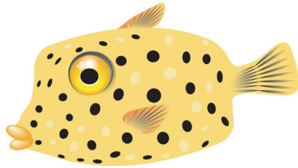
GRADE 3 UNIT 1 OVERVIEW
Shoreline Habitats



Introduction

Shoreline habitats are unique areas greatly influenced by tidal patterns, neighboring estuaries and wetlands, and human uses. Each shoreline habitat supports a great diversity of life. While many of the habitats thrive, some of them require our attention so that we can monitor our human impact, and not negatively affect the abundance of life in these areas.

In this unit, students engage in a variety of activities as they learn about shoreline habitats and the diversity of life within them. Lesson 1 and 2 focus on rocky intertidal and sandy shoreline areas. Students help create a class mural of a shoreline habitat by adding three-dimensional models of organisms to the appropriate places along this imaginary shoreline in their classroom. They learn the relationship between structure and function in organisms, and then demonstrate their understanding by creating “Guess Who” riddles about organisms and their unique adaptations.

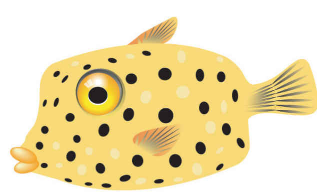
Lastly, students learn how interrelated various shoreline habitats are with other habitats by investigating the watershed concept through the Hawaiian *Ahupuaʻa* land management system. Students apply their knowledge of shoreline habitats by ultimately proposing solutions to potential real-world problems.

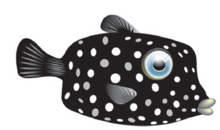
Note to teachers: In the scientific world, the term “Coastal Ecosystems” is more widely used than the term “Shoreline Habitats.” Researchers typically prefer to categorize coastal ecosystems into specific rocky intertidal, sandy shoreline, or wetland ecosystems. If students or teachers require further information about shoreline habitats to enhance this unit, search terms should be expanded to include “coastal ecosystems.”

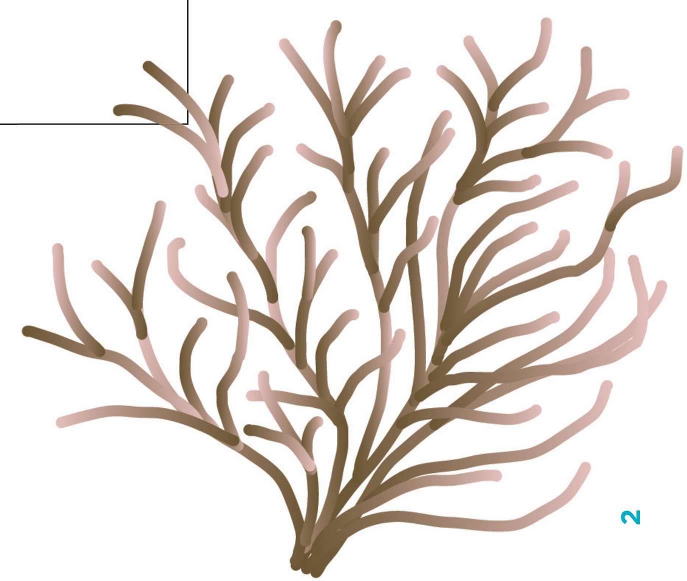
At A Glance

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

ESSENTIAL QUESTIONS	HCPSIII BENCHMARKS*	LESSON, Brief Summary, Duration
What are the different Hawaiian Shoreline habitats? How are Hawaiian Shoreline organisms adapted to survive in their harsh environments?	Science Standard 4: Life and Environmental Sciences: Structure and Function in Organisms: SC.3.4.1 Compare distinct structures of living things that help them to survive. Science Standard 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution: SC.3.5.1 Describe the relationship between structure and function in organisms. Language Arts Standard 6: Oral Communication: Conventions and Skills: LA.3.6.1 Use oral language to obtain information, complete a task, and share ideas and personal opinions with others. LA 3.1.3 Use new grade-appropriate vocabulary, including homophones and homographs, introduced in stories, informational texts, word study, and reading.	**Lesson 1: Hawai'i's Shoreline Habitats** Students use music to move about the room and share with other children what they know about Hawaiian shoreline habitats. They record their ideas about these habitats and learn new science vocabulary words to express their ideas. A K-W-L chart may be used instead of milling around the room with music. Two 45-minute periods

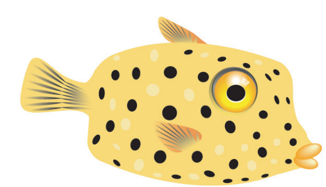






ESSENTIAL QUESTIONS	HCPSIII BENCHMARKS*	LESSON, Brief Summary, Duration
What unique structural features or behaviors help organisms to survive in Hawai‘i’s shoreline habitats?	Science Standard 4: Life and Environmental Sciences: Structure and Function in Organisms: SC.3.4.1 Compare distinct structures of living things that help them to survive. Science Standard 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution: SC.3.5.1 Describe the relationship between structure and function in organisms. Visual Arts Standard 1: Visual Arts: FA.3.1.1 Use the elements and principles of art and design, including value (i.e. tint and shades, analogous colors) line, rhythm, movement, proportion, and balance. FA.3.1.2 Use a variety of art and technology media to create an original work of art. Language Arts Standard 5: Writing: Rhetoric: LA.3.5.1 Add details, descriptions, and information from different sources to elaborate meaning.	**Lesson 2: Awesome Adaptations** Students learn organisms of the shoreline ecosystem and their special adaptations. After being given an outline drawing of an organism, they label parts needed for survival with a brief description, then color and use various other arts and crafts items to depict a “realistic” form of the organism. Two 45-minute periods

ESSENTIAL QUESTIONS	HCPSIII BENCHMARKS*	LESSON, Brief Summary, Duration
What structure and function would a species need to survive on the coastal shoreline, or coastal wetland in its new environment?	Science Standard 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution: Science SC.3.4.1 Compare distinct structures of living things that help them to survive. Visual Arts Standard 1: Visual Arts: FA.3.1.3 Use observational skills in creating an original work of art. Language Arts Standard 6: Oral Communication: Conventions and Skills: LA.3.6.1 Use oral language to obtain information, complete a task, and share ideas and personal opinions with others. LA.3.6.5 Vary expression, level, pacing, and intonation according to content and purpose.	**Lesson 3: Creature Feature** Students use their knowledge about various organisms and their structures to create their own creature. The students will "invent" a new species that had just arrived onto the Hawaiian shoreline ecosystem and will need to express how the creature needs to change to survive. They use art materials to make a colorful drawing, or 3-D model of a new species they have created. Students describe the various parts of their invented creature, explaining how the special adaptations help their organism survive. Two 45-minute periods

