to organize the information • information is not always broken up into categories • title is legible but does not bring attention to the topic • some headings are used 	<ul style="list-style-type: none"> • disorganized presentation • difficult to read • title is not easily read or clearly visible; difficult to know what topic has been chosen • not many bullets have been used to help organize the information • there are no headings that let the reader know what they will be learning about
Sources	<ul style="list-style-type: none"> • information frequently refers to examples and details in the text • student uses 3 or more additional sources that are current and relates to the topic at hand • Information from sources are used in a way to support main point and support claim • A bibliography is included somewhere on the pamphlet 	<ul style="list-style-type: none"> • information sometimes refers to examples and details in the text • students uses 2 or more additional resources that are current and relates to the topic at hand • Information sometimes supports main point and topic • A bibliography is included somewhere on the pamphlet 	<ul style="list-style-type: none"> • information does not always relate to the information in the text • student had used one additional source that is current and relates to the topic at hand • Information does not always support the topic • A bibliography is included somewhere on the pamphlet 	<ul style="list-style-type: none"> • information does not refer to the text • there are no additional supporting sources • Information does not relate to the topic at hand and does not bring awareness to the issue • A bibliography has not been included
Diagrams/ Images	<ul style="list-style-type: none"> • very detailed images/pictures • neatly drawn • lots of labeling and headings to describe what is being shown • information in visual representation of data clearly supports the topic and speaks to the urgency required 	<ul style="list-style-type: none"> • good detail in drawings • there has been some use of labelling and headings to describe what is being shown • information in visual representation is organized and makes sense to the topic 	<ul style="list-style-type: none"> • some detail in drawings • Images/drawings are not always complete and don't always relate to the information they are supposed to be supporting • visual representation of data does not speak to the urgency of the topic 	<ul style="list-style-type: none"> • not a lot of detail in drawings • images appear to be incomplete • a visual representation of data has not been included in the pamphlet

Rubric	Level 4	Level 3	Level 2	Level 1
Content/Ideas	<ul style="list-style-type: none"> • Notes include a lot of information and detail about 'what', 'why', 'how' • interesting facts are included throughout • clear evidence of research and understanding of issues related to the topic chosen • information is very detailed, well described, and fully explained • student has included an abundance of information on all the requirements of the project 	<ul style="list-style-type: none"> • Notes explain the 'what', 'why', and 'how' • there is good evidence of research and understanding of issues related to the topic that has been chosen • information is complete with some supporting detail • student has included information pertaining to all the requirements of the project 	<ul style="list-style-type: none"> • Some information is missing • there is some evidence of research and understanding of issues related to the topic chosen • information is missing important details and content has not been fully explained • student has not included information on all the requirements needed for this project 	<ul style="list-style-type: none"> • Short and incomplete answers • not much detail has been included • no or little evidence that there has been research and an understanding of the topic chosen • information is incomplete and does not meet requirements of the project
Mechanics	Contains no errors in the conventions (grammar, punctuation, capitalization, and spelling). The errors do not interfere with understanding of the content	Contains 1-2 errors in the conventions (grammar, punctuation, capitalization, and spelling). The errors do not interfere with understanding of the content	Contains 3-4 errors in the conventions (grammar, punctuation, capitalization, and spelling). The errors may interfere with understanding of the content	Contains more than 5 errors in the conventions (grammar, punctuation, capitalization, and spelling). The errors interfere with understanding of content

Additional Comments: _____

Name: _____ Date: _____

Exit Card

One detail I found interesting about _____'s pamphlet

about _____ is:

A second detail I found interesting is:

LESSON 2

A Pool of Pollution

Curriculum Correlations

Next Generation Science Standards

5-ESS3-1

C3 Framework for Social Studies

D4.7.3-5

Common Core State Standards

RI.4.1

RI.4.2

RI.4.7

Ontario Science and Technology Standards

Grade 5. Conservation of Energy and Resources, 1.1

Ontario Language Arts Standards

Grade 4. Reading, 1; 1.1, 1.2, 1.5, 1.6

Materials

- *Why are Oceans Important?*
- *Preventing Ocean Pollution*
- Whiteboard or chalkboard
- Whiteboard markers or chalk
- Markers, pens, or pencils
- Glitter
- Water
- Bowls/Cups (one per student)
- Computers
- Science journals
- *Our Oceans, Our Pollution, Our Problem Workshee*

Objectives

Students will be able to:

- Identify and explain how ocean pollution affects ocean life and human health.
- Identify ways communities have used science to combat the effects of ocean pollution.
- Explain different strategies and approaches individuals and communities can take to address problems surrounding plastic consumption.

Setting the Stage

Explain to students that in the previous lesson, we explored *how* global warming and climate change affects oceans around the globe. As we move forward in this lesson, we are going to dive deeper into *why* oceans are important and the effects pollution can have on social and environmental factors.

