GRADE 3 UNIT 2 OVERVIEW
Open Ocean Habitats

Introduction

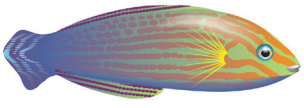
The open ocean has always played a vital role in the culture, subsistence, and economic well-being of Hawai‘i’s inhabitants. The Hawaiian Islands lie in the Pacific Ocean, a body of water covering more than one-third of the Earth’s surface.

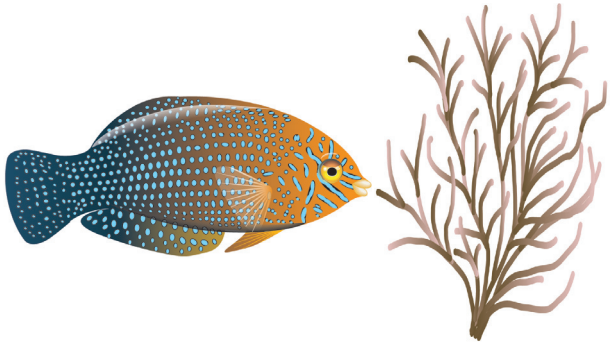
In the following four lessons, students learn about open ocean habitats, from the ocean’s lighter surface to the darker bottom floor thousands of feet below the surface. Although organisms are scarce in the deep sea, there is a large diversity of organisms in addition to bottom fish such as polycheate worms, crustaceans, and bivalve mollusks. They come to realize that few things in the open ocean have adapted to cope with the increased pressure from the weight of the water column at that depth, in complete darkness and frigid temperatures.

Students find out, through instruction, presentations, and website research, that the vast open ocean is divided into zones. The pelagic zone consists of the open ocean habitat that begins at the edge of the continental shelf and extends from the surface to the ocean bottom. This zone is further sub-divided into the photic (sunlight) and disphotic (twilight) zones where most ocean organisms live. Below these two sub-zones is the aphotic (darkness) zone.

In this unit, students learn about each of the ocean zones, and identify and note animals living in each zone. They also research and keep records of the evolutionary physical features and functions that animals they study have acquired to survive in harsh open ocean habitats. Animals and fish have developed amazing survival techniques, including schooling, where same-size fish swim as one in large groups to confuse predators. Some fish in darker zones have evolved ingenious light-producing systems *(bioluminescence),* sometimes in unique associations with light-producing bacteria that they use to communicate, find prey, or startle predators.

During supervised movement games, students re-enact how ocean animals move and act in their respective and oftentimes crowded habitats in search of food, or to escape predators. Students also play flash card games to review, and reinforce what students have learned about ocean animals, many of which, for example sharks (*mano*), dolphins, whales, and others, are common to Hawai‘i. Students are also asked to demonstrate their acquired knowledge of open ocean habitats and animals living within by taking a culminating unit test.





At A Glance

Each Lesson addresses HCPS III Benchmarks. The lessons provide an opportunity for students to move toward mastery of the indicated benchmarks.

ESSENTIAL QUESTIONS	HCPS III BENCHMARKS	LESSON, Brief Summary, Duration
How might you describe the open ocean from the surface to the bottom? What are the characteristics of each of the zones in the open ocean?	Fine Arts Standard 1: Visual Arts: FA.3.1.1 Use the elements and principles of art and design, including, value (i.e., tints and shades, analogous colors), line, rhythm, movement, proportion, and balance. Physical Education Standard 1: Movement Forms: PE 3-5.1.1 Use locomotor and non-locomotor skills in a mature (proper) form. Physical Education Standard 2: Cognitive Concepts: PE 3-5.2.2 Identify procedures for safe participation in physical activities. Language Arts Standard 6: Oral Communication: LA 3.6.1 Use oral language to obtain information, complete a task, and share ideas and personal opinions with others	**Lesson 1: Ocean All Around** Students play a movement game to promote excitement and build on prior knowledge of the open ocean. During the activity, students exhibit safe-play etiquette while sharing their background knowledge of the open ocean. Upon completion of the movement game, students view a PowerPoint presentation to gain a deeper insight into the characteristics of the open ocean zones. The end of the lesson has the students using elements of art to color a water column in shades and tints of blue and black to represent the different ocean zones. Two 45-minute periods
What are the features of animals that live in open ocean habitats? How do the features of open ocean animals help them to survive in their habitat?	Science Standard 4: Life and Environmental Sciences: SC.3.4.1 Compare distinct structures of living things that help them to survive. Fine Arts Standard 1: Visual Arts: FA.3.1.3 Use observational skills in creating an original work of art.	**Lesson 2: Creature Features** In this lesson the students make open ocean flash cards. The class learns about each ocean animal's unique structure and behaviors that allow them to function and survive in the open ocean habitat. They draw and color ocean animals into the correct zone of the water column they colored in Lesson 1 to create a final ocean zone poster. Students will use observational skills to draw and color their ocean animals from pictures used on their flash cards. Two 45-minute periods

