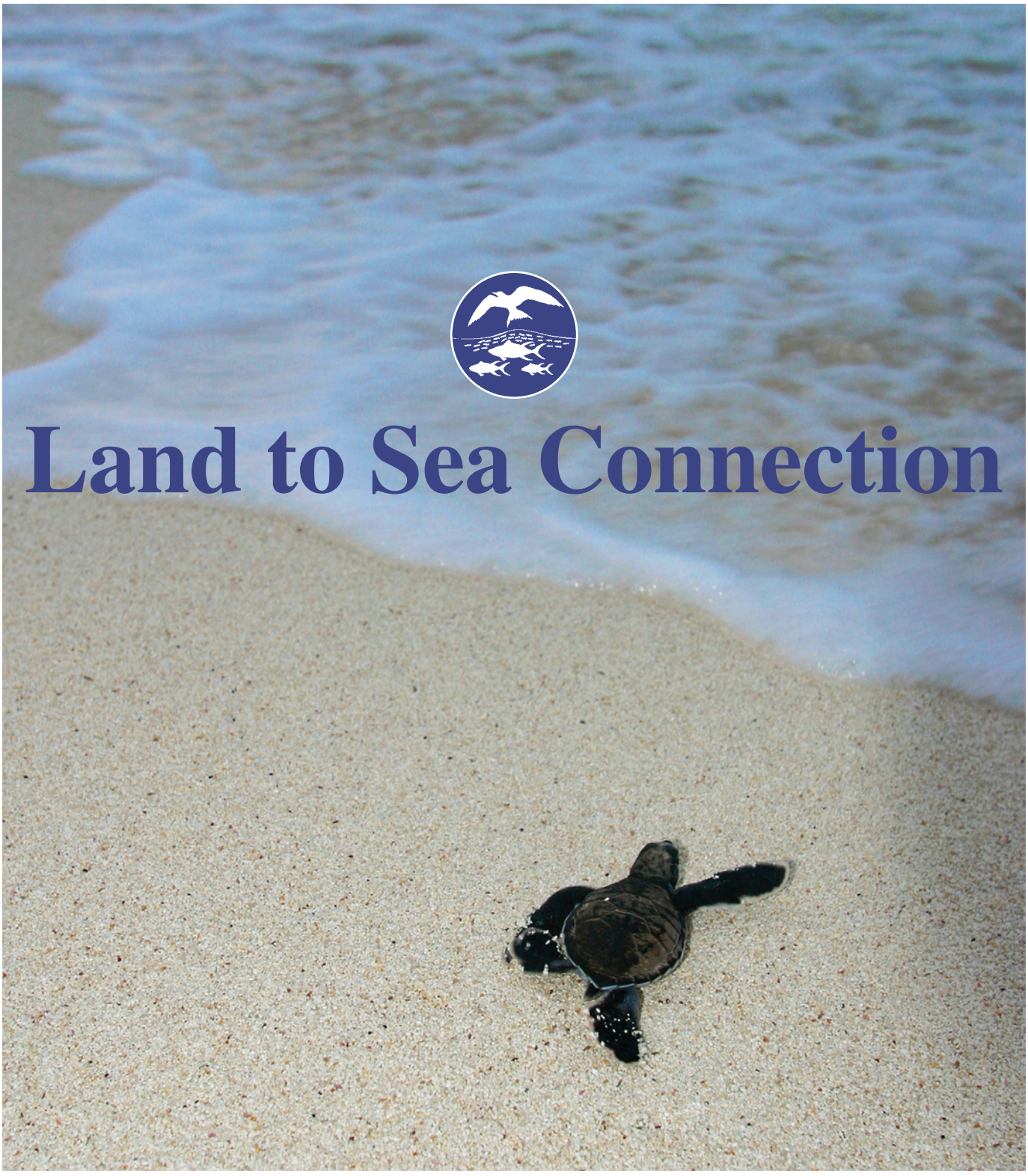


Land to Sea Connection

Pōhai ka manu maluna, he iʻa ko lalo.

When the birds circle above, there are fish below.
—Mary Kawena Pukui, *ʻŌlelo Noʻeau* 2667

Land to Sea Connection

Teacher's Introduction

Seabirds flying back and forth between the land and sea are a visible link of the land to sea connection. They are a vital part of the circle of life, enriching nearshore waters with nutrients from their guano and helping to maintain balance in the reef ecosystem that sustains them. Like the seabirds, each of us living on an island relies on the land to sea connection. Looking to the "kūpuna" islands, we can see these connections without all of the layers of human activities that tend to obscure our interdependence with the land and sea.

Northwestern Hawaiian Islands Ecosystem

The remote Northwestern Hawaiian Islands (NWHI), now a Marine National Monument, include the northern three quarters of the Hawaiian archipelago, a two-million acre ecosystem of coral reefs, atolls, small islands, seamounts, banks, and shoals. Here, in a nearly balanced functioning dynamic between land and sea, millions of seabirds nest, thousands of sea turtle eggs hatch, an abundance of sharks and large predatory fish thrive, and thousands of marine species flourish. The relatively undisturbed coral reef habitat supports more than 7,000 marine species, one-quarter of which are endemic, which means they exist nowhere else on the planet.

Let's take a look at the land to sea connection by following a Hawaiian monk seal diving off one of the remote NWHI. In deep banks off the reef, the seal swims among colorful precious corals where strange-looking garden eels wait to ambush their prey. Schools of onaga and ʻōpakapaka dwell in this pristine deep habitat along with large primordial-looking sharks. The seal rises near and observes a school of ʻahi that chases its prey to the surface. Seabirds swirl and dart overhead, attracted to the small fish fleeing from the ʻahi. The seal swims gracefully among the many species of corals that grow in the warm, clear, shallow water surrounding the island. Colorful and diverse marine life—invertebrates and fishes—abound here, supported by algae species that form the base of the food chain. The algae flourish in these waters that are enriched with nitrogen from seabird guano. In the shallow lagoon, the seal swims past resting dolphins and is shadowed by giant ulua before hauling out onto the beach to rest. On the beach, sea turtles bask in the sun and thousands of seabirds compete for nesting sites among the native plants. The loud calling of the seabirds provides a stark contrast to the silence of the deep sea banks. Here on this remote island we see healthy seabird populations roosting and nesting among native plants that provide much needed shade. These native plants also stabilize the windswept sand dunes. The wildlife on these islands are supported by the food and land that originates from the island's ancient volcano. Over millions of years, coral polyps grew around the volcano, providing a foundation for an incredible, dynamic coral reef ecosystem.

The 14 million seabirds that nest in the NWHI, the Hawaiian monk seals, and the green sea turtles all rely on healthy land and sea habitats. A healthy sea mirrors a healthy land--one is not possible without the other. Hawaiian monk seals, with a population of only 1,100 seals, are critically endangered. These endemic mammals need protected beaches that provide them with critical resting and pupping areas. The remote beaches and healthy reefs of the NWHI are critical to the turtles as well. More than 90% of all green sea turtles in the entire Hawaiian archipelago return to the protected beaches of one atoll in the NWHI to nest.

NWHI Habitat Description

Terrestrial Habitat: The NWHI include about 3,524 acres of land. The habitat types vary from coastal dry shrubland on Nihoa, Mokumanamana (Necker), Laysan, and Lisianski to coastal dry grasslands and herblands on the smaller, lower islands of French Frigate Shoals and Pearl and Hermes Atoll. These vegetation types have become so rare on the main Hawaiian Islands that textbooks often use photographs of these islands to illustrate them. Nihoa Island, for example, is one of the most biologically pristine islands in the Pacific, and probably most closely represents the original island appearance and biota present before humans came to the Hawaiian Islands.

The low sandbar islets of French Frigate Shoals and Pearl and Hermes Atoll support very little vegetation. A few larger shrubs survive the rigors of winter wash-overs by storm waves and low soil moisture to become the prized nesting sites of red-footed boobies, black noddies, and great frigatebirds. Space is highly contested by the animals of the atoll, and breeding, feeding, and basking take place on three levels—in burrows, on the surface, and on top of and in the few shrubs available.

Reef and Nearshore Marine Community Habitat: The Northwestern Hawaiian Islands contain more reef acreage than all of the main Hawaiian Islands, as well as greater diversity in marine habitat (e.g., lagoon complexes and barrier reefs). Fringing reefs and atoll reefs surrounding shallow lagoons are extensive in the area and make up most of the shallow water marine habitat. Corals are the most conspicuous members of the reef community, although other organisms such as coralline algae, mollusks, echinoderms, and foraminiferans aid in the reef-building process. Coral reefs provide habitat, shelter, and food for thousands of marine species and provide valuable substrate or anchorage for the sandy islands or islets, the lifeblood support system for millions of seabirds, sea turtles, monk seals, and land-based endemic plants and insects.

The geological and biological characteristics of the nearshore marine community are intimately tied to the volcanic origin of the Hawaiian Islands, coral reef formation, and the northwestward movement of the Pacific plate. The emergent portion of all islands north of Gardner Pinnacles consists entirely of calcium carbonate deposited by coral reefs and associated marine organisms. Were it not for coral growth, these islands would have sunk at the latitude of Gardner Pinnacles millions of years ago. Instead, corals and other calcifying organisms have built reefs, which have kept pace with sinking and erosion of the volcanic islands.

Variations in coral species dominance do occur and some types of coral, such as the genus *Acropora*, are restricted to the center of the chain. The coral reefs offer a variety of habitat types, including fore and back reefs, lagoons, coral flats, banks, and shoals.

Endemism: The NWHI have one of the highest rates of endemism in the Pacific for marine and terrestrial species. Researchers estimate that these islands are home to many species that occur naturally nowhere else on the planet; these include 12 endemic species of plants, 7 endemic land mollusks, 64 endemic arthropods, and 4 endemic land birds. The species' distribution and habitat requirements make them very fragile and extremely susceptible to predation, over-harvesting, and being out-competed by alien species.

Land to Sea Connection

Grades 4 - 5 Unit Map

Unit Essential Question: How is life on land connected to life in the sea?

