A Hands-on Guide to Hawaii's Open Ocean Ecosystem

Created By Blake McNaughton & Robert Lozano

Partnerships for Reform through Investigative Science and Mathematics Program
UH Hilo, National Science Foundation

Edition # 1
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Grade Level: 5th Grade

Purpose: This curriculum is designed to communicate:
I. How the open ocean around Hawaii and the Pacific is physically and biologically structured.
II. What the major natural and human induced impacts to the open ocean ecosystem are.
III. How science helps us to study open ocean environment and manage the people and resources in that environment.

Hawaii Content and Performance Standards Addressed (HCPS III):
5.1 The Scientific Process: Scientific Investigation: Discover, invent, and investigate using the skills necessary to engage in the scientific process.
5.2 The Scientific Process: Nature of Science: Understand that science, technology, and society are interrelated.
5.3 Life and Environmental Sciences: Organisms and the Environment: Understanding the unity, diversity, and interrelationships of organisms, including their relationship to cycles of matter and energy in the environment.
5.4 Life and Environmental Sciences: Structure and Function in Organisms: Understand the structures and functions of living organisms and how organisms can be compared scientifically.

Rationale: The open ocean accounts for approximately seventy percent of the Earth’s surface. In Hawaii, forty one percent of the state is ocean. The ocean creates Hawaii’s weather, provides Hawaii’s residents with food, and surrounds our islands to make us the most isolated island chain in the world. Therefore, understanding how the ocean functions, how we use and study the ocean, and how that use impacts the ocean is critical for Hawaii youths to understand. This curriculum uses hands-on activities to promote interactive learning about the open ocean ecosystem.
Lessons Plan

This unit is structured to last nine weeks or a full quarter. The lessons plans are structured to last two 50 minute classes per week. This means the unit takes at least 18 class periods to complete. This structuring is a result of most 5th grade classes having at least two science classes per week. If there a teacher has more than two science classes per week then there are several optional activities which supplement the unit and are included in this curriculum. Taught as an entire unit the lessons flows together, however many of the lessons may be taken out of context to deliver a particular concept.

Materials need for this curriculum are minimal, however there are some expendable materials that may have to be purchased. Prior to teaching this unit, the instructor should browse the lesson plans and catalog which materials may have to be obtained. Some of the final project research requires the use of a computer with internet access and therefore access to computers should be requested at the appropriate time.

Each lesson plan includes a summary of the lesson and primary objectives as well as a vocabulary list which may be used in vocabulary lessons or spelling lessons. The lesson plans also include background information for the instructor as well as additional internet links that provide background information on each lesson.

Prelesson (20 minutes)
Students conduct a pre-assessment and are introduced to what the open ocean is

Wk 1: Students are introduced to what the open ocean is through brainstorming and pictures. The students then explore the physical (abiotic) features of the Pacific open ocean. The students also learn where Hawaii is situated in the Pacific and the characteristics of the ocean that surrounds us. Students then learn how the areas of the ocean change through a hands-on lab that models how currents move water.

Wk 2: Students learn about the amazing organisms in the open ocean. The students then examine how the physical features of the ocean define where these organisms make their homes by using an organism’s physical requirements to map their potential distributions throughout the Pacific Ocean basin. Students will learn about organism limitations and how mapping is used as an important scientific tool today.

Wk 3: Students learn about how different organisms interact with each other in the open ocean in terms of predator-prey relationships by using their organism cards. Students then learn how these relationships build food webs. Students are introduced to how we, as humans, represent the top predator in every foodweb.

Wk 4: Students learn how open ocean organisms in Hawaii are adapted to the habitat they live in and the role they play in that habitat. Organisms that swim long distances will have well formed fins while those that drift may have no fins at all. Students will create their own superfish, a fish that is perfectly adapted for its environment. Students will also dissect a squid to examine the features and adaptations of an animal that supports a large commercial fishery.
**Wk 5:** Students are introduced to what a fishery is and what types there are. Students will learn about fisheries in Hawaii and the issues facing our oceans through a powerpoint presentation. They will then learn about two exceptional people, Ken Norris and Sam LaBudde as well as be introduced to the final project.

**Wk 6:** In this lesson students learn how fishing equipment, technology, and the way we fish affect the organisms in the open ocean. Students play the game fishbowl fisheries to see how different types of fishing impacts how many fish are caught and how much bycatch is caught. Students must then hypothesize and test how a change in fishing equipment or fishing style can reduce bycatch. This change is called fishery management. Students will also continue working on their final project.

**Wk 7:** Students learn about some of the major anthropogenic (human created) issues that the open ocean ecosystem faces today. These issues directly affect Hawaii’s ocean flora and fauna and the people that depend on the ocean. Students learn how noise pollution and marine debris are two ocean killers. Students then hypothesize how different kinds of marine debris will interact with different kinds of marine creatures and graph the results.

**Wk 8:** Students continue their research and finalize their fisheries presentation.

**Wk 9 Final Project:** Students present their research on their fisheries biology, impacts, original fisheries management, and scientific monitoring.

**Formative Assessment:** Students first fill out a pre-assessment test designed to test their preconceptions of the open ocean. During the unit students are assessed using homework questions, worksheets, experiments, art, group work, and presentations. The students are encouraged at all time to participate and ask questions, be creative, and use their logic.

**Summative Assessment:** Students will present their fishery in terms of the organism that provides the basis for the fishery, how we fish for that organism, how the act of fishing may be effecting the environment, a current problem with the fishery, and a potential solution to that problem. The students will be graded on their presentation, knowledge, research, and innovation.

