Songs of the Sea

Science Grades 3,4 and 5

This unit provides standards-based lessons to accompany OPAK (Ocean Protection Advocacy Kids) programs run in classrooms. Designed to teach students about whale’s native to our coastal waters, at different grade levels it provides content focusing on the life cycle, habits and habitats of baleen and toothed whales. Students in grade 3 will work to answer questions including “What do whales need to live and grow?”, “How does weather affect whale migration?” And “What differences and similarities are found between different whale species?”. In grade 4 they will be introduced to sound waves and their role in the processes of whale echolocation and communication. Grade 5 will look closely at human impact on our marine environment, learning how micro-plastics can ultimately affect the diet of the whale and other marine life. At each grade level, a main component of this unit is a whale-watching field trip during which students will apply what they've learned through skill building lessons presented by OPAK naturalists in the classroom. Throughout the unit students at all grade levels will be asked to identify problems and design solutions related to the protection of whale habitats, drawing on what they’ve learned and experienced to compose a “song for the sea” reflecting their understanding of what they have learned and experienced.

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**Please provide us some background information on the unit development.** In order to help others who are interested in this topic understand a bit more about what you created, we will write a short introduction to each unit and provide some images, in addition to posting the completed units on the Cape Cod Regional STEM Network website ([www.capecodstemnetwork.org](http://www.capecodstemnetwork.org)). Please help us by answering the questions below after you have completed your unit.

1. Who helped to create this unit?

|  |  |
| --- | --- |
| Names | School (Grade/course taught) |
| Lisa Green | Bournedale Elementary School Grade K |
| Melanie Colby, Jeffrey Morgan | OPAK founders/ program facilitators |

1. **What were some sources of inspiration for this unit?**

The OPAK philosophy " "With the rapidly changing climate of our globe and our oceans, it is crucial now more than ever to inspire and educate future generations to become strong environmental leaders." This statement resounds here on Cape Cod more strongly than in most places. Our beautiful beaches, varied ecosystems and diverse wildlife offer so much enjoyment for so many, providing educators with the unique opportunity to develop awareness, helping students to make personal connections that could allow them to make a difference either individually or as a group.

1. **In your own words, what are you hoping students learn—big picture—through this unit?**

My hope is that students will walk away from this unit with a better understanding of ways that they personally can help to protect this amazing species and others living in our coastal waters.

1. **What might students find exciting in this unit?**

This unit offers such varied, active opportunities for students to learn about whales. There is so much more to do when learning about whales than simply "watch"! They will tow plankton, play interactive games, get a "feel" for how blubber protects whales from extreme cold and express themselves through music and art. There is truly something that will appeal to every different learning style.

1. **What science standards or real-world content did you strive to emphasize?**

This unit focuses primarily on life science highlighting the impact of interactions between whale and human populations.

1. **How would you say that this unit “matters” to the STEM community? Or to our community on Cape Cod? Or to the larger community?**

Cape Cods history has long included stories reflecting the relationship between humans and whales, generally not focusing on supporting the survival of whale populations. As our next generations begin to explore our local shores it should be with a better understanding of the fragile balance that exists between the people living, working and playing on Cape Cod and the the populations of species that we share our waters with.

1. **What’s the most important lesson you learned as you created this?**

While I am generally aware of and in agreement with the need to protect our environment, I was not aware that there were so many large and small factors that as individuals we often overlook but that collectively impact the survival of our local species.

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| **Grade 3**  **Stage 1 Desired Results** | | | | | | | |
| MA STE Standards  **3-ESS2-1.** Use graphs and tables of local weather data to describe and predict typical weather  during a season in an area.  **3-LS1-1.** Use simple graphical representations to show that different types of organisms have  unique and diverse life cycles. Describe that all organisms have birth, growth,  reproduction, and death in common but there are a variety of ways in which these  happen.  **3-LS3-1.** Provide evidence, including through the analysis of data, that plants and animals have  traits inherited from parents and that variation of these traits exist in a group of  similar organism. | | | **ESSENTIAL QUESTIONS**  What do whales need to live and grow?  How does weather affect whale migration?  What differences and similarities are found between different whale species?  How does human activity impact the survival of whales and other sea life? | | | | |
| **UNDERSTANDINGS - *Students will understand that…***  Whales migrate to warmer waters based on seasonal weather patterns.  Whales are mammals with specific traits that determine the way that they are born, grow, reproduce, and die.  There are many different species of whales each with specific traits inherited from their parents,  classifying them as a type and variations that identify them as belonging to a larger group.  Human activity impacts whale populations.  ***Students will be skilled at….***  Describing the life cycle, habits and habitat of whales found in our coastal waters.  Identifying characteristics of whales that classify them as belonging to a specific species.  Recognizing seasonal patterns that produce favorable conditions for whales to live in our immediate area.  Communicating the importance of environmental advocacy to others through song, poetry or art. | | | | |
| **TRANSFER - *Students will be able to independently use their learning to…***  Describe how whales are born, grow, live and die.  Identify factors that put whale populations at risk.  Communicate ideas for environmental advocacy to peers and adults through words or in pictures. | | | | |
|  | | | **Cross-Curricular Connections**  English language arts  Social/emotional growth and development  Music education  Art education | | | | |
| **Stage 2 Evidence** | | | | | | | |
| **Formative Assessment Ideas:**  Students will respond in writing to the question: "Do you think that it is important for people living on Cape Cod to advocate for whales and other sea life living in our coastal waters? Why or why not?"  Students will play a whale fact game drawing on prior knowledge and preconceived notions to determine if statements presented are true or false. | | | | | | | |
| **Summative Assessment Ideas:**  Individually or in groups students will react to what they have learned and experienced. Either writing a poem, speech, song or creating visual artwork they will express their ideas for ways that humans can work to protect whale populations and why it is important to do so. | | | | | | | |
| **Stage 3 Learning Plan** | | | | | | | |
| **Introductory Lesson**  Lesson that introduces the content. More teacher directed | **Constructing Lesson**  Lessons that engage students in building and linking together understanding. Guided/collaborative. Student/teacher or partners/small group | | | **Practice Lesson**  Lessons or activities that students can complete relatively independently | | **Assessment Lesson**  Formative: Check-ins along the way to see if students “get it”  Summative: Students showing what they know, when you feel they are ready | |
| **Stage 3 Learning Plan** | | | | | | | |
| **Summary of Key Learning Events and Instruction** | | | | | | | |
| **Lesson Name** | | **Type** (Introductory, Constructing, Practice, and Assessment) | | | **Content Addressed** | | **Standards Included (by number)** |
| **Whale facts – What do we THINK we know about whales?** | | Formative assessment | | | General knowledge about whales and impact of human activity | | 3-LS1-1 |
| **Amazing whales** | | Constructing | | | Whale life cycle, habits and habitat of the humpback whale (baleen) and pilot whales (toothed) | | 3-LS1-1 |
| **Why here?** | | Constructing | | | How do seasonal weather patterns and geography make Cape Cod an ideal habitat for whales? | | 3 – ESS2-1, 3- LS1-1 |
| **Whale Watch** | | Practice | | | Observing traits inherited from parents and variations of traits seen among whale species | | 3-LS1-1, 3-LS3-1,  3-ESS2-1 |
| **Song for the Sea** | | Assessment | | | Students will draw from what they have learned, experienced and felt to compose a song advocating for the protection of whales found in our area. | | 3-LS1-1, 3-LS3-1,  3-ESS2-1 |