Hawai'i DOE Standards & Nā Honua Mauli Ola	Focus Questions & Activities	Key Concepts	DOE Benchmarks
Grade 4 **Science 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution** Unity and Diversity **Grade 5** **Science 2: The Scientific Process Nature of Science** Unifying Concepts and Themes **Nā Honua Mauli Ola 14 - 8** Learners reflect on the relationship between the natural environment and people.	What roles do corals play in the coral reef ecosystem? **ACTIVITY 1: Reef Builders**	• Tiny animals called "polyps" construct corals. Most coral reefs are formed by many polyps living together in a colony. • Corals are both producers and consumers. They use their stinger-lined tentacles to capture tiny animals (plankton) that drift by in the currents. • Corals also obtain food through a unique relationship with single-celled algae that produces sugar through photosynthesis. • Coral reefs provide habitat for marine life, coastal protection, recreation opportunities, and resources for human use.	**SC.4.5.2** Describe the roles of various organisms in the same environment. **SC.5.4.3** Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.
Grades 4 - 5 **Science 3: Life and Environmental Sciences: Organisms and the Environment** Cycles of Matter and Energy Interdependence **Grades 4 - 5** **Language Arts 5: Writing** Meaning	How are different marine and reef organisms adapted to their environment and how are they dependent on one another for survival? **ACTIVITY 2: Circle of Life**	• Producers (algae, phytoplankton) provide oxygen and a source of food to marine animals. • Marine animals (consumers including the herbivores, omnivores, and carnivores) provide carbon dioxide and nutrients to the plants (producers). • The interdependence of producers, consumers, and decomposers creates a balanced ecosystem.	**SC.4.3.1** Explain how simple food chains and food webs can be traced back to plants. **SC.5.3.2** Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter. **LA.4.5.1** Use appropriate facts and interesting details that develop the intended meaning and anticipate the needs of the audience. **LA.5.5.1** Use information from appropriate sources: self, peers, and a variety of grade-appropriate sources.

Land to Sea Connection

Grades 4 - 5 Unit Map

Hawai'i DOE Standards, GLOs, & Nā Honua Mauli Ola	Focus Questions & Activities	Key Concepts	DOE Benchmarks
Grade 4 **Science 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution** Unity and Diversity **Grade 5** **Science 3: Life and Environmental Sciences: Organisms and the Environment** Cycles of Matter and Energy Interdependence **Grades 4 - 5** **Language Arts 4: Writing: Conventions and Skills** Range of Writing **Nā Honua Maoli Ola 4 - 2** Learners acquire in-depth cultural knowledge through interaction with kūpuna. **GLO 2: Community Contributor** **GLO 4: Quality Producer** **GLO 5 Effective Communicator**	How are Hawaiian monk seals, seabirds, and green sea turtles dependent on both the ocean and land habitat for their survival? **ACTIVITY 3:** **Land to Sea Survival Shuffle**	• Hawaiian monk seals, seabirds, and green sea turtles need both healthy land and sea habitats to survive, beaches are important resting places, and the sea provides a habitat for feeding. • Sharks, seals, seabirds, and sea turtles are part of a food chain where each organism is dependent on other organisms for food. • Human activities on beaches and marine debris in the ocean affect the survival of seals, turtles, and seabirds.	**SC.4.3.2** Describe how an organism's behavior is determined by its environment. **SC.4.5.3** Describe how different organisms need specific environmental conditions to survive. **SC.5.3.1** Describe the cycle of energy among producers, consumers, and decomposers. **LA.4.4.1** and **LA.5.4.1** Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as pieces to reflect on learning.

Student Journal

Unit 2 – Land to Sea Connection

Pōhai ka manu maluna, he iʻa ko lalo.

When the birds circle above, there are fish below.
—Mary Kawena Pukui, *ʻŌlelo Noʻeau* 2667

Student's Name:_____

School:_____

Date started:_____

Date ended:_____

Student Assessment Overview

Unit 2 Essential Question: How is life on land connected to life in the sea?

Nā Honua Mauli Ola (Hawaiian Guidelines) in this unit
- Acquire in-depth cultural knowledge through interaction with kūpuna.
- Reflect on the relationship between the natural environment and people.

General Learner Outcomes (GLOs) in this unit

GLO 2: Cooperate with and help and encourage others in group situations.
GLO 4: Recognize and understand what quality performances and products are.
GLO 5: Communicate effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information.

How you will be graded for this unit:

Individual Journal

It is your responsibility (kuleana) to complete a journal for this unit. Following is a checklist of the pages you will need to include in your journal. Place this page in your journal and make a check next to each item when your complete it. You will be given more details during each lesson.

Standards and Journal Pages	✓ Completed
1. Reef Builders – Standards: Gr. 4 - Science 5; Gr. 5 - Science 2 • **Journal - 8**: Model of coral polyp and descriptive label	
2. Circle of Life – Standards: Gr. 4 - 5 - Science 3 and Language Arts 2 • **Journal - 9**: Reef research (2 pages) • **Journal - 10**: Circle of life drawing and description	
3. Land to Sea Survival Shuffle – Standards: Gr. 4 - Science 5; Gr. 4 - 5 Science 3 and Language Arts 4 • **Journal - 11:** Land to sea connection drawing and description	

Unit Culminating Activity - Due Date:_____

As you work on your journal, you will be working toward completing the culminating activity for this unit. Your challenge: Interview a Hawaiian kupuna to find out how Hawaiians understand the connection between themselves and all living things and the connection between life on land and life in the sea. Write a story to summarize what you learn from the kupuna and how it applies to what you have learned in this unit. Your story should:
- Answer the unit essential question
- Include drawings showing the connection between life on land and life in the sea
- Explain the “circle of life” showing the relationships between plants and animals in a coral reef food web
- Explain the Hawaiian view of the connections between life on land and life in the sea.

We will review a rubric to help guide you in meeting the standard benchmarks for this assignment.

Unit 2 Culminating Activity Rubric - Grade 4

Name_____ **Date**_____ **Total Points** _____

Essential Question: How is life on land connected to life in the sea?

DOE Benchmarks & Nā Honua Mauli Ola	Kūlia (Exceeds Standard)	Mākaukau (Meets Standard)	ʻAno Mākaukau (Almost at Standard)	Mākaukau ʻOle (Below Standard)
Science 3: Life and Environmental Sciences Describe how an organism's behavior is determined by its environment. *Points* ___	Your story explains and gives examples of how the behavior of different animals is determined by their environments.	Your story describes how the behavior of different animals is determined by their environments.	Your story identifies a way that an animal's behavior is influenced by its environment.	Your story recognizes that an animal's behavior is influenced by its environment.
Science 5: Life and Environmental Sciences Describe the roles of various organisms in the same environment. *Points* ___	Your writing analyzes how the roles of different animals affect the way they interact in the coral reef community.	Your writing describes the roles of different animals in the coral reef community.	Your writing identifies a few animals and their roles in the coral reef community.	In your story, you were able to recall, with assistance, very few animals and their roles in the coral reef community.
Science 5: Life and Environmental Sciences: Describe how different organisms need specific environmental conditions to survive. *Points* ___	Your story explains why different organisms need specific environmental conditions to survive.	Your story describes how different organisms need specific environmental conditions to survive.	Your story lists specific environmental conditions that organisms need to survive.	Your story recalls that organisms need specific environmental conditions to survive.
Nā Honua Mauli Ola 14 - 8 Explain the Hawaiian view of the connections between life on land and life in the sea. *Points* ___	The Hawaiian view of the connection between life on land and life in the sea is clearly explained, with detail in your story.	The Hawaiian view of the connection between life on land and life in the sea is explained in your story.	The Hawaiian view of the connection between life on land and life in the sea is not clearly explained in your story.	The Hawaiian view of the connection between life on land and life in the sea is not explained in your story.

Unit 2 Culminating Activity Rubric - Grade 5

Name_____ **Date**_____ **Total Points** _____

Essential Question: How is life on land connected to life in the sea?

DOE Benchmarks & Nā Honua Mauli Ola	Kūlia (Exceeds Standard)	Mākaukau (Meets Standard)	ʻAno Mākaukau (Almost at Standard)	Mākaukau ʻOle (Below Standard)
Science 3: Life and Environmental Sciences Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter. *Points* ___	Your story explains and gives examples of how specific relationships among producers, consumers, and decomposers in the coral reef ecosystem affect the cycling of matter.	Your story describes the interdependent relationships among producers, consumers, and decomposers in the coral reef ecosystem in terms of the cycling of matter.	Your story identifies a few relationships between producers, consumers, or decomposers in the coral reef ecosystem in terms of the cycling of matter.	In your story, you recall, with assistance, that matter cycles in the coral reef ecosystem among producers, consumers, and decomposers.
Science 3: Life and Environmental Sciences Describe the cycle of energy among producers, consumers, and decomposers. *Points* ___	Your writing and/or drawings explain and give detailed examples of the cycle of energy among producers, consumers, and decomposers.	Your writing and/or drawings describe the cycle of energy among producers, consumers, and decomposers.	Your writing and/or drawing describe a part of the energy cycle with an example (e.g., describes one or two parts of a food chain).	Your writing and/or drawing recognizes an example of part of an energy cycle.
Language Arts 5 Writing and Nā Honua Mauli Ola 4 - 2 Use information from appropriate sources: self, peers, and a variety of grade-appropriate sources. Acquire in-depth cultural knowledge through interaction with kūpuna. *Points* ___	Your story is an excellent summary of the Hawaiian view of the land to sea connection. Examples provided show application to what has been learned in the unit.	Your story is a good summary of the Hawaiian view of the land to sea connection. Examples provided help to show what has been learned.	Your summary of the Hawaiian view of the land to sea connection needs more examples to be clear.	Your story does not show evidence of learning about the Hawaiian view of the land to sea connection.

Reef Builders

What roles do corals play in the coral reef ecosystem?

Hawai'i DOE Standard Benchmarks

Grade 4
Science 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution – Unity and Diversity.
- **SC.4.5.2** Describe the roles of various organisms in the same environment.

Grade 5
Science 2: The Scientific Process: Nature of Science - Unifying Concepts and Themes
- **SC.5.2.1** Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.

Nā Honua Mauli Ola 14 - 8

Plan for meaningful learner outcomes that foster the relationship and interaction among people, time, space, places, and natural elements around them to enhance one's ability to maintain a "local" disposition with global understandings.
- Learners reflect on the relationship between the natural environment and people.

Key Concepts

- Tiny animals called "polyps" construct corals. Most coral reefs are formed by many polyps living together in a colony.
- Corals are both producers and consumers. They use their stinger-lined tentacles to capture tiny animals (plankton) that drift by in the currents.
- Corals also obtain food through a unique relationship with single-celled algae that produce sugar through photosynthesis.
- Coral reefs provide habitat for marine life, coastal protection, recreation opportunities, and resources for human use.

Activity at a Glance

Students make models of coral polyps and create the coral framework for a class coral community mural that they will complete in the "Circle of Life" lesson that follows.

Time

2 class periods

Assessment

Students:
- Complete a model of a coral polyp depicting the algae and coral.
- Write a label for their model that describes the roles of the algae (zooxanthellae) and the coral in the coral reef environment and how coral polyps create a coral reef.
- Write a reflection about the relationship between people and the coral reef environment.