These lessons are created by PRISM and may be recreated for any use except commercial. However many of these materials may be drawn from the Lawrence Hall of Science and other sources. Mahalo to any source that may have indirectly contributed to this curriculum and we hope you do not take offense if you were not cited directly.
What is the open ocean?

How do scientists study the open ocean?

What are the physical properties of the open ocean and how do currents change them?

What are some of the organisms in the ocean?

How do the physical properties of the ocean define what organisms live there?

How do the organisms in the open ocean interact with each other in terms of food webs?

Introduction to fisheries.

How do open ocean organisms structures fit the physical parameters of the zones of ocean they live in?

What happens to the structure of ocean foodwebs when we remove organisms or whole levels?

How do the kids describe their view of the open ocean?

What are the current threats to the open ocean ecosystem including marine debris and noise pollution?
What is the open ocean?

What are the physical properties of the open ocean and how do currents change them?

How do the kids describe their view of the open ocean?

What are some of the organisms in the ocean?

How do the physical properties of the ocean define what organisms live there?

How do the organisms in the open ocean interact with each other in terms of food webs?

Introduction to fisheries.

How do they use this knowledge to manage this ecosystem?

How do scientists study the open ocean?

What are the current threats to the open ocean ecosystem including marine debris and noise pollution?

What happens to the structure of ocean food webs when we remove organisms or whole levels?

How do open ocean organisms structures fit the physical parameters of the zones of ocean they live in?
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<th>Timeline</th>
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<td><strong>Week 1</strong></td>
<td>Physical Properties of the Open Ocean and Currents</td>
<td>What is the open ocean? What are the physical properties of the open ocean and how do they change?</td>
<td>Students will be able to define what the open ocean is and describe some of the major physical properties including salinity, temperature, currents, nutrient levels and depth.</td>
<td>Ocean Brainstorm (what do you know?). Currents lab examining what happens when water with different properties combine.</td>
<td>what misconceptions do the students have about the open ocean?</td>
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<td>Organism Cards (a parade of different players in the sea). Map an ocean organisms habitat based of their preferences in terms of salinity, nutrients, temp, and depth.</td>
<td>What do the students know about ocean organisms? How were their mapping efforts?</td>
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<td><strong>Week 2</strong></td>
<td>Organisms in the Open Ocean, Where They Live, and Why They Live There.</td>
<td>What are some of the organisms in the ocean? How do the physical properties of the ocean define what organisms live there?</td>
<td>Students will be able to describe some of the plants and animals in the open ocean, discuss where they live, and why they live there and not in other places. This lesson will center on organisms in Hawaii.</td>
<td>Organism Cards (a parade of different players in the sea). Map an ocean organisms habitat based of their preferences in terms of salinity, nutrients, temp, and depth.</td>
<td>How does the student fill out their foodweb and answer the following questions</td>
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<td><strong>Week 3</strong></td>
<td>Organisms Interrelationships with Each other in the Open Ocean</td>
<td>How do the organisms in the open ocean interact with each other in terms of food webs? Introduction to fisheries.</td>
<td>Students will be able describe the general levels in an ocean foodweb, demonstrate how open ocean foodwebs are structured and define what a fishery is.</td>
<td>Food-web structuring (identifying the building blocks).</td>
<td>How does the student fill out their foodweb and answer the following questions</td>
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<td><strong>Week 4</strong></td>
<td>Function and Structure of Open Ocean Organisms.</td>
<td>How do open ocean organisms structures fit the physical parameters of the zones of ocean they live in?</td>
<td>Students will be able describe some physiological adaptions of open ocean organisms and how these adaptations are beneficial.</td>
<td>Squid dissection and design your own superfish.</td>
<td>Do the students put structure together with function?</td>
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<td><strong>Week 5</strong></td>
<td>Introduction to Fisheries.</td>
<td>What is a fishery? How do fisheries effect the open ocean environment?</td>
<td>Students will be able to discuss what a fishery is, describe some fisheries in Hawaiian waters, and discuss the impacts fisheries have on the ocean.</td>
<td>Fisheries presentation and accompanying questions</td>
<td>Do students pay attention and understand the content?</td>
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<td><strong>Week 6</strong></td>
<td>Fishery Science and Management</td>
<td>How are fisheries managed? How does fishing equipment affect how many and what kind of fish are caught</td>
<td>Students will be able to discuss fishery management and the effects of changing fishing equipment</td>
<td>Students simulate fishing on the open ocean with different fishing equipment. Students must then alter that equipment to avoid bycatch.</td>
<td>How do the students play the game and alter their fishing equipment?</td>
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<td><strong>Week 7</strong></td>
<td>Impacts to the Open Ocean</td>
<td>What are some of the major impacts to the open ocean? How can we mitigate those impacts?</td>
<td>Students will be able to define some of the major threats to the open ocean and discuss how these threats change the ocean environment.</td>
<td>Marine debris presentation and simulation of debris impacts and demonstration of noise in the ocean.</td>
<td>Do the students fill out the marine debris worksheet correctly?</td>
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<td><strong>Week 8 &amp; 9</strong></td>
<td>Fishery Presentations</td>
<td>How do the kids describe their fishery, their management solution, and the monitoring of the open ocean?</td>
<td>Students will demonstrate their overall understanding of the open ocean fisheries, the problems therein, and how we may manage and monitor those.</td>
<td>Student presentation creation, presentation, and question &amp; answer.</td>
<td>Summative: Has the unit altered student preceptions of the open ocean?</td>
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