






**Overarching Question:** How can sound be useful in conserving the biodiversity in coral reef ecosystems?





This lesson bundle is designed to be student- or teacher-led, allowing teachers to adjust support to meet the needs of all students. The interactive lessons enable screen reader and spell check and include clickable sound buttons. The sounds are also embedded in the teacher slides for whole class instruction, allowing printed documents to be used. The lessons are designed to build understanding but can be taught in isolation if the teacher provides additional context. Teachers are encouraged to read through the students' documents and the slide deck before conducting the lesson, ensuring that all links are live. Speaker notes have been provided on the slide deck to assist when conducting whole-group instruction.

Lesson	Essential Questions	What Students Learn	Science & Engineering Practices	Crosscutting Concepts	Resources
<p><b>Lesson 1:</b> <i>Seeing with Sound</i></p> <p><b>Time: 50 minutes</b></p> <p><b>Tips &amp; Tricks:</b></p> <p>Preview all content to ensure links are live.</p> <p>Open the teacher presentation in speaker view to access speaker notes. Speaker notes help to guide the lesson and provide technical support when navigating media rich content.</p>	<p>Can sound be used to determine the health of an ecosystem?</p> <p>What types of ecosystems are best for monitoring by sound?</p> <p>Can biodiversity be assessed by sound?</p>	<p>Sound gives us clues about our environment.</p> <p>Sound is used to monitor the health of individuals when other senses may be too invasive.</p>	<p>Constructing explanations</p> <p>Obtaining, evaluating, and communicating information</p>	<p>Cause and effect</p> <p>Scale, proportion, and quantity</p>	<p><b>Teacher Resources</b></p> <p><a href="#">Teacher Presentation Slides 1-10</a></p> <p><b>Student Resources</b></p> <p> Notetaking Guide_Lesson_1.pdf</p> <p> Lesson_1_Interactive PDF.pdf</p> <p> Lesson_1_Printable PDF.pdf</p>





Lesson Bundle: Listening to the Ocean: Soundscapes of Coral Reefs

<p><b>Lesson 2: Consider Coral Reefs</b></p> <p><b>Time: 50 minutes</b></p> <p><b>Tips &amp; Tricks</b></p> <p>Spend some time familiarizing yourself with the Half-Earth map before demonstrating it for the class. Instructions are in the students' documents.</p>	<p>Do coral reefs need greater protection?</p> <p>Can biodiversity determine the health of an ecosystem?</p> <p>What coral reefs are in greatest need of protection?</p>	<p>Coral reefs are vulnerable to human impacts.</p> <p>The loss of coral negatively impacts biodiversity.</p> <p>Coral reefs are important for humans.</p> <p>Coral reefs need protection.</p>	<p>Analyzing and interpreting data.</p> <p>Using mathematical and computational thinking.</p> <p>Constructing explanations</p> <p>Obtaining, evaluating, and communicating information</p>	<p>Cause and effect</p> <p>Structure and function</p> <p>Stability and change</p>	<p><b>Teacher Resources</b></p> <p><a href="#">Teacher Presentation Slides 11-15</a></p> <p><b>Student Resources</b></p> <p> Lesson_2_Interactive PDF.pdf</p> <p> Lesson_2_Printable PDF.pdf</p> <p><b>Online Resources</b></p> <p><a href="https://map.half-earthproject.org/">https://map.half-earthproject.org/</a></p>
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Lesson Bundle: Listening to the Ocean: Soundscapes of Coral Reefs

<p><b>Lesson 3:</b> <i>Investigating the Soundscapes of Coral Reefs</i></p> <p><b>Time: 50 minutes</b></p>	<p>Why do healthy coral reef ecosystems sound different than degraded reef ecosystems?</p> <p>What can the sources of sound tell us about the health of a coral reef ecosystem?</p>	<p>Biologists use tools to collect sound samples in the ocean.</p> <p>Healthy coral reefs sound different than unhealthy coral reefs</p> <p>The soundscape is a mix of sounds in an area.</p> <p>There are three categories of sound based on its source.</p> <p>The types of sound present in a reef ecosystem provide clues about its overall health.</p>	<p>Asking questions</p> <p>Constructing explanations</p> <p>Engaging in argument from evidence</p> <p>Obtaining, evaluating, and communicating information.</p>	<p>Cause and effect</p> <p>Stability and change</p>	<p><b>Teacher Resources</b></p> <p><a href="#">Teacher Presentation Slides 16-23</a></p> <p><b>Student Resources</b></p> <p> Lesson_3_Interactive PDF.pdf</p> <p> Lesson_3_Printable PDF.pdf</p>
<p><b>Lesson 4: <i>How Do We Identify Sounds?</i></b></p> <p><b>Time: 50 – 90 minutes</b></p>	<p>How do we identify sound?</p> <p>What is frequency?</p> <p>How do is loudness measured?</p> <p>What does a low/high pitch sound like?</p> <p>What does low/high volume look like graphically?</p> <p>Are there patterns in sound that helps to identify its source?</p>	<p>Sound can be identified and represented graphically using pitch and amplitude.</p> <p>Anthrophony, geophony, and biophony have identifiable characteristics and patterns.</p> <p>Sound patterns can be measured and graphed using spectrograms.</p>	<p>Asking questions</p> <p>Analyzing and interpreting data</p> <p>Using mathematics and computational thinking</p> <p>Constructing explanations</p> <p>Obtaining, evaluating, and communicating information.</p>	<p>Patterns</p> <p>Cause and effect</p> <p>Energy and matter</p>	<p><b>Teacher Resources</b></p> <p><a href="#">Teacher Presentation Slides 24-28</a></p> <p><b>Student Resources</b></p> <p> Lesson_4_Interactive PDF.pdf</p> <p> Lesson_4_Printable PDF.pdf</p>