Hawai'i DOE Rubric

Advanced	Proficient	Partially Proficient	Novice
Science Grade 4			
Analyze how the roles of different organisms affect their interaction in the same environment.	Describe the roles of different organisms in the same environment.	Identify a few organisms and their roles in the same environment.	Recall, with assistance, very few organisms and their roles in the same environment.

Science Grade 5			
Consistently select and use models and simulations to effectively represent and investigate features of objects, events, and processes in the real world.	Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.	With assistance, use models or simulations to represent features of objects, events, or processes in the real world.	Recognize examples of models or simulations that can be used to represent features of objects, events, or processes.

Vocabulary

algae – simple plants that live in water
community – an assemblage of plants and animals living within a defined area
nutrients – any substance that promotes growth in living organisms
photosynthesis – the process of using energy from the sun to make starches and sugars from carbon dioxide and water
plankton – tiny floating or drifting organisms in the water
coral polyp – a tiny animal with a soft body and feeding tentacles that surround the mouth
producers – organisms that use energy from the sun to produce their own food
consumers – animals that get their energy by feeding on plants or other animals
zooxanthellae – microscopic, single-celled algae that live inside the tissues of corals and some other animals

Materials

- Student Assessment Overview (provided in Unit Introduction)
- Navigating Change photo CD (provided)
- student reading (provided)
- student journal - 8 (provided)
- modeling clay or play dough (two different colors)
- tape
- stapler
- scissors
- construction paper
- drawing pens
- colored markers
- dead coral specimens

Advance Preparation

- Make a copy of the Student Assessment Overview from the Unit Introduction for each student.
- Make a copy of the student reading and journal - 8 for each student.
- Gather some dead coral from the beach and bring it to class.

- Gather the modeling clay and craft materials listed above.
- Clear a wall space for students to begin working on a coral reef community mural.

Teacher Background Information

(Provided in student reading material.)

Teaching Suggestions

1. Introduce the unit.
- Distribute the Student Assessment Overview (from the Unit Introduction) and use these documents to introduce students to the unit.
- Review the projects and assignments and discuss the journals that students will be producing. Set a deadline for the culminating project and review the sample rubric.

2. Divide the class into groups and give each group a sample of coral to examine.
- Ask students to give their coral a name and come up with adjectives that describe it.
- Ask students to describe what they think the coral is made of and how coral reefs are formed.
- Record students' ideas about coral on the board.

3. Show the image of the coral reef from the Navigating Change photo CD provided with the *Teacher's Guide*.
- Ask students to find the different species of coral that are pictured in the photograph.

4. Distribute the student reading.
- Have students take turns reading aloud. Define new vocabulary.
- Revisit their ideas about coral and fill in new information on the board.
- Review or introduce the concept of photosynthesis and discuss the role of the zooxanthellae in the process.

5. Distribute student journal - 8 and review the polyp model-building task.
- Give each student a small handful of modeling clay or play dough (in two colors).
- Ask students to create a model of a coral polyp using one color of clay to make a cup-shaped skeleton and the other to make the polyp with its tentacles.
- Have students answer the questions on the journal page and use the information to write descriptive labels for their models.

6. Display students models and labels in the classroom.
- Have students go on a gallery walk to see the models and review labels their classmates have created.
- If desired, they could join the models together to make a model reef.

7. Show students the area set aside for the coral community wall mural.
- Distribute craft materials and have students create the reef from paper cut-outs.
- Ask each group of students to create a different type of coral to make up the reef.
- Explain that the mural will be completed with plants and animals in the activity that follows.

8. Ask students to share their personal reflections about why coral reefs are important in their lives.
- Summarize students' responses on the board or chart paper.
- Have students categorize their responses by topic such as coastal protection, habitat, and how they interact with reefs, including fishing, snorkeling, or gathering limu.
- Explain that students will be learning more about local reefs and participating in service projects to monitor and mālama (care for) these precious resources.

Extended Activity

Have students create a pop-up reef model of either the NWHI or the main Hawaiian Islands. Models for the pop-up reef can be found in the Unit 3 Appendix. Students can find additional information about reef organisms at:

- *http://waquarium.otted.hawaii.edu*
- *http://www.coralreefnetwork.com*
- *http://explorers.bishopmuseum.org/nwhi*
- *http://www.hawaiireef.noaa.gov/about/welcome.html*
- *http://www.bishopmuseum.org/research/natsci/fish/fishimages.html*

Resource Materials

Orr, Katherine. (1992).*The Hawaiian Coral Reef Coloring Book*. Owings Mills, MD: Stemmer House Publishers.

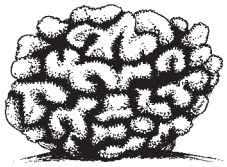
Maragos, J. & Gulko, D. (Eds.). (2002). *Coral Reef Ecosystems of the Northwestern Hawaiian Islands: Interim Results Emphasizing the 2000 Surveys.* Honolulu, HI: U.S. Fish and Wildlife Service and the Hawai‘i Department of Land and Natural Resources. (See color images and information on pages 14-15.)

What are corals?

Scientists originally thought corals were plants because they didn't seem to move around. Today we know that tiny animals called "polyps" construct corals. Most polyps are no bigger than a grain of rice, and it takes many polyps living together in a colony to build coral reefs. Each polyp sits within a cup-like skeleton and is connected to its neighbor polyps by a layer of living tissue. The tiny coral polyp has a sac-like gut with a single opening (the mouth) surrounded by a ring of tentacles. The tentacles are imbedded with hundreds or thousands of tiny stinging cells used for defense and capturing prey.

As polyps grow, more polyps will form from their sides. More polyps will continue to bud in this way, leaving behind an empty skeleton. While this empty skeleton coral may look like rock, it is not, since rocks are not made by animals. When coral polyps reproduce, the offspring drift in currents until they settle to form new coral colonies.

Corals come in many different shapes and sizes. The three most common stony corals in the main Hawaiian Islands are lobe coral, cauliflower coral, and finger coral. Each type of coral is adapted to live in a different habitat. Lobe corals form most of our reefs. Cauliflower coral lives in shallow waters where it is adapted to withstand wave action. Finger coral is found in deeper waters where there is less wave action.



Cauliflower Coral

Table corals are found primarily at French Frigate Shoals where they thrive in warm, calm waters. This type of coral is not found in the main Hawaiian Islands. To learn more about these fascinating corals go to: *http://www.hawaiianatolls.org/research/NOWRAMP2002/features/mystery_of_corals.php*

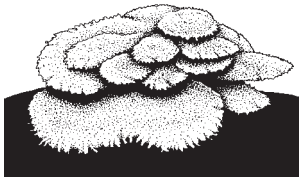
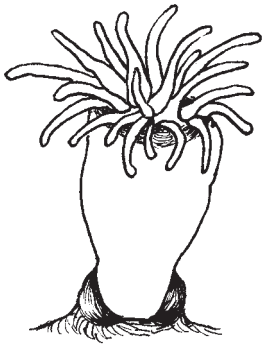


Table Coral

Some corals do not build reefs and are soft. Other corals live in very deep water, below where light from the sun can penetrate. These deep sea corals depend only on the plankton they catch with their stinging cells for food. The skeletons created by these deep-sea corals are very hard and some are harvested to make jewelry, like black and gold coral pendants.

What do corals eat?

Corals use their stinger-lined tentacles to capture tiny animals (plankton) that drift by in the currents. Plankton includes tiny crustaceans and mollusks that are barely visible without a microscope, as well as the tiny eggs and larvae of reef animals. Corals obtain most of their food through a unique relationship with single-celled algae called zooxanthellae. These algae live inside the coral tissues where they use the energy from sunlight to convert water and carbon dioxide into sugar. The algae use some of the sugar themselves, but much of it is available to the coral polyps.



Coral Polyp

Name_____ Date_____

Build a Model Coral Polyp

1. Use the information from the student reading to help you design a model of a coral polyp.

- Use two different colors of clay; one for the coral skeleton and one for the polyp.
- Sketch your model in the box and label the skeleton and the polyp.

Model Sketch

2. Create a label for your model that includes the answers to these questions:

- What does the algae, zooxanthellae, in the polyp provide for the coral?

- How is coral both a producer and consumer?

- How do the polyps create a coral reef?

3. On the back of this page, write a reflection about the many ways our lives would be different if there were no coral reefs in the Islands.

Circle of Life

How are different reef organisms dependent on one another for survival?

Hawai'i DOE Standard Benchmarks

Grades 4 - 5
Science 3: Life and Environmental Sciences: Organisms and the Environment – Interdependence Cycles of Matter and Energy

- **SC.4.3.1** Explain how simple food chains and food webs can be traced back to plants.
- **SC.5.3.2** Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter.

Language Arts 5: Writing: Rhetoric - Meaning

- **LA.4.5.1** Use appropriate facts and interesting details that develop the intended meaning and anticipate the needs of the audience.
- **LA.5.5.1** Use information from appropriate sources: self, peers, and a variety of grade-appropriate sources.

Key Concepts

- Producers (algae, phytoplankton) provide oxygen and a source of food to marine animals.
- Marine animals (consumers including the herbivores, omnivores, and carnivores) provide carbon dioxide and nutrients to the plants (producers).
- The interdependence of producers, consumers, and decomposers creates a balanced ecosystem.

Activity at a Glance

Students work in teams to conduct research about the roles that different species play in a coral reef ecosystem. Students create a coral reef mural and play a team game using the research they have completed to help teach each other about the "circle of life."

Time

3 class periods

Assessment

Students:

- Complete a drawing of a "circle of life" diagram that shows relationships between plants and animals in a coral reef.
- Describe how organisms in the coral reef can be traced back to plants.
- Describe the interdependent relationships among producers, consumers, and decomposers in the coral reef.

Hawai'i DOE Rubric

Advanced	Proficient	Partially Proficient	Novice
Science Grade 4			
Compare the characteristics of simple food chains with those of food webs.	Explain how both simple food chains and food webs can be traced back to plants.	Describe how simple food chains or food webs can be traced back to plants.	Recognize that simple food chains or food webs can be traced back to plants.