**Grade 3 Lesson 1: Whale Facts – What do we THINK we know about whales?**

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| **Overview of the Lesson:** What will students be doing?  Assessing prior knowledge to determine a starting point for understanding. Activities will begin to determine what students know or assume about whales and their relationship with humans.  **Time (minutes): 10-15 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  **3-LS1-1** |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What do whales need to live and grow?  How does weather affect whale migration?  What differences and similarities are found between different whale species?  How does human activity impact the survival of whales and other sea life? |
| **Science Objectives -Students will understand:**  Whales migrate to warmer waters based on seasonal weather patterns.  Whales are mammals with specific traits that determine the way that they are born, grow, reproduce, and die.  There are many different species of whales each with specific traits inherited from their parents,  classifying them as a type and variations that identify them as belonging to a larger group.  Human activity impacts whale populations. |
| **Language Objectives and/or Targeted Academic Language**  Baleen, mammal, migrate, species |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Whales are fish and do not give live birth, whales live in one location throughout the year, there are no variations between whale species. |
| **Instructional Materials/Resources/Tools**  OPAK Whale Fact sheet, blindfold |
| **Assessment:** How will you know that the students got it?  Verbal responses at lesson close will indicate understanding and areas to expand. |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science)** and defining problems (for engineering)  2. Developing and using models  3. Planning and carrying out investigations  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science)** and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:** This lesson occurs in the classroom with naturalists from the Ocean Protection Advocacy Kids, Inc. (OPAK) Students will engage in a game designed to test their prior knowledge or assumptions relating to whales before introducing new content. |
| **Opening/Engagement:**   1. Students are asked to consider everything that they know, think or have heard about whales and to respond with one word that describes what they are thinking or feeling. 2. OPAK naturalists will provide and Introduce the “Whale Fact” game. |
| **During the Lesson:**   1. As each fact is read one of the naturalists reveals if it is true or false, providing additional information to support the statement. |
| **Lesson Closing**   1. Following the game students and naturalists will meet as a group. Students will be asked to respond to the questions: 2. Indicate with show of hands: “How many of you were correct 100% of the time? 50%? 25%” 3. Respond verbally “What whale facts surprised you the most, and why?” (identifying preconceived ideas or misconceptions) 4. Naturalist will tell students that they are going to spend time learning about whales in preparation for a whale watching field trip. |

**Grade 3 Lesson 2: Amazing Whales**

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| **Overview of the Lesson:** What will students be doing?  Students will learn about and compare two species of whales found in waters of Cape Cod: Humpback whales (baleen) and Pilot whales (toothed), examining their life cycles, feeding habits, sizes, migration patterns and natural predators.  **Time (minutes): 40 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?   * 3-LS1-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What do whales need to live and grow?  What differences and similarities are found between different whale species?  How does human activity impact the survival of whales and other sea life? |
| **Science Objectives**  Whales are mammals with specific traits that determine the way that they are born, grow, reproduce, and die.  There are many different species of whales each with specific traits inherited from their parents,  classifying them as a type and variations that identify them as belonging to a larger group.  Human activity impacts whale populations. |
| **Language Objectives and/or Targeted Academic Language**  Baleen, toothed, mammal, humpback, pilot, predator, habitat, traits, species |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Whales are fish, do not breath air and do not give live birth or nurse their young. All whales have teeth. |
| **Instructional Materials/Resources/Tools**   * Rope to measure approximate lengths, water, shallow container, cut grass, cut carrot circles, hair comb, kitchen tongs |
| **Assessment:** How will you know that the students got it?  Students will complete a brief written assessment in the form of an “exit ticket” at the close of this lesson. |
| **Lesson Overview:**  Led by OPAK naturalists, this lesson introduces students to the whale life cycle, focusing on migration, comparison of size and methods of eating for the humpback whale (baleen) and pilot whales (toothed) |
| **Opening/Engagement:**   1. Ask: “Can you think of “major events” or “firsts” that you and your family have celebrated since you were small and will continue to celebrate as you grow?” (allow students to respond – i.e.: first steps, first lost tooth, first day of school, becoming a teenager, getting a driver’s license etc.) 2. Say: “We’re going to think about whales in the same way – we’ve picked three “major events” from the whale’s life to explore. All whales are mammals. They have live births, drink milk from their mothers, and breath air. Not all whales have the same characteristics. We are going to look at what makes some species of whales unique. We will look at the what happens in the life of a newborn humpback and pilot whale, we’ll measure to compare measurements of different species of whales as they become adolescents and will experiment to see what it would be like to eat as either a baleen or toothed whale. |
| **During the Lesson:**   1. Using a photo or image of a humpback whale explain: “The baby humpback whale is born in warm waters. When they are born they can weigh as much as one ton (2000 pounds) and are about 9 feet long. For the first year, they will stay by their mother’s side. They nurse on her high-fat milk for at least 5 months or up to a year. Young humpback whales grow to be about 30 feet long in the first year and will be about 50 feet long when fully grown. Mother humpback whales stay with the baby in warm protected waters until he or she are ready to be on their own. 2. Using a photo or image of a pilot whale explain: “Pilot whale calves are roughly 5 feet long when born and weigh about 135 pounds. They will nurse for up to 3 years. Pilot whales are very social and travel in large pods. Pilot whales stay together in the same pod even after becoming adults. Pilot whales can grow to be about 20 feet long. 3. Say: “So that we’ll have a better idea of how different these and other whales are in size, we are going to measure a few different whale lengths using rope that has been marked in lengths of 5 and 10 feet.” 4. Provide groups of students with cards depicting the name and image of various whales, including each whales size in feet and lengths of marked rope. Allow groups to lay out rope showing how long each whale is. 5. Say: “We can see that different species of whales vary in size. Another thing that makes them very different is the way that they eat.” 6. Showing students section of baleen explain that all whales are mammals carnivores (eat other animals) there are two groups of whales that eat om very different ways. Baleen whales are filter feeding and eat plankton, and small mysid shrimp. Baleen whales do not have teeth. The other group of whales, toothed whales are hunters and chase and capture prey such as fish, squid, crabs, starfish and other ocean creatures. Once captured, toothed whales swallow their prey whole. 7. Experiment: Divide students into two groups: Baleen eaters and Toothed eaters. Provide both groups with shallow containers holding a few inches of water. Sprinkle finely chopped grass on top of the water for Baleen eaters, inviting them to use a comb to “catch” as much grass as they can with it. Drop pieces of cut carrot into the trays of the toothed eaters, providing them with tongs to “catch” as much as they can. 8. Students can switch groups to try the other method if time allows. |
| **Lesson Closing**   1. End by asking students which method they found easier and why, explaining that the humpback whale eats 4,400-5,500 pounds of plankton each day and that the pilot whale eats up to 70 pounds of food each day. 2. Provide students with exit ticket asking them to provide a short answer to the question: “What was one thing about whales that you were surprised to learn and why?” |