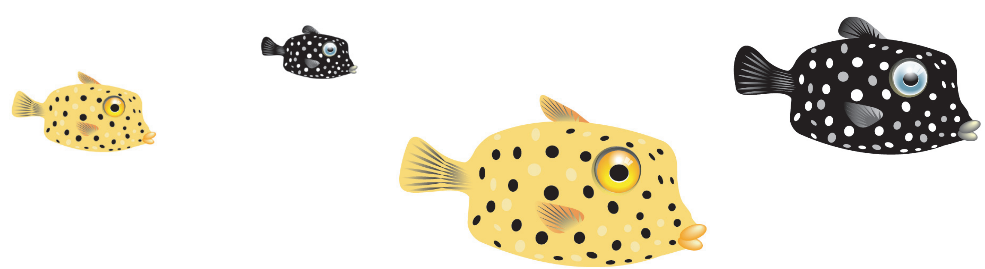


ESSENTIAL QUESTIONS	HCPSIII BENCHMARKS*	LESSON, Brief Summary, Duration
How do distinct physical and behavioral features of organisms enable them to survive in their environment?	Science Standard 4: Life and Environmental Sciences: Structure and Function in Organisms: SC.3.4.1 Compare distinct structures of living things that help them to survive. Science Standard 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution: SC.3.5.1 Describe the relationship between structure and function in organisms. Language Arts Standard 1: Reading: Convention and skills: LA.3.1.3 Use new grade appropriate vocabulary introduced in stories, informational texts, word study, and reading. Language Arts Standard 4: Writing: Convention and Skills: LA.3.4.1 Write a variety of grade appropriate formats for a variety of purposes and audiences. LA.3.4.6 Write legibly, adhering to margins, correct spacing between letters in a word and words in a sentence.	**Lesson 4: Guess Who?** Students use the vocabulary and what they have learned about the structures and adaptations of shoreline organisms to write “guess who?” riddles (“I” statements). These statements will describe the organism and other students will make educated guesses about which organism is being described and validate their hypothesis. First, the teacher will model, then have students create their own statements to share in either small groups or as a large group activity. One 45-minute period

ESSENTIAL QUESTIONS	HCPSIII BENCHMARKS*	LESSON, Brief Summary, Duration
How can communities manage and care for their coastal environments?	Language Arts Standard 6: Oral Communication: Conventions and Skills: LA.3.6.1 Use oral language to obtain information, complete a task, and share ideas and personal opinions with others. LA.3.6.3 Give verbal and nonverbal feedback to a speaker to promote mutual understanding. LA.3.6.4 Clarify spoken messages by restating, questioning, or elaborating.	**Lesson 5: Shorelines in Trouble** After learning about the shoreline habitat and some of the organisms that live there, students will be introduced to some problems which could impact this ecosystem. Students are given information to read on traditional Hawaiian *Ahupua'a* management of the watershed, and how these methods helped preserve the natural resources. Next, they are given a short article to read on modern issues related to the health, use, and management of our watersheds, particularly the shorelines. Students note the actions that both groups used that sustained the habitat and cite ways that past practices still work in present day. Students work in groups using a problem solving graphic organizer to brainstorm solutions to their shoreline management problems. Each group presents ideas and solutions to the class. Two or three 60- minute periods

ESSENTIAL QUESTIONS	HCPSIII BENCHMARKS*	LESSON, Brief Summary, Duration
How can I help Hawaiian shoreline habitats that are threatened by human impacts?	Science Standard 4: Life and Environmental Sciences: Structure and Function in Organisms: SC.3.4.1 Compare distinct structures of living things that help them to survive. Language Arts Standard 4: Writing: Conventions and Skills: LA.3.4.1 Write a variety of grade-appropriate formats for a variety of purposes and audiences as, short reports on content area topics.	**Culminating Lesson: My Shoreline Habitat Report** In lesson 5, students examined the past and present practices in shoreline management and prepared a group oral presentation of the problems and possible solutions of the shoreline habitat. In the culminating lesson each student will demonstrate what he/she learned by writing a mini-action paper or creative writing piece about their solution(s) to a shoreline habitat problem. The papers include pictures and writing that describes the shoreline habitat problem and possible solutions. Three 45-minute periods

* "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 specific to the performance tasks within each lesson.

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

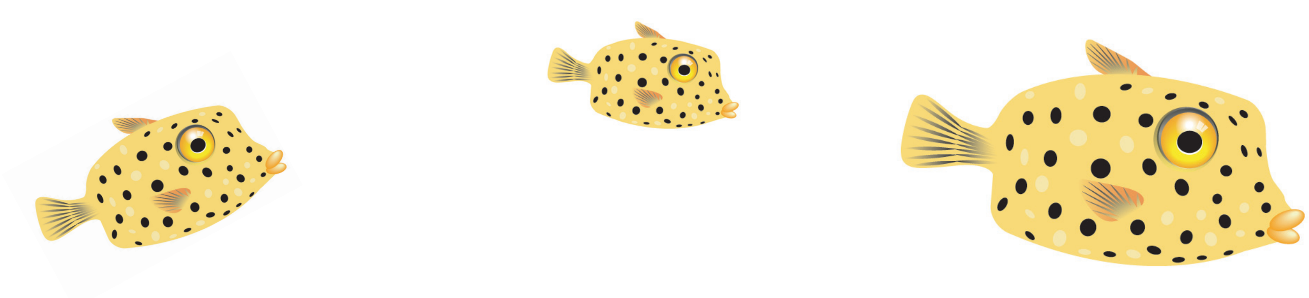
Topic		**How the Arts are Organized**	
Benchmark FA.3.1.1		Use the elements and principles of art and design, including, value (i.e., tints and shades, analogous colors), line, rhythm, movement, proportion, and balance	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Consistently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

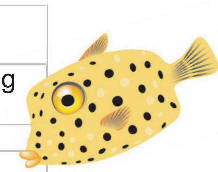
Topic		**How the Arts are Organized**	
Benchmark FA.3.1.2		Use a variety of art and technology media to create an original work of art	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Use an extensive variety of art and technology media to create an original work of art	Use a variety of art and technology media to create an original work of art	Use a few art and technology media to create an original work of art	Use one or two art and technology media to create an original work of art

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		**Vocabulary and Concept Development**	
Benchmark LA.3.1.3		Use new grade-appropriate vocabulary, including homophones and homographs, introduced in stories, informational texts, word study, and reading	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Use new grade-appropriate vocabulary, including homophones and homographs, with precision, fluency, and accuracy	Use new grade-appropriate vocabulary, including homophones and homographs, with no significant errors	Use new grade-appropriate vocabulary, including homophones and homographs, with difficulty and a few significant and/or many minor errors	Use new grade-appropriate vocabulary, including homophones and homographs, with great difficulty and/or many significant errors

Topic		**Range of Writing**	
Benchmark LA.3.4.1		Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as: • stories with a beginning, middle, and end and poems with sensory details • short reports on content area topics • pieces related to completing tasks • friendly letters • responses to literature • pieces to reflect on learning and to solve problems	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Insightfully adapt writing to grade-appropriate formats for a variety of purposes and audiences	Adapt writing to grade-appropriate formats for a variety of purposes and audiences	Write with some adaptation to grade-appropriate formats for a variety of purposes and audiences	Write with little adaptation to grade-appropriate formats for a variety of purposes and audiences