ESSENTIAL QUESTIONS	HCPS III BENCHMARKS	LESSON, Brief Summary, Duration
How can we compare different open ocean animals? What kind of structures do open ocean animals have and how do these structures enable them to survive?	Science Standard 4: Life and Environmental Sciences: SC.3.4.1 Compare distinct structures of living things that help them to survive. Science Standard 5: Life and Environmental Sciences: SC.3.5.1 Describe the relationship between structure and function in organisms. Language Arts Standard 1: Reading: LA.3.1.5 Read grade-appropriate narrative and informational text aloud with fluency and accuracy. LA.3.1.6 Locate information in a variety of grade-appropriate sources·	**Lesson 3: Dare to Compare** Students choose two animals from their card deck to compare. They will use information they already have and use other resources, such as the internet and library to find out more about the two animals. After listing information on the two animals selected, they will use a Venn diagram to present that information. Two 45-minute periods
How do the various structures and behaviors of open ocean animals enable them to survive?	Science Standard 4: Life and Environmental Sciences: SC.3.4.1 Compare distinct structures of living things that help them to survive. Science Standard 5: Life and Environmental Sciences: SC.3.5.1 Describe the relationship between structure and function in organisms. Physical Education Standard 1: Movement Forms: PE.3-5.1.1 Use locomotor and non-locomotor skills in a mature (proper) form. Language Arts: Standard 7: Oral Communication: LA.3.7.1 Add concrete details and specific facts to support and develop ideas when speaking.	**Culminating Lesson: Eat or Be Eaten!** Students play a game: “Eat or Be Eaten!” to understand different behaviors and functions some open ocean animals use to survive. They use different locomotor skills to move forward in the game. After the game, students reflect on the activity, and orally share facts and details to support questions regarding open ocean animal structures and functions. The lesson ends with students demonstrating their knowledge about the open ocean habitat and animals that live there by taking a unit test. One 60-minute period

* “Hawai‘i Content & Performance Standards III Database.” Hawai‘i Department of Education. June 2007. Department of Education. 17 Dec. 2007.

Benchmark Rubric

I. HCPS III Benchmarks*

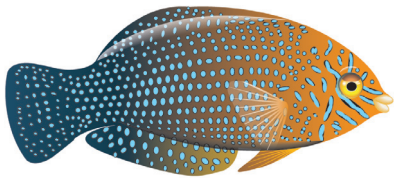
Below is a general Benchmark Rubric. Within each lesson, there are other assessment tools and additional rubrics specifically addressing the performance tasks of each lesson topic.

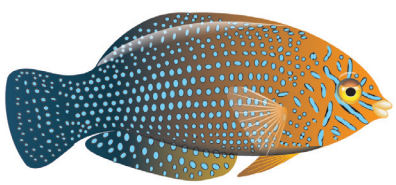
Topic		**Cells, Tissues, Organs, and Organ Systems**	
Benchmark SC.3.4.1		Compare distinct structures of living things that help them to survive	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Group living things by the distinct structures that help them to survive and provide justification for the grouping	Compare distinct structures of living things that help them to survive	Describe a few ways in which distinct structures of living things help them to survive	Name distinct structures of living things that help them to survive

Topic		**Unity and Diversity**	
Benchmark SC.3.5.1		Describe the relationship between structure and function in organisms	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Classify the structures of organisms according to their function	Describe the relationship between structure and function in organisms	Identify the relationship between structure and function in an organism	Recall that structures in organisms are related to the functions they perform

Topic		**How the Arts are Organized**	
Benchmark FA.3.1.1		Use the elements and principles of art and design, including, value (i.e., tints and shades, analogous colors), line, rhythm, movement, proportion, and balance	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Consistently use the elements and principles of art and design, including, value, line, rhythm, movement, proportion, and balance	Usually use the elements and principles of art and design, including, value, line, rhythm, movement, proportion, and balance	Sometimes use the elements and principles of art and design, including, value, line, rhythm, movement, proportion, and balance	Rarely use the elements and principles of art and design, including, value, line, rhythm, movement, proportion, and balance

Topic		**How the Arts Communicate**	
Benchmark FA.3.1.3		Use observational skills in creating an original work of art	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Consistently use observational skills in creating an original work of art	Usually use observational skills in creating an original work of art	Sometimes use observational skills in creating an original work of art	Rarely use observational skills in creating an original work of art





Topic		Fundamental Skills	
Benchmark PE.3-5.1.1		Use locomotor and non-locomotor skills in a mature (proper) form	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Consistently use locomotor and non-locomotor skills in a mature (proper) form	Usually use locomotor and non-locomotor skills in a mature (proper) form	Sometimes use locomotor and non-locomotor skills in a mature (proper) form	Rarely use locomotor and non-locomotor skills in a mature (proper) form

Topic		Safety and Play Etiquette	
Benchmark PE.3-5.2.2		Identify procedures for safe participation in physical activities	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Explain why a variety of different procedures help keep people safe during participation in physical activities	Identify procedures for safe participation in physical activities	Name a procedure that keeps people safe during physical activities	Select from a list of procedures that keep people safe during physical activities

Topic		Fluency	
Benchmark LA.3.1.5		Read grade-appropriate narrative and informational text aloud with fluency and accuracy	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Read aloud a grade-appropriate narrative and informational text, with fluency, accuracy, and expression	Read aloud a grade-appropriate narrative and informational text, with fluency and accuracy	Read aloud a grade-appropriate narrative and informational text, with minimal fluency or accuracy	Read aloud a grade-appropriate narrative and informational text, with little or no fluency or accuracy

Topic		Locating Sources/ Gathering Information	
Benchmark LA.3.1.6		Locate information in a variety of grade-appropriate sources	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Locate substantive information in an extensive variety of grade-appropriate resources	Locate information in a variety of grade-appropriate resources	Locate limited information in a few grade-appropriate resources	Locate information in one or two grade-appropriate resources or locate irrelevant information

Topic		Meaning	
Benchmark LA.3.5.1		Add details, descriptions, and information from different sources to elaborate meaning	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Add relevant details, descriptions, and information from different sources that insightfully elaborate meaning	Add relevant details, descriptions, and information from different sources that elaborate meaning	Add some trivial details, descriptions, and information from different sources that relate to but do not elaborate meaning	Add irrelevant or very few details, descriptions, and information from different sources that do not elaborate meaning