**Grade 3 Lesson 3: Why Here?**

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| **Overview of the Lesson:** What will students be doing?  Students will learn how seasonal weather patterns and geography make Cape Cod an ideal habitat for whales. They will also begin to consider ways that human activity on Cape Cod and its surrounding waters put whales that migrate here at risk.  **Time (minutes): 30 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  3 – ESS2-1, 3- LS1-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How does weather affect whale migration?  How does human activity impact the survival of whales and other sea life? |
| **Science Objectives: Students will be skilled at:**  Recognizing seasonal patterns that produce favorable conditions for whales to live in our immediate area. |
| **Language Objectives and/or Targeted Academic Language**  Phytoplankton, food web, critical habitat, conservation |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**  Map of Cape Cod indicating Stellwagen Bank, plankton sample, materials for water sampling test |
| **Assessment:** How will you know that the students got it?  Verbal participation |
| **Lesson Overview:**  Students will begin to understand what factors make Cape Cod Bay a critical habitat for whale species and will identify ways that human activity impact that habitat**.** |
| **Opening/Engagement:**   1. Show students map of Cape Cod asking them to respond verbally to the question: “When are people most likely to visit Cape Cod and why?” 2. List responses on “human” side of chart (template attached) (summer time – warm, sun, beaches, boating, etc.) 3. Refer to map again asking: “When are whales most likely to migrate to Cape Cod and why?” (student responses should be sparse) |
| **During the Lesson:**   1. Invite students to examine plankton sample, using the map to explain that during the winter months the wide shallow bay protected by the “arm” of Cape Cod creates the perfect habitat for blooms of phytoplankton. Right whales who are searching for food come here to eat, becoming part of this habitat. 2. Explain: “Scientists have monitored Cape Cod Bay to determine what environmental characteristics make it ideal. These include salinity, ambient light, temperature, phytoplankton and zooplankton.” 3. Demonstrate water sampling to better explain salinity. Explain that while on the whale watch you will test water and tow for plankton. 4. Indicate on map the location of Stellwagen Bank, explaining that both it and the geography of Cape Cod were formed by glaciers during the last major ice age. The depth of its sea floor and tidal currents help to make it an ideal habitat for whales. |
| **Lesson Closing**   1. Referring to the human side of the chart asking students to consider how the human activities that they’ve listed impact the whales who swim here. 2. If visiting the Center for Coastal Studies is NOT included in the upcoming field trip, have class watch this Spinnaker video clip prior to the trip: <https://www.wcvb.com/article/on-the-water-spinnaker-the-whale/22488187> 3. Invite students to respond to the video clip or visit |

**Grade 3 Lesson 4: Whale Watch**

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| **Overview of the Lesson:** What will students be doing?  Towing for plankton, sampling water, observing whale behaviors.  **Time (minutes): Full Day** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  3-LS1-1, 3-LS3-1,  3-ESS2-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What do whales need to live and grow?  How does weather affect whale migration?  What differences and similarities are found between different whale species?  How does human activity impact the survival of whales and other sea life? |
| **Science Objectives**  **Students will be skilled at:**  Describing the life cycle, habits and habitat of whales found in our coastal waters.  Identifying characteristics of whales that classify them as belonging to a specific species. |
| **Language Objectives and/or Targeted Academic Language**  Humpback, pilot, minke, calf, habitat, flippers, flukes, breach, blow, observe |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Some students may be anxious about boating or encountering whales. |
| **Instructional Materials/Resources/Tools**  Materials for water sampling and plankton towing |
| **Assessment:** How will you know that the students got it?  Verbal feedback and engagement, completion of field journal page recording water quality, number and type of whales observed, emotional responses |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science**) and defining problems (for engineering)  2. Developing and using models  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science**) and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:** Full day field trip – Whale Watch |
| **Opening/Engagement:**   1. Students should be given specific instructions for expectations while aboard the boat. 2. Students will be provided with field journal page (template attached) which will stand as assessment and used for final activity. |
| **During the Lesson:**   1. While onboard students will record results of water testing and observations of plankton collected, types and number of whales seen, and thoughts/emotions generated from experiencing the whale watch. |
| **Lesson Closing**   1. The culminating activity, the creation of an advocacy song based on information generated during prior lessons and experiences while aboard the whale watch will follow this field trip. |

**Grade 3 Lesson 5: Song for the Sea**

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| **Overview of the Lesson:** What will students be doing?  Using information generated from lessons and on the whale watch trip to create a song advocating for the protection of marine life.  **Time (minutes): 30 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  3-LS1-1, 3-LS3-1, 3-ESS2-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How does human activity impact the survival of whales and other sea life? |
| **Science Objectives**  Describing the life cycle, habits and habitat of whales found in our coastal waters.  Identifying characteristics of whales that classify them as belonging to a specific species.  Recognizing seasonal patterns that produce favorable conditions for whales to live in our immediate area.  Communicating the importance of environmental advocacy to others through song, poetry or art. |
| **Language Objectives and/or Targeted Academic Language**  Habitat, environment, advocate, protection, human activity |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**  Completed Field journal pages, inspiration board, musical instruments |
| **Assessment:** How will you know that the students got it?  They will successfully compose a song that conveys a message of environmental advocacy. |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science**) and defining problems (for engineering)  2. Developing and using models  3. Planning and carrying out investigations  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science)** and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  With support from OPAK naturalists’ students will use information gained through lessons and responses to what they have experienced to compose a song that advocates for protecting the local environment for marine life including whales. |
| **Opening/Engagement:**   1. Remind students of the mission of Ocean Protection Advocacy Kids Inc., explaining your role and commitment. 2. Explain that music has historically been a way to share a message with others and can be the vehicle that carries their message as well. 3. Have students refer to their field journal pages, create an “inspiration board” of words and phrases reflecting what they know and feel. |
| **During the Lesson:**   1. Work with students to select words or phrases, creating a rhyme or pattern of statements. 2. Provide for students or have students generate a pattern or beat that the poem can be sung to. |
| **Lesson Closing**   1. Practice and then record the song that is produced. 2. If some students are uncomfortable performing in front of others, allow them to write individual poems or songs. |