Topic		**Punctuation, Capitalization, Spelling, and Handwriting**	
Benchmark LA.3.4.6		Write legibly, adhering to margins and correct spacing between letters in a word and words in a sentence	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Write neatly and legibly, adhering to margins and correct spacing between letters in a word and words in a sentence to create a highly effective product	Write legibly, adhering to margins and correct spacing between letters in a word and words in a sentence	Write with some legibility, partially adhering to margins and correct spacing between letters in a word and words in a sentence	Write with little legibility, not adhering to margins and correct spacing between letters in a word and words in a sentence

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		**Critical Listening**	
Benchmark LA.3.6.3		Give verbal and nonverbal feedback to a speaker to promote mutual understanding	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Give insightful verbal and nonverbal feedback to a speaker to promote mutual understanding	Give verbal and nonverbal feedback to a speaker to promote mutual understanding	Give superficial verbal and nonverbal feedback to a speaker that promotes some mutual understanding	Give very little relevant verbal and nonverbal feedback to a speaker to promote mutual understanding

Topic		Critical Listening	
Benchmark LA.3.6.4		Clarify spoken messages by restating, questioning, or elaborating	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Clarify spoken messages when needed by restating, questioning, or elaborating, with specific details, in a highly effective way	Clarify spoken messages when needed by restating, questioning, or elaborating	Clarify some spoken messages when needed or only partially clarify a message by restating, questioning, or elaborating	Clarify very few spoken messages when needed by restating, questioning, or elaborating or use these listening strategies ineffectively

Topic		Delivery	
Benchmark LA.3.6.5		Vary expression, level, pacing, and intonation according to content and purpose	
Rubric			
Advanced	**Proficient**	**Partially Proficient**	**Novice**
Vary expression, level, pacing, and intonation, in a highly effective way, according to content and purpose	Vary expression, level, pacing, and intonation according to content and purpose	Vary some expression, level, pacing, or intonation according to content and purpose	Use little variation in expression, level, pacing, or intonation according to content and purpose

II. General Learner Outcomes*

A list of the Hawai‘i Department of Education’s General Learner Outcomes (GLOs) follows. 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.

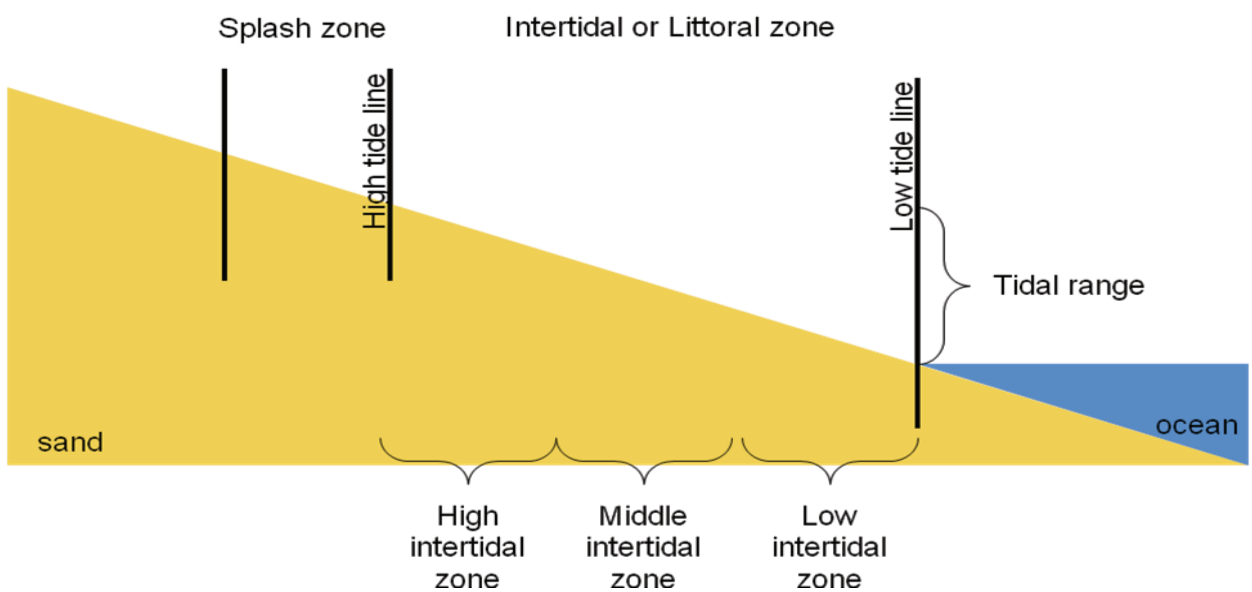
What are the physical conditions of the intertidal zone?[1] (Lesson 1)

The area along our coastlines where land and sea intersect is known as the **intertidal** or **littoral zone.** This zone is located between the high and low tide line. Included in the intertidal zone are **tide pools,** which are pools of water isolated from the rest of the ocean during low tide, and the **splash zone,** which is above the high-tide line but gets occasional splash from waves and salt spray from wind. Several factors are important in determining the types of organisms found in a given intertidal community, including: air/sun exposure, **substrate** type, salinity, and wave action.

The intertidal zone can be divided into three different regions, depending on the amount of time they are covered by water. The **high intertidal zone** is covered by water during high tide only. This can be a harsh environment to live in because of long periods of exposure to the sun and air, high salinity levels, and often high wave exposure. The **middle intertidal zone** is covered by water about 50% of the time (per tidal cycle). Temperatures in this zone are less extreme because of shorter exposure times to the sun, and consequently, salinity levels are only slightly higher than the sea. The **low intertidal zone** is only uncovered during low tide and is the least variable habitat of the intertidal zone. As one progresses from the high intertidal zone to the low intertidal zone, the diversity of organisms tends to increase. (For more information on tides and the intertidal zone see: http://ceres.ca.gov/ceres/calweb/coastal/rocky.html.)

The **tidal range,** which is the difference between high and low tide, is highly variable between locations and collectively defines the size of the intertidal zone. For example, the tidal range at the Bay of Fundy in Nova Scotia can be as much as 17 meters while some areas in the Caribbean can have a tidal range as low as 0.5 meters. Because Hawai‘i’s daily tidal fluctuations are small, the tidal range in Hawai‘i is only about 1 meter.

Some areas of Hawai‘i get regular swells that result in a large splash zone. In these cases, it is wave action, not tidal flux, which influences what animals can live there. In other areas of Hawai‘i where the shoreline is protected from waves, such as *O‘ahu’s Kahana Bay*, there is a predictable assemblage of organisms at different tidal heights, a phenomenon called **tidal zonation.** Turf algae dominate the low mark, or low intertidal zone. Higher in the intertidal zone, one finds successively: the mussels *Isognomon californicum* and *Brachidontes crebristriatus* (*nahawele li‘ili‘i*), and the **introduced species** of barnacles *Balanus amphitrite* and *Chthamalus proteus*. Higher in the intertidal zone, above the barnacle band, one finds the limpet *Siphonaria normalis* (*‘opihi ‘awa*) and the Nerite snail *Nerita picea* (*pipipi*). In the splash zone, above the high



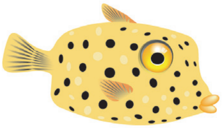
tide mark, are various littorine snail species (*Periwinkles*), and an isopod (a type of crustacean with seven pairs of legs and a flattened oval body). Research in the intertidal zone has received little attention in Hawaiʻi, and much work still needs to be done to characterize this habitat. (For more information on the intertidal zone in Hawaiʻi, see: http://www.intertidalHawaii.org/.)