Topic		Discussion and Presentation	
Benchmark LA.3.6.1		Use oral language to obtain information, complete a task, and share ideas and personal opinions with others	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Use creative oral language to obtain information, complete a task, and share ideas and personal opinions with others, in a highly effective way	Use oral language to obtain information, complete a task, and share ideas and personal opinions with others	Use typical oral language that sometimes aids in obtaining information, completing a task, or sharing ideas and personal opinions with others	Use inappropriate oral language that does not aid in obtaining information, completing a task, or sharing ideas and personal opinions with others

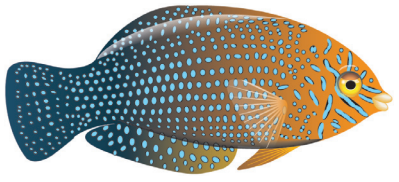
Topic		Meaning	
Benchmark LA.3.7.1		Add concrete details and specific facts to support and develop ideas when speaking	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Add concrete details and specific facts to support and develop ideas when speaking, in a highly effective way	Add concrete details and specific facts to support and develop ideas when speaking	Add obvious or trivial details and facts that partially support and develop ideas when speaking	Add vague details and irrelevant facts that do not support and develop ideas when speaking

II. General Learner Outcomes*

Below is a list of the HIDOE General Learner Outcomes (GLOs). Each Unit of the Lessons from the Sea Curriculum addresses the GLOs. Within some lessons, there is more specific mention of individual GLOs with specific pertinence.

I. Self-directed Learner. (The ability to be responsible for one's own learning.)
II. Community Contributor. (The understanding that it is essential for human beings to work together.)
III. Complex Thinker. (The ability to demonstrate critical thinking and problem solving.)
IV. Quality Producer. (The ability to recognize and produce quality performance and quality products.)
V. Effective Communicator. (The ability to communicate effectively.)
VI. Effective and Ethical User of Technology. (The ability to use a variety of technologies effectively and ethically.)

** "Hawai'i Content & Performance Standards III Database." Hawai'i Department of Education. June 2007. Department of Education. 17 Dec. 2007.*



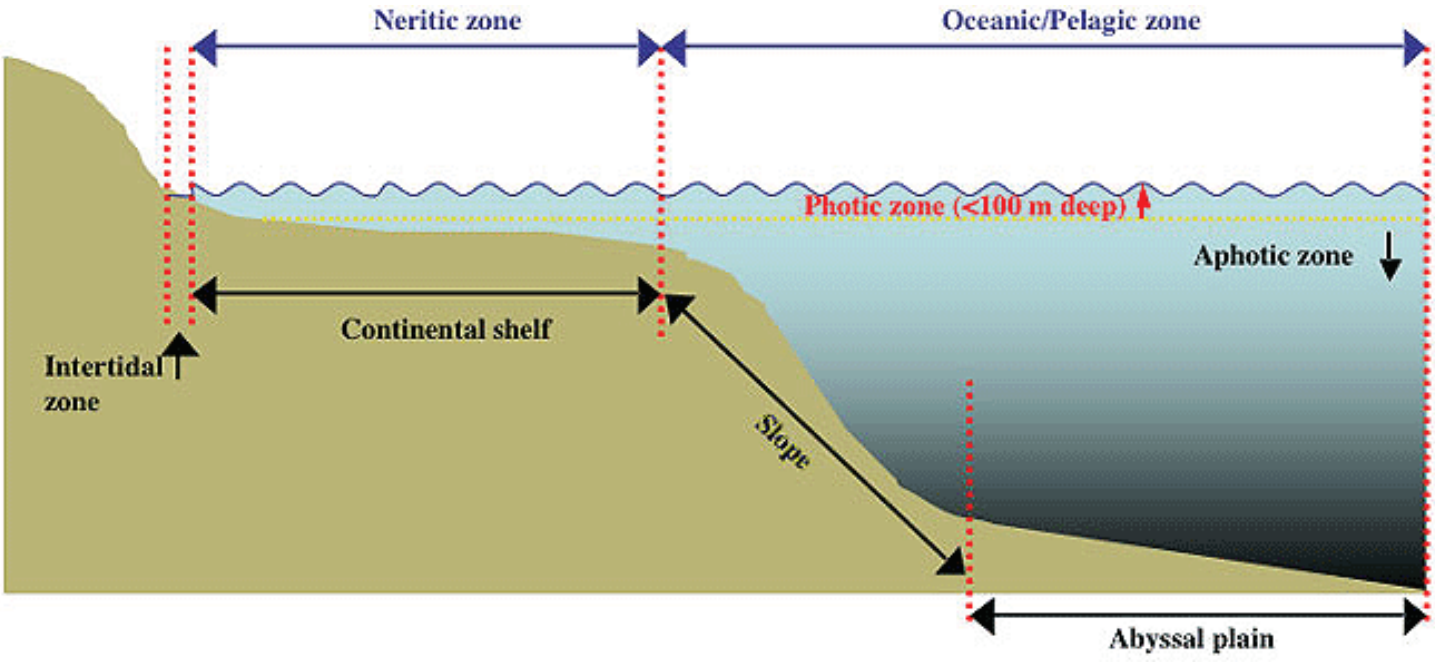
Science Background for the Teacher

Note: Bolded words found within this section are defined in the *Science Background for the Teacher Glossary.* The footnotes refer to the references found in the *Science Background for the Teacher Bibliography* at the end of this section.

What are the different zones of the open ocean[1]? (Lesson 1)

The vast and complex open ocean is divided by a series of zones, each characterized by differing physical and biological properties. The open ocean habitat (or the **oceanic zone**) generally begins at the outer edge of the **continental shelf**, extending from the surface down to the deepest depths of the ocean. The water environment of this region, collectively referred to as the **pelagic zone**, is further subdivided into the **epipelagic, mesopelagic, bathypelagic,** and **benthopelagic zones**. Each of these zones is delineated by both depth and by the relative penetration of sunlight through the water.