Advanced	Proficient	Partially Proficient	Novice
Science Grade 5			
Explain and give examples of how specific relationships among producers, consumers, and decomposers in an ecosystem affect the cycling of matter.	Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycling of matter.	Identify a few relationships between producers, consumers, or decomposers in an ecosystem in terms of the cycling of matter.	Recall, with assistance, that matter cycles in an ecosystem among producers, consumers, and decomposers.
Language Arts Grade 4			
Use appropriate facts and interesting details that creatively develop the intended meaning and clearly anticipate the needs of the audience.	Use appropriate facts and interesting details that develop the intended meaning and anticipate the needs of the audience.	Use some trivial facts and obvious details that relate to but do not develop the intended meaning or anticipate the needs of the audience.	Use inappropriate facts and irrelevant details that do not develop the intended meaning or anticipate the needs of the audience.
Language Arts Grade 5			
Integrate information from an extensive variety of appropriate sources: self, peers, and grade-appropriate sources.	Use information from a variety of appropriate sources: self, peers, and grade-appropriate sources.	Use information from a few appropriate sources: self, peers, and grade-appropriate sources.	Use information from one or two appropriate sources: self, peers, and grade-appropriate sources.

Vocabulary

algae – simple plants that live in water
carnivores – animals that feed on other animals
community – an assemblage of plants and animals living within a defined area
consumers – animals that get their energy by feeding on plants or other animals
decomposers – organisms that help to break down plant and animal matter into nutrients that producers need to grow
ecosystem – the interacting system of living organisms and their environment
herbivores – animals that feed on plants
interdependence – the concept that everything in nature is connected to each other and cannot survive without the help of other plants, animals, and abiotic factors such as sun, soil, air, and water
nutrients – any substance that promotes growth in living organisms
omnivores – animals that feed on both plants and other animals
photosynthesis – the process of using energy from the sun to make starches and sugars from carbon dioxide and water
phytoplankton – single-celled or multi-cellular plants
producers – organisms that use energy from the sun to produce their own food

Materials

- student journal - 9 (2 pages) and 10 (provided)
- coral community cards (provided)
- coral community drawing (provided)
- student research sheet (provided)
- Navigating Change slide show (provided on Navigating Change Photo and Resource CD)

- tape
- stapler
- roll of string or yarn
- scissors
- construction paper
- drawing pens
- colored markers

Advance Preparation

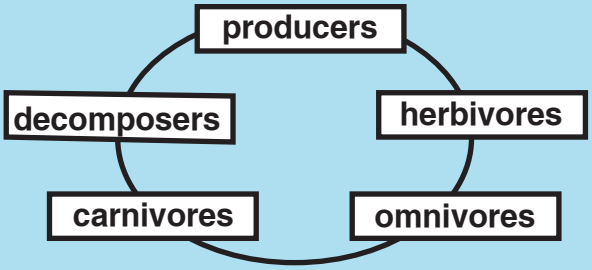
- Copy student journals 9 - 10 for each student.
- Make one copy of each coral community card sheet.
- Copy the student research sheet for each student.
- Copy the coral community drawing onto a transparency.

Teacher Background Information

Coral reefs are complex communities of plants and animals. The colonies of corals that grow next to and on top of each other form the basis for this fascinating community, providing food, shelter, and diverse living spaces for many kinds of plants and animals. One way to understand the complex relationships among the plants and animals is to examine the roles that different species play in the coral reef community.

Corals are unique in that they play a dual role as producers and carnivores. The producers in the coral community also include the microscopic phytoplankton and the larger algae that use the energy from sunlight to convert water and carbon dioxide into sugar in the process of photosynthesis. The producers are the basis of the food chain, providing food for the herbivores, such as the turtles and colorful parrotfish that live on the reef. Carnivores, such as moray eels, monk seals, and sharks prey on the herbivores, which helps to keep their populations in balance.

Darting among the corals are many beautifully colored fish that have adapted to feed on both plants and animals. These omnivores include the moorish idol, reef triggerfish, and the raccoon butterflyfish. Finally, the coral community would not be complete without the creatures that make up nature's clean-up crew. These decomposers include the crabs and lobsters that scavenge for food, feeding on decaying plants and animals.



Teaching Suggestions

1. **Challenge students to complete the coral community mural that was started in the previous activity.**
- Ask students what they need to add to the coral to create this community.
- Show the Navigating Change slide show on the CD provided with the *Teacher's Guide*.
- Discuss students reactions to the images from the NWHI.

2. **Project the coral community drawing using an overhead projector and discuss it with students.**
- Ask students to describe what they know about a coral reef ecosystem.
- Review what they know about the role of different members of the coral reef community (producers, herbivores, omnivores, carnivores, and decomposers).
- The dotted lines on the drawing show what each organism feeds on. Use this information to foster class discussion on the interdependence of the organisms that live on the coral reef.

3. **Divide the class into six teams—the producers, herbivores, omnivores, decomposers, and two teams of carnivores.**
- Give each team one page of coral reef community cards. Explain that these cards will be used in a game, but first each team needs to do some research to answer the questions on their cards.

4. **Distribute student journal - 9 and review the tasks on the two pages with students.**
- Check students' definitions of terms listed on the page.
- Discuss the value of laulima (cooperation) and the importance of teamwork in completing the research. (Note, if students are unable to find all of the answers in the course of their research, assist them with information provided on the teacher answer sheet.)

5. **When teams complete their research, have them complete the coral community mural.**
- Distribute craft materials for students to finish creating the mural.
- Students may want to refer to the coral community drawing projected earlier as a guide.

6. **When the mural is completed, have teams present what they have found in their research.**
- Check their information against the teacher answer sheet provided, and have students make any necessary corrections.
- Ask other students to take notes. Explain that the information they record will help them to play a coral community game.

7. **Set up the game.**
- After each group's presentation, have students post their coral community cards on the mural they have created. Staple or tape the cards so that they can be flipped over to reveal the information on the back.
- Introduce the game using the game instructions provided at the end of this activity.

8. **Distribute student journal - 10 and review the tasks.**
- Ask students to draw a circle of life diagram that includes arrows to show the interdependence of different groups in the coral reef community.
- Ask students to write a paragraph in their journals that explains their drawings.

9. **Have students share their drawings and discuss their ideas.**
   Discussion Questions
   - What keeps the circle of life going?
   - How is the circle of life like a web?
   - What is the source of energy for the community?
   - How would the coral reef community be affected if we eliminated one of the groups?
   - What do producers provide for the community?
   - What do consumers provide for producers?
   - Which of the groups do you think has the highest populations of species? Why?
   - What role do seabirds play in this community?

Extended Activities

Have students use their research to create an illustrated class book or field guide about the coral reef community to share with younger students. For additional information and images, see the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve's web site at: *http://www.hawaiireef.noaa.gov/education/kids/.*

Challenge students to use images from the CD provided with this guide to create their own multimedia presentations about the circle of life. Additional photographs of wildlife from the Midway Atoll National Wildlife Refuge are available from: *http://midway fws.gov/wildlife/default.htm.*

Circle of Life Game Instructions

Objective:

To discover relationships between plants and animals in the coral community

Game Set-up:

Teams of students gather around the coral reef mural they have created. Coral community cards are attached to the mural in a way that they can be removed or flipped over to reveal information. A helper from each team is chosen to represent the category researched. These helpers stand by the mural and assist with the game.

To Play:

- Have teams take turns selecting a category from the circle of life—producers, herbivores, omnivores, carnivores, or decomposers. They must select a category other than the one they researched!
- When a team selects a category to begin play, the helper from the team that researched that category points to the cards of the plants or animals in that category. (The two carnivore teams may alternate representing the carnivores.)
- The team playing selects one of the organisms on the cards. They have 60 seconds to check notes and identify a plant or animal on the mural that is connected to the organism, i.e., one that it eats or that eats it. For example, if the team chooses herbivores, the helper from the herbivore team points to the 4 herbivores on the mural. The team then picks one of the herbivores and identifies a plant that the herbivore eats or an animal that feeds on the herbivore.
- Once they identify a connection, the helper flips over the card of the herbivore and reveals if the answer is correct. The teacher has the final say on whether a connection is correct.*
- If the team is correct, one point is awarded. If the team is incorrect, other teams may raise hands to be called on to answer. The first team to answer correctly receives a point.
- After each turn, a check mark is made on the front of the card that was correctly answered and a string or yarn is attached to the mural connecting the two organisms.
- Continue playing until each team has had at least two turns.
- Once a team has chosen a plant or animal in a category, that card may not be chosen again by any teams.

Optional: Play a bonus round where each team selects one organism from a group other than the one they researched. Have teams call out their selections. Give everyone 60 seconds to come up with a fun fact or an adaptation the organism has developed to survive on the reef. Take turns letting each group relate its information and have the team helpers flip over the cards and check answers.

At the end of two or three rounds, add up points and declare a winner.

**Note that on the teacher answer sheet, some answers to "What does it eat?" are general, such as "small crabs" or "small fish" or "invertebrates." In these cases any fish, crab, or invertebrate will be considered a match in the game. Under the category of "Who are its predators?" some animals are listed as "herbivorous fish" or "carnivorous fish." In those cases, as long as students select a fish in the appropriate category their answers should be considered correct. For the purpose of understanding relationships among groups of organisms, having specific matches is not critical. "Correct" answers for the game are highlighted on the teacher answer sheet.*

Reef Research

Name:_____ **Date:**_____

The coral reef community includes five groups of plants and animals. Find out what role each group plays in the coral community and describe this role below. The first one is completed for you as an example.

1. Producers – They provide food for plant-eating animals through photosynthesis. Photosynthesis is the process of using energy from the sun to make starches and sugar from carbon dioxide and water.

2. Herbivores

3. Omnivores

4. Carnivores

5. Decomposers/Scavengers

Challenge: Work together with your teammates to research the group of organisms on your coral community cards. Then work with other teams to complete a coral community class mural.

- Divide up the coral community cards among your team members and research the answers to the questions. Record your answers in the table on the following page. Then print answers neatly on the cards, which will be used in a game.
- Find out the color of the plant or animal and color the organisms on the cards.
- Create a coral community mural with other teams. Use construction paper to make cut-outs of the organisms on your cards. Work with other teams to make these cut-outs in proportion to each other so that the large carnivores are bigger than small herbivores. Place these cut-outs on the mural.
- Prepare to share what you have learned with other teams.

Circle of Life

Student Journal - 9 (continued)

Conduct research to find the information on the back of your coral community cards. Record what you find in the table below.

Species	What does it eat?	Who are its predators?	How is it adapted to survive on the reef?	Fun Facts...

Check out these web sites:

Marine life – fishes, monk seals, sharks, seabirds, plants and algae:
http://waquarium.otted.hawaii.edu/MLP/marine_life.html
http://www.hawaiianatolls.org/keiki/index.php
Seabirds:
http://midway.fws.gov/wildlife/birds.html
http://www.botany.hawaii.edu/gradstud/eijzenga/ OIRC/oahu.htm

Spanish dancer sea slug:
http://aquarium.ucsd.edu/learning/learning_res/voyager/nudibranch/
Sharks:
http://aquarium.ucsd.edu/learning/learning_res/creature_features/sharks.cfm
Fishes:
http://bishopmuseum.org/research/natsci/fish/fishimages.html
Corals:
http://www.biosbcc.net/ocean/marinesci/04benthon/crani.htm
http://coralreefnetwork.com/marlife/corals/porit.htm

Circle of Life

Student Journal - 10

Name:_____ **Date:**_____

Draw a “circle of life” diagram that shows relationships between plants and animals in a coral reef.

1. How is everything in the coral reef connected to the plants?

2. Describe the relationships among producers, consumers, and decomposers in your coral reef drawing.

Coral Community Cards Teacher Answer Sheet

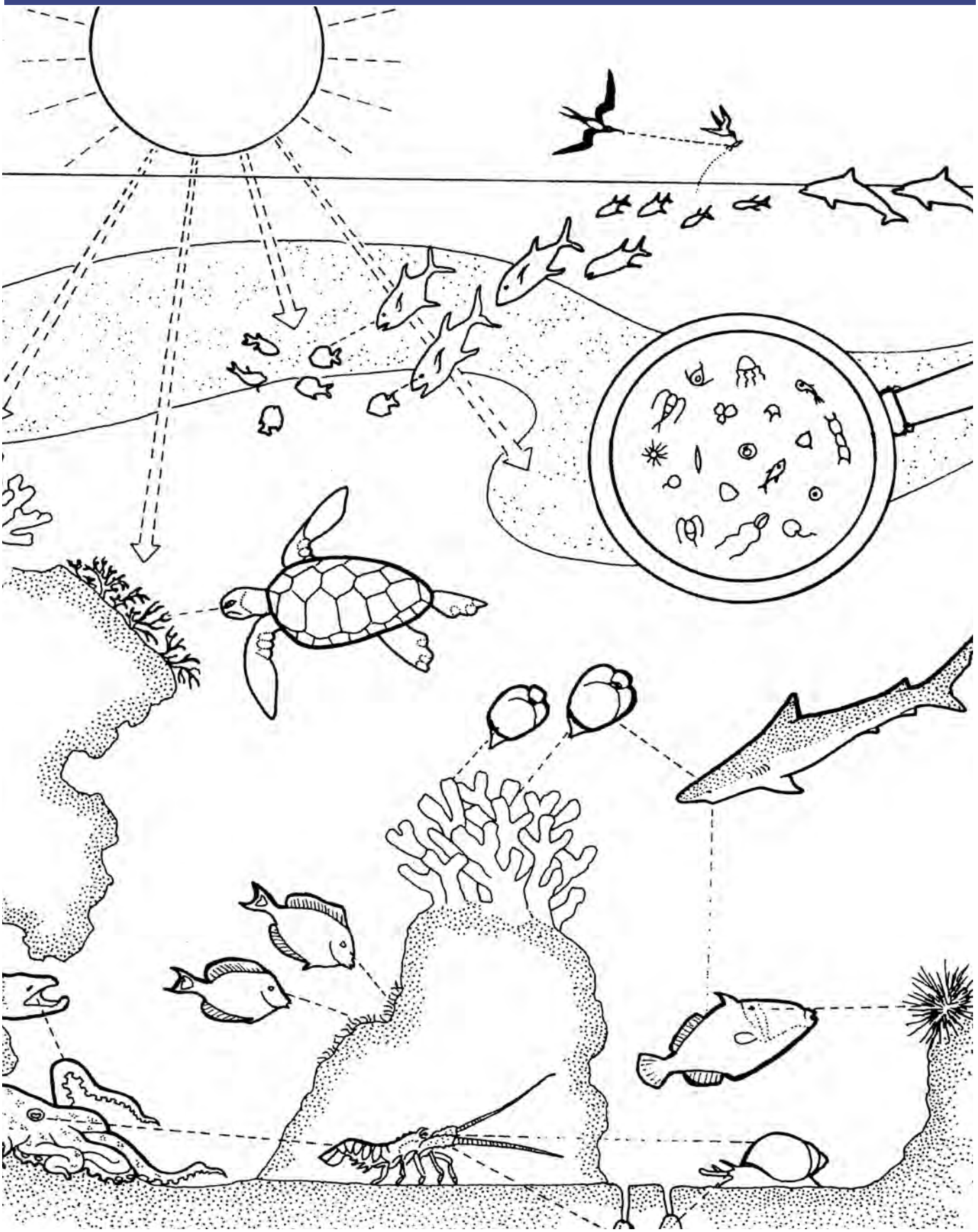
Organisms in bold are those that will be on the mural and will be answers to the game that students play.

Species	What does it eat?	Who are its predators?	How is it adapted to survive on the reef?	Fun Facts...
Yellowfin goatfish – weke	**Small crabs lobsters, fish,** echinoderms, mollusks, worms	Humans	• Pushes its snout into sediments and expels sand via its gill cover	• In rare cases, can cause hallucinations when head is eaten
Spanish dancer	Sponges	**Carnivorous fish**	• Uses two long featherlike attachments that have chemical sensors to detect food • Uses camouflage; turns the color of what it eats • Stores poisons after eating poisonous sponges, then uses for protection	• Can swim for hours by undulating its body • When disturbed, flares out mantle edges, increasing size and display • Smells like freshly picked ginger
Red-footed booby	**Small fish**	Humans, **sharks** (eat juveniles)	• Has gland to wax feathers • Has pointed bill for catching fish	• They are dependent on large schools of `ahi for their survival. `Ahi force prey to the water surface where boobies catch them • Guano washing off islands creates a nutrient-rich food source for coral reef animals
Lobe coral– pōhaku puna	Zooplankton; nutrition through symbiotic algae	Humans, large **parrotfish, butterflyfish,** one type of blenny	• Have zooxanthellae (algae) living in their tissues, which produce sugars through photosynthesis	• Coral polyps reproduce and their offspring drift off to new areas and begin forming new coral colonies. They can also reproduce through fragmentation
Octopus – he‘e	Mainly reef crustaceans (shrimp, **lobster, crab**), mollusks (primarily cowry snails), **fishes**	Humans, **moray eels, sharks, monk seals, ulua, big fish,**	• Changes skin color to match environment • Crawls with eight arms or uses “jet propulsion” to escape • Paralyzes prey with toxin in saliva • Squirts ink to hide during escape	• Probably the most intelligent of invertebrates • Able to change skin color to match the bottom as it swims
White-mouthed moray eel – puhi‘oni‘o	**Reef fish**, crustaceans (shrimp, **lobster, crab**), **octopuses**	Humans, **ulua**	• Hides in holes and crevices of the reef • Can move forward and backward • Can survive on only one meal for a long time	• Rarely aggressive unless threatened • Moray eels have back curved teeth; bites can be serious

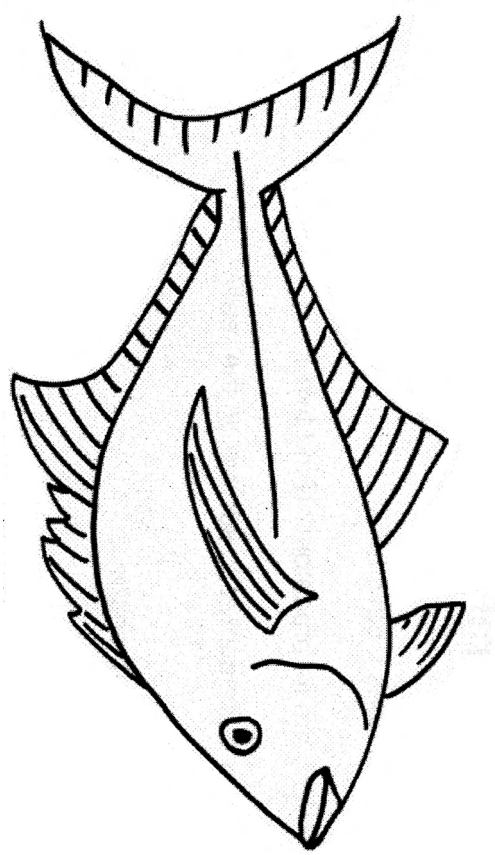
Hawaiian monk seal – ʻĪlioholoika-uaua	**Reef fish, octopus, lobster, eel** (except large morays)	Large tiger and Galapagos sharks	• Can dive as deep as 1,500 feet • Able to remain submerged for 15 to 30 minutes	• Capable of eating as much as 10% of their body weight in a day • Shed their skin (molt) each year • Most endangered marine mammal whose entire population is in U.S. waters
Blacktipped reef shark – manō	**Reef fish, octopus,** crustaceans **(lobsters, crabs), dead animals**	Humans, bigger sharks	• Has counter shading (camouflage) • Has excellent senses, including ability to detect electrical charge of buried prey • Hunts at night and dawn	• Teeth set in soft cartilaginous jaws pull out easily but are quickly replaced by constant growing of new rows of teeth • Skin is composed of needle-like teeth, or denticles, that point toward the tail
Sargassum seaweed – limu kala	Uses sunlight, carbon dioxide, and water to make sugars and starches	Humans, **herbivorous fish**	• Has a holdfast that keeps it in place • Can grow new plant from its holdfast • Has gas-filled floats among the blades that help keep it upright towards the sun	• In Hawaiian culture, limu kala is used to help loosen or remove wrong in settling disputes • Used in the purification ceremony after the death of a relative
Cauliflower coral – koʻa	Nutrients from symbiotic algae; zooplankton	**Triggerfish, raccoon butterflyfish**	• Uses stinger cells to paralyze its prey	• Early Hawaiians used the coral like sand paper. Also used in building of temples dedicated to fishing
Phytoplank-ton	Uses sunlight, carbon dioxide and water to make sugars and starches	Zooplankton, **small fish,** clams, oysters, whales	• Makes its own food using energy from the sun	• Billions of these cells provide most of the plant material consumed by animals in the ocean; gives water a green color
Ogo – limu manauea	Uses sunlight, carbon dioxide and water to make sugars and starches	Humans, **herbivorous fish**	• Has a holdfast that attaches to rocks and coral	• Has a mild flavor and crunchy texture; it is chopped and added to raw fish to make poke
Convict tang – manini	**Algae**	Humans, **sharks, seals**	• Has stripes that break up the body outline, which might confuse predators • Swims in schools • Has down-turned mouth with flexible comb-like teeth that are good for grazing on algae	• These algae feeders help to prevent fast-growing seaweeds from becoming dominant on the reef

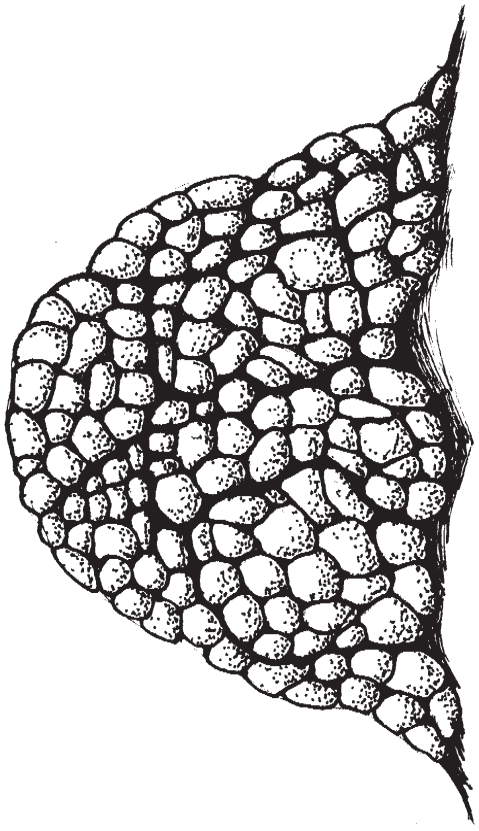
Bullethead parrotfish – uhu	**Algae**	Humans, **carnivorous fish**	• Hides among the rocks and corals of the reef at night • Protects itself with a mucus cocoon while sleeping • Scrapes dead coral to feed on algae; pair of hard grinding plates in throat crushes coral into fine powder, eliminated as sand	• Estimated that a large parrotfish could produce as much as a ton of sand in a year • Terminal phase bullethead parrotfishes are males that started out as females
Rock-boring sea urchin – ʻina	**Algae**	**Triggerfish**	• Lives in holes and depressions in rocks • Uses scraping jaws to deepen holes in rocks • Uses movable spines for protection	• Uses long sucker-tipped tube feet to move trapped food to mouth on its underside
Green sea turtle – honu	**Algae**; juveniles also feed on **plankton**, jellyfish, and fish eggs	Tiger sharks, humans	• When resting, can stay underwater for as long as 2.5 hours	• Migrates up to 800 miles from feeding areas near coast of MHI to nesting beaches in NWHI
Spiny lobster – ula	Reef invertebrates and **dead animals**	Humans, **monk seals, sharks, large carnivorous fish**	• Hides under ledges and in caves • Has powerful tail muscles that enable quick backward escape	• Active at night • Relies on spines covering its body rather than claws for protection
Hawaiian lobster – ula pāpapa	Mollusks (snails, oysters), invertebrates, **dead animals**	Humans, **monk seals, sharks, large carnivorous fish**	• Hides in crevices and caves of the reef	• Doesn't have any large claws
White crab – kūhonu	**Dead or dying fish**, small shrimp, worms	**Eels**, barracuda, **large carnivorous fish**	• Has strong spine on each side of carapace	• Hawaiian name, kūhonu, means "turtle back"
Thin-shelled rock crab – ʻaʻama	**Dead or dying fish,** small shrimp, worms	**Eels**, barracuda, **large carnivorous fish**	• It can dart and move quickly to avoid predators	• In times of trouble, it was said, "When the sea is rough, the ʻaʻama crabs climb up on the rocks"
Yellow-fin surgeonfish – pualu	**Algae**; young fish feed on zooplankton	**Sharks, seals**	• Uses two knifelike spines at base of tail to defend itself and catch prey	• Can alter its body color to nearly black with white ring around tail
Moorish idol – kihikihi	Sponges	**Sharks, seals**	• Extracts prey from crevices with elongated jaw • Has disruptive coloration that makes it hard to see where the fish starts and ends	• Hawaiian name means curves or zigzag

Reef triggerfish – humuhumu-nukunuku-apua‘a	Snails, **corals,** shrimp**, crabs, sea urchins**	**Sharks, seals**	• Has eyes that are set high and move independently so that it can scan for food and predators at the same time • When threatened, dives into a crevice and wedges itself in by erecting large dorsal spines • Has fused teeth, which allow it to feed on hard-shelled animals	• Hawaiians made interesting use of triggerfish—they dried them to use as firewood, and used them as replacement for pigs in some religious ceremonies • In 1984, the reef triggerfish was selected as the official state fish of Hawai‘i
Raccoon butterflyfish – kīkākapu	Tube worms, **coral polyps,** invertebrates, **algae**	**Sharks, seals**	• Has false eye spot near the tail that confuses predators.	• Juveniles recruit, or grow up, in tidepools • Common name comes from similar appearance to raccoons, with black bar across eyes



Coral Community Cards - Carnivores

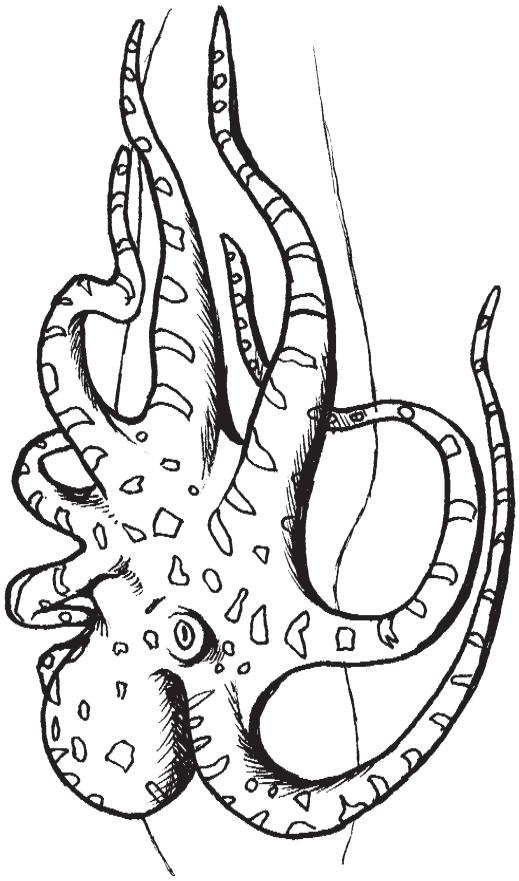


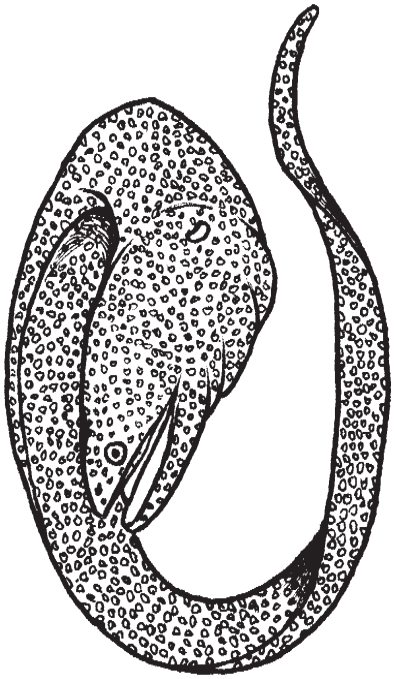


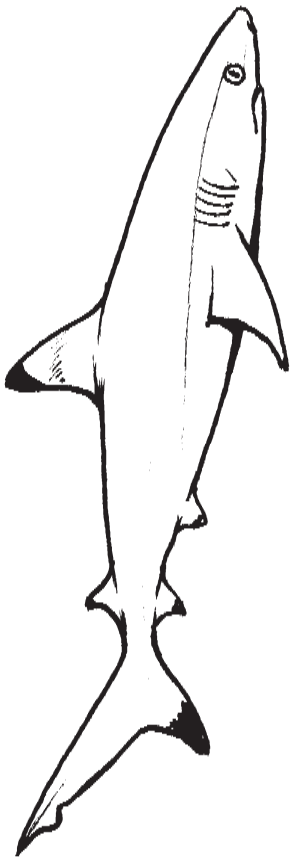
Coral Community Cards - Carnivores

Yellowfin Goatfish (Weke)	Spanish Dancer (Sea Slug)
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**
Red-Footed Booby	**Lobe Coral**
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the sea?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**

Coral Community Cards - Carnivores



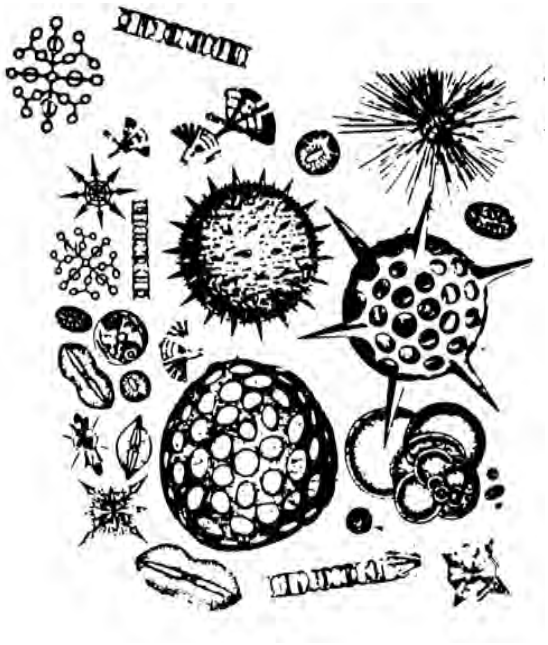


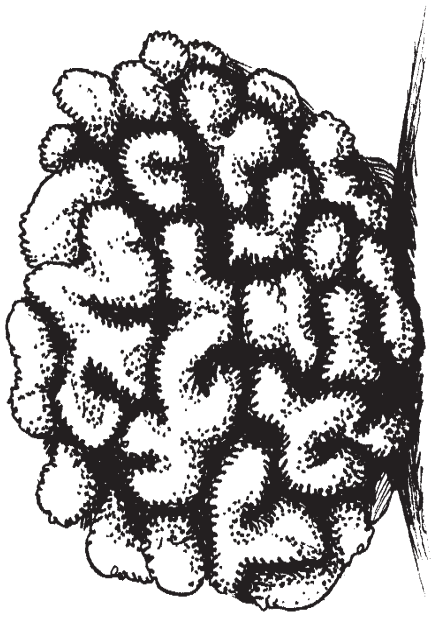


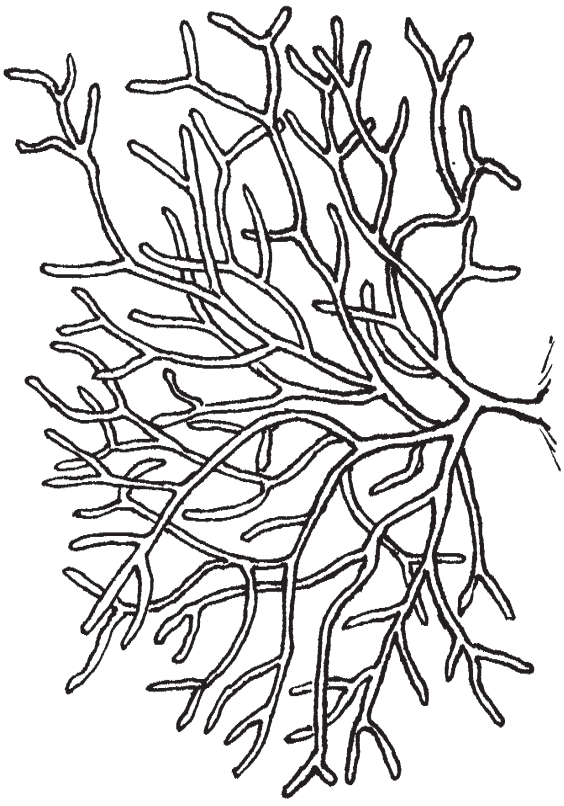
Coral Community Cards - Carnivores

Octopus (He‘e)	Wide-Mouthed Moray Eel (Pūhi)
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**
Monk Seal (Īlioholoikauaua)	**Black-Tipped Reef Shark (Manō)**
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**