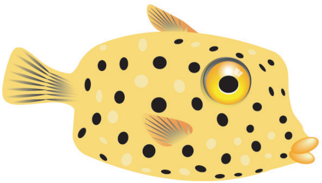
What are the roles and/or functions of the plants and animals that live in the intertidal zone, and how do they depend upon each other?[2] (Lessons 1 - 2)

Interactions such as **competition, predation, facilitation**, and **indirect interactions** between the plants and animals that live in the intertidal zone are the major forces in determining what roles these organisms have in this habitat. These interactions are also important in determining where in the intertidal zone different organisms are found. Also, organisms in the upper limit of the intertidal zone are influenced by their ability to cope with varying degrees of air and sun exposure. Because of the often limited amount of suitable habitat available, competition for space is a major interaction in intertidal ecosystems. This is especially true in the rocky intertidal where habitat is limited. For example, classic experiments by Joseph Connell in the 1960's showed that in the intertidal, one species of barnacle out-competes another species of barnacle at lower tide levels. This type of interaction was termed **competitive exclusion,** and the experiment showed that an organism's range in the intertidal is influenced by both the physical properties of the intertidal zone and by competition. Another set of classic experiments by Robert Paine in the 1970's showed that predation also influences an organism's range in the intertidal. In this example, the lower limits of mussels were influenced by predation from sea stars. When the predatory sea stars were removed, the mussels extended to lower tide heights where they were able to out-compete resident algae. In the Hawaiian intertidal, a similar situation may occur between the rock shell (a small snail, *Vexilla vexillum*) and the helmet urchin (*hāʻukeʻuke kaupali, Colobocentrotus atratus*). By preying on the helmet urchin, the rock shell may be able to control the population size of the helmet urchin. Studies on this interaction, however, are ongoing. (For more information on predators of the intertidal zone see: http://www2.Hawaii.edu/~cbird/HawaiisRockyShore/frames.htm. or http://www2.Hawaii.edu/~cbird/HawaiisRockyShore/predators.htm.)

In addition to the well-studied interactions of competition and predation, other interactions are beginning to be recognized. Facilitation occurs when one organism helps another without a detrimental effect to itself. For example, organisms can often provide habitat for other organisms to live in. In some habitats, thick dense algae mats in the upper intertidal can provide refuge for other organisms when they are exposed, preventing **desiccation.** Mussels, sea grass, and kelp beds in the intertidal provide refuge for organisms from potential predators.

Indirect interactions occur when the interaction of one organism with another affects a third organism. The predatory sea stars in the example above help maintain diversity in the intertidal by preying on mussels, which would out-compete other organisms if left unchecked. The sea stars were therefore described as a **keystone species**, a species that plays a critical role in the diversity of the ecosystem, because they kept the mussel population in check. When the sea star was removed, the mussels were able to out-compete other organisms for space, and the total number of species in the ecosystem decreased. Therefore, by preying on the mussels, the sea stars indirectly affect many other species. In the Hawaiian intertidal, indirect interactions occur between the yellow-foot *ʻopihi* (*ʻopihi ʻālinalina,* **Cellana sandwicensis**) and the helmet urchin (*hāʻukeʻuke kaupali*).





What features do the animals in the intertidal zone have that help them survive?[3] (Lessons 1-4)

An organism's ability to withstand exposure to the highly variable environmental conditions of the intertidal is a major factor in determining what zone they are able to live in. Intertidal organisms have developed special **adaptations** to help them survive. Because oxygen is extracted from the water by marine organisms, a major challenge in the intertidal is the ability to not dry out when exposed to the air and sun during low tides. Different animals have different mechanisms to cope with this. **Mobile** animals such as crabs, like the *ʻaʻama* crab (*Grapsus tenuicrustatus*), are able to periodically move back into the water to remain moist. They will also move into small crevices in the rock where small pockets of moisture, and shade from the hot sun can be found. Rock boring urchins (*ʻina*, *Echinometra mathaei* and *E. oblonga*) are able to create their own shelter by using their hard spines and scraping jaws to enlarge natural holes in the rock. **Sessile** animals, like barnacles, limpets and mussels, can not move back into the water, and have other mechanisms to deal with drying out. The Hawaiian mussel (*nahawele liʻiliʻi*, *B. crebristriarus*) is able to close its shell tight to remain moist. Limpets (*ʻopihi*, *Cellana exarata* and *C. sandwicensis*) have a muscular foot, which allows them to seal their shells to the rocks to remain moist. Slow-moving motile organisms, like the black nerite snail (*pipipi, N. picea*) have an **operculum** which they can seal against their shell to remain moist.

Organisms must also be able to resist wave action in the intertidal. Just as the *ʻopihi's* muscular foot allows them to remain moist, it also allows them to hold on to its substrate so that it is not swept away by waves. Mussels, such as *nahawele li'ili'i,* are able to attach themselves to the rocks with **byssal threads** secreted by their foot. The organisms in the intertidal also tend to be small which decreases their chance of getting swept away by the waves.

Many species of plants are found along the **littoral fringe**, also known as the splash zone because they are splashed by waves or sprayed by salt carried by the wind. These organisms also have special adaptations to help them survive in the difficult intertidal ecosystem. Leaf hairs and shiny leaf surfaces help to reflect the sun's rays, and to prevent heating and slow down evaporation. The thick and fleshy tissues of succulent plants help to store water, and their waxy leaf surfaces help prevent water loss. Special leaf arrangements minimize the amount of leaf surface exposed to the sun, helping the plant stay cool. Many plants are low to the ground with small leaves and shallow, spreading root systems which protect them from wind, and keep them anchored in shifting sands or barren rock. Plants found along Hawaiʻi's littoral fringe include the beach *naupaka* (*Scaevola sericea*), beach morning glory, *pōhuehue* (*Ipomoea pes-caprae*), beach vitex (*pōhinahina*, *Vitex rotundifolia*), beach *ʻilima* (*Sida fallax*), false sandlewood, *naio* (*Myoporum sandwicense*), and the endangered species *ʻōhai* (*Sesbania tomentosa*). (For more information on plants of the littoral fringe in Hawaiʻi see: http://www.waquarium.org/_library/images/education/marinelifeprofiles/coastalplants0909.pdf)



What are some environment impacts to the intertidal zone?[4] (Lesson 5)

As the human population continues to grow, our effects on the natural environment have become more pronounced. Intertidal ecosystems face a wide variety of threats from human activities on the land and in the ocean. Coastal development is a major contributor to the loss of shoreline habitat. Coastal areas are home to more than 50% of the population of the United States, and development in these areas continues to increase. Shoreline armoring, like seawalls, are heavily employed to protect private property along the coast, but can also have the negative effect of habitat loss by increasing harmful shoreline erosion. Shoreline development can also increase the amount of sediment that is washed into coastal water systems during rain events. This can have negative impacts on water quality, making it difficult for species to survive. Oil spills can cause large-scale disturbances, altering ecosystem communities through differential survival. Ships occasionally run aground and can cause severe damage to rocky shoreline assemblages. The harvesting of intertidal organisms by humans can also negatively affect intertidal ecosystems. For example, *ʻopihi* populations in Hawaiʻi have been severely over-harvested as they are highly prized by Hawaiʻi's residents for consumption. **Invasive species** can out-compete native intertidal organisms. The introduced barnacles, *Balanus amphitrite* and *Chthamalus proteus,* are common in protected Hawaiʻi rocky intertidal areas, out-competing native species. Global climate change may also have serious implications for intertidal areas in the near future. As sea levels rise, intertidal ecosystems may be severely altered or completely displaced.

What are other types of shoreline habitats and what kinds of adaptations do organisms living in these habitats possess?[5] (Lessons 1-4)

Sandy beach habitats can be divided into three zones: the upper zone, middle zone, and the lower beach zone. The upper zone lies above the high tide mark, also known as the **wrack line**. Wind tends to be the major physical force in this area, piling sand into small mounds and dunes. The dunes of the upper zone in sandy beach habitats are a harsh environment with little freshwater, lots of wind, high soil pH, occasional salt spray and intense sun. Animal life in this zone is scarce and consists mainly of terrestrial visitors like feral cats and mongoose. On isolated sandy beach habitats like those at *Kaʻena Point, moli,* or Laysan albatross come to nest among the many species of plants that grow among the dunes. The plants that are commonly found there have adapted to the harsh conditions by being **halophytic**, or salt tolerant. They also have creeping stems and roots that allow them to spread out and grow low to the ground, anchoring in the sand. To retain water, many plants have waxy coatings or hairs on their leaves, others are succulent-like, producing thick leaves capable of holding moisture. Common plants found in this zone in Hawaiʻi include: beach morning glory (*pōhuehue*), beach *naupaka* (*naupaka kahakai*), *nehe,* and *hinahina*. (For more info on plants found in this zone see: http://www.state.hi.us/dlnr/dofaw/nars/kaena/kaenafr.html)

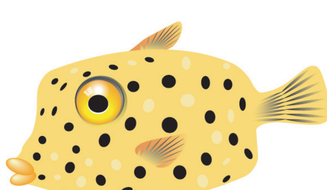
The middle sandy beach zone can be characterized as a shifting habitat. It lies below the wrack line but above the low tide line. Wave action moves the sand and does not allow much to live on the surface. Little research has been conducted in the middle sandy beach habitats in Hawaiʻi specifically, in many cases a typical middle sandy beach habitat can be described as the surface of the sand seeming quite barren. However, all one has to do is dig a little to find an abundance of life below. The **infauna,** species that live *in* the sand, are adapted to the middle zone of the sandy beach habitat. Based on personal observations of the author and colleagues, in Hawaiʻi you might see on a typical beach: Ghost crabs that scurry back and forth with the waves in search of food and make burrows just above the wave zone to hide in; Mole crabs (or turtle crabs) that bury themselves, back end first, in the sand in the wave zone exposing only their antennae to capture small food particles. Clams and annelid worms are more permanent members of the infauna in the lower part of the sandy middle zone. The clams use strong foot muscles to bury into the sand and filter water through siphons that protrude the surface of the sandy beach. It is common to see the small wholes of the siphons bubbling when the tide recedes. Other visitors of the middle beach zone include the Hawaiian sea turtle and Monk seal. It's common to see these marine animals haul themselves out of the water to bask on the beach, nest or pup. Because there is little research in these areas, observations will likely vary from beach to beach.

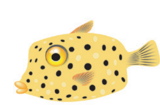
As with the middle sandy beach habitat, there is little research on the lower sandy beach habitats of Hawai‘i. However, a typical lower sandy beach zone can be described as being constantly submerged. This zone is small compared to the upper and middle zone and varies greatly depending on the type of beach. Again, based on personal observation by the author and colleagues, exposed high energy beaches like Sandy beach and *Mōkapu beach* do not have much living in the lower zone due to the constant wave action. In more protected beaches like those in Hanauma Bay or *Kāne‘ohe Bay,* schooling fish, gobies, and flounders can be seen in the shallows. Common schooling fish include species of mullet (*‘ama‘ama*), goatfish (*weke ‘ā*) and flagtails (*a‘hole‘hole*). Porcupine pufferfish are active predators on shellfish and crabs and often visit this zone in search of their next meal. Small mounds of sand are usually a sign of a goby burrow. Many gobies share their burrow with shrimps; this type of relationship is considered a **mutualism.** On rare occasions, one may see baby sharks swimming in the protected shallows of the low sandy beach zone. Observations however are likely to vary by site.

Wetlands refer to an area of land where water covers the soil, or is present at or near the soil surface for all or parts of the year. There are two main types of wetlands: coastal and inland. **Estuaries**, a type of coastal wetland, are affected by the rise and fall of the tides. Estuaries occur at the mouths of rivers where the fresh water meets the ocean water, creating an environment of varying **salinities. Halophytic** plants have special **adaptations** that allow them to thrive in saline environments. While it's estimated that only 1% of Hawai‘i's recreational and commercial fish species are dependent on wetlands, many other important organisms live in Hawai‘i's wetland habitats. Mullet (*‘ama‘ama*), milkfish (*awa*), shrimp (*‘opae*) and Hawaiian anchovies (*nehu*) depend on wetlands for food and breeding grounds. Waterfowl endemic to Hawai‘i such as the Hawaiian stilt (*ae‘o*), Coot (*‘alae kea*), and Duck (*koloa*) live in wetlands and are endangered in part due to the loss of wetland habitats in Hawai‘i. All three of these birds spend most of their lives eating aquatic plants, aquatic insects, fish, worms and crabs. The black-crowned night heron (*‘auku‘u*) is the main natural predator in the wetland, eating juvenile fishes and even the young of other wetland birds.

Plants common in wetland habitats include the invasive California grass (also known as *‘para’*), a large grass growing up to 1 meter tall. Para grass is not a true hydrophyte, but is common in wetlands. The common cattail with its characteristic brown, bob flower is also an invasive that out-competes native wetland plants by forming extensive **rhizome** mats, and the abundant, invasive water hyacinth is a floating plant with violet flowers that spreads quickly over wetland ponds. Native wetland plants of Hawai‘i include: the *kāmole*, or primrose willow, a herbaceous shrub with yellow four petal flowers, the *makai kaluhā*, an indigenous wetland bulbrush with light brown flower heads, and the *neke*, or swamp fern, with leathery green fronds that can grow to 1 meter in length.

Plants and animals have many different adaptations that allow them to thrive in wetland environments. As mentioned for plants, many of them are hydrophytes, growing in water saturated soils or completely submersed. Others are halophytes, growing in waters and soils influenced by the sea. Plants with specialized root structures called rhizomes that grow above the soil allow the gaseous transfer of oxygen into the roots to be transported to all parts of the plant. Plants that grow in high salinity environments, for example mangroves, have specialized adaptations that allow them to secrete salt onto their leaves to be washed or blown away by rain or wind. Non native plants such as mangrove and California grass have thrived greatly in Hawai‘i because of these specialized adaptations. Given that the soils of wetlands are saturated and soft, plants have also adapted specialized supporting structures to help anchor them into the soil. **Buttresses** are a type of **prop root** found on mangrove trees that grow on the lower part of the stem or trunk to provide the plant with extra support. Other plants like the cattails or grasses grow horizontal root structures, or rhizomes, that spread low to the ground to provide support. A key adaptation that animals have developed to live in the variable environment of wetlands is the ability to adjust its physiological tolerance to varying salinities. This is best described in **euryhaline** fish and invertebrate species that **migrate** from fresh, **brackish** and saltwater. Euryhaline organisms are able to withstand differing amounts of salinity





due to special cellular processes that allow them to regulate the amount of internal salt concentrations relative to the external environment. Hawaiian flag-tail (*āholehole*) and stripped mullet *(ʻamaʻama)* are two such fish that can migrate from salt to brackish water to forage.

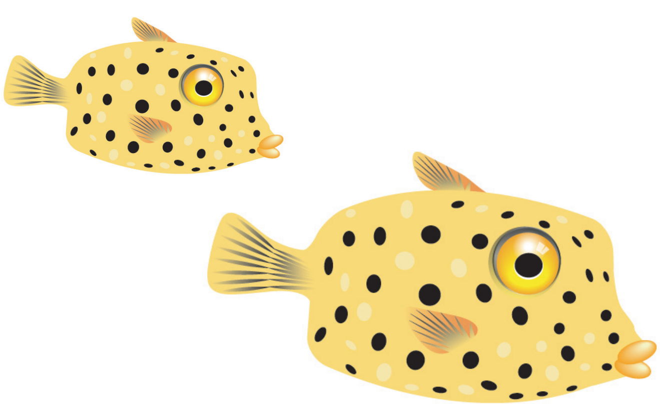
What is the scientific classification system?[6] (Lesson 4)

The modern system of scientific classification for organisms is rooted in the work of Carolus Linnaeus who grouped species according to shared **morphological** characteristics. The most specific grouping is **species.** A species is generally a group of organisms, or populations of organisms, that are common in form and can breed with each other. **Binomial nomenclature** is the formal method of naming species. As indicated by the term "binomial," the scientific name of a species is a combination of two terms: the *Genus* of the organism (capitalized), and the species name (not capitalized), and are by convention italicized. The groupings scientists use, from least specific to most specific are: Domain, Kingdom, Phylum, Class, Order, Family, *Genus*, and *species*. Each level is defined as a grouping of the next most specific grouping. For example, *Genus* is a collection of related *species*; Family is a collection of related genera (*ʻgeneraʼ* is the plural form of the word *ʻgenusʼ*), etc. However, while species is specifically defined based on a group of organisms that can inter-breed, the groupings above the species are more complex. Scientists sometimes debate whether a certain *Genus* belongs in a certain Family, or whether a certain species belongs in a certain *Genus*. As an example of the scientific classification system, the classification for the black-foot *ʻopihi (ʻopihi makaiaūli, Cellana exarata)* is shown below:

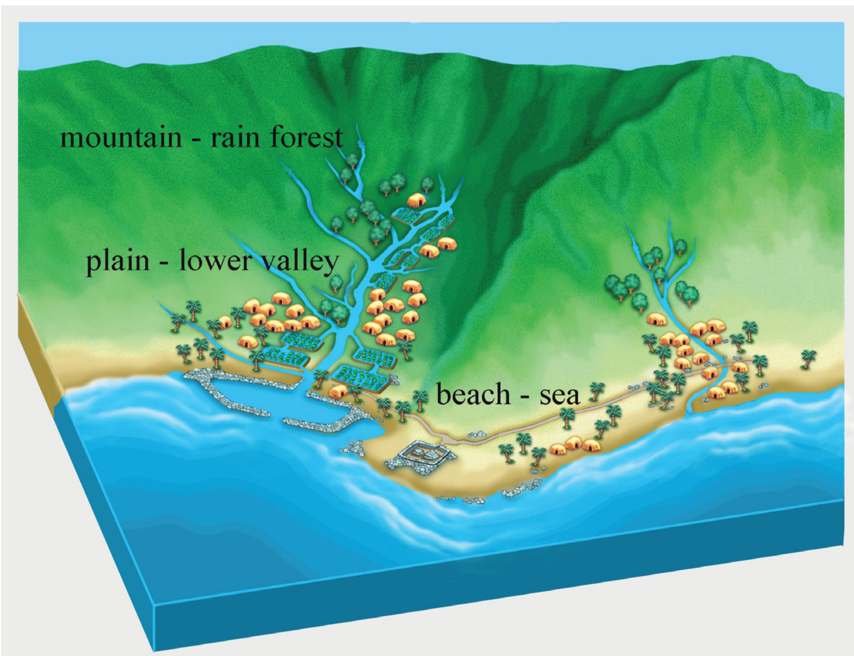
Domain: *Eukaryota*
- Kingdom: *Animalia*
  - Phylum: *Mollusca*
    - Class: *Gastropoda*
      - Order: *Patellogastropoda*
        - Family: *Patellidae*
          - Genus: *Cellana*
            - Species: *exarata*

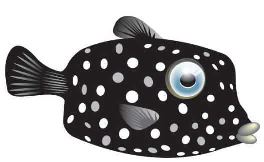
What is the Ancient Hawaiian Ahupuaʻa management system of watersheds? How did this system protect the shoreline areas?[7] (Lesson 5)

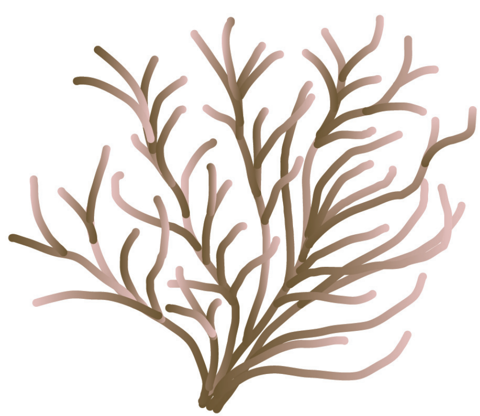
In ancient Hawaiʻi, a system of land tenure and management evolved that mirrored the natural landscape of the islands. This land division system, called an *ahupuaʻa*, consisted of strips of land that generally extended from the mountain to the sea. However, the *ahupuaʻa* management system went beyond modern **watershed** management systems in that they involve ecological management by integrating natural resource concerns with cultural, human, and spiritual resources. The *ahupuaʻa* system allowed ancient Hawaiians to cultivate and utilize resources from the environment, while preserving the natural dynamics of the watershed ecosystem. Land resources in the *ahupuaʻa* system included taro (*kalo*) grown under both "upland" conditions (*kalo maloʻo*, where the fields are rain fed or irrigated, but not flooded) and "wet" taro (*kalo wai,*



grown under frequently or constantly flooded conditions). Taro was, and is a vital part of the cultural and agricultural traditions of the Hawaiian people. The coastal sea, including the intertidal region, was also a part of the *ahupuaʻa* system. Salt-water fish ponds (*loko iʻa*) were used for fattening and storing fish for food. Fish ponds provided a source of fish when weather and surf conditions prevented fishing on the open waters of the sea. The *ahupuaʻa* not only provided resources in traditional Hawaiʻi, they also provided protection for the shoreline and intertidal areas. Ancient Hawaiians recognized that actions taken on one part of the ecosystem affected other parts of the ecosystem. Managing the entire ecosystem, rather than a single part of the ecosystem, ensured that the ecosystem as a whole remained healthy and sustainable. (For more information on the traditional Hawaiian *ahupuaʻa* management system see: http://hawaii.gov/dbedt/czm/initiative/wec/html/descrip/management.htm)







Science Background for the Teacher Glossary

adaptation: a feature of an organism that has evolved over a period of time by the process of natural selection such that it increases its long-term reproductive success.
anoxic: without oxygen.
brackish water: water that is partly fresh and partly salty.
binomial nomenclature: the scientific system of naming organisms with two words, *Genus* and *species.*
buttress: prop root structure on the lower part of a trunk or stem to aid in support.
byssal thread: strong threads secreted by mussels to attach to rocks and large, generally heavy objects in the intertidal zone.
competition: the process in which organisms with similar requirements contend for resources.
competitive exclusion: competition between species that is so intense, that one species completely eliminates another species from the area.
desiccation: dehydrating; drying out.
estuary: semi-enclosed coastal body of water with one or more rivers and streams running into it and an open connection to the sea.
euryhaline: an organism that can tolerate a wide range of salinity.
facilitation: an ecological interaction where one organism benefits another without a detrimental effect to itself.
halophytic: plants that are salt tolerant and able to grow in salty soil.
high intertidal zone: area of the intertidal zone covered by water during high tide only.
indirect interaction: an interaction of one organism with another that affects a third organism.
infauna: organisms that live within the sand.
intertidal zone: the area between low- and high-tide marks and alternately covered by water and exposed to air during each tidal cycle.
invasive species: generally, a non-native species of plants or animals that out-competes native species in a specific habitat; native species can sometimes become invasive.
keystone species: organisms that play dominant roles in an ecosystem and affect many other organisms.
littoral fringe: area of land adjacent to the intertidal zone.
littoral zone: synonym for intertidal zone.
low intertidal zone: area of the intertidal zone exposed only during low tide.
middle intertidal zone: area of the intertidal zone that is covered by water approximately half the time of each tidal cycle.
mobile: able to move around.
morphological: the physical shape, size, and form of an organism.
mutualism: a relationship between two organisms that results in a positive interaction for both involved.
operculum: a lid-like covering which serves as a protective "door," sealing the opening to the shell of gastropods when the animal withdraws into the shell.
predation: the hunting, and/or consumption of living organisms by other living organisms.
prop root: discrete root structures found on mangroves and some herbaceous plants that grows out from the lower portion of the trunk or stem to aid in structure support.
rhizome: horizontal, shallow root masses that produce shoots above and roots below ground.
salinity: the amount of dissolved salts present in a liquid.
sessile: organisms that remain attached to a substrate.
shoreline habitat: the area where the ocean meets the land.
species: generally, a group of related organisms which are common in form, and can breed with each other.
splash zone: area above the high-tide mark in the intertidal zone that gets occasional splash from waves and salt spray from wind.
substrate: the surface on which a plant or animal grows or is attached.
tidal zonation: the predictable assemblage of organisms at different tidal heights.
tide pool: a pool of water left along the shore as the tide level falls.
tidal range: the difference between high and low tide; defines the size of the intertidal zone.
watershed: all the land that drains into a particular body of water.

wetland: an area of land where water covers the soil or is present at or near the soil surface for all or parts of the year.
wrack line: the area of the beach along the high tide line where debris is likely to collect.

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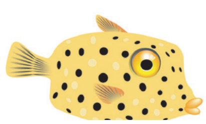
NOAA Resources

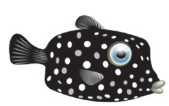
Below is a list of resources compiled by the Outreach Education Office of the National Oceanic and Atmospheric Administration. The science standards and the ocean literacy principles addressed in this unit were used as a guideline in selecting the following resources. To access the print resources listed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

- **"Bays & Estuaries" activity book by Coral Reef Conservation Program with Project WET**
- **"Exploring An Estuary: Where Rivers Meet the Sea" developed by NC NERR**
- **Oceans for Life: Saved by a Shark and Predators Among Us lesson plans and videos (can be adapted) found at** http://oceanslive.org
- **Discover Coral Reefs" activity book by Coral Reef Conservation Program with Project WET**
- **"Why is Hawai'i's Ocean Important?" A Keiki Activity Book" found at** http://www.coastalscience.noaa.gov/education/hibook.pdf





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.

6. The ocean and humans are inextricably interconnected.
6b. From the ocean we get food, medicine, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
6c. The ocean is a source of inspiration, recreation, rejuvenation and discovery. It is also an important element in the heritage of many cultures.
6e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications (changes to beaches, shoves and rivers).
6g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Lesson 1: 5a. 5f.
Lesson 2: 5d.5f.
Lesson 3: 5d.5e. 5f.
Lesson 4: 5d.5e. 5f.
Lesson 5: 5d. 6b. 6c. 6e. 6g.
Culminating: 1a. 6a. 6b. 6c. 6e.6g.

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.
3c. Changes in climate conditions can affect the health and function of ecosystems and the survival of entire species. The distribution patterns of fossils show evidence of gradual as well as abrupt extinctions related to climate change in the past.

Lesson 1: 3a.
Lesson 2: 3a.
Lesson 3: 3a.
Lesson 4: 3a.
Lesson 5: 3a, 3c.

NOAA Marine Science Career - Case Studies

Rob Toonen, PhD

Associate Research Professor

Hawai‘i Institute of Marine Biology, UH Manoa

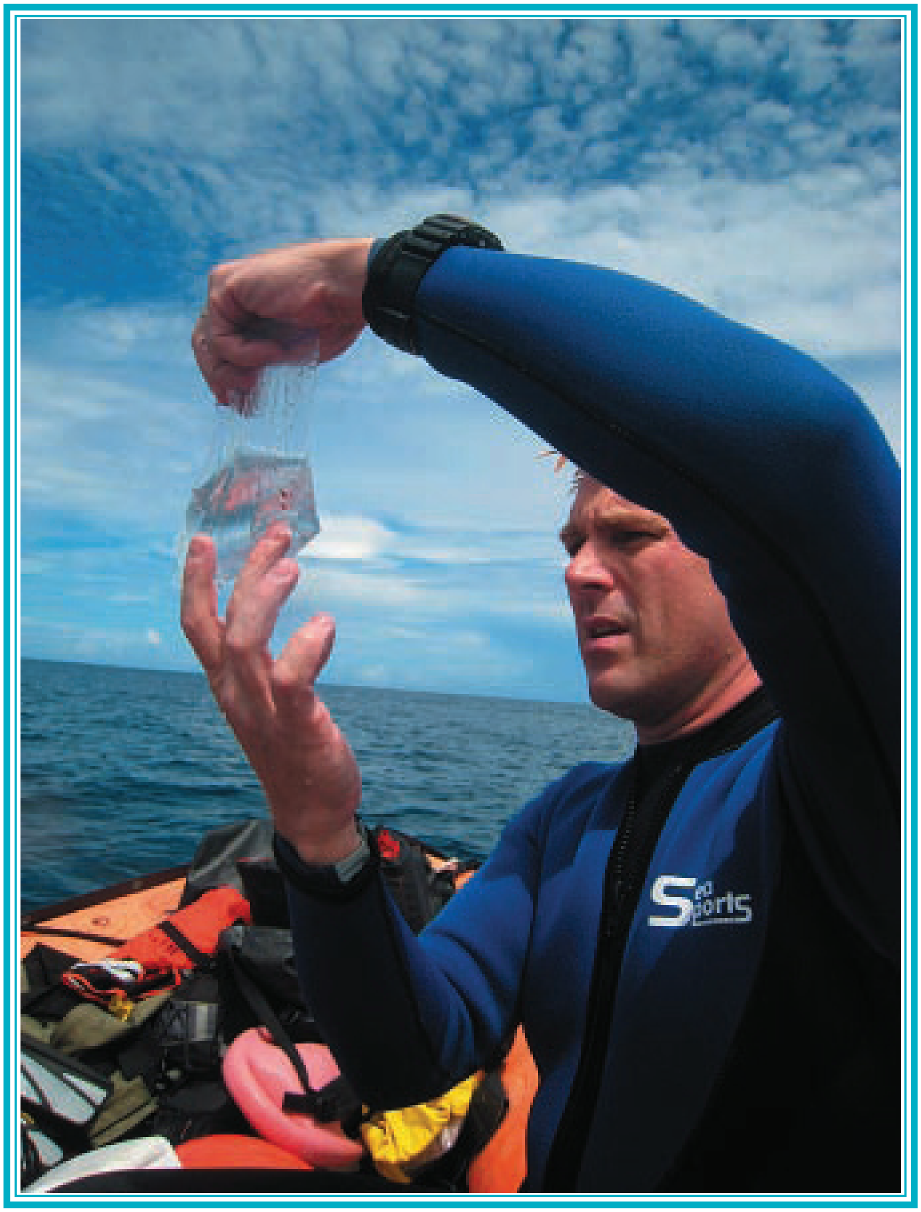
There are many different types of organisms that live in our oceans and for a marine biologist there are many things to study.

Dr. Rob Toonen is an Associate Research Professor who works at the Hawai‘i Institute of Marine Biology with the University of Hawai‘i at Manoa. Rob shared with us information about his research and what it took to become a research professor in the field of marine biology.

Rob’s lab is located about 50 yards from a coral reef, which means he is able to go right outside and do his work. Some of his research investigates how marine invertebrates are able to develop from their larval stage and successfully grow on the coral reef. Many marine animals begin their lives in an immature stage, where their shape is different from their adult form. Rob is interested in how these animals are able to travel through the water, how they decide where to settle and grow, and how some animals can delay their change from the juvenile to the adult body form. Rob is also interested in aquarium science and how animals are raised specifically for the aquarium trade, so he tries to have at least one aquarium science research project underway in his lab at any given time.

Have you always been interested in marine life?

I became interested in marine life when I was young. I grew up in Canada about a twenty hour drive from the nearest ocean. Since we did not live near the ocean my dad brought the ocean to me by setting me up with several aquariums to care for. This sparked my love of marine biology and my fascination with the diversity and complexity within the marine world, especially coral reefs.



How did you become a marine biologist?

My career path started by managing a fish shop and I continued that work through college. When I started college I thought I would instantly become a marine biologist. To my surprise I learned there were several background courses I needed to take before I could even get to all the marine biology classes. My college experience taught me that the things you have to learn are not always what you want to be learning; however, looking back, I now see the importance of all of that information. It turns out that those writing and public speaking skills I obtained and thought were not going to be useful, are a big part of my current job. Completing my Zoology bachelor's degree at the University of Alberta is something that I owe to several of my professors and mentors who played a crucial role in helping and keeping me on track to my current career.

In the process of getting my Master's degree in Marine Sciences at the University of North Carolina followed by my Ph.D. in Population Biology at the University of California at Davis, I worked as a dolphin trainer, had my own aquarium repair and maintenance business and worked as an environmental consultant. Finally in 2003, after years of field experience and the completion of all of my degree programs, I was finally able to be a researcher in Hawai'i. Today I get to use what I learned from all of my previous jobs, my love of aquaria and all of my years of schooling to conduct research on coral reefs.

Do you have any advice for students who might want to be marine biologists?

If you are interested in marine biology, the best way to start is to volunteer. Volunteering at places like a research lab to get research experience will result in many opportunities.

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

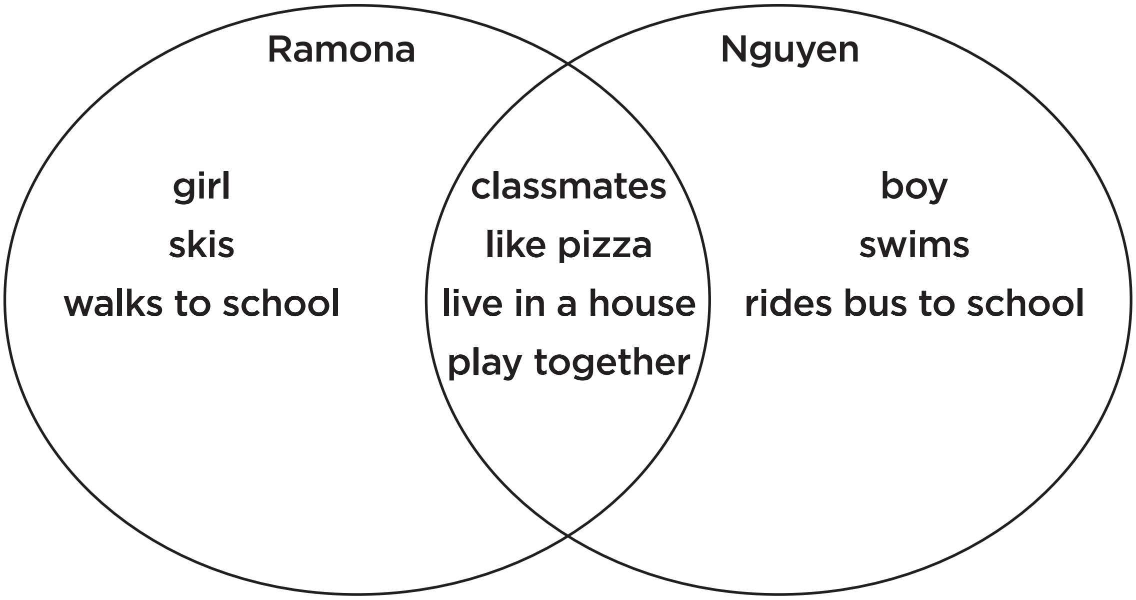
Round table can be used for brainstorming, reviewing, or practicing while also serving as a team builder. Students sit in teams of 3 or more, with one piece of paper and one pencil. The teacher asks a question which has multiple answers. Students take turns writing one answer on the paper, then passing 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.



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