



**OCEAN
WISE**

Species at Risk

EDUCATOR GUIDEBOOK

Grades 9 - 12

CONTENTS

- 0 • Land Acknowledgement • Note to Educators • Glossary
 - Introduction
 - Curriculum Links
- 1 Climate Change - Humpback Whale
- 2 Ocean Pollution - Killer Whale
- 3 Fishery Bycatch - Great White Shark
- 4 Plastic Pollution - Hawksbill Turtle
- 5 Habitat Loss - Sea Otter
- 6 Appendix

LAND ACKNOWLEDGEMENT

We acknowledge and are grateful that many Ocean Wise employees work and play on the traditional, ancestral and unceded territories of the x^wməθk^wəyəm (Musqueam), S_kwxwú7mesh (Squamish), and səliłwətaʔt (Tsleil-Waututh) peoples.



INTRODUCTION

The Earth's ocean and its interconnected systems are vital to every living thing on Earth. Marine species play a pivotal role in maintaining the efficiency and balance of these systems, and their role in the ocean has a direct impact on its health. And yet the health of the ocean, and the well-being of all life on earth, is at risk due to human activity.

Everyday thousands of animals fall victim to the anthropogenic threats imposed on the ocean, and species are pushed to the point of extinction. Indeed, as of 2022, as many as 45 thousand marine species are at risk of extinction due to climate change, plastic pollution, and overfishing! It is going to take a deep, transformational change in humanity's consciousness and behaviors regarding the ocean to ensure species protection and to preserve healthy, sustainable life on this planet.

At Ocean Wise, we believe this is possible – but we need to work together. Our youth must become aware of the interconnectedness

between our lives and the ocean and understand the important role diverse species play in the health of the environment. By merging our experience with climate change education and the research of our own conservation teams, we aim to do just that. For over 50 years, we have dedicated our work to ocean conservation and education guided by the international community such as the Sustainable Development Goals (SDG) of the United Nations and the International Union of Conservation for Nature (IUCN). Informed by recognized science and climate change education pedagogies, these lessons aim to guide our youth to become leaders of change. The ultimate objective being to educate, equip and empower students to become ocean champions and stewards for species at risk.



NOTE TO EDUCATORS

Each lesson follows the same format throughout the kit with **critical questions** and **reflections** built into the **activities** section.

The kit follows the overarching theme of **interconnectedness**, integrating decolonization practices with scientific, conservation, and Indigenous knowledge. The **thought book** component prompts students to journal on interconnectedness and consider its connection to each lesson's focus. Through reflection, students will consider their role in decolonization and climate action so that they are encouraged to be changemakers within their community.

Each lesson ends with ways to **take action**. We invite educators and students to create their own actions acknowledging that those provided may not be accessible or applicable to all. We recognize that individual action should be coupled with systemic change, so we aim to empower students through active approaches and creative problem solving that address individual or smaller-scale behavior change, but also through actions that can positively influence large systemic issues.

Finally, we want to thank you for promoting climate change education, social justice and Indigenous knowledge in your classroom. By doing so, you are providing a unique skill set to the future leaders of the world so they are better equipped to deal with environmental issues. Nonetheless, today you are the leader, leading our youth towards a cleaner and more sustainable future.



CURRICULUM LINKS

The table below illustrates curriculum connections, outlining the Big Ideas in a variety of courses and detailing which lessons are connected to which Big Ideas. Please note that although this resource is developed with a focus on aligning to the BC curriculum, there exists a lot of overlap across provincial curricula and lesson activities possess room for interpretation so different curriculum objectives can be met, making this kit applicable throughout Canada.

LESSON 1

- Science 9
- English Language Arts 9
- Social Studies 9
- Science 10
- Composition 10
- Social Studies 10
- Earth Sciences 11
- Environmental Science 11
- Science for Citizens 11
- Composition 11
- Exploration in Social Studies 11
- Environmental Science 12
- Specialized Science 12
- English Studies 12
- B.C. First Peoples 12
- Contemporary Indigenous Studies 12
- Law Studies 12
- Physical Geography 12
- Social Justice 12
- Urban Studies 12

LESSON 2

- Science 9
- English Language Arts 9
- Science 10
- Composition 10
- Social Studies 10
- Environmental Science 11
- Science for Citizens 11
- Composition 11
- Exploration in Social Studies 11
- Environmental Science 12
- Specialized Science 12
- English Studies 12
- B.C. First Peoples 12
- Contemporary Indigenous Studies 12
- Social Justice 12
- Urban Studies 12

LESSON 3

- Science 9
- English Language Arts 9
- Social Studies 9
- Applied Design, Skills, and Technologies 9
- Composition 10
- Social Studies 10
- Entrepreneurship and Marketing 10
- Food studies 10
- Environmental Science 11
- Science for Citizens 11, Composition 11
- Exploration in Social Studies 11
- Food Studies 11
- Environmental Science 12
- Specialized Science 12
- English Studies, 12
- B.C. First peoples 12
- Contemporary Indigenous Studies 12
- Social Justice 12
- Entrepreneurship 12
- Food Studies 12

LESSON 4

- English Language Arts 9
- Social Studies 9
- Composition 10
- Social Studies 10
- Food Studies 10
- Environmental Science 11
- Science for Citizens 11
- Composition 11
- Exploration in Social Studies 11
- Food Studies 11
- Environmental Science 12
- English Studies 12
- B.C. First Peoples 12
- Contemporary Indigenous Studies 12
- Social Justice 12
- Urban Studies 12

LESSON 5

- Science 9
- English Language Arts 9
- Social Studies 9
- Applied Design, Skills, and Technologies 9
- Social Science 10
- Entrepreneurship and Marketing 10
- Food Studies 10
- Earth Sciences 11
- Environmental Science 11
- Science for Citizens 11
- Exploration in Social Studies 11
- Marketing and Promotion 11
- Food Studies 11
- Environmental Science 12
- Specialized Science 12
- English Studies 12
- B.C. First Peoples 12
- Contemporary Indigenous Studies 12
- Social Justice 12
- Urban Studies 12
- Entrepreneurship 12, and Food Studies 12

GRADE	SUBJECT	BIG IDEAS	CONNECTED LESSON(S)
9	Science	The biosphere, geosphere, hydrosphere, and atmosphere are interconnected as matter cycles and energy flows through them.	1, 2, 3, and 5
	English Language Arts	Exploring stories and other texts help us understand ourselves and make connections to others and to the world.	2, 4, and 5
		Texts are socially, culturally, and historically constructed.	1, 2, 3, 4, and 5
	Social Studies	The physical environment influences the nature of political, social, and economic change.	1, 3, 4, and 5
	Applied Design, Skills, and Technologies	Social, ethical, and sustainability considerations impact design.	3 and 5
10	Science	Energy is conserved, and its transformation can affect living things and the environment.	1 and 2
	Composition	Engagement with writing processes can support creativity and enhance clarity of expression.	1, 2, 3, and 4
	Social Studies	The development of political institutions is influenced by economic, social, ideological, and geographic factors.	1
		World views lead to different perspectives and ideas about developments in Canadian society.	1, 2, 3, 4, and 5
	Entrepreneurship and Marketing	Social, ethics, and sustainability considerations impact design and decision making.	3 and 5
	Food Studies	Social, ethical, and sustainability considerations impact design.	3, 4, and 5



GRADE	SUBJECT	BIG IDEAS	CONNECTED LESSON(S)
11	Earth Sciences	The distribution of water has a major influence on weather and climate.	1 and 5
	Environmental Science	Complex roles and relationships contribute to diversity of ecosystems.	1, 2, and 5
		Changing ecosystems are maintained by natural processes.	1 and 5
		Human practices affect the sustainability of ecosystems.	1, 2, 3, 4, and 5
		Humans can play a role in stewardship and restoration of ecosystems.	1, 2, 3, 4, and 5
	Science for Citizens	Scientific processes and knowledge inform our decision and impact our daily lives.	1, 2, 3, and 4
		Scientific understanding enables humans to respond and adapt to changes locally and globally.	1, 2, 3, 4, and 5
	Composition	Engagement with writing processes can support creativity and enhance clarity of expression.	1, 2, 3, and 4
	Exploration in Social Studies	Decision making in urban and regional planning requires balancing political, economic, social, and environmental factors.	1, 2, 3, and 4
		A society's laws and legal framework affect many aspects of people's daily lives.	1
		Understanding how political decisions are made is critical to being an informed and engaged citizen.	1



GRADE	SUBJECT	BIG IDEAS	CONNECTED LESSON(S)
11		Religion can powerfully shape social, political, legal, and environmental values.	1, 2, 3, 4, and 5
	Marketing and Promotion	Marketing services and products can be designed through consultation and collaboration.	5
	Food Studies	Social, ethical and sustainability considerations impact design.	3, 4, and 5
12	Environmental Science	Human actions affect the quality of water and its ability to sustain life.	1, 2, and 4
		Human activities cause changes in the global climate system.	1
		Sustainable land use is essential to meet the needs of a growing population.	3
		Living sustainably supports the well-being of self, community, and earth.	1, 2, 3, 4, and 5
	Specialized Science	Biodiversity is dependent on the complex interactions and processes between biotic and abiotic factors.	1, 2, 3, and 5
		Climate change impacts biodiversity and ecosystem health.	1
	English Studies	The examination of First Peoples cultures and lived experiences through text builds understanding of Canadian's responsibilities in relation to Reconciliation.	1, 2, 3, 4, and 5
	B.C. First Peoples	The impact of contact and colonialism continues to affect the political, social, and economic lives of B.C. First Peoples.	1, 2, 4, and 5



GRADE	SUBJECT	BIG IDEAS	CONNECTED LESSON(S)
12		The identities, worldviews, and languages of B.C. First Peoples are renewed, sustained, and transformed through their connection to the land.	3 and 5
	Contemporary Indigenous Studies	The identities, worldview, and languages of indigenous peoples are renewed, sustained, and transformed through their connection to the land.	3 and 5
		Reconciliation requires all colonial societies to work together to foster healing and address injustices.	1, 2, 3, 4, and 5
	Law Studies	Laws can maintain the status quo and can also be a force for change.	1
		A society's laws and legal framework affect many aspects of people's daily lives.	1
	Physical Geography	Interactions between human activities and the atmosphere affect local and global weather and climate.	1
	Social Justice	Individual worldviews shape and inform our understanding of social justice issues.	1, 2, 3, and 4
		Social justice initiatives can transform individuals and systems.	1, 2, 3, 4, and 5
	Urban Studies	Urbanization is a critical force that shapes both human life and the planet.	1, 2, 3, 4, and 5
		Decision making in urban and regional planning requires balancing political, economic, social, and environmental factors.	1, 2, 3, and 4
		Urban planning decisions and other government policies can dramatically affect the overall quality of life in cities.	1



GRADE	SUBJECT	BIG IDEAS	CONNECTED LESSON(S)
12	Entrepreneurship	Design for the life cycle includes consideration of social and environmental impacts.	3 and 5
		Services and products can be designed through consultation and collaboration.	3 and 5
	Food Studies	Services and products can be designed through consultation and collaboration.	3 and 5
		Tools and technologies can be adapted for specific purposes.	3

GLOSSARY

• ANTHROPOGENIC

The impact on the environment, as it relates to climate change, originating from human activities.

• APEX PREDATOR

A predator at the top of their food chain with no natural predators. This term excludes humans.

• BREACHING

When whales use their powerful tail to launch themselves out of the water.

• BY-CATCH

Fish or non-target species that are caught unintentionally while fishing for another species.

• CETACEANS

An order of aquatic mammals that includes all whales, dolphins, and porpoises.

• FORAGING/FORAGE

When animals actively search for food in their environment.

• INTERNATIONAL UNION OF CONSERVATION FOR NATURE (IUCN)

An international organization working in the field of nature conservation and the sustainable use of natural resources.

• KEYSTONE SPECIES

An organism that significantly defines how an ecosystem functions. Without this species, the ecosystem may be dramatically altered or cease to exist.

• OVERFISHING

Removing a species of fish from the ocean, through fishing activities, at a rate greater than the species can replenish its population.

• TROPHY

A fish that is captured only for its large size and not necessarily used for subsistence.

• URCHIN BARREN

A part of the ocean where the urchin population growth has gone unchecked causing the destructive grazing of kelp forests.

Lesson 1

Climate Change - Humpback Whale



BACKGROUND

The humpback whale is found in all major oceans and is a highly migratory species. They feed in cold productive waters during the summer and travel to warm tropical waters for the winter to breed. As an animal that lives mostly in nearshore areas and is known for its spectacular surface-active behavior, including breaching and tail slapping, the majestic humpback whale is incredibly popular among whale watchers. However, not too long ago, the humpback whale was a target for a much more gruesome activity - whale hunting. The humpback whale was one of the five large whale species hunted throughout the 19th century and consequently, some populations were dramatically reduced by almost 95%! Today, the humpback whale population has mostly recovered due to conservation efforts to prevent whaling and has been listed as a species of least concern by the International Union of Conservation (IUCN). However, a more contemporary issue is now threatening their existence.

Research has shown that climate change disproportionately affects ecosystems at higher latitudes, which the humpback whale relies on for intensive feeding throughout

the year. As climate change warms ocean waters and melts sea ice, changes in the food web decreases the abundance of the humpback whale's prey. As they have less to feed on, these whales are unable to meet certain survival requirements. In fact, the higher number of unsuccessful pregnancies and lower calving rates of the humpback whale population in the north Atlantic has been attributed to the lack of available prey. Indeed, 65% of the humpback whale's breeding grounds are projected to be adversely impacted by climate change this century. As water temperatures rise above the range tolerated by humpback whales, they may stop using these areas altogether further reducing their breeding rates.

As the humpback whale population just began to show signs of recovery from their exploitation by whalers, they now face the impacts of climate change. While humans have contributed to the successful protection of the spectacular humpback whale, there is still lots of work for us to do, especially as it relates to climate change mitigation.



STUDENTS WILL BE ABLE TO

- Develop an understanding of how climate change affects ocean health and species.
- Make connections between mitigating climate change and protecting species.
- Deepen their understanding of the urgency of the climate crisis, its patterns, and the different opportunities to resolve it.

CRITICAL QUESTIONS

- What are the most significant ways that the changing climate can impact ocean health?
- What are some of the ways marine animals can help mitigate climate change?
- What are some measures that can be implemented to resolve or reduce the adverse impacts of climate change?

RESOURCES

- Watch: [Scientists Study Humpback Whales for Clues on Climate Change Impact by ABC News](#)
- Watch: [Research Dives Deep to Understand Climate Impacts on Whales by Griffith University](#)
- Watch: [What is Environmental Law by Oxford Academic](#)
- Watch: [How Whales Can Help Us to Fight Climate Change by Terra Mater](#)
- View: [The Climate Change Machine by NASA](#)
- Read: [Why Traditional Knowledge Holds the Key to Climate Change by United Nations University](#)
- Read: [Ocean Wise in the Field, Spotting Humpback Whales](#)



ACTIVITIES

1. MISSION C: A GLOBAL SCALE CLIMATE PROTECTION

- As a class, watch [What is Environmental Law by Oxford Academic](#). Ask students, individually or in groups, to propose a universal environmental law that will protect Earth's natural climate and all living things that depend on it without depleting nor completely eliminating the use of other resources needed to survive. Students shall refer to the *Guide to Building Universal Environmental Law* found in their workbook.
- a. Discuss as a class how each proposed universal environmental law may directly or indirectly resolve the adverse impacts of climate change on the environment of the humpback whale.



ALTERNATIVE / ADDITIONAL ACTIVITIES

these activities are proposed as alternatives to activity 1

- Have students visit the Carbon Dioxide and Global Temperature topics on the [Climate Change Machine by NASA](#). Discuss as a class their observations. Refer to the guiding questions below during the discussion:

GUIDING QUESTIONS

- Were there any overlaps of the patterns (spatial, intensity, etc) observed between the two topics?
 - What are some economic activities that have intensified over the years and have contributed to these observed patterns?
 - How have these economic activities contributed to the change in Carbon Dioxide and Global temperature (i.e., greenhouse gas effect)?
3. Watch: [How Whales Can Help Us to Fight Climate Change by Terra Mater](#). Discuss as a class the ways that marine organisms, such as the humpback whale, can help mitigate climate change. Refer to the guiding questions below during the discussion:

GUIDING QUESTIONS

- What type of species characteristic would be most influential when considering an animal's role in climate change mitigation?
- How does a species' interaction with other trophic levels, such as producers, affect their role as climate change mitigators?
- Do you believe that adding an economic value to a species or natural element will encourage its protection?

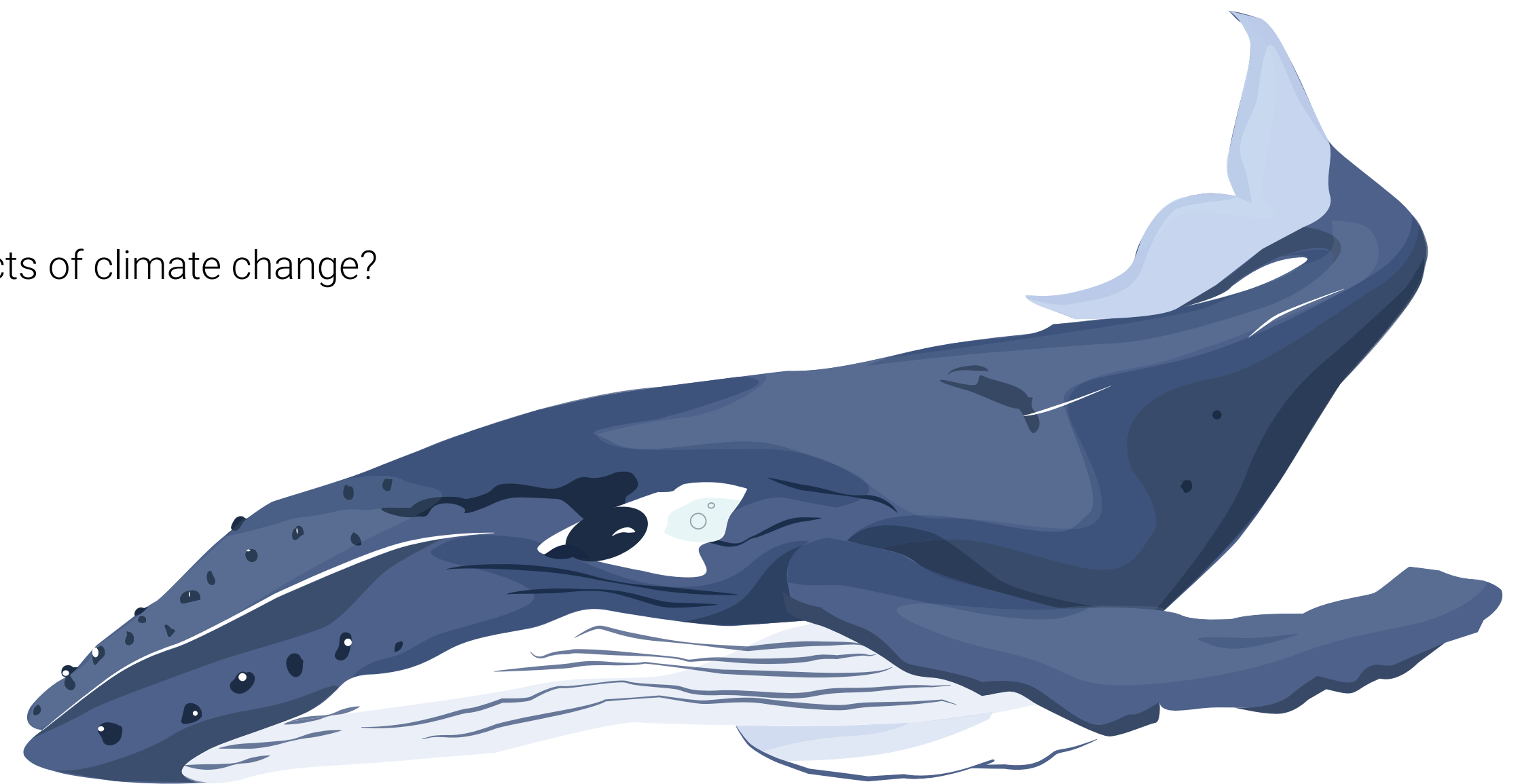


THOUGHTBOOK

This lesson focused on the different ways we contribute to climate change and how we can change our practices to reduce our environmental impacts and footprint. Take time to journal on your thoughts and the things you have learned.

REFLECT

1. What are the most significant ways that the changing climate can impact ocean health?
2. What are some of the ways marine animals can help mitigate climate change?
3. What are some measures that can be implemented to resolve or reduce the adverse impacts of climate change?





TAKE ACTION

Report a whale sighting using [*Ocean Wise Whale Report Alert System*](#).

THE WHY

Reporting a whale sighting provides researchers with information about the abundance of a species in order to properly determine the status of the population (i.e., improving, steady or declining). It also informs scientists about the distribution of whales and how feeding and breeding grounds may be impacted due to climate change. With a better understanding of the abundance and distribution of whales, people in the vicinity can be made aware of their presence and reduce the risk of vessel strikes and other human inflicted disturbances. By helping provide more information to scientists and the community, you can have a role in contributing to climate change mitigation and conservation measures to help protect species like the humpback whale!

CLIMATE CHANGE
Humpback Whale

OCEAN POLLUTION
Killer Whale

FISHERY BYCATCH
Great White Shark

PLASTIC POLLUTION
Hawksbill Turtle

HABITAT LOSS
Sea Otter



Lesson 2

Ocean Pollution - Killer Whale

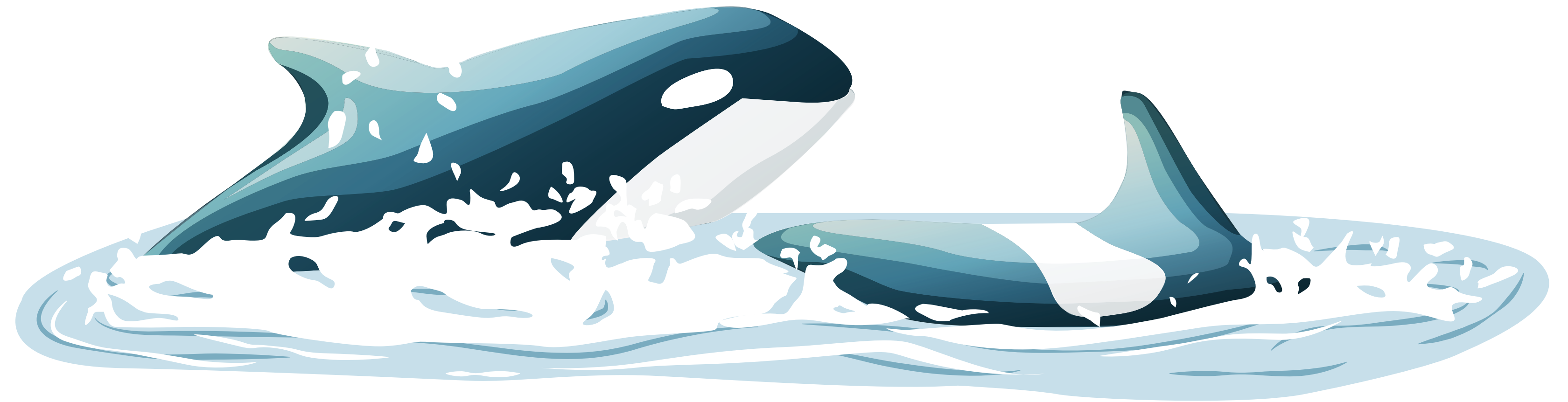
BACKGROUND

Orcas, more commonly known as killer whales, are the largest marine mammals belonging to the dolphin family. Despite living mostly in colder regions where their prey is most abundant, killer whales can be found all over the world feeding on a variety of different prey. In fact, this species has the most varied diet and foraging behavior of all cetaceans. Despite being so widely distributed and easily recognized by their signature black and white coloring, it has been extremely difficult for researchers to accurately gather information on species distribution and population size as they are found in such remote areas. This has led to the IUCN listing the killer whale as a data deficient species on their Red List.

Although little is known about the killer whale, scientists have shown that their greatest threat is ocean pollution. While ocean pollution affects all marine animals, it has a disproportionately greater effect on killer whales as they are a top (apex) predator. This means that they are found at the top of the food chain where the bioaccumulation of ocean pollutants is at its highest. Bioaccumulation occurs when a toxin enters the food chain via primary producers (i.e., algae) and increases in

concentration as it moves up. Top predators, such as the killer whale, will possess the highest concentration of that toxin. Killer whales are most likely to be harmed by industrial and household chemicals, which persist through the food chain over several decades by storing itself in the blubber of the killer whale's prey. As a result of their chemical contamination via feeding, killer whales across the world are facing high rates of infertility, high rates of calf death (due to mothers offloading chemicals to their calves via milk), and poor immune system functioning, which has contributed to a decline in their population.

There is no doubt that the ban of certain ocean pollutants has significantly mitigated the effects of its bioaccumulation in killer whales. However, we must recognize that we have yet to act on countless unregulated pollutants entering our ocean. We still have lots of work to do.



STUDENTS WILL BE ABLE TO

- Understand the interdependence of ocean health, the food chain, and trophic structure connections as it pertains to ocean pollution.
- Understand the interconnectedness of species within the same food chain in an ecosystem.
- Develop a meaningful understanding of the importance of delivering scientific information to the public with the objective to lead an environmentally cleaner future.

CRITICAL QUESTIONS

- What pollutants (or properties of pollutants) have the most impact on ocean health?
- How do pollutants affect all species in an ecosystem? Why are certain species more affected by ocean pollutants than others?
- Why are Indigenous peoples disproportionately affected by ocean pollution?

RESOURCES

- Watch: [Bioaccumulation and Biomagnification: Increasingly Concentrated Problems! by Catalina Island Marine Institute](#)
- Read: [Ocean Wise Blog: Tracking Contaminants in Killer Whale Habitat by Ocean Wise](#)
- View: [Ocean Wise's Pollution Tracker by Ocean Wise](#)
- Read: [What is a Research Briefing by Oxford Review](#)
- Read: [Impact of Pollution on Native People by Native Knowledge 360](#)

ADDITIONAL RESOURCES

- Watch: [Killer Whales Under Threat by Ocean Wise](#)
- Read: [OCEANWATCH Spotlight – Pollution Hotspots in Killer Whale Habitat Pinpointed by New Conservation Tool by Ocean Wise](#)
- Read: [Parallels Drawn Between Endangered Orcas and Indigenous Experiences by CBC](#)
- Read: [Native American Killer Whale Mythology by Native Peoples](#)



ACTIVITIES

1. Watch [*Bioaccumulation and Biomagnification: Increasingly Concentrated Problems! by Catalina Island Marine Institute*](#) and read [*Ocean Wise Blog: Tracking Contaminants in Killer Whale Habitat by Ocean Wise*](#).
 - In small groups, ask students to select a top ocean predator and draw their respective food chain including species from all trophic levels (from producer to top predator) and answer the questions in their workbook. Discuss as a class some of the similar patterns in their findings. Refer to the guiding questions below during the discussion:

GUIDING QUESTIONS

- **Are your top predators herbivores, omnivores, or carnivores?**
 - **At which trophic level does the pollutant enter the trophic structure?**
 - **Is the top predator directly or indirectly affected by the pollutant?**
 - **From the information in the video you just watched, which animal in your trophic structure would you say is the most affected by the pollutant?**
- Students should also come up with 3 practices that individuals and corporations can implement to prevent this pollutant from reaching waterways (this can include environmentally friendly alternatives). Make sure they are creating realistic practices and considering the additional costs for those implementing these practices.

2. View [*Ocean Wise's Pollution Tracker by Ocean Wise*](#). Using the interactive map, students should select a coastal location and a pollutant and create a scientific briefing that they will later present to the class. The scientific briefing should target how this pollutant impacts the killer whale. A scientific briefing has the purpose of explaining information concerning ideas, issues, analyses, advice, recommendations, and more. If unsure on how to create a scientific briefing, consult [*What is a Research Briefing by Oxford Review*](#).
3. As a class, read the texts and watch the videos of [*Impact of Pollution on Native People by Native Knowledge 360*](#). Discuss how ocean pollution disproportionately affects Indigenous peoples by following the discussion questions at the end of the slideshow. Encourage students to mention the pollutants and species they have addressed in previous activities (if applicable).



THOUGHTBOOK

In this lesson, you learned about ocean pollution and how it impacts not one, but nearly all species in a food chain or ecosystem, as well as pollution's negative impact on all species, especially those most at risk. Take a moment to pause and reflect on what you have learned and how it made you feel.

REFLECT

1. What pollutants (or properties of pollutants) have the most impact on ocean health?
2. How do pollutants affect all species in an ecosystem? Why are certain species more affected by ocean pollutants than others?
3. Why are Indigenous peoples disproportionately affected by ocean pollution?





TAKE ACTION

Take [***Ocean Wise Plastic Pledge!***](#) Reduce your consumption of single-use plastic, for example: bring a reusable water bottle or reusable containers in your lunchbox!

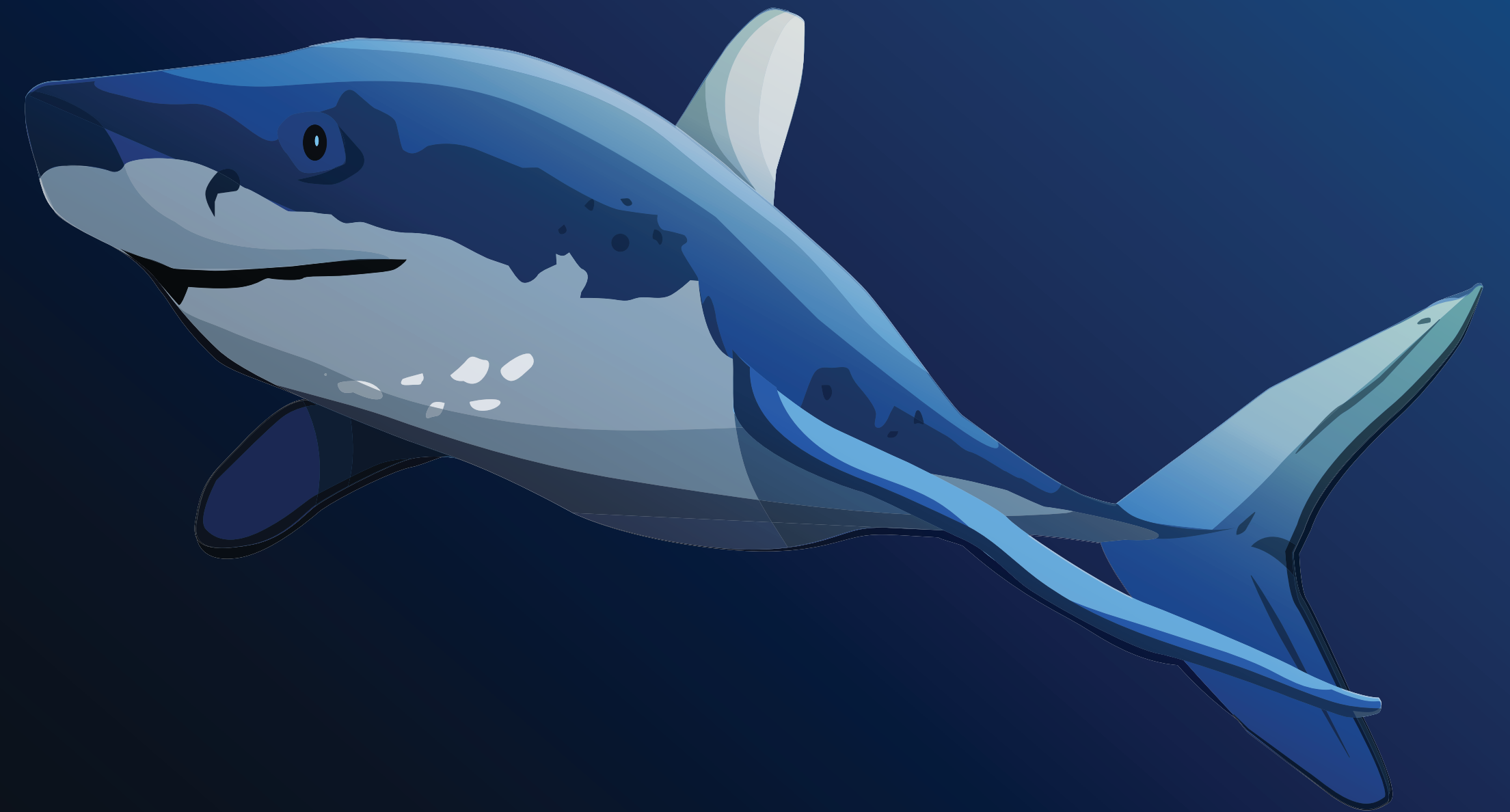
THE WHY

Not only does reducing your consumption of single-use plastic (such as plastic straws or bags) prevent plastics from entering the environment, but it also discourages their production and the release of harmful chemicals used to create them (including the industrial chemicals harming killer whales!) By taking Ocean Wise's Plastic Pledge and reducing your use of plastics, you are contributing to the reduction of not one, but two types of ocean pollutants from entering our waterways.