Lesson Bundle: Listening to the Ocean: Soundscapes of Coral Reefs

<p><b>Lesson 5:</b> <i>Constructing Mental Models</i></p> <p><b>Time: 50 minutes</b></p>	<p>Can a framework be created to help identify the source of a sound? Why do degraded coral reefs sound different than healthy coral reefs?</p> <p>What types of sounds would you expect to hear near a healthy coral reef?</p> <p>What sounds would you expect to hear near a degraded coral reef?</p>	<p>Using the patterns of biophony, anthrophony, and geophony a framework can be created to identify the source category of an unknown sound.</p> <p>Degraded reefs are likely to have less biophony than healthy reefs.</p> <p>Healthy reefs are likely to have less anthrophony than degraded reefs.</p> <p>Geophony is the least likely sound to provide clues into the overall health of a coral reef ecosystem/</p>	<p>Asking questions</p> <p>Developing and using models</p> <p>Analyzing and interpreting data</p> <p>Using mathematics and computational thinking</p> <p>Obtaining, evaluating, and communicating information.</p>	<p>Patterns</p> <p>Cause and effect</p> <p>Stability and change</p>	<p><b>Teacher Resources</b></p> <p><a href="#">Teacher Presentation Slides 29-36</a></p> <p><b>Student Resources</b></p> <p> Lesson_5_Interactive PDF.pdf</p> <p> Lesson_5_Printable PDF.pdf</p> <p><b>Online Resources</b></p> <p><a href="https://www.youtube.com/watch?v=B5WS2dleh88">https://www.youtube.com/watch?v=B5WS2dleh88</a></p>
<p><b>Homework: Self-Reflection</b></p> <p><b>Time: 10 minutes</b></p> <p>Self-Reflection can be combined with Lesson 5 or the assessment if homework is not an option.</p>	<p>Why do healthy coral reefs sound different than degraded coral reefs?</p> <p>How can sound be useful in assessing the biodiversity in coral reef ecosystems?</p> <p>How can biodiversity serve as a measure for overall ecosystem health?</p>	<p>Healthy reefs are noisier because they are more biodiverse. Biodiversity serves as a proxy for overall health because it indicates that there is enough food and shelter to support a variety of species.</p>	<p>Constructing explanations</p> <p>Engaging in argument from evidence</p> <p>Communicating information</p>	<p>Cause and effect</p> <p>Stability and change</p>	<p><b>Teacher Resources</b></p> <p><a href="#">Teacher Presentation Slides 37</a></p> <p><b>Student Resources</b></p> <p> Lesson_6_Interactive PDF_Reflection.pdf</p> <p> Lesson_6_Printable PDF_Reflection.pdf</p>

Lesson Bundle: Listening to the Ocean: Soundscapes of Coral Reefs

<p><b>Formative Assessment</b></p> <p><b>Time: 30 minutes</b></p>	<p>Describe bioacoustic monitoring.</p> <p>How can sound be useful in assessing the biodiversity in coral reef ecosystems?</p> <p>What would a scientist likely observe in a healthy reef ecosystem?</p> <p>What would a scientist likely observe in an unhealthy reef ecosystem?</p>	<p>Scientists use underwater recorders to obtain sound data. Sound data is interpreted and classified as biophony, geophony, or anthrophony.</p> <p>The recording data helps scientists determine the health of an coral reef ecosystem.</p> <p>A healthy ecosystem will have more biophony, and a degraded ecosystem with have more anthrophony.</p>	<p>Constructing explanations</p> <p>Engaging in argument from evidence</p> <p>Communicating information</p>	<p>Patterns</p> <p>Cause and effect</p> <p>Stability and change</p>	<p><b>Student Resources</b></p> <p> Lesson_7_Interactive PDF_Assessment.p</p> <p> Lesson_7_Printable PDF_Assessment.pdf</p>
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