Provide each student with a small bowl of water and some glitter. Prompt students to sprinkle the glitter into their bowl. Tell students that the glitter represents plastic that has ended up in the ocean. Ask students:

- What do you notice about the glitter? Is it floating or is it sinking?

Tell students to start swirling the water with their finger and observe what happens. The swirling motion should draw the glitter into a whirlpool. It will eventually sink below the surface of the water and become much less visible to the eye. The experiment is a simulation of how a **gyre** works.

- A gyre is a location in the ocean that is formed by a circular system of currents. Naturally, ocean debris such as seaweed, other forms of plant life, and some ocean life will collect in these points. However, dangerous debris such as plastics and other pollutants also become trapped in these gyres, making it very difficult to clean up because the plastic eventually sinks through various layers of the ocean.

Have students turn to page 14 of *Preventing Ocean Pollution*. Ask students:

- What stands out to you about the magnitude of the Great Pacific Garbage Patch? How does this image contribute to your understanding of the current issue that exists in our oceans?

Brainstorm with students the consequences that this debris would have on the ocean. Provide the following prompts:

- How would plastics affect sea life such as plants and animals? What impact would debris have on living things naturally found in gyres?
- Plankton and algae are primary sources of food for sea animals such as fish and turtles. However, in order for algae and plankton to grow, they need a lot of sunlight and oxygen. How do you think plastic pollution impacts the growth of algae and plankton?
- What might the consequences be for humans if there are less fish and turtles? Think about the natural food chain. How about the fish caught for food that have ingested plastics or chemicals?

Activity

Explain to students that in addition to environmental impacts, there are social impacts of climate change and pollution. Social impacts might affect an individual's employment, their ability to travel, and their way of living. Describe an example, such as the following: an accumulation of plastic debris in the ocean would impact an individual's livelihood if their primary source of income was fishing.

Provide students with *Our Oceans, Our Pollution, Our Problem Worksheet*. Students will use the books *Why are Oceans Important?* and *Preventing Ocean Pollution* to complete the handout.

Through this task, students will explore the effects of pollution on human health as well as analyze how communities use science ideas to help combat the harmful effects of pollution.

Tell students: It is not unreasonable to argue after reading the texts, one of the major contributors to ocean pollution is plastic. Not only does plastic impact our environment, but it impacts our health.

Students will use a plastic calculator to determine roughly how many plastic items they consume and get rid of each year (<https://www.earthday.org/plastic-pollution-calculator-2/>).

Students will write a report that speaks to their results of the plastic calculator and provide strategies and approaches that they could use to reduce their consumption. In their report, students will:

- Reflect on the results that were provided. What did they find surprising?
- Explain how their understanding of plastic consumption has changed after reading how plastic debris contributes to ocean pollution. What do they know now, that they did not know before?
- Describe how plastic consumption is a global issue
- Explain ways that they, their families, and their community could reduce plastic consumption or bring awareness to the issue
- Provide a prediction of what might happen as a result of their actions

Extensions

- Challenge students to commit to some of the strategies they suggested to reducing plastic consumption in their report. Students will complete a chart each day that details what they did on that day to take action

Wrap-Up

Students will hand in *Our Oceans, Our Pollution, Our Problem Worksheet* as well as their report on plastic consumption.

Assessment

Assess *Our Oceans, Our Pollution, Our Problem Worksheet* for understanding and for completion. Teacher will assess students' plastic reports for their understanding of the factors contributing to plastic consumption, as well as their sense of agency to reduce their own use.

Name: _____ Date: _____

Our Oceans, Our Pollution, Our Problem!

Using the books *Why are Oceans Important?* and *Preventing Ocean Pollution*, answer the following questions.

1) How does pollution impact the ocean-related human activities that are so important to us?

2) Many ocean-related human activities contribute to ocean pollution. Give two examples.

3) What are some of the ways people and/or organizations are trying to combat the effects of ocean pollution?

Choose one or two examples from the books. How will their efforts make a difference?

What do you think some of the long-term results might be from these changes?

4) Think about how humans would be affected if we could no longer benefit from the oceans' resources.

Explain some of the social factors that might affect us. What would you be most impacted by?

6) Interpret one piece of information that has been presented in a chart, graph, diagram, etc. and explain what data is being presented to the reader. What was it about this visual representation of data that stands out to you?

What is its significance?

7) If humans are the problem, we also need to be the solution. What are some strategies you would recommend for bringing this issue to the forefront in your own community?

LESSON 3

"Sea"ing things Sustainably

Curriculum Correlations

C3 Framework for Social Studies

D4.6.3-5

Common Core State Standards

RI.4.1

RI.5.3

Ontario Social Studies Standards

Grade 4. People and the Environment: B2.1, B2.2

Grade 5. People and Environments: B1.1, B1.2, B1.3

Ontario Language Arts Standards

Grade 4. Reading: 1; 1.1, 1.4, 1.7, 1.8 4; 4.2

Materials

- *Using Ocean Resources Sustainably*
- Whiteboard or chalkboard
- Whiteboard markers or chalk
- Markers, pens, or pencils
- Projector for movie
- Bag of popped, plain popcorn
- Oyster crackers
- Goldfish crackers
- Small cups (1 per student)
- Serving bowls (1 per group)
- Spoons (1 per student)
- Spatulas (1 per group)
- Tongs (1 per group)
- Chart paper
- Computers

Objectives

Students will be able to:

- Explain the importance of environmental stewardship and sustainable practices that help keep oceans healthy.
- Investigate an issue or challenge associated with balancing human needs/wants and environmental stewardship.
- Write a letter to a government representative that raises attention to the issue or challenge and present a plan of action that could be taken to address it.

Setting the Stage

Explain to students that they have explored how oceans are important to human health and livelihoods. They have also learned that oceans act as a buffer to rapidly changing weather and climate patterns. Students also explored how human activity causes pollution and impacts ocean ecology.

Tell students that today, they will explore how ocean resources can be used more sustainably. Brainstorm with students the meaning of sustainability and write responses on the whiteboard.

Take away concept:

- Sustainability means using the ocean's resources in a way that keeps them healthy for the future

Show students the following video:

- Sustainability: Bluefin Bait: <https://www.nationalgeographic.org/media/sustainability-bluefin-bait/>

Discuss as a group why the overfishing of herring affected the tuna. Ask students:

- What made the fishing process unsustainable? How did the overfishing of herring affect the people who relied on tuna as their source of income? What provisions were put into place by the government to help bring back the tuna?

Students will participate in a sustainable fishing game. Handouts and further instructions for the game can be found at the following link: <https://www.calacademy.org/educators/lesson-plans/sustainable-fishing>

During this game, students will discover how fishing impacts different populations of animals in the ocean. Following the game, have students reflect on the activity and think of different strategies they could implement if they were to play the game again. Ask students:

- What methods worked best? What strategies did they find the least helpful?
- How might these ideas translate into how real fisheries work?

Take away concept:

- It is important for industries to adopt sustainable practices so that ocean health can be maintained.

Divide students into small groups of 4 to 5. In their small groups, students will read *Using Ocean Resources Sustainably*. On a piece of chart paper, students will create a T-Chart. On the one side of the chart, students will list an unsustainable practice (i.e. overfishing). On the other side, students will write some ideas or suggestions for how that practice could be changed to become more sustainable. Each group will present their chart to the class.

Activity

Students will participate in a project in which they will explore an issue associated with balancing human needs and wants with environmental stewardship. They will then investigate how the government (local, state or provincial, or federal) is working to address this issue. Working in pairs, students will complete the following:

- Formulate a list of questions that will help guide their investigation (i.e. why is this currently an issue? Who or what is being affected by this process? Why is this issue conflicting with environmental stewardship?) The teacher should meet with each student pair to discuss their topic and ensure that the questions they have asked will assist them with their understanding of the topic.
- Gather data and information from various sources to illustrate the details of the issue.
- Explore the environmental and social impacts of this issue.
- Research actions (or lackthereof) being taken by at least one level of government.
- Write a letter to a government representative explaining the findings of their investigation and creating a plan of action to assist with this issue.

Extensions

- After rounds of review and proofreading, invite students to send the letter to their chosen government representative.
- Invite students to present their findings to the Principal and become an advocate for their chosen issue/challenge. Present some ideas on what the school could do to bring awareness to the issue and/or begin assisting to lessen the problem

Wrap-Up

Students will hand in their guiding questions, research, and written letter. As a class, discuss ways that this project has inspired them. Encourage students to think about their action plans and how they could commit to taking action in their communities.

Assessment

The teacher should meet with pairs throughout the duration of this project to discuss progress, the information found in their research, as well as their proposed plan of action. Teachers should take anecdotal notes on student understanding, learning, and progress throughout the project.

Assess the letters using the *Letter to a Representative Checklist*.

Student Names: _____ Date: _____

Letter to a Representative Checklist

Criteria	Yes	No
List of questions shows investigation of who, what, when, where, and why.		
Data gathered shows understanding of issue, including environmental and social effects.		
Research notes the actions taken (or lacking) by one or more levels of government.		
Letter to government representative explains issue and its effects.		
Letter to government representative includes a plan of action that lays out specific suggestions to achieve sustainability.		
Letter to government representative includes correct formatting and writing conventions.		

Additional Comments: _____