Lesson 3

Fishery Bycatch - Great White Shark



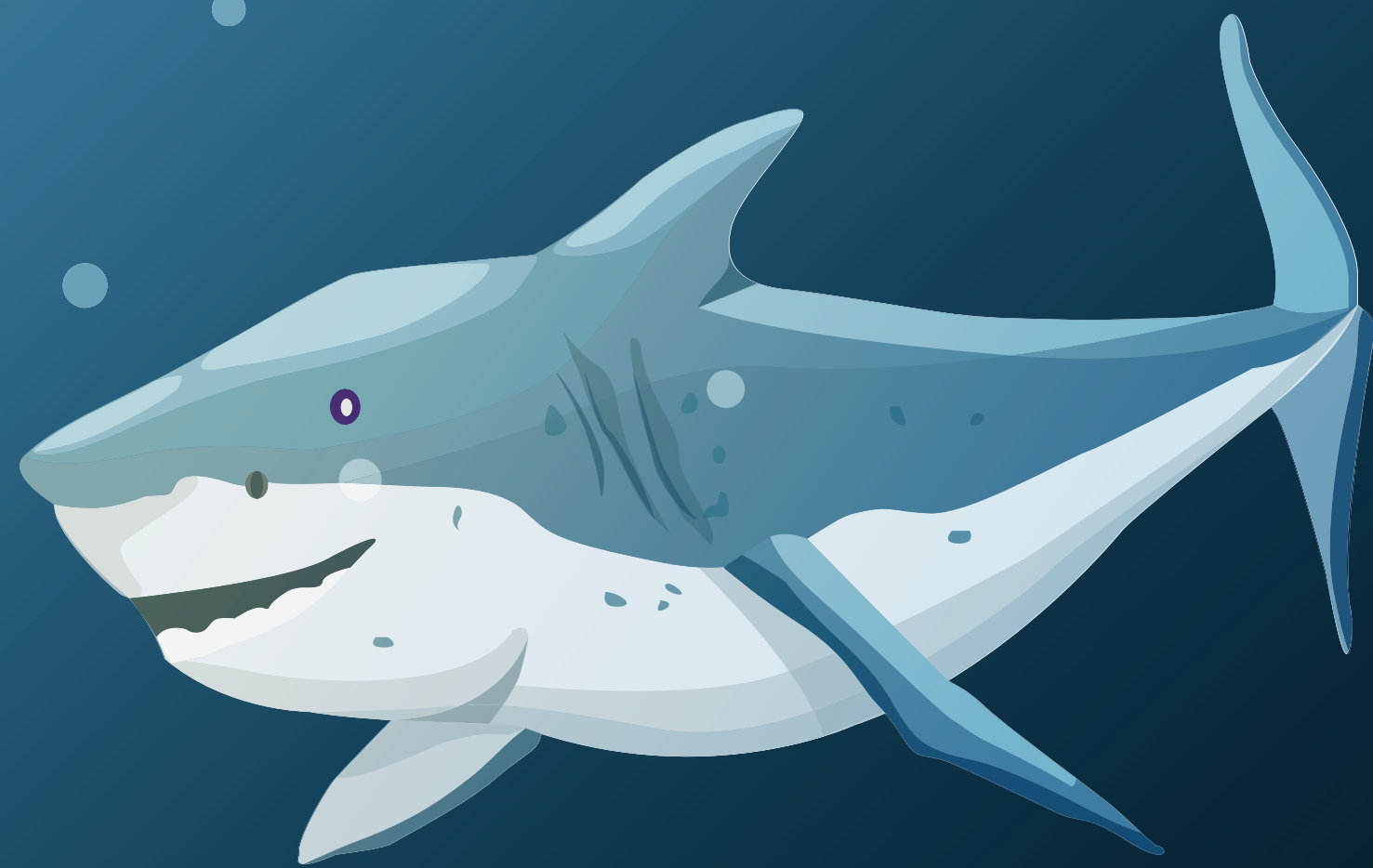
BACKGROUND

Perhaps one of the most iconic shark species, the great white shark is the largest predatory fish on earth. They are found in oceans around the world where they feed on seals, whales, and seabirds. Despite humans not being their prey, they can sometimes make mistakes! Each year, a third to a half of the 100 shark attacks reported throughout the world are caused by great white sharks attacking people who harass them or try to feed them. However, they are not trying to eat us! Unlike what is portrayed in the media, such as in the film *Jaws*, great whites are not malicious creatures that intend to cause harm, but simply mistake us for prey. In fact, humans pose a greater threat to them as we kill around 100 million sharks and rays every year.

The great white shark population is in decline owing to years of being hunted by humans for their highly valued fins and teeth or as trophies. Over the past 150 years, global populations have declined by an estimated 30%-49%. Today, despite the value of shark products, great whites are rarely caught on purpose by commercial fisheries as they target other shark or fish species

whose meat is more desirable for food. Instead, great whites, especially juveniles, are accidentally caught in fishing nets as by-catch. During their yearly migration, great whites pass through areas with high levels of fishing activity increasing their vulnerability to becoming by-catch. These fisheries also pose an additional threat as they contribute to the overfishing and abundance reduction of the great white's prey.

With the great white shark's population in decline, the IUCN has listed the species as vulnerable on their Red List. They are also listed as endangered under the Canadian Species at Risk Act (SARA) and many other legislations across the world. Being listed in legislation gives great white sharks legal protection, however, simply listing their name on a piece of paper is not enough to protect this species, especially if fisheries continue to use unsustainable and dangerous fishing practices.



STUDENTS WILL BE ABLE TO

- Deepen their personal connection to global environmental issues caused by humans and our reliance on natural resources.
- Deepen their understanding of how unsustainable fishing and resource use by humans impacts ocean and species health.
- Improve the ability of individuals and communities to make informed and responsible consumer choices regarding seafood and other ocean resources.

CRITICAL QUESTIONS

- What are the differences between the sustainable and unsustainable use of ocean resources?
- What are the most damaging effects that human seafood consumption has on ocean ecosystems? How has our reliance on seafood impacted ocean health?
- How can traditional Indigenous knowledge and practices inform fisheries on how to use and manage ocean resources sustainably and respectfully?

RESOURCES

- Read: [The Ocean Literacy Principles on pg.5 of Ocean Literacy](#)
- Read: [What is Bycatch by the Consortium For Wildlife Bycatch Reduction](#)
- Watch: [Will the Ocean Ever Run Out of Fish by TED-Ed](#)
- Watch: [David Attenborough Explains What We Need to Do to Stop Overfishing by World Economic Forum](#)
- View: [Fishery Science by Department of Fisheries and Oceans Canada](#)
- Read: [A Brief Introduction to Indigenous Fishing by AIATSIS](#)
- Read: [Want to Save BC Salmon? Bring Back Indigenous Fishing Systems, Study Says by Stephanie Wood](#)



ACTIVITIES

1. SUSTAINABLE FOOD SUPPLY TO FEED THE WORLD

Students are tasked to set up a sustainable wild capture fishery or aquaculture facility to nourish the global population without depleting other resources needed to survive.

- Ask students, individually or in groups, to propose a sustainable wild capture fishery or aquaculture facility following the *Sustainable Seafood Company Guide* found in their workbook.
- Allow students to present to the class their proposed strategy and discuss the reasoning behind the selection of the target species, methods, and management approaches.



ALTERNATIVE / ADDITIONAL ACTIVITIES

these activities are proposed as alternatives to activity 1

- Ask students to read [What is Bycatch by the Consortium For Wildlife Bycatch Reduction](#) and discuss with students some species characteristics or behaviors that may make them more vulnerable to by-catch. Try to relate these characteristics back to the great white shark. Refer to the *guiding questions* during your discussion.

GUIDING QUESTIONS

- Does species size influence by-catch, and how?
- Does prey type influence by-catch, and how?
- Does species habitat and distribution influence by-catch, and how?
- Does species feeding behavior influence by-catch, and how?

b. Individually or in groups, students will be tasked with researching the physiological and behavioral characteristics of the great white shark and apply their findings when designing a potential by-catch reduction system for this specific species. They can present their proposal as a diagram or brief paragraph.

- As a class, watch [Will the Ocean Ever Run Out of Fish by TED-Ed](#) and [David Attenborough Explains What We Need to Do to Stop Overfishing by World Economic Forum](#). From their understanding of overfishing, students shall research an overfished species and come up with 2 conservation measures which can help restore this fish stock. They should consider Traditional Indigenous fishery management approaches by reading [Want to Save BC Salmon? Bring Back Indigenous Fishing Systems, Study Says by Stephanie Wood](#). You are also encouraged to browse through the [Fishery Science by Department of Fisheries and Oceans Canada](#) with students.

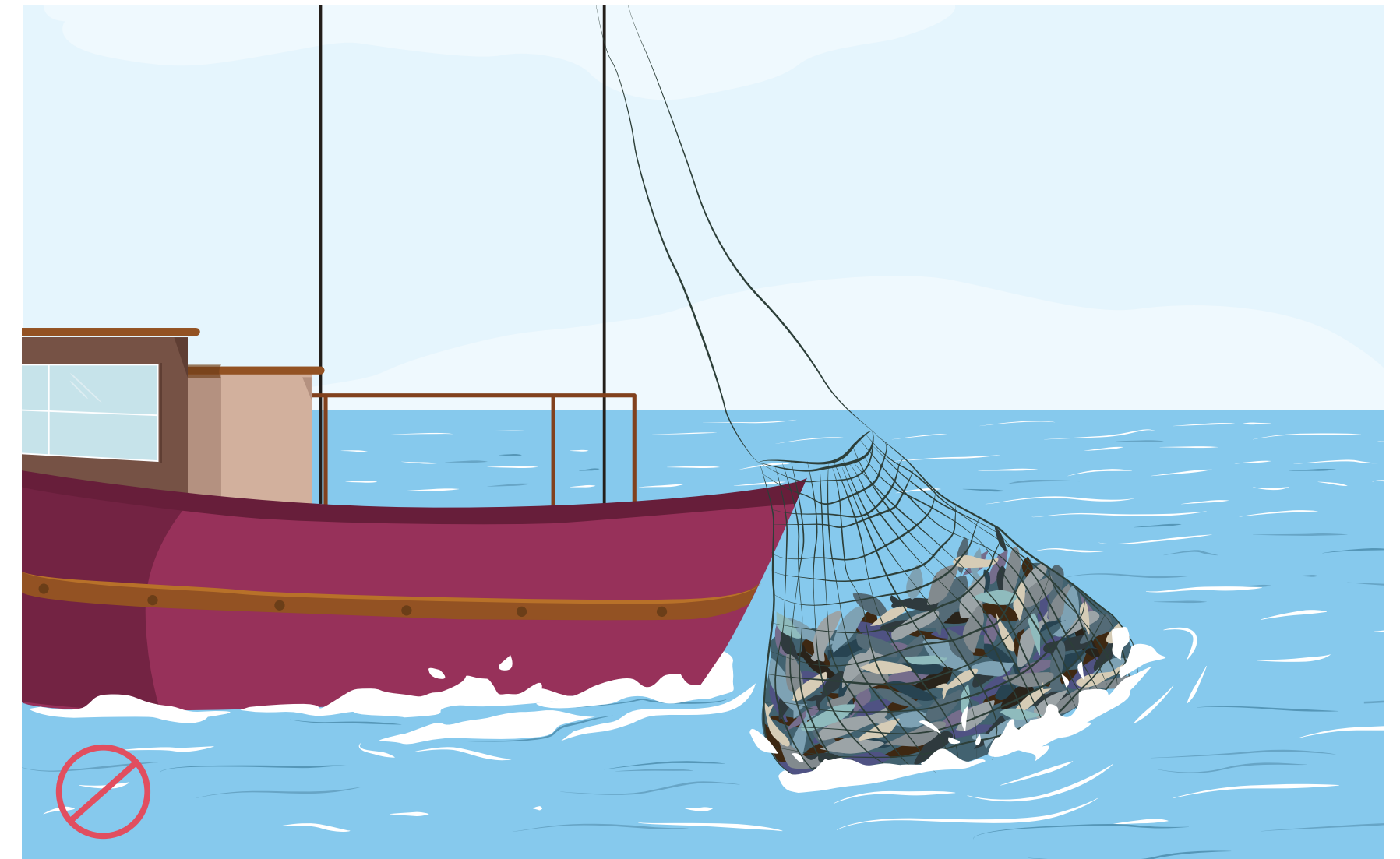


THOUGHTBOOK

From these activities, you should understand how unsustainable fishing practices, such as overfishing and by-catch, impact ocean health. Reflect on the environmental cost of the overexploitation of ocean resources such as seafood.

REFLECT

1. What are the differences between the sustainable and unsustainable use of ocean resources?
2. What are the most damaging effects that human seafood consumption has on ocean ecosystems? How has our reliance on seafood impacted ocean health?
3. How can traditional Indigenous Knowledge and practices inform fisheries on how to use ocean resources sustainably and respectfully?





The Ocean Wise seafood symbol is your assurance of an ocean-friendly choice.



TAKE ACTION

Use the [Ocean Wise Seafood Partner Map](#) and the [Ocean Wise Seafood Recommendations](#) before purchasing a seafood product and look for our logo on seafood packaging!

THE WHY

Ocean Wise’s seafood recommendations identify sustainably farmed or fished seafood products. By using the variety of tools created by Ocean Wise, such as the Seafood Partner Map and Seafood Recommendations Search Tool, you can easily make an informed choice regarding the sustainability of the seafood that you are purchasing. By doing so, you will be directly contributing to ocean sustainability by supporting fisheries which have implemented the appropriate measures to protect and respect our ocean and its resources and encouraging others to do the same.

Lesson 4

Plastic Pollution - Hawksbill Turtle

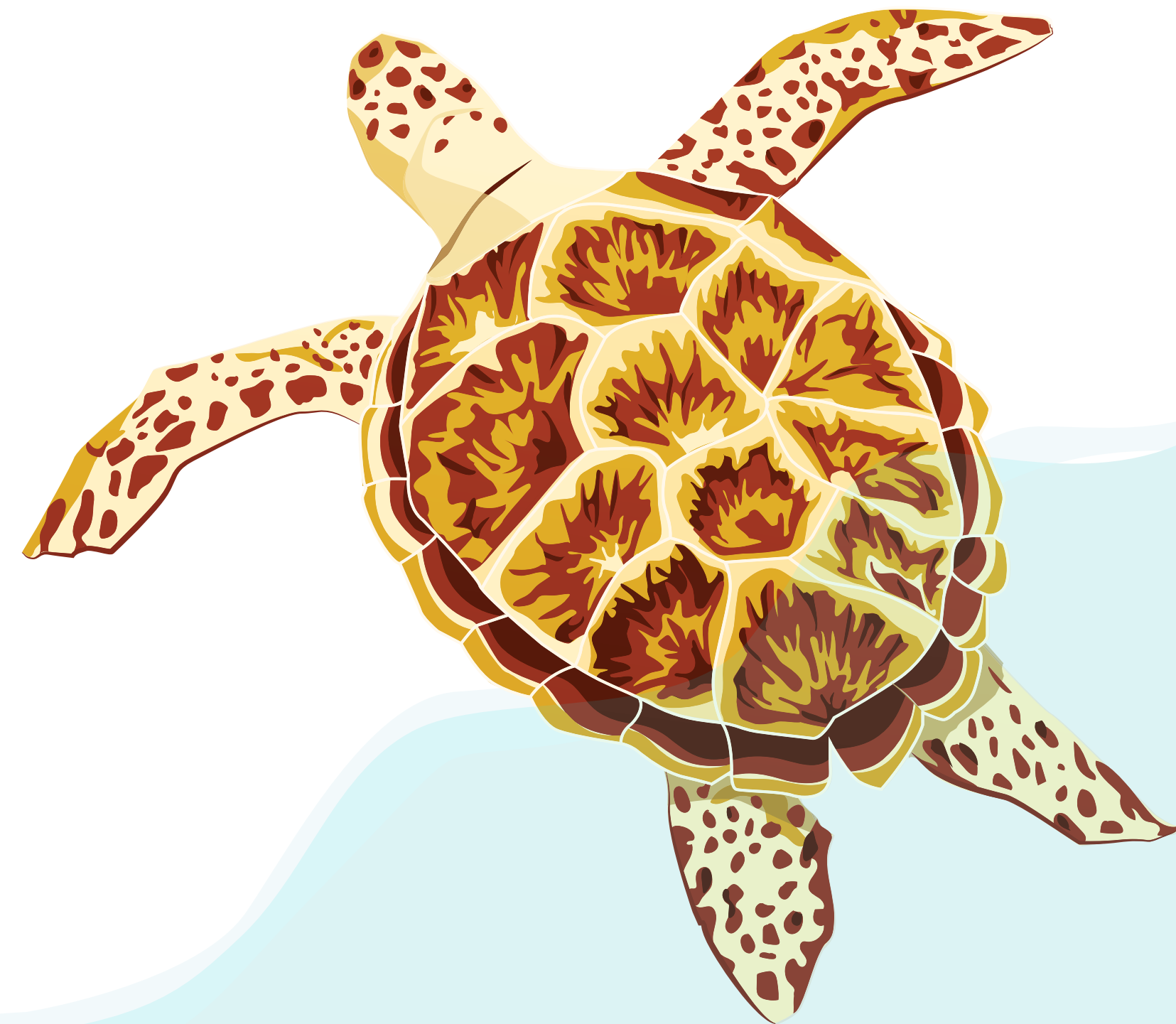


BACKGROUND

Hawksbill turtles are globally distributed throughout the tropical and subtropical waters of the Atlantic, Indian, and Pacific oceans. They can be found migrating in the open ocean between breeding and foraging sites, however most of their time is spent near reefs and on sandy beaches reaching from Australia and Indonesia to Mexico and Puerto Rico. Unfortunately, it is their frequent appearance on beaches and in coastal waters which make them vulnerable to threats such as hunting, loss of habitat, fishery by-catch, and marine pollution.

The hawksbill turtle is known for the uniqueness and beauty of their shell making them a target for hunters and illegal wildlife trade. They are also particularly vulnerable to habitat loss from coastal development as they lay their nests further in-land compared to other sea turtle species. However, the most severe threat to the hawksbill turtle's global population is that of marine pollution, more specifically plastic pollution. The threat of plastic pollution to the hawksbill turtle is multifaceted. Marine plastic debris can often be mistaken as food and ingested, (a floating plastic bag is mistaken for a jellyfish for example), causing reduced growth rates and reproductive output, poor health, and death. While fisheries threaten the hawksbill sea turtle through bycatch, they are also contributors to plastic pollution by leaving ghost fishing gear in the ocean. Turtles get entangled in this gear causing fatal lacerations and drowning. When plastic pollution washes up on the shoreline, it threatens nesting mothers as they can't dig through to lay their eggs and they will often get entangled or injured by beach litter. Furthermore, plastic pollution on the shoreline can barricade hatchlings from reaching the ocean.

Despite being only one type of pollution, the variety of impacts that plastic has on the hawksbill turtle is what make it such a powerful threat. With the increasing amount of plastic entering our ocean, it is no surprise that the hawksbill turtle has been listed as critically endangered by the IUCN. Unfortunately, this situation is not getting any better. While we have already lost 85% of the species, their population is still in decline. Therefore, we must act fast and reduce our plastic consumption to save the hawksbill turtle and many other species!



STUDENTS WILL BE ABLE TO

- Understand how plastic pollution impacts ocean health and species.
- Create an understanding of the applicability of small-scale conservation and citizen science initiatives.
- Deepen their understanding of how plastic pollution affects species in nearby and further away ecosystems.

CRITICAL QUESTIONS

- How does plastic pollution adversely impact ocean health and marine species?
- What are some alternatives to single-use plastic that are less detrimental to the environment?
- How can we use citizen science to inform small-scale conservation initiatives?

RESOURCES

- View: [Ocean Wise Shoreline Clean Up Data Card by Ocean Wise](#)
- View: [iNaturalist Introduction](#)
- View: [iNaturalist App Download](#)
- Watch: [How to Make an Observation on iNaturalist using our Mobile App by iNaturalist](#)
- Read: [Getting Started by iNaturalist](#)
- Watch: [How Ocean Plastic Threatens Sea Turtles by Newsy](#)
- Watch: [30 Days Without Single Use Plastics - One Small Step by Now This](#)
- Read: [How Seabirds and Indigenous Science Illustrate the Legacies of Plastic Pollution by Stephanie B. Borelle et al.](#)
- Read: [Climate Change Threatens Indigenous populations and Traditional Ecological Knowledge by Samantha Chisholm Hatfield](#)



ACTIVITIES

1. GARBAGE CLEAN UP X CITIZEN SCIENCE

STEP 1 - GARBAGE CLEAN UP

As a class, conduct a garbage clean up either on school property or in a local outdoor community by following the *Garbage Clean Up Guidelines - For Educators* found in the lesson four section of the appendix.

- Ask students to identify the different types of plastic products gathered during your clean up and record their observations in their [Ocean Wise Shoreline Clean Up Data Card by Ocean Wise](#).
- Once observations are recorded and garbage is collected, assist students with garbage triage and proper disposal.

STEP 2 – SPECIES ID

- Once the garbage clean-up is complete, ask students to take out their phone/tablet and open [iNaturalist](#) (app needs to be [downloaded](#) before hand). If using iNaturalist, watch [How to Make an Observation on iNaturalist using our Mobile App by iNaturalist](#) and view [Getting Started by iNaturalist](#). Ask students to walk around and try to identify different animals or insects in the vicinity of where the garbage clean up took place. Their observations will automatically be recorded and saved and can be found in the “me” section at the bottom of the screen.

Note: if students do not have access to the internet, they can take pictures and upload them once back in the classroom.

STEP 3 - GARBAGE CLEAN UP AND CITIZEN SCIENCE REPORT

- Students will be tasked with writing a scientific report which identifies how the different types of waste they collected, with a focus on plastic, hinder the habitat and health of one of the species they identified.
 - The scientific report should include an introduction, methods, results (graphs, tables, etc.), discussion, and conclusion section. See the *Student Guidelines for a Citizen Science Report* in the student workbook for reference.
 - [Watch 30 Days Without Single Use Plastics - One Small Step by Now This](#). Have students dedicate one paragraph in their discussion or conclusion to advocate for alternatives to single-use plastics.





THOUGHTBOOK

Now that you have participated in your own garbage clean up and citizen science project targeting plastic pollution, reflect on the positive impact you brought to your school, community, and environment!

REFLECT

1. How does plastic pollution adversely impact ocean health and marine species?
2. What are some alternatives to single-use plastic that are less detrimental to the environment?
3. How can we use citizen science to inform small-scale conservation initiatives?





Ocean Wise | Shoreline Cleanup



TAKE ACTION

Take part in an [Ocean Wise Shoreline Cleanup](#) with your classmates or within your community!

THE WHY

So far, Ocean Wise's shoreline cleanups have removed 13, 915kg of litter from coastlines in Canada and the United States. Shoreline cleanups have prevented these plastics from entering marine ecosystems, reducing fatal impacts on thousands of species, such as the hawksbill sea turtle. Since plastics travel with ocean currents around the world, by organizing or participating in a shoreline cleanup, you are contributing to the removal of plastics in every ocean and shoreline around the world!

CLIMATE CHANGE
Humpback Whale

OCEAN POLLUTION
Killer Whale

FISHERY BYCATCH
Great White Shark

PLASTIC POLLUTION
Hawksbill Turtle

HABITAT LOSS
Sea Otter

Lesson 5

Habitat Loss - Sea Otter



BACKGROUND

The southern sea otter once called the entire West Coast home, with populations stretching from Baja, California, to the Pacific North-West. However, when the hunting of this charismatic creature for their fur began in the 1700s, the population was rapidly decimated to the point that they were thought to be extinct. In 1977, a small population was discovered on an island 500 km off California's coastline, and this led to huge efforts to repopulate their species! Today, efforts to keep the animal thriving have intensified thanks to various conservation organizations, including Ocean Wise. While the wild population has been holding steady in the thousands for nearly a decade, it has not grown significantly. Of the 13 otter species, the IUCN lists 5 as endangered, 5 as near threatened, and 2 as vulnerable. Researchers believe that the lack of population growth is a result of competition for food and various anthropogenic threats.

Sea otters are vulnerable to many human inflicted threats including pollution, habitat destruction, poaching, overfishing, and entanglement in ghost nets and rogue fishing gear. As many live near major oil tanker routes, oil spills are another major threat to sea

otters. Oil destroys the insulative properties of the sea otter's fur which is responsible for keeping them warm. Therefore, when sea otters unintentionally wander into an oil spill, they become more susceptible to hypothermia as their fur encounters oil.

The changing environment is another threat to sea otters, especially with changes observed in kelp forests. Sea otters are a keystone species in kelp forests as they forage on kelp-grazing invertebrates, such as sea-urchins, keeping their population to a minimum and preventing the formation of urchin barrens. In return, kelp provides sea otters with cover from predators, habitat, and nurseries. As ocean warming persists and sea otter populations are threatened, the intensifying degradation of kelp forests is leaving sea otters out in the open ocean, stranded and helpless with no protection. In just the last 30 years, over 725 sea otters have been stranded. However, in areas with at least 10% kelp cover, virtually no strandings have been reported. This shows that there are hopeful solutions to restore sea otter populations including Seaforestation. By growing kelp to restore underwater forests, Seaforestation can help support ecosystems and save the sea otter population!



STUDENTS WILL BE ABLE TO

- Understand the connection between human actions and degradation of a food web.
- Understand the importance of kelp forests to all living things.
- Understand the interconnectedness of ecosystem functioning and ocean health.

CRITICAL QUESTIONS

- What are the potential effects, negative or positive, of removing a species from an ecosystem?
- How does ocean health depend on ecosystem relationships?
- How can humans create consumer goods which simultaneously protect critical ecosystem components?

RESOURCES

- Watch: [The Importance of Kelp by the Hakai Institute](#)
- Watch: [Sea Otters: This Kelp Forest's Best Friend by National Geographic](#)
- Watch: [Some Animals Are More Equal than Others: Keystone Species and Trophic Cascades by Bio Interactive](#)
- Read: [What Are Keystone Species by the National Marine Sanctuary Foundation](#)
- Watch: [Sea Otters: This Kelp Forest's Best Friend by National Geographic](#)
- Read: [The Seaweed Company Home Page](#)
- View: [Kelp Scones | Ocean Kitchen by Ocean Wise Seafood](#)
- Read: [Return of Sea Otters to B.C. Coast by CBC](#)
- Read: [Indigenous People and Nature: A Tradition of Conservation by UNEP](#)
- Read: [Cultural Significance of Oregon's Sea Otters by Elakha Alliance](#)

ADDITIONAL RESOURCES

- Watch: [Sea Otters vs Climate Change by One Earth](#)



ACTIVITIES

1. Kelp Product Business Plan: Students are tasked with creating a kelp product and building a business plan for that product.
 - As a class, view [The Seaweed Company Home Page](#) & [Kelp Scones | Ocean Kitchen by Ocean Wise Seafood](#). Discuss as a class the uniqueness and utility of the products for individuals and the environment.
 - Get students into small groups to brainstorm what their dream kelp product would be. Students should write a business/product proposal following the *Business Plan Guide* found in their workbook.
 - Have students present their business plan/dream product to the class.



ALTERNATIVE / ADDITIONAL ACTIVITIES

these activities are proposed as alternatives to activity 1

- Have the class read: [Return of Sea Otters to B.C. coast by CBC](#). Separate the class into two groups to debate the pros and cons of reintroducing a species to an area where it had previously been eliminated as a conservation technique. Each side should be assigned a pros and cons approach and should consider perspectives from an Indigenous and non-Indigenous lens. You shall be the moderator of the debate.

- Watch [The Importance of Kelp by the Hakai Institute](#) and [Sea Otters: This Kelp Forest's Best Friend by National Geographic](#). Discuss as a class what may have happened to kelp forests when sea otter populations were decimated in the 1700's and how this may have contributed to climate change.





THOUGHTBOOK

Now that you have a better understanding of how each species has a special role in an ecosystem, especially keystone species, you should also better understand the consequences if one of those species disappears. Reflect on the role of all species as it relates to the integrity of an ecosystem.

REFLECT

1. What are the potential effects, negative or positive, of removing a species from an ecosystem?
2. How does ocean health depend on ecosystem relationships?
3. How can humans create consumer goods which simultaneously protect critical ecosystem components?



TAKE ACTION

Buy a sustainable kelp product!

THE WHY

Similar to your business ideas, there are many great products with kelp in them! Next time you go to the grocery store, take a look at the toothpaste, shampoo, salad dressings, dairy products, and/or frozen foods to see if they contain kelp. By buying sustainable kelp you are supporting and ensuring the planting of kelp. In other words, you are enabling greater carbon storage by kelp and better protection of sea otters and other ocean creatures which rely on kelp for a home! Kelp is also incredibly healthy and considered to be an excellent source of micronutrients, antioxidants, vitamins, and dietary fiber. So, buy a sustainable kelp product to make sure you and the ocean stays healthy!

APPENDIX

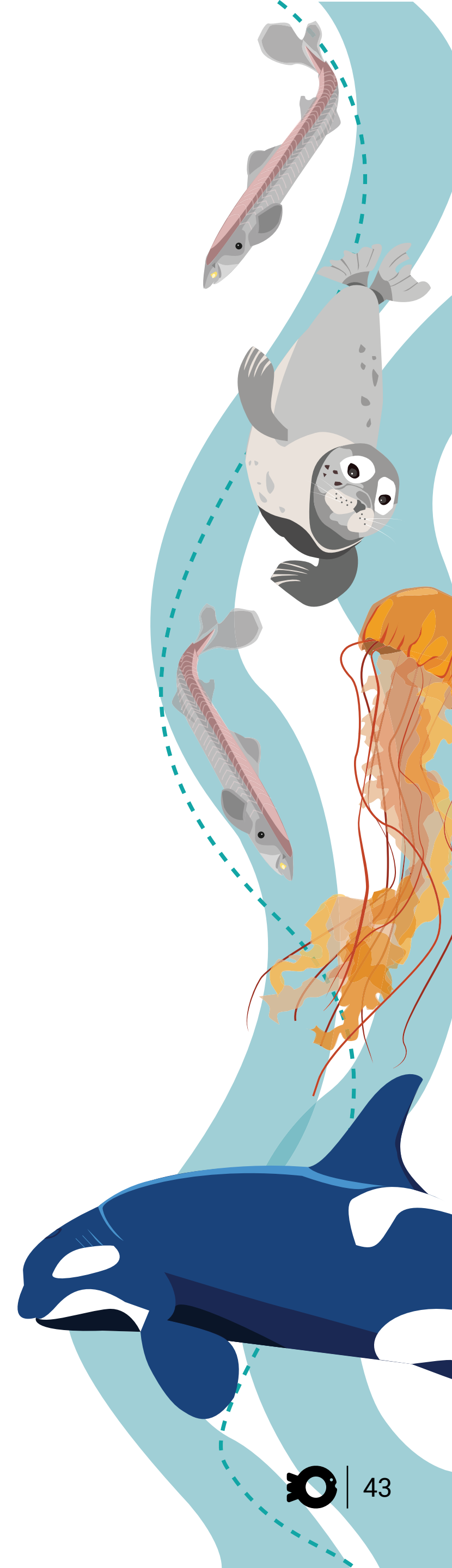
LESSON 4

Garbage Clean Up Guidelines - For Educators

When conducting a garbage clean up, the most important thing is your safety. Please read and follow the guidelines below when conducting a garbage cleanup to make sure that you and all participants are safe.

1. Survey your clean up site. You want to make sure that the area where you will be conducting your clean up does not pose any threat to students. Things to look out for; hidden ditches, high traffic areas, cliffs, etc.
2. Gather supplies. You will need:
 - Gloves - preferably reusable safety or garden gloves to avoid single use plastic gloves. You can encourage students to bring their own.
 - Buckets or garbage bags - to place the garbage in.
 - Sharps container - note that garbage such as broken glass, broken hard plastics, metal, etc should be placed in the sharps container and handled by the educator or host of the clean up. A sharp container can be a bucket or box which cannot be torn or pierced by a sharp object.
 - Data cards - should be printed for each student. You can find a PDF version [here](#). A copy is also found in their workbook.

- Pickers (optional) - to pick up garbage. You can encourage students to bring their own.
3. Go to the clean up site and divide the class into small groups (3-4 students). Designate a rough area to each group where they will conduct their garbage cleanup. Make sure students record their findings in the data cards.
 4. At the end of the garbage clean up, assist students with separating garbage (plastic recyclables, paper recyclables, cans, etc) so they can be disposed of properly.



WHAT IS OCEAN WISE?

Ocean Wise is a non-profit organization whose mission is to empower communities and individuals to take action to protect and restore our world's ocean.

Ocean Wise does this by tackling three critical ocean challenges - climate change, overfishing and plastic pollution – through six intersecting initiatives: seaforestation, changing arctic, plastics, fisheries and seafood, youth, and whales. Through our work we make a real and measurable difference to the health and well-being of the ocean and the people who depend on it. You can learn more about the actions you can take at ocean.org.

Looking for more Ocean education?

Ocean Wise's Education team offers in-person mobile education opportunities, online virtual programs, and more. Ocean Wise Professional Development Workshops are designed to train educators on discussing ocean health and literacy for students K-12. Visit ocean.org or email education@ocean.org to learn more.

Follow us on Social Media

IG: [@oceanwise](https://www.instagram.com/oceanwise), FB: [@oceanwise](https://www.facebook.com/oceanwise), TW: [@oceanwise](https://twitter.com/oceanwise), LK: [@oceanwise](https://www.linkedin.com/company/oceanwise)

Sign up for our [newsletter](#).

Have feedback? We would love to hear from you!

Please take 4 minutes to [rate us](#).

This project was undertaken with the financial support of the Government of Canada.