Coral Community Cards - Producers



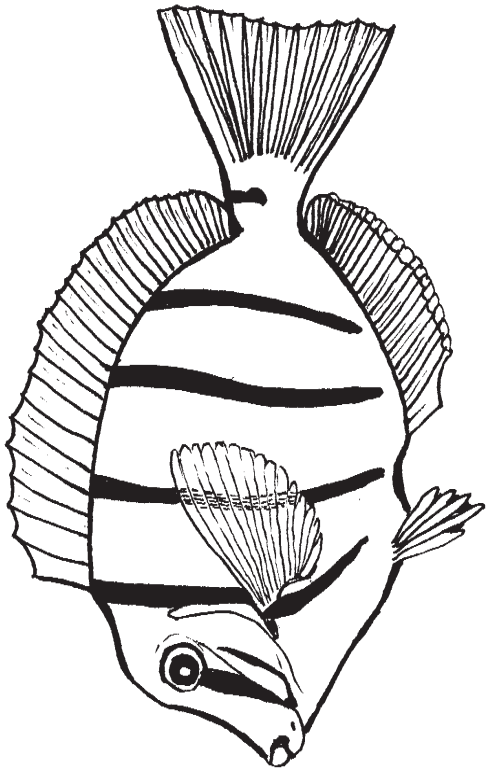


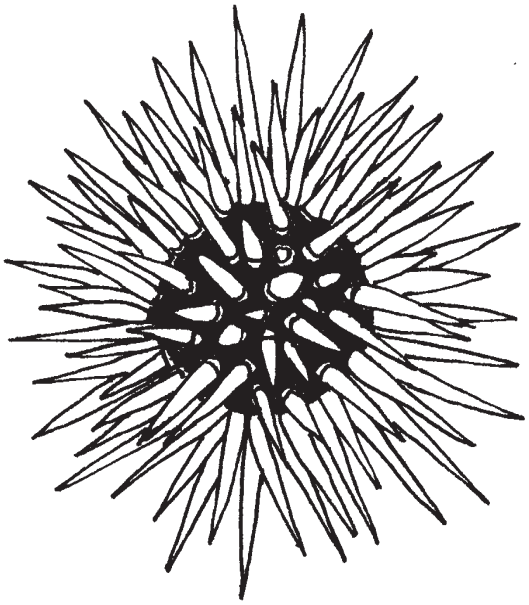


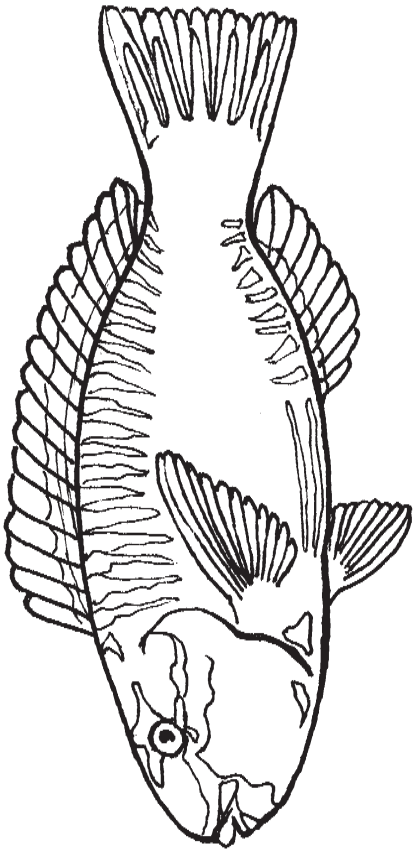
Coral Community Cards - Producers

Sargassum Seaweed (Limu Kala)	Cauliflower Coral (Ko‘a)
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**
Phytoplankton	**Ogo (Limu Manauea)**
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**

Coral Community Cards - Herbivores



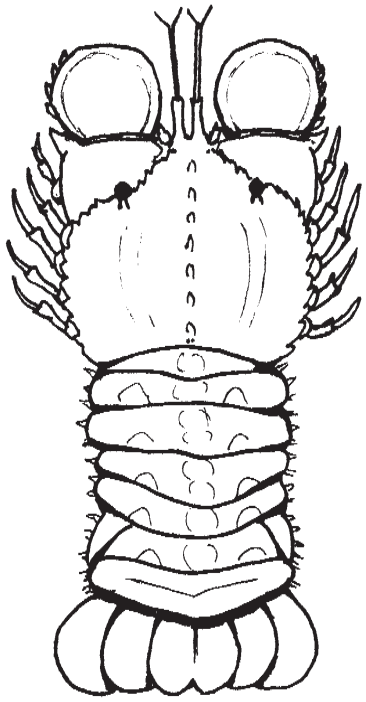


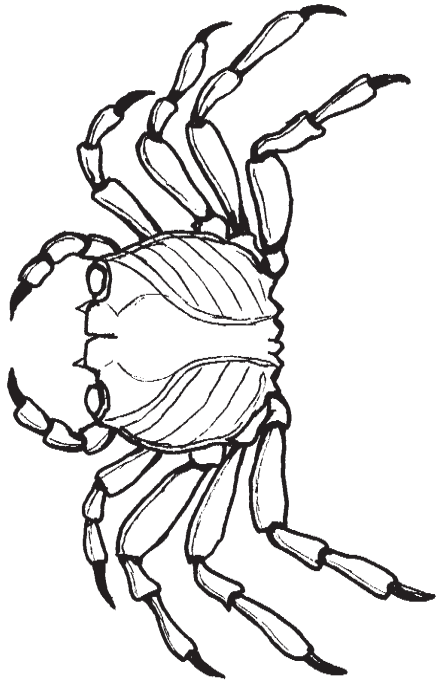


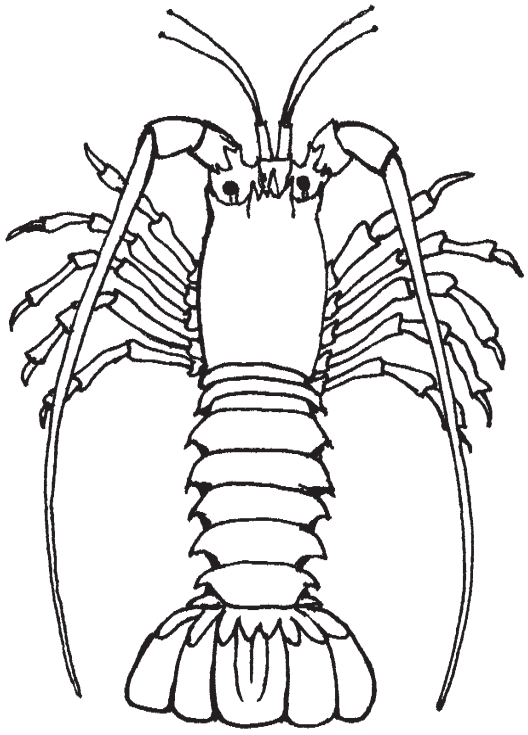
Coral Community Cards - Herbivores

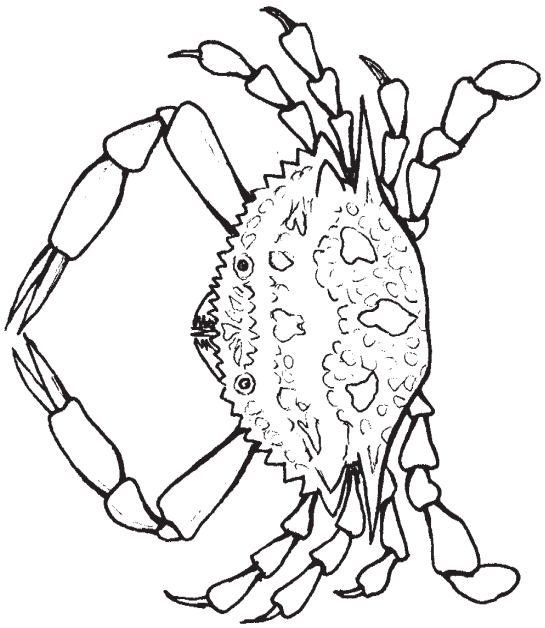
Convict Tang (Manini)	Bullethead Parrotfish (Uhu)
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**
Rock-Boring Sea Urchin (‘Ina)	**Green Sea Turtle (Honu)**
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**