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| **Grade 4 Stage 1 Desired Results** | | | | | | | |
| MA STE Standards  4-LS1-1. Construct an argument that animals and plants have internal and external structures that support their survival, growth, behavior, and reproduction.  4-PS4-1. Develop a model of a simple mechanical wave (including sound) to communicate that waves (a) are regular patterns of motion along which energy travels and (b) can cause objects to move.  4-PS4-3. Develop and compare multiple ways to transfer information through encoding, sending, receiving, and decoding a pattern. | | | **ESSENTIAL QUESTIONS**  What are sound waves?  What is echolocation?  How do toothed whales use echolocation to navigate from one place to another?  How and why do whales produce “songs” to communicate with one another?  How does human activity impact a whale’s ability to use echolocation and to communicate?  How can humans alter activity to protect whale habitats? Why is song an effective way for both whales and humans to communicate? | | | | |
| **UNDERSTANDINGS - *Students will understand that…***  Echolocation is the use of sound waves and the reception of their echoes to determine where objects are.  Toothed whales emit sounds that travel from their foreheads and reflect off objects. They use this process to gather information and “see” the world around them.  Whales use echolocation primarily for navigation and hunting.  Some whales use sound waves made by clicks, whistles and pulsed calls to communicate and socialize. When these waves bounce off an object, they return to the whale, allowing the whale to identify the shape of the object.  Sound created by human activity has a negative impact on whale’s ability to use sound waves for echolocation and communication.  ***Students will be skilled at..***.  Constructing an argument showing that whales have structures that allow them to navigate and communicate using sound waves.  Developing a model using sound waves and patterns to communicate with one another.  Constructing an argument showing that whales use sound waves for both echolocation and communication.  Demonstrating ways that humans impact sound waves used by whales for navigation and communication. | | | | |
| **TRANSFER - *Students will be able to independently use their learning to…***  Describe verbally or in writing ways that human activity impacts a whale’s ability to use echolocation or communicate, providing an argument that supports the reduction of such activities.  Communicate through song ideas for environmental advocacy | | | | |
|  | | | **Cross-Curricular Connections**  English language arts  Social/emotional growth and development  Music education | | | | |
| **Stage 2 Evidence** | | | | | | | |
| **Formative Assessment Ideas:**  Students can be asked to explain their understanding of sound waves prior to beginning this lesson. | | | | | | | |
| **Summative Assessment Ideas:**  Whole group will create a song reflecting ways that we can reduce human impact (noise pollution) for marine mammals. | | | | | | | |
| **Stage 3 Learning Plan** | | | | | | | |
| **Introductory Lesson**  Lesson that introduces the content. More teacher directed | **Constructing Lesson**  Lessons that engage students in building and linking together understanding. Guided/collaborative. Student/teacher or partners/small group | | | **Practice Lesson**  Lessons or activities that students can complete relatively independently | | **Assessment Lesson**  Formative: Check-ins along the way to see if students “get it”  Summative: Students showing what they know, when you feel they are ready | |
| **Stage 3 Learning Plan** | | | | | | | |
| **Summary of Key Learning Events and Instruction** | | | | | | | |
| **Lesson Name** | | **Type** (Introductory, Constructing, Practice, and Assessment) | | | **Content Addressed** | | **Standards Included (by number)** |
| Underwater waves (sound waves) | | Introductory | | | Introduction to sound waves and their applications | | 4-PS4-1 |
| Which way did he go? (echolocation) | | Constructing | | | What is echolocation? Which whales use echolocation and what structures allow them to use it? | | 4-PS4-1, 4-LS4-1,4-PS4-3 |
| Do you speak whale? (communication) | | Constructing | | | How do whales use sound waves to communicate with one another? | | 4-PS4-1, 4-LS4-1,4-PS4-3 |
| Whale Watch (sonar) | | Practice | | | Identifying and comparing ways that humans and whales use sound waves to navigate, hunt and communicate. | | 4-PS4-1, 4-PS4-3 |
| Song for the Sea | | Assessment | | | Whole group will create a song reflecting ways that we can reduce human impact (noise pollution) for marine mammals. | | 4-PS4-1, 4-PS4-3 |

**Grade 4 Lesson 1: Sound Waves**

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| **Overview of the Lesson:** What will students be doing?  Introduction to sound waves and their applications. Students will observe patterns created by sound waves using an oscilloscope.  **Time (minutes):** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  4-PS4-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What are sound waves? |
| **Science Objectives**  Students will learn that a sound wave is a pattern of disturbance caused by the movement of energy traveling through a medium. |
| **Language Objectives and/or Targeted Academic Language**  Sound wave, pattern, disturbance, medium, movement |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  The term “wave” applies only to water |
| **Instructional Materials/Resources/Tools**  Oscilloscope (can access on iPad or iPhone through app), guitar |
| **Assessment:** How will you know that the students got it?  Observation, verbal feedback |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science**) and defining problems (for engineering)  2. **Developing and using models**  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. **Using mathematics and computational thinking**  6. **Constructing explanations** (for science) and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  Introduction to sound waves and their applications. Students will observe variations in patterns created by different sound waves using an oscilloscope. |
| **Opening/Engagement:**   1. Tell students:a sound wave is a pattern of disturbance caused by the movement of energy traveling through a medium (such as air or water) as it propagates away from the source of that sound. The source is some object that causes a vibration, such as a ringing phone or a person’s vocal cords. |
| **During the Lesson:**   1. Say: “Sound waves are invisible, but we are going to use a tool called an oscilloscope to get a better idea of what those waves would look like. A guitar string is fixed at both ends and has some elasticity so can vibrate.” 2. Use guitar to demonstrate: 3. When an object vibrates very quickly it creates a high frequency, the peaks of the waves are closer together. When we hear that we say: “high pitched”. 4. When an object vibrates very slowly, it creates a low frequency, the peaks are far apart. When we hear a sound like this we say “low pitched” 5. In a soft sound (whisper) the wave is not very tall – this is called amplitude. 6. In a loud sound (say using a big voice) – the wave is very tall! |
| **Lesson Closing**   1. Tell students: “When we listen to the guitar, other instruments, or voices we are hearing sound waves as they travel through air, but we also said that a sound wave could travel through a different medium, such as water. Since molecules in liquids are closer together than those in gas (air), sound travels more quickly, about four times faster. 2. Many ocean animals rely on sounds to communicate with one another, find food, navigate or tell where they are going, and to protect themselves. We are going to learn how whales use sound waves for a process called “echolocation”. |

**Grade 4 Lesson 2: Which way did he go?**

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| **Overview of the Lesson:** What will students be doing? Students will play a game called “Beep, Boop” that simulates the use of sound waves to determine location. They will learn basic principles of echolocation, which whales use echolocation and what structures allow them to use it.  **Time (minutes): 30** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  4-PS4-1, 4-LS4-1,4-PS4-3 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What is echolocation?  How do toothed whales use echolocation to navigate from one place to another? |
| **Science Objectives**  **Students will learn:**   * Echolocation is the use of sound waves and the reception of their echoes to determine where objects are. * Toothed whales emit sounds that travel from their foreheads and reflect off objects. They use this process to gather information and “see” the world around them. * Whales use echolocation primarily for navigation and hunting. * Some whales use sound waves made by clicks, whistles and pulsed calls to communicate and socialize. When these waves bounce off an object, they return to the whale, allowing the whale to identify the shape of the object. |
| **Language Objectives and/or Targeted Academic Language**  Echolocation, navigate, emit, sound wave, socialize |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Students may be unclear about which structures a whale uses in echolocation. |
| **Instructional Materials/Resources/Tools**  Blindfold, defined space to play movement game, diagram of toothed whales sinuses (<https://www.google.com/searchq=structures+that+toothed+whales+use+for+echolocation>) |
| **Assessment:** How will you know that the students got it?  Verbal responses |
| **Science and Engineering Practices included (put the included ones in bold):**  1**. Asking questions** (for science) and defining problems (for engineering)  2. **Developing and using models**  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science**) and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  OPAK naturalists will introduce and oversee the game “Beep, Boop” simulating the way a whale might use sound to navigate without sight. Following this OPAK naturalists will explain which whales use echolocation, uses for echolocation and the structures that they use to create sound waves. |
| **Opening/Engagement:**   1. OPAK naturalists will provide instructions for the game. 2. Students will engage in playing. 3. Variation: If time allows, naturalists will provide instructions that allow students to experience using echolocation to follow a specified path without vision. |
| **During the Lesson:**   1. After game address the group of students asking them to identify what aspects of the game were most difficult and why. 2. Explain: “There are two main groups of whales. Toothed whales and Baleen whales. Toothed whales hunt for food and because its not always easy for them to see where they are going underwater, echolocation allows them to find food without sight.” 3. Display image of structures that toothed whales use for echolocation, indicating where sinuses are located. 4. Explain that toothed whales use a sensory ability called echolocation to locate food and navigate underwater. They do this by moving air between air spaces or sinuses in their head, creating a vibration. The vibration travels through the water and when it hits an object, creates an echo, allowing the whale to know where objects are. Toothed whales include Pilot whales, sperm whales, orcas, and beluga whales. |
| **Lesson Closing**   1. Tell students: “It’s important to remember that only toothed whales use echolocation, but that all whales use sound waves. We are going to learn next how Baleen whales use sound waves to communicate. “ |

**Grade 4 Lesson 3: “Do you speak whale?”**

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| **Overview of the Lesson:** What will students be doing?  Students will listen to an audio clip of whales singing, be introduced to characteristics of the class of whales known as “baleen” and learn how and possibly why whales use sound waves to communicate with one another.  **Time (minutes): 30 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  4-PS4-1, 4-LS4-1,4-PS4-3 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How and why do whales produce “songs” to communicate with one another? |
| **Science Objectives**  Students will learn how sound travels in the context of whale communication. |
| **Language Objectives and/or Targeted Academic Language**  Vocalization, communication, sound wave, language |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Students may believe that all whales communicate in this way |
| **Instructional Materials/Resources/Tools**  Baleen sample, audio clip of whale sounds, TED ED “Why do whales sing?”, lyrics for “My Dirty Stream” by Pete Seeger and “Big Yellow Taxi” by Joni Mitchell |
| **Assessment:** How will you know that the students got it? |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions** (for science) and defining problems (for engineering)  2. Developing and using models  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations** (for science) and designing solutions (for engineering)  7. Engaging in argument from evidence  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  Students will begin to identify the correlation between sound waves, whale communication and the impact of human activity on that communication. |
| **Opening/Engagement:**   1. Students will listen to audio clip of whale song, 2. Play clip again, now inviting students to sing along with the whale song. 3. Play the clip a third time, providing students with pencil/paper to use lines to “draw” what they hear |
| **During the Lesson:**   1. Ask: “What patterns do you hear when you listen to that song? How are the drawings that you made like the sound waves we heard and saw using the oscillator in the first part of this lesson? 2. Explain: “When we listen to the whale song we hear musical patterns that are used to communicate. Unlike humans, whales do not communicate with words, they use sound waves, just like the ones that we were creating at the beginning of this lesson.” 3. Play TED ED video – “Why do whales sing?” (5:13) |
| **Lesson Closing**   1. Say: We’ve established that both toothed whales and baleen whales use sound waves to communicate and navigate. We saw at the end of the video how human activity (boating, military sonar, drilling for oil.) is impacting their ability to do these things. 2. Provide students with copies of songs written and performed by popular artists that reflect a message of advocacy for a specific purpose. 3. Ask students to read the songs and identify what each songs purpose or message is. 4. Explain that the culminating activity for this unit will be their own creation of a song that shares a message of advocacy for marine mammals. |

**Grade 4 Lesson 4: Whale Watch**

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| **Overview of the Lesson:** What will students be doing?  Full day whale watching field trip, students will observe first hand the habitat/environment shared by humans and whales, record whale sightings and compose a song advocating for the protection of marine mammals including whales.  **Time (minutes): Full Day** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  4-PS4-1, 4-PS4-3 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How does human activity impact a whale’s ability to use echolocation and to communicate?  Why is song an effective way for both whales and humans to communicate? |
| **Science Objectives**  **Students will:**  Observe whales in their natural habitat  Demonstrate understanding that humans impact sound waves used by whales for navigation and communication |
| **Language Objectives and/or Targeted Academic Language**  Observe, record, reflect,Humpback, pilot, minke, calf, habitat, flippers, flukes, breach, blow |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  This will most likely be the first whale watching experience for many students |
| **Instructional Materials/Resources/Tools**  Materials to compose |
| **Assessment:** How will you know that the students got it?  **Song produced by students should reflect knowledge of lessons and ideas for advocacy.** |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions** (for science) and defining problems (for engineering)  2. Developing and using models  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science**) and designing solutions (for engineering)  7. Engaging in argument from evidence  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  Students will embark on a whale watch where they will observe whale’s native to the Cape and Islands in their natural habitat. As a culminating activity they will combine impressions experienced during the trip with information collected during lessons prior to this trip to describe verbally or in writing ways that human activity impacts a whale’s ability to use echolocation or communicate, providing an argument that supports the reduction of such activities. |
| **Opening/Engagement:**   1. Students should be given specific instructions for expectations while aboard the boat. 2. Students will be provided with field journal page (template attached) which will stand as assessment and used for final activity. |
| **During the Lesson:**   1. While onboard students will record reactions to observing whales. Students will draw on these in the final component of this lesson. |
| **Lesson Closing**   1. The culminating activity, the creation of an advocacy song based on information generated during prior lessons and experiences while aboard the whale watch will follow this field trip. |

**Grade 4 Lesson 5: Song for the Sea**

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| **Overview of the Lesson:** What will students be doing?  Using information generated from lessons and on the whale watch trip to create a song advocating for the protection of marine life.  **Time (minutes): 30 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  4-PS4-1, 4-PS4-3 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How does human activity impact the survival of whales and other sea life?  How can humans alter activity to protect whale habitats?  Why is song an effective way for both whales and humans to communicate? |
| **Science Objectives**  Describing the life cycle, habits and habitat of whales found in our coastal waters.  Identifying characteristics of whales that classify them as belonging to a specific species.  Communicating the importance of environmental advocacy to others through song, poetry or art. |
| **Language Objectives and/or Targeted Academic Language**  Habitat, environment, advocate, protection, human activity |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**  Completed reflections from whale watch, inspiration board, musical instruments |
| **Assessment:** How will you know that the students got it?  They will successfully compose a song that conveys a message of environmental advocacy. |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science**) and defining problems (for engineering)  2. Developing and using models  3. Planning and carrying out investigations  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science)** and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**   * With support from OPAK naturalist’s students will use information gained through lessons and responses to what they have experienced to compose a song that advocates for protecting the local environment for marine life including whales. |
| **Opening/Engagement:**   1. Remind students of the mission of Ocean Protection Advocacy Kids Inc., explaining your role and commitment. 2. Explain that music has historically been a way to share a message with others and can be the vehicle that carries their message as well. 3. Have students refer to their field journal pages, create an “inspiration board” of words and phrases reflecting what they know and feel. |
| **During the Lesson:**   1. Work with students to select words or phrases, creating a rhyme or pattern of statements. 2. Provide for students or have students generate a pattern or beat that the poem can be sung to. |
| **Lesson Closing**   1. Practice and then record the song that is produced. 2. If some students are uncomfortable performing in front of others, allow them to write individual poems or songs. |

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| **Grade 5 Stage 1 Desired Results** | |
| MA STE Standards  5-LS2-1. Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water, and soil in the environment to show that animals can eat plants and/or other animals for food, and that some organisms break down dead organisms and recycle some materials back to the air and soil. Emphasis is on matter moving throughout the ecosystem.    5-ESS3-1. Obtain and combine information about ways communities reduce human impact on the Earth’s resources and environment by changing an agricultural, industrial, or community practice or process.  5-ESS3-2(MA). Test a simple system designed to filter particulates out of water and propose one change to the design to improve it. | **ESSENTIAL QUESTIONS**  What is plankton and how are they essential to marine ecosystems?  How are whale populations impacted by microplastics?  How does human activity increase the production of microplastics?  What methods can humans use to reduce water pollution? |
| **UNDERSTANDINGS –**  ***Students will understand that…***  Plankton are key components of marine ecosystems, forming the base of most marine food webs.  Whale populations are put at risk due to environmental issues  Human impact on Earth’s resources and the environment can be changed by altering agricultural, industrial or community practice.  Designs that filter particles out of water can produce positive change for our environment.  ***Students will be skilled at….***  Identifying different types of plankton and describing what their roles are in a marine ecosystem.  Developing a model depicting a marine food web that includes plankton, fish and whales.  Identifying characteristics specific to whales categorized as belonging to the class “baleen”.  Identifying ways that human activity increases water pollution, putting marine ecosystems at risk.  Testing simple designs to filter particles out of water, proposing changes that will improve their designs. |
| **TRANSFER - *Students will be able to independently use their learning to…***  Identify everyday items that lead to the production of microplastics.  Explain verbally or in writing how human activity can result in putting whale populations at risk.  Actively advocate for the reduction of human impact on marine ecosystems. |

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| **Stage 2 Evidence** | | | | | | |
| **Formative Assessment Ideas:** Brief written response to the question: How does human activity impact whales living in our coastal waters?  Hands-on sorting activity identifying materials that can create microplastics followed by “plastic use” questionnaire to assess personal responsibility. | | | | | | |
| **Summative Assessment Ideas:** Journal page to be completed during whale watch providing feedback regarding whales identified, water testing results and reactions to what they see.  Individual or whole group song using reactions recorded on journal page, advocating for environmental change that will have positive impact. | | | | | | |
| **Stage 3 Learning Plan** | | | | | | |
| **Introductory Lesson**  Lesson that introduces the content. More teacher directed | **Constructing Lesson**  Lessons that engage students in building and linking together understanding. Guided/collaborative. Student/teacher or partners/small group | | **Practice Lesson**  Lessons or activities that students can complete relatively independently | | **Assessment Lesson**  Formative: Check-ins along the way to see if students “get it”  Summative: Students showing what they know, when you feel they are ready | |
| **Stage 3 Learning Plan** | | | | | | |
| **Lesson Name** | | **Type** (Introductory, Constructing, Practice, and Assessment) | | **Content Addressed** | | **Standards Included (by number)** |
| What difference does it make? | | Formative assessment | | Brief written response to human activity question. Sorting activity - begin to identify materials that can create microplastics. Completion of “plastic use” questionnaire. | | 5 ESS3-1 |
| Microplastics | | Constructing | | Identify whales belonging to the class known as “baleen”. Classifying plankton and identifying their role in the marine food web. | | 5-LS2-1, 5 ESS3-2 |
| Human impact | | Constructing | | Identifying practices that lead to the production of microplastics. Students will learn to do a water sampling, then will design and test simple systems for water filtration, identifying challenges and working to improve designs. | | 5LS2-1, 5 ESS3-1, 5 ESS3-2 |
| Whale Watch | | Practice | | Water sampling, geography, baleen whale’s native to Cape Cod, plankton tow | | 5 ESS3-2 |
| Song for the Sea | | Assessment | | Combine content learned through lessons with reactions from whale watch to create a song advocating for environmental awareness. | | 5 LS2-1, 5 ESS3-1, 5 ESS3-2 |

**Grade 5 Lesson 1: What difference does it make?**

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| **Overview of the Lesson:** What will students be doing?  Brief written response to human activity question.  Sorting activity - begin to identify materials that can create microplastics. Completion of “plastic use” questionnaire.  **Time (minutes): 20** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  5-ESS3-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How does human activity increase the production of microplastics?  What methods can humans use to reduce water pollution? |
| **Science Objectives**  **Students will:**  Identify everyday items that lead to the production of microplastics.  Explain verbally or in writing how human activity can result in putting whale populations at risk. |
| **Language Objectives and/or Targeted Academic Language**  Pollution, recycle, microplastic, ecology, habitat, food web |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Student understanding of the aquatic food web, students thinking that “human impact” involves only activities people engage in on or near the water. |
| **Instructional Materials/Resources/Tools**  Human activity short response template, Various materials for biodegradable sorting activity |
| **Assessment: How will you know that the students got it?**  Responses collected from writing sample and verbal responses following sorting activity. |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science) and defining problems (**for engineering)  2. Developing and using models  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations** (for science) and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  Students will begin by responding verbally or in writing to the question: **“**“How does human activity impact whales living in our coastal waters?” Following this they will work in groups to sort a selection of materials that do/do not contain materials that are broken down naturally and will not have long-term harmful effects on marine life. |
| **Opening/Engagement:**   1. Ask students to write briefly in response to the question “How does human activity impact whales living in our coastal waters?” 2. Invite students to share their responses. 3. When done sharing responses agree that each shows an example of negative human impact and that we will look closely at another way which might not seem as obvious. |
| **During the Lesson:**   1. Define the word “biodegradable” explaining that “Something biodegradable is capable of being decomposed by bacteria or other living organisms. Biodegradable items are environmentally friendly. Non-biodegradable items cannot be changed and can damage the environment.” 2. Provide a box of varied common household objects, inviting students to examine each item and decide if it would fall into the category of “biodegradable” or “non-biodegradable”. 3. When they’ve completed sorting take time to examine each pile with them, explaining why each item should be placed in which pile. |
| **Lesson Closing**   1. Explain that not only are the items in the pile which is “non-biodegradable” an environmental risk, those containing plastic can overtime, break down to become microplastics. Microplastics are less than 5 millimeters long (about the size of a sesame seed) and these very tiny particles create one of the biggest risks to marine mammals including whales. |

**Grade 5 Lesson 2: Microplastics**

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| **Overview of the Lesson:** What will students be doing?  Watching a video clip from the trailer for “A Plastic Ocean”, Observing method for towing plankton and reviewing the aquatic food web for Baleen whales to learn about the impact of microplastics.  **Time (minutes): 30** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  5-LS2-1, 5-ESS3-2 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What are plankton and how are they essential to marine ecosystems?  How are whale populations impacted by microplastics?  How does human activity increase the production of microplastics? |
| **Science Objectives**  **Students will understand that:**  Plankton are key components of marine ecosystems, forming the base of most marine food webs.  Whale populations are put at risk due to environmental issues  Human impact on Earth’s resources and the environment can be changed by altering agricultural, industrial or community practice. |
| **Language Objectives and/or Targeted Academic Language**  Plankton, marine, ecosystem, microplastics, environmental, food web |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Students may be unfamiliar with the aquatic food web |
| **Instructional Materials/Resources/Tool**  Video clip from the trailer for “A Plastic Ocean”, sample of Baleen, plankton samples, towing net |
| **Assessment:** How will you know that the students got it?  Verbal responses and interactions |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science)** and defining problems (for engineering)  2. **Developing and using models**  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations** (for science) and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |

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| **Lesson Overview:**  Students will watch a video clip from the trailer for “A Plastic Ocean”, observe the method for towing plankton and review the aquatic food web for baleen whales to learn about the impact of microplastics. |
| **Opening/Engagement:**   1. Begin by showing students the video clip from “A Plastic Ocean”   Invite students to share their reactions to the video.   1. Ask and allow students to respond to the question: “Is this something that they were/were not aware of? Would seeing it before we answered the question about human impact have changed your response?” |
| **During the Lesson:**   1. Explain: “The video clip showed images of plastics floating in the water, entangling animals. What we can’t see are the microplastics that are sickening and killing marine animals, including whales.” 2. Display section of baleen, explaining variations between toothed and baleen whales, explaining that the average humpback whale (belonging to the class called baleen) eats approximately 4000 pounds of plankton each day. 3. Display plankton sample emphasizing their minute size, naming the two main groups of plankton and differences between them. |
| **Lesson Closing**   1. Explain: “Along with the larger waste that we were able to see in the video, microplastics are being formed by the breakdown of non-biodegradable waste. This can come from plastics and plastic fibers like some of the materials we sorted earlier.” 2. Zooplankton ingest the plastic particles, which means that the humpback whale could potentially be ingesting 4000 pounds of microplastic each day, leading to reduced fertility and decreasing populations. |

**Grade 5 Lesson 3: Human Impact**

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| **Overview of the Lesson:** What will students be doing?  Students will identify practices that lead to the production of microplastics. They will learn to test water and when presented with the challenge to clean polluted water as thoroughly as possible, they will work in groups to design and test simple systems for water filtration, identifying challenges and working to improve designs.  **Time (minutes): 30** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  5-LS2-1, 5-ESS3-1, 5-ESS3-2 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  How are whale populations impacted by microplastics?  How does human activity increase the production of microplastics?  What methods can humans use to reduce water pollution? |
| **Science Objectives**  Students will obtain and combine information about ways communities reduce human impact on the Earth’s resources and environment by changing a practice or process. They will test a simple system designed to filter particulates out of water and propose one change to the design to improve it. |
| **Language Objectives and/or Targeted Academic Language**  Filtration, sampling, water quality, ph., turbidity, acidity, polluted, microplastic, environmental resource |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Students may believe that if water is clear, it is clean. |
| **Instructional Materials/Resources/Tools**  Video clip: “What are microplastics” <https://oceanservice.noaa.gov/facts/microplastics.html>  Shallow plastic buckets, water, coffee filters, fabric squares, paper towel, small screens, sieves, spoons, scoops, tongs, coffee grounds, cooking oil, food color, bits of plastic, string, wood and metal, water testing kit. |
| **Assessment:** How will you know that the students got it?  Observation and verbal feedback |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science) and defining problems (for engineering**)  2. **Developing and using models**  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. **Using mathematics and computational thinking**  6. **Constructing explanations (for science) and designing solutions (for engineering)**  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  Students will identify practices that lead to the production of microplastics. They will learn to test water and when presented with the challenge to clean polluted water as thoroughly as possible, they will work in groups to design and test simple systems for water filtration, identifying challenges and working to improve designs. |
| **Opening/Engagement:**   1. Watch video clip of “What are Microplastics” 2. Explain to students that when we talk about “human impact” we know that it can either be positive or negative. 3. Invite students to generate a list of positive things that they can do to reduce microplastics. |
| **During the Lesson:**   1. Mini-lab – provide groups of students with a shallow container of water. 2. Ask students to describe the water in the container, asking “Could you drink this water/bathe with this water/swim in this water?” 3. Add the following to each container of water: Coffee grounds, cooking oil, food color, bits of plastic, string, paper, wood, metal, asking the same questions. 4. Provide each group of students with a variety of materials that they can use to “clean” the water. Allow each group about 10 minutes to design and test a method for doing so. |
| **Lesson Closing**   1. Ask each group of students if they have been successful in returning their water to its original state. Why/why not? 2. Explain that water that appears clear might not be clean, asking what factors could cause clear water to be unclean. 3. Demonstrate water sampling for students explaining that the ph. turbidity and acidity of water is equally important to maintaining a healthy environment for sea creatures. |

**Grade 5 Lesson 4: Whale Watch**

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| **Overview of the Lesson:** What will students be doing?  Students will visit the Spinnaker exhibit at the Provincetown Center for Coastal Studies, embarking on a whale watch where they will tow plankton (illustrating the abundance found in marine habitats), sample water (recording ph., turbidity and acidity and observe whale behaviors.  **Time (minutes): Full Day** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  5-ESS3-1, 5-ESS3-2, 5-LS2-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What are plankton and how are they essential to marine ecosystems?  How are whale populations impacted by microplastics?  How does human activity increase the production of microplastics?  What methods can humans use to reduce water pollution? |
| **Science Objectives**  **Students will be skilled at:**  Identifying different types of plankton and describing what their roles are in a marine ecosystem.  Developing a model depicting a marine food web that includes plankton, fish and whales.  Identifying characteristics specific to whales categorized as belonging to the class “baleen”.  Identifying ways that human activity increases water pollution, putting marine ecosystems at risk. |
| **Language Objectives and/or Targeted Academic Language**  Humpback, pilot, minke, calf, habitat, flippers, flukes, breach, blow, observe |
| **Anticipated Student Pre-conceptions/Misconceptions (optional)**  Some students may be anxious about boating or encountering whales. |
| **Instructional Materials/Resources/Tools**  Materials for water sampling and plankton towing |
| **Assessment:** How will you know that the students got it?  Verbal feedback and engagement, completion of field journal page recording water quality, number and type of whales observed, emotional responses |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science**) and defining problems (for engineering)  2. Developing and using models  3. **Planning and carrying out investigations**  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science**) and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**  Students will visit the Spinnaker exhibit at the Provincetown Center for Coastal Studies, embarking on a whale watch where they will tow plankton (illustrating the abundance found in marine habitats), sample water (recording ph., turbidity and acidity and observe whale behaviors. |
| **Opening/Engagement:**   1. Students will visit the Center for Coastal Studies where they will view the Spinnaker exhibit. 2. Students will make connections between Spinnakers story and the need to promote awareness for environmental protection. 3. When boarding the boat, students should be given specific instructions for expectations while aboard the boat. 4. Students will be provided with field journal page (template attached) which will stand as assessment and used for final activity. |
| **During the Lesson:**   1. While onboard students will record results of water testing and observations of plankton collected, types and number of whales seen, and thoughts/emotions generated from experiencing the whale watch. |
| **Lesson Closing**   1. The culminating activity, the creation of an advocacy song based on information generated during prior lessons and experiences while aboard the whale watch will follow this field trip. |

**Grade 5 Lesson 5: Song for the Sea**

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| **Overview of the Lesson:** What will students be doing?  Using information generated from lessons and on the whale watch trip to create a song advocating for the protection of marine life.  **Time (minutes): 30 minutes** |
| **Standard(s):** What standards (s) will be the focus of the lesson?  5-ESS3-1, 5-ESS3-2, 5-LS2-1 |
| **Essential Question(s):** What essential questions will be addressed in this lesson?  What are plankton and how are they essential to marine ecosystems?  How are whale populations impacted by microplastics?  How does human activity increase the production of microplastics?  What methods can humans use to reduce water pollution? |
| **Science Objectives**  **Students will show understanding that:**  Whale populations are put at risk due to environmental issues  Human impact on Earth’s resources and the environment can be changed by altering agricultural, industrial or community practice. |
| **Language Objectives and/or Targeted Academic Language**  Habitat, environment, advocate, protection, human activity |
| **Instructional Materials/Resources/Tools**  Completed reflections from whale watch, inspiration board, musical instruments |
| **Assessment:** How will you know that the students got it?  They will successfully compose a song that conveys a message of environmental advocacy. |
| **Science and Engineering Practices included (put the included ones in bold):**  1. **Asking questions (for science**) and defining problems (for engineering)  2. Developing and using models  3. Planning and carrying out investigations  4. **Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. **Constructing explanations (for science)** and designing solutions (for engineering)  7. **Engaging in argument from evidence**  8. **Obtaining, evaluating, and communicating information** |
| **Lesson Overview:**   * With support from OPAK naturalist’s students will use information gained through lessons and responses to what they have experienced to compose a song that advocates for protecting the local environment for marine life including whales. |
| **Opening/Engagement:**   1. Remind students of the mission of Ocean Protection Advocacy Kids Inc., explaining your role and commitment. 2. Explain that music has historically been a way to share a message with others and can be the vehicle that carries their message as well. 3. Have students refer to their field journal pages, create an “inspiration board” of words and phrases reflecting what they know and feel. |
| **During the Lesson:**   1. Work with students to select words or phrases, creating a rhyme or pattern of statements. 2. Provide for students or have students generate a pattern or beat that the poem can be sung to. |
| **Lesson Closing**   1. Practice and then record the song that is produced. 2. If some students are uncomfortable performing in front of others, allow them to write individual poems or songs. |