In the epipelagic zone (0–200 meters) (0-657 feet), penetrating sunlight allows for relatively high photosynthetic activity of **phytoplankton** (generally, microscopic algae), providing energy and food sources for other organisms. This "lighted" region is therefore also encompassed by, and referred to as the **photic zone**. Below the epipelagic (or photic zone), deeper water organisms must rely primarily on energy sources generated from the photic zone above. It is at this depth that the mesopelagic (200–1,000 meters) (656-3281 feet) begins, followed by the bathypelagic (1,000–4,000 meters) (3281-13123 feet), and finally the benthopelagic (4,000–6,000 meters) (13123.4-19685 feet) zone. In these regions, little to no light penetrates, and therefore all of these deeper and darker depths fall into the region known as the **aphotic zone**. More information can be found at http://oceanexplorer.noaa.gov/edu/curriculum/section5.pdf

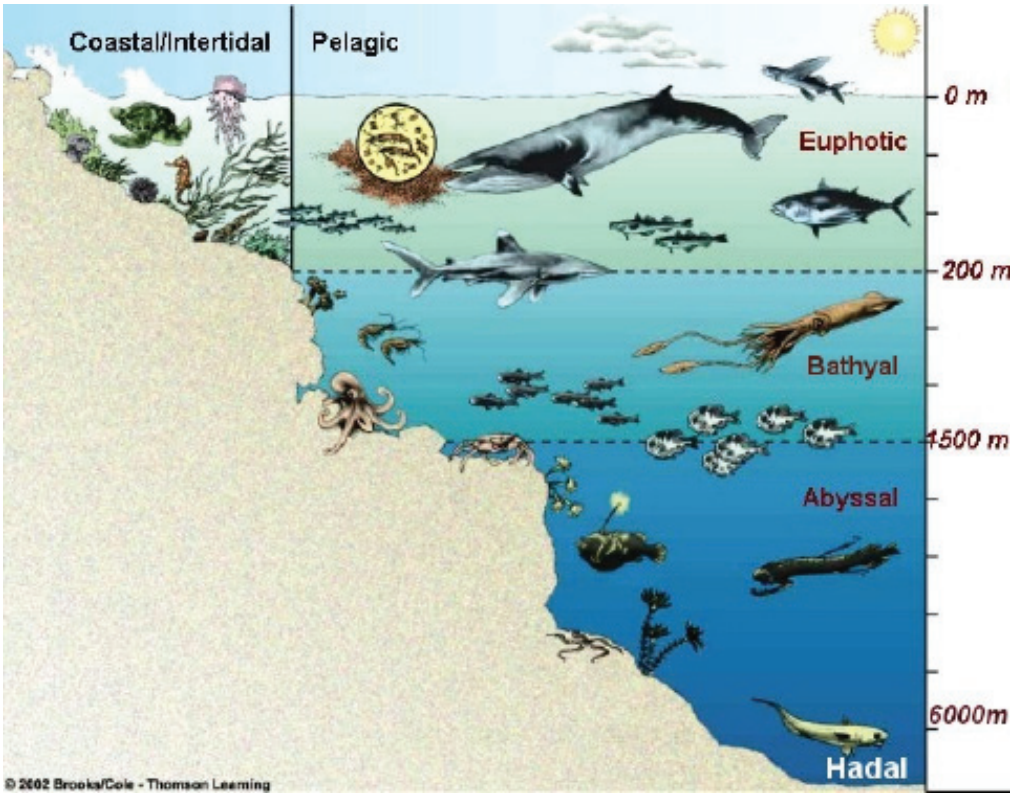


What animals live in the different zones[2]? (Lesson 2)

The word **epipelagic** is often used synonymously with the word **pelagic**. It is in this zone that many familiar fish are found, including groups such as jacks (*ulua*), dolphinfishes (*mahimahi*), opahs, tunas and skipjacks (*ʻahi and aku*), flying fish, mackerels (*ʻopelu*), marlin, sailfish, swordfish and billfish (*aʻu*), and many others. Sharks (*mano*) and manta ray (*hahalua*) are also found in these regions, although undoubtedly many species frequently visit greater depths than the 200-meters (656 feet) limit of the epipelagic zone. The epipelagic zone is by far the most important in terms of fisheries and human consumption, it is the source of approximately half of the 70–80 million tons of fish captured worldwide. Generally, fish in this region have evolved similar features to open ocean swimmers, including characteristics such as silvery coloring, counter-shading, and body streamlining (see next section). Many epipelagic fish also exhibit schooling and migratory behaviors and are endothermic (able to internally maintain body temperature).

Mesopelagic communities are typified by fish groups such as lanternfish, hatchetfish, and lightfish, as well as other invertebrates including shrimp and squid. Fish in the mesopelagic zone tend to be small and silvery in color. In the deeper bathypelagic and benthopelagic zones (just above the bottom, or **benthos)**, less commonly known organisms are found, including anglerfish, rattails, seadevils, and brotulas. Because environmental conditions in the mesopelagic, bathypelagic, and benthopelagic zones (low levels of light and relative scarcity in prey compared to that of the nearshore or epipelagic habitats), many organisms in this region have evolved features such as light-emitting **bioluminescent** organs (hence descriptive names like lanternfish and lightfish), large dagger-like teeth (e.g., viperfishes), modified dorsal fins, or other appendages that act as "lures" for attracting prey (e.g., anglerfish, hatchetfish), very large eyes, and/or stalked eyes for capturing low levels of light (usually in the mesopelagic zone). In the deepest depths where complete darkness provides no selective advantage for sight (usually the bathypelagic and benthopelagic zones), some organisms lack eyes entirely.

Many of these deeper water organisms tend to feed on small animals such as **plankton** (fish eggs, larvae, microscopic crustaceans), as well as food matter falling from the photic zone above. Mesopelagic fish (generally lanternfish) commonly migrate upward during nighttime hours for feeding, and then back down to greater depths during daytime hours. Other organisms might use their bioluminescence to attract prey.

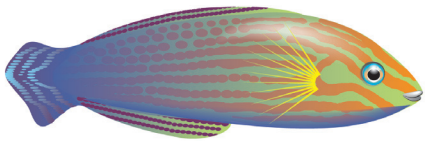


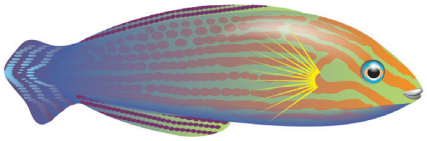
In addition to adaptations in response to the scarcity of light, animals of the deeper waters have evolved to cope with the increased pressure from the weight of the water column. Particularly in the bathypelagic and benthopelagic zones, **evolution** has resulted in the loss of the gas bladder, which in shallow water fishes functions as buoyancy control. The mesopelagic lanternfish, however, maintain their gas bladders, which aid and function in the nightly vertical migration behavior. The bathypelagic anglerfish have also evolved some of the most bizarre sexual dimorphisms known in order to surmount difficulties in finding mates in very dark and vast habitats. Male anglerfishes can be extremely tiny, with females growing to ten times that size. Once a male and female encounter one another, the male attaches and embeds himself to the body of the female, and in essence becomes parasitic and totally dependent on the female for nutrition.

Many of the unique features of deep-water fish have evolved through **convergence**, that is, they have become similar in morphology (shape), or other characteristics, not because they are closely related to each other, but rather because of the similar selective pressures of their environments. The similarities in their forms and characteristics, therefore, are not due to common genetic lineages, or their close genealogical relationships, but rather an outcome of natural selection from the same environmental pressures resulting in the emergence of similar traits. For a short descriptive video of adaptations of deep-water organisms, go to: http://www.pbs.org/wgbh/nova/abyss/life/bestiary.html and http://www.learningdemo.com/noaa/ Lesson 6-Deep Sea Benthos.

What are some ways an open ocean animal might protect itself from predators[3]? (Lesson 4)

Open ocean fish, particularly those of the epipelagic (more commonly referred to as the pelagic) zone, have evolved a number or adaptations that may aid in their survival. Many pelagic species can be characterized as continuous swimmers, forming schools, and having counter-shading that make them difficult to see from above or below. For example, tunas and swordfishes are fast, long-distance swimmers, having efficient circulatory systems that provide the necessary energy to cover the vast expanse of ocean to find scattered prey resources. Many smaller pelagic fish can *fly* out of the water to escape predators. The flying fish, for example, can actually double their escape velocity while airborne. Schooling behaviors of many fish are thought to be protective behaviors that help them avoid predation by confusing potential predators. Large numbers of fish in a school along with abrupt movements that almost look choreographed help them to survive. For example, mackerel scad (*ʻopelu*) tend to form such schools and are common in Hawaiʻi. The sharks (*mano*), rays, dolphins, and whales typify counter-shading. They are darker on the body's dorsal (top) side, and lighter on the ventral (under) side. This makes these fish more difficult to spot from above (they blend in with the darker deep water below them), or from below (they blend in with the clearer shallow water above them).





What are ways you could explore the open ocean or ocean depths[4]?

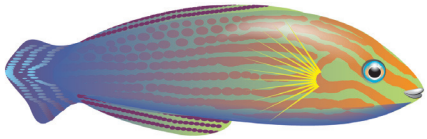
Studying open ocean deep-water species is not as straightforward as studying near-shore coastal or reef-dominated ecosystems. Alternative technologies are required to explore open ocean depths. Most commonly, researchers examine the open ocean by using large vessels as a platform from which they can deploy numerous instruments that measure physical and biological properties of the ocean, such as temperature, salinity, current, and turbidity.

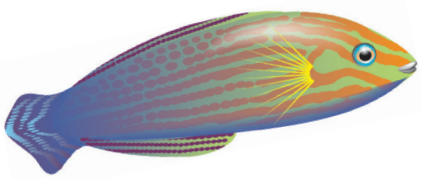
One innovative use of technology to study the mesopelagic boundary community is the use of acoustic equipment deployed from a vessel to assess abundance. Abundance is important to understand, because species present in the mesopelagic (typically lanternfish, squid, and shrimp) are an important food source for other deep-water and pelagic species such as bottomfish (e.g., *ehu, onaga, ʻopakapaka, hapuʻupuʻu*), dolphin (*naiʻa*), and tuna (*ʻahi*). By creating acoustic echo profiles that are unique to individual species of fish based on their shapes, researchers are able to do rapid, large-scale measurements of their abundance in the open ocean.

Deep-water submersibles have been employed in a more direct manner to explore even deeper depths of the open ocean. These submersibles can be either unmanned (autonomous or cable-fastened) vehicles that can take physical measurements and images of the underwater environment, or more sophisticated vehicles driven by highly trained pilots. Using these types of technologies, researchers are able to discover many new species, including bacterial mats, invertebrates, and fish. At the *University of Hawaiʻi at Mānoa's Hawaiʻi Undersea Research Lab* (HURL), researchers are exploring deep-ocean habitats around the islands, and discovering many new and unique organisms, mapping the seafloor, and observing geologic and volcanic formations. For more detailed information of underwater submersible missions and their recent discoveries, see: http://www.soest.Hawaii.edu/HURL/gallery.html and http://oceanexplorer.noaa.gov.

A front view of the Remote Operated Vehicle Hercules shows the powerful arms, lights, and cameras. Image courtesy of L. Arnold.

The DeepWorker is a submersible vessel driven by a highly trained pilot to explore the underwater world. This vessel can descend to depths as great as 2,000 ft.





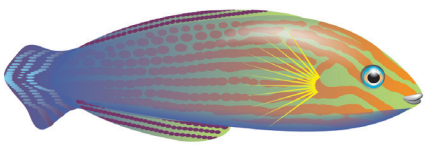
Science Background for the Teacher Glossary

aphotic zone: the deeper regions of the water environment in which no light penetrates; generally the bathypelagic and benthopelagic zones.
bathypelagic zone: follows the mesopelagic zone; generally 1,000–4,000 meters in depth, low to no light penetration; together with the benthopelagic zone falls into the aphotic or midnight zone.
benthopelagic zone: follows the bathypelagic zone; generally 4,000–6,000 meters in depth, no light penetration, and falls into the aphotic or midnight zone; sometimes referred to as the abyssal zone.
benthos: the bottom or bed of a body of water, including the sand, mud, silt, and organisms that live there; also benthic community.
bioluminescence: the production of light by a living organism, usually through a symbiotic association with light-producing bacteria.
continental shelf: the shallow, gradually sloping seabed around a continental or island margin, usually not deeper than 200 meters.
convergence: the evolution of similar heritable traits attributable to natural selection from pressures in similar environments, as opposed to resulting from common genetic lineage.
disphotic or "twilight" zone: the poorly lit zone of the ocean below the photic zone.
epipelagic zone: the upper region of the pelagic zone where light penetrates, typically 0–200 meters in depth; also referred to as the photic zone; in common discourse used interchangeably with pelagic zone.
evolution: the process through which a population of organisms accumulates genetic changes over generations that can lead to adaptations to environmental conditions.
mesopelagic zone: follows the epipelagic zone; generally 200–1,000 meters in depth, with low light penetration; commonly referred to as the disphotic zone.
oceanic zone: the deep ocean waters, away from the influence of land, generally beginning at the outer edge of the continental shelf.
pelagic zone: the water environment of the oceanic zone.
photic zone: the upper region of the water environment in which light penetrates, allowing for photosynthesis, generally in the epipelagic zone; sometimes referred to as the sunlight zone or euphotic zone.
phytoplankton: the plant forms of plankton; generally small microscopic algae and diatoms.
plankton: small, usually microscopic organisms that drift, or swim in the water column.

Science Background for the Teacher - Bibliography

[1-4] ***Science background information condensed and/or compiled from the following sources:***

1: NOAA Ocean Explorer. (2006). Ocean Zones. Retrieved March 15, 2007, from http://oceanexplorer.noaa.gov/edu/curriculum/section5.pdf
Duxbury, A. B., & Duxbury, A. C. (1999). *Fundamentals of Oceanography* (3rd ed.). Boston: McGraw-Hill.
2: Tyson, P. (2000). Deep-sea Beastiary. Retrieved March 15, 2007, from http://www.pbs.org/wgbh/nova/abyss/life/bestiary.html
NOAA. (N/A). Lesson 6-Deep sea benthos. Retrieved March 15, 2007, from http://www.learningdemo.com/noaa/
Helfman, G. S., Collette, B. B., & Facey, E. D. (1997). *The Diversity of Fishes*. Malden, MA: Blackwell Publishing, Ltd.
3: Helfman, G. S., Collette, B. B., & Facey, E. D. (1997). *The Diversity of Fishes*. Malden, MA: Blackwell Publishing, Ltd.
4: Tinker, S. W. (1991). *Fishes of Hawai'i*. Honolulu, HI: Hawaiian Service, Inc.
Bennoit-Bird, K. (2006). Hawaiian mesopelagic boundary community. Retrieved March 15, 2007 from http://oregonstate.edu/~benoitbk/mbc.html
HURL (2007). Image Database. Retrieved March 15, 2007 from http://www.soest.hawaii.edu/HURL/gallery.html NOAA (2007). Ocean explorer. Retrieved March 15, 2007 from http://oceanexplorer.noaa.gov/



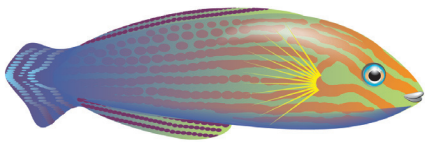
NOAA Resources

Below is a list of resources compiled by the Outreach Education Office of the National Oceanic and Atmospheric Administration. The science standards and the ocean literacy principles addressed in this unit were used as a guideline in selecting the following resources. To access the print resources listed below, contact NOAA's Outreach Education Office directly:

Outreach Unit
NOAA Office of Public and Constituent Affairs
1305 East West Highway #1W514
Silver Spring, MD 20910
Phone: (301) 713-1208
Email: NOAA-OUTREACH@noaa.gov
http://www.education.noaa.gov/

Resources:

- **"Flowing Ocean: Understanding the Gulf Stream" poster by COSEE-SE and NOAA.**
- **"Marine Mammals" and "Explore Oceans" activity book developed in collaboration with Project WET.**
- **NOAA Fisheries "The Kid's Times" found at:** http://www.nmfs.noaa.gov/pr/education/turtles.htm **and** http://www.nmfs.noaa.gov/pr/education/whales.htm



OCEAN LITERACY ESSENTIAL PRINCIPLES

1. The Earth has one big ocean with many features
   1a. The ocean is the dominant physical feature on our planet Earth- covering approximately 70% of the planet's surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian and Arctic.

5. The ocean supports a great diversity of life and ecosystems
   5a. Ocean life ranges in size from the smallest virus to the largest animal that has lived on Earth, the blue whale.
   5d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
   5e. The Ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.
   5f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e. it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.
   5g. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, methane cold seeps and whale falls rely only on chemical energy and chemosynthetic organisms to support life.

Lesson 1: 1a. 5e. 5f. 5g.
Lesson 2: 5a. 5d. 5e. 5f. 5g.
Lesson 3: 5d. 5e. 5f. 5g.
Culminating: 1a. 5a. 5d. 5e. 5f. 5g.

CLIMATE LITERACY ESSENTIAL PRINCIPLES

3. Life on Earth depends on, is shaped by, and affects climate.
   3a. Individual organisms survive within specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish.

Lessons 1 ,2, and Culminating: 3a

NOAA Marine Science Career - Case Studies

Jeff Drazen, PhD

Associate Professor

University of Hawai'i- Department of Oceanography

Are you interested in the creatures that live in the deep-sea? Dr. Jeff Drazen is! Jeff Drazen is an Associate Professor at the University of Hawai'i and leads the Deep-Sea Fish Ecology Lab. In his lab, Jeff studies the role of fish in deep-sea ecosystems. They are interested in how these fish find food and survive.

Jeff grew up in the Pacific Northwest, and from the age of three, Jeff would visit the beach spending time exploring tide pools and fishing. At a young age, he decided he was going to go to college and study marine biology. Jeff attended the University of San Diego for his undergraduate degree in biology and marine science. While in college, Jeff developed an interest in research. Jeff was fascinated by the fact that there are animals that exist that people don't even know about and places people have never been. As a deep-sea ecologist, Jeff gets to collect samples from our ocean floor and discover new things about the creatures that live there.

The process of doing research is ongoing. There are new discoveries all the time, so Jeff spends a lot of his time reading to keep up with all the research going on. He also has colleagues all over the world that often email to share their findings. As a scientific researcher, you have to write proposals to get money for the research you want to conduct. Once you get the funding, you go through the process of completing the research, which involves collecting the data and then analyzing your data in order to figure out what it means. Finally, you have to write and publish a paper about your research, so that you can share your discoveries with the world.

Most of Jeff's research requires trips out to sea. Jeff will go out on what is called an 'Oceanographic Cruise'. On these trips, they deploy trawling nets and instruments to collect samples. Most of their time onboard the boat, involves a lot of waiting. It takes the nets about 2 hours to reach the seafloor, then 2 hours of trawling (when the actual fish collection occurs), followed by another 2 hours to get the net back to the boat. Jeff's team uses several instruments on the seafloor; cameras to photograph organisms, instruments to catch fish, and other instruments to do experiments with the organisms they encounter. When the net finally comes back up from the seafloor everything is very frantic! Scientists identify and count the fish and take tissue samples. These samples or data collected are then taken back to Jeff's lab for analysis.

During his years of research Jeff has had the opportunity to see some really cool creatures. One of his favorite organisms is the spook fish. He likes the spook fish because it has a special adaptation that helps it to survive in the open ocean; its head has a translucent top. The spook fish lives in the mesopelagic or twilight zone 200-1000 meters below the surface. This habitat contains little to no sunlight. The spook fish has really big eyes that are used for looking up to see shadows of fish against the little bits of sunlight that make it down that deep. Spook fish are only a few inches long, have very small mouths and they like to eat jellyfish. Researchers in California used a remotely operated vehicle or ROV to take video of this fish and its behavior (you can find it on youtube.com). It is easy to see why these unique adaptations make the spook fish one of Jeff's favorites!

Jeff's interest and curiosity in the creatures of the deep sea has led to some amazing discoveries. If you are interested in becoming a research scientist Jeff suggests that you work hard in school, spend time in the tidepools, go to the beach, and go fishing. He says, "You can learn a lot, just by taking a few minutes to sit down and watch what animals do."

If you want to learn more, visit him at http://www.soest.Hawaii.edu/oceanography/faculty/drazen/fishes.htm

Glossary of Cooperative Learning Techniques

In an effort to maximize student engagement and learning, the NOAA Sea Earth and Atmosphere curricular resources were designed using cooperative learning techniques. This guide defines the expectations for implementation of each technique.

What is Cooperative Learning?

Cooperative learning may be broadly defined as any classroom learning situation in which students of all levels of performance work together in structured groups toward a shared or common goal. According to Johnson, Johnson and Holubc, (1994): "Cooperative learning is the instructional use of small groups through which students work together to maximize their own and each other's learning." In classrooms where collaboration is practiced, students pursue learning in groups of varying size: negotiating, initiating, planning and evaluating together. Rather than working as individuals in competition with every other individual in the classroom, students are given the responsibility of creating a learning community where all students participate in significant and meaningful ways. Cooperative learning requires that students work together to achieve goals which they could not achieve individually.

Jigsaw

To Jigsaw materials refers to the use of a strategy in which each student on a team receives only a piece of the material that is to be learned in which that student becomes the "expert." Once the material is learned each member of the team takes a turn teaching the other members their assigned content. This type of dynamic makes the students rely on the other members of their team to learn all of the material.

Think-Pair-Share

This four-step discussion strategy incorporates wait time and aspects of cooperative learning. Students (and teachers) learn to LISTEN while a question is posed, THINK (without raising hands) of a response, PAIR with a neighbor to discuss responses, and SHARE their responses with the whole class. Time limits and transition cues help the discussion move smoothly. Students are able to rehearse responses mentally and verbally, and all students have an opportunity to talk.

Numbered Heads

This structure is useful for quickly reviewing objective material in a fun way. The students in each team are numbered (each team might have 4 students numbered 1, 2, 3, 4). Students coach each other on material to be mastered. Teachers pose a question and call a number. Only the students with that number are eligible to answer and earn points for their team, building both individual accountability and positive interdependence.

KWL Chart

A pre-assessment tool consisting of three vertical columns. Students list what they "**K**now" about a topic. What they "**W**ant" to know about a topic. The last column students share what they have "**L**earned" about a topic.

KWL CHART

Be sure to bullet your list.

Use content words only (nouns, verbs, names of people and places, dates, numbers, etc.).

WHAT DO I KNOW?	WHAT DO I WANT TO KNOW? *or* WHAT DO I WANT TO SOLVE?	WHAT HAVE I LEARNED?
•		•

Role Cards

Assign students to cooperative learning groups. Once students are in their groups the teacher will hand out premade role cards that will help each member of the group contribute to the completion of the given task. Before roles are assigned, the teacher should explain and model the task as well as the individual roles for students so that they know and understand how his/her individual role will contribute to the success of the group completing the task. When this technique is used, taking on a different role will aide in student proficiency.

Example of role cards:

Role Card #1

Facilitator:

Makes certain that everyone contributes and keeps the group on task.

Role Card #2

Recorder:

Keeps notes on important thoughts expressed in the group. Writes final summary.

Role Card #3

Reporter:

Shares summary of group with large group. Speaks for the group, not just a personal view.

Role Card #4

Materials Manager:

Picks up, distributes, collects, turns in, or puts away materials. Manages materials in the group during work.

Role Card #5

Time Keeper:

Keeps track of time and reminds groups how much time is left.

Role Card #6

Checker:

Checks for accuracy and clarity of thinking during discussions. May also check written work and keeps track of group point scores.

Round Table

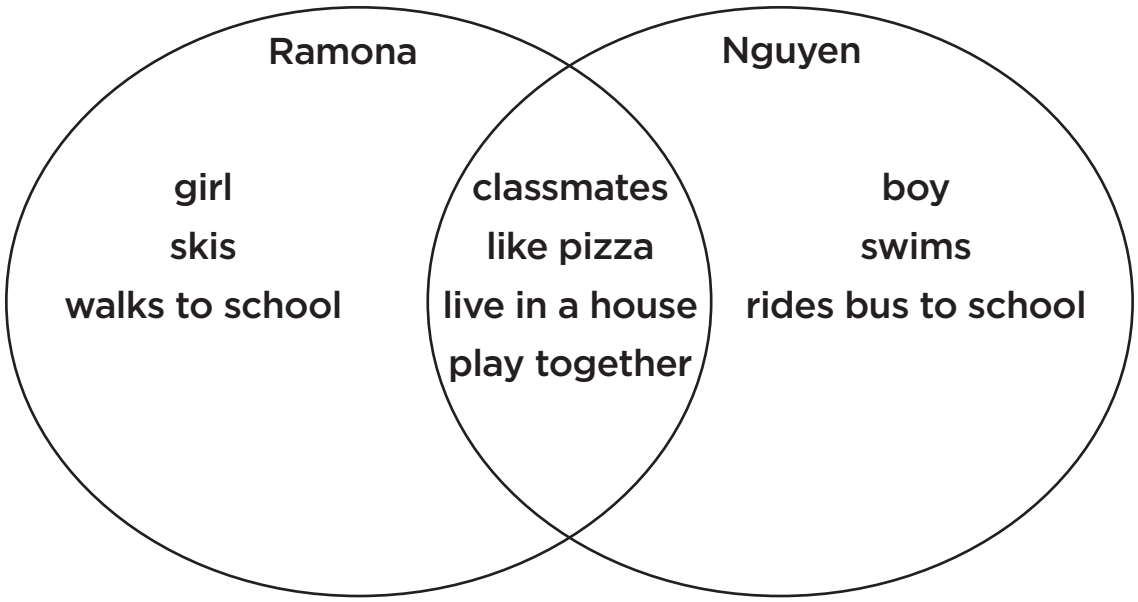
Round table can be used for brainstorming, reviewing, or practicing while also serving as a team builder. Students sit in teams of 3 or more, with one piece of paper and one pencil. The teacher asks a question which has multiple answers. Students take turns writing one answer on the paper, then passing the paper and pencil clockwise to the next person. When time is called, teams with the most correct answers are recognized. Teams reflect on their strategies and consider ways they could improve.

Three-Step Interview

This involves structured group activity with students. Using interviews/listening techniques that have been modeled; one student interviews another about an announced topic. Once time is up, students switch roles as interviewer and interviewee. Pairs then join to form groups of four. Students take turns introducing their pair partners and sharing what the pair partners had to say. This structure can be used as a team builder, and also for opinion questions, predicting, evaluation, sharing book reports, etc.

Venn Diagram

A diagram using circles to represent sets, with the position and overlap of the circles comparing and contrasting the relationships between two given pieces of information.



References and Credits

Armour, R. (1974). *Sea Full Of Whales.* Scholastic.

Cole, J. (1994). *The Magic School Bus On The Ocean Floor.* Scholastic.

Demi (1991). *Find Demi's Sea Creatures.* New York, New York: Grosset & Dunlap.

DK Publishing. (1991). *Sharks and Other Creatures of the Deep*. DK Children.

Maestro, B. (1997). *A Sea Full of Sharks.* Scholastic.

National Marine Sanctuaries. (2007). *Oceans for Life Lesson Plans and Videos.* Retrieved January 17, 2007 from National Marine Sanctuaries Website: http://sanctuaries.noaa.gov/education/welcome.html

Selberg, I. (1990). *Secrets of the Deep.* Dial Books for Young Readers.

Smithsonian Institution's National Museum Of Natural History. (2007). *A Smithsonian Institution Traveling Exhibition.* Retrieved January 16, 2007 from The Ocean Planet Website: http://seawifs.gsfc.nasa.gov/ocean_planet.html

Tocci, S. (2005). *Marine Habitats Life in Saltwater*. Franklin Watts.

Waikiki Aquarium. (2006). *Marine Life Profiles*. Retrieved January 17, 2007 from the Waikiki Aquarium Website: http://www.waquarium.org/MLP/marine_life.html.

Wells, S. (1991). *The Illustrated World of Oceans.* Rockefeller Center, New York: Simon & Schuster.