Coral Community Cards - Decomposers/Scavengers





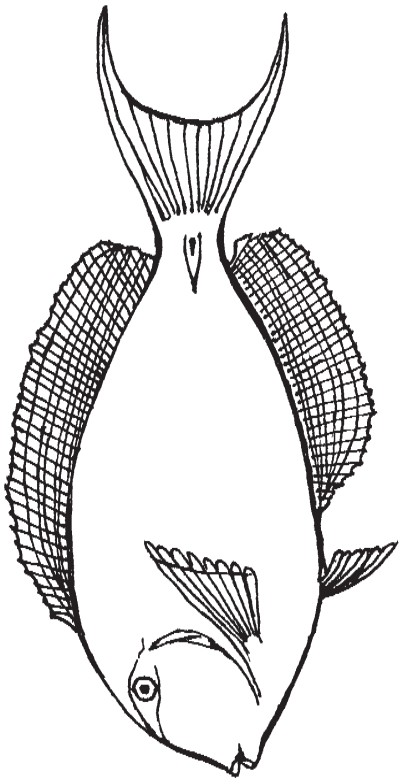


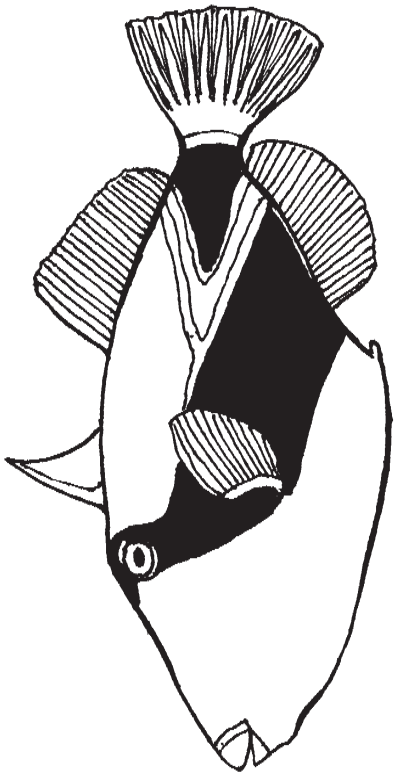


Coral Community Cards - Decomposers/Scavengers

Spiny Lobster (Ula)	Hawaiian Lobster (Ula pāpapa)
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**
White Crab (Kūhonu)	**Thin-Shelled Rock Crab (‘A‘ama)**
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**

Coral Community Cards - Omnivores





Coral Community Cards - Omnivores

Yellow-fin Surgeonfish (Pualu)	Moorish Idol (Kihikihi)
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**
Reef Triggerfish (Humuhumunukunukuapua'a)	**Raccoon Butterflyfish (Kīkākapu)**
Discover: **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**	**Discover:** **What does it eat?** **Who are its predators? (Find two.)** **How is it adapted to survive on the reef?** **A fun fact to share…**

Land to Sea Survival Shuffle

How are Hawaiian monk seals, seabirds, and green sea turtles dependent on both ocean and land habitats for their survival?

Hawai'i DOE Standard Benchmarks

Grades 4 - 5
Science 3: Life and Environmental Sciences: Organisms and the Environment - Interdependence
- **SC.4.3.2** Describe how an organism's behavior is determined by its environment.
- **SC.5.3.1** Describe the cycle of energy among producers, consumers, and decomposers.

Grade 5
Science 5: Life and Environmental Sciences: Diversity, Genetics, and Evolution - Unity and Diversity
- **SC.4.5.3** Describe how different organisms need specific environmental conditions to survive.

Grades 4 - 5
Language Arts 4: Writing: Conventions and Skills - Range of Writing
- **LA.4.4.1** and **LA.5.4.1** Write in a variety of grade-appropriate formats for a variety of purposes and audiences, such as pieces to reflect on learning.

Nā Honua Mauli Ola 4 - 2

Instill a desire for lifelong exploration of learning, teaching, leading, and reflecting to pursue standards of quality and excellence.
- Learners acquire in-depth cultural knowledge through interaction with kūpuna.

General Learner Outcomes

Community Contributor: The understanding that it is essential for human beings to work together
- **GLO 2** Cooperates with and helps and encourages others in group situations.

Quality Producer: The ability to recognize and produce quality performances and quality products
- **GLO 4** Recognize and understand what quality performances and products are.

Effective Communicator: The ability to communicate effectively
- **GLO 5** Listens to, interprets, and uses information effectively.

Key Concepts

- Hawaiian monk seals, seabirds, and green sea turtles need both healthy land and sea habitats to survive; beaches are important resting places and the sea provides a habitat for feeding.
- Sharks, seals, seabirds, and sea turtles are part of a food chain in which each organism is dependent on other organisms for food.
- Human activities on beaches affect the survival of seals, turtles, and seabirds.

Activity at a Glance

Students play the role of monk seals, seabirds, and green sea turtles in an interactive outdoor game where they have to collect food cards without falling prey to a shark. They are challenged by marine debris and the loss of beach resting areas, which simulates human disturbances to land and sea habitats. Students then interview kūpuna about Hawaiian beliefs of the connection between life on land and life in the sea to complete the unit culminating activity.

Time

2 - 3 class periods

Assessment

Students:

- Illustrate land and sea habitats used by turtles, seabirds, and monk seals and include their food sources and predators.
- Describe how the animals' behaviors, such as nesting and feeding, are determined by the beach and ocean environment.
- Describe the specific environmental conditions the animals need to survive, and what people can do to help.
- Diagram the flow of energy among producers, consumers, and decomposers in the coral reef ecosystem.
- Interview a kupuna about Hawaiian beliefs of connections between life on land and life in the sea and incorporate findings into a story that answers the unit essential question (Unit Culminating Activity).

Hawai'i DOE Rubric

Advanced	Proficient	Partially Proficient	Novice
Science Grade 4			
Explain and give examples of how different organisms' behaviors are determined by their environments.	Describe how an organism's behavior is determined by its environment.	Identify a way that an organism's behavior is influenced by its environment.	Recognize that an organism's behavior is influenced by its environment.
Explain why different organisms need specific environmental conditions to survive.	Describe how different organisms need specific environmental conditions to survive.	List specific environmental conditions that organisms need to survive.	Recall that organisms need specific environmental conditions to survive.
Science Grade 5			
Explain and give detailed examples of the cycle of energy among producers, consumers, and decomposers.	Describe the cycle of energy among producers, consumers, and decomposers.	Describe a part of the energy cycle with an example (e.g., describe one or two parts of a food chain).	Recognize an example of part of an energy cycle.
Language Arts Grades 4 - 5			
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.

Vocabulary

predator – an animal that hunts and kills other animals for its food
prey – an animal hunted or caught for food
habitat – the place or environment where a plant or animal naturally lives and grows
endangered – plant or animal species in danger of going extinct
hō'ihi - respect
human disturbance – direct event created by people that results in harming plants or animals
extinction – the total disappearance of a species
invertebrate – an animal without a backbone
food chain – a sequence of organisms, each of which uses the next lower member of the sequence as a food source
ecosystem – the interacting system of living organisms and their environment
National Marine Sanctuary – a system of underwater parks, managed by NOAA'S Office of National Marine Sanctuaries, intended to protect and preserve biological, cultural, and historical resources

National Wildlife Refuge – a federal designation given to protected areas managed by the U.S. Fish and Wildlife Service for the primary purpose of providing necessary habitat for wildlife
Marine Protected Area – an area in which marine resources receive special protection
seabird – a bird that spends most of its life at sea

Materials

- monk seal, seabird, and turtle cards (provided)
- monk seal, seabird, and turtle food cards (provided)
- Navigating Change video segment - "Land to Sea Connection" (provided on DVD)
- shark headband template (provided)
- student journal - 11 (provided)
- 12 X 12 cardboard, canvas or carpet squares (one for each student)
- scissors
- glue
- oak tag
- yarn or string
- rubber bands or elastic (for shark headband)

Advance Preparation

- Copy the culminating activity rubric to share with students (provided in Unit Introduction).
- Make 5 copies of each food card page.
- Make 2 copies of each monk seal, seabird, and turtle card page (add additional copies if there are more than 25 students in the class).
- Use one color paper for the seal and its food, and different colors of paper for the turtle and seabirds and their respective foods.
- Glue the pages to card stock, laminate them and cut out the cards.
- Punch holes in the seal, seabird, and turtle cards and attach yarn or string so students can wear the cards around their necks.
- Use the template provided to make a shark headband (make two if you have more than 30 students).
- Locate a grassy area suitable for running.

Teacher Background Information

Hawaiian monk seals, seabirds, and green sea turtles are highly dependent on both land and sea habitats. Hawaiian monk seals feed in the ocean and rest, safe from predators, on beaches. Seabirds feed and rest at sea and come to the land to breed and nest. They rely on native plants for shade nest and rear their young. Green sea turtles feed at sea and come to land to rest, reproduce, and lay their eggs. Both land and sea habitats are crucial to the survival of these three animals.

Hawaiian Monk Seals

Adult Hawaiian monk seals are more than 6.5 feet long and can weigh more than 400 lbs. When they are hunting on a reef, Hawaiian monk seals can remain submerged for 15 to 30 minutes, depending on how deep they dive and how active they are underwater. They can dive to a depth of more than 1,500 feet. They are solitary animals that are rarely found in groups. They are native to the Hawaiian archipelago, and their main breeding grounds are found in the NWHI, particularly around French Frigate Shoals. Waters around the islands are an important feeding area for Hawaiian monk seals. There, they feed on fishes, octopuses, eels, and lobsters that find shelter among colonies of deep-water corals. The seals also feed on flatfishes from sand fields. Hawaiian monk seals naturally spend about a third of their time resting and sleeping on isolated beaches. They are not "lazy," but conserve energy between their hunting and foraging trips. Large tiger sharks are their main natural predator, and the presence of sharks may be another possible reason for the seals to minimize their time in the water and maximize their time on the beach.

Seabirds

Seabirds have adaptations to the marine environment that makes them quite different from terrestrial (land) birds. Like terrestrial birds, seabirds have hollow bones and specific bill adaptations to help them catch the food they eat. They add to the food chain by becoming prey, depositing guano on land and in the ocean, or when they decompose, adding nutrients to the cycle of life. Yet seabirds spend most of their lives at sea, coming to land only for breeding and nesting. They can eat, sleep, and rest at sea. They possess a special gland behind their eyes that desalinates saltwater so that they can obtain drinking water from the ocean. They have webbed feet, which allows them to take off and land skillfully on the water's surface. Many seabirds have feet placed farther back on their bodies, which allows them to propel themselves downward during a dive.

There are around 30 species of seabirds in Hawai'i, and many of them can only be found in the Monument. Seabirds nest in colonies of a few hundred to several thousand or millions of birds. Most seabirds eat fish, squid, and floating materials such as fish eggs. The oldest known documented North American bird in the wild, a Laysan albatross, was found on Midway Atoll in 2002. The band numbers indicated it had been banded as an adult bird 51 years earlier! Currently we know seabirds live anywhere from 5 to 51 plus years and have a wingspan of a few inches up to 11 feet.

All seabirds are threatened in many ways by human activities. Although seabirds are rarely hunted by humans, they suffer because of pollution, marine debris, and disturbances to their breeding and nesting grounds as a result of human activities. Of particular threat are being hooked and drowning because they forage on bait food used by the commercial fishing industry; becoming entangled in disposed nets, gear, and plastic trash such as soda rings; and ingesting small, disposable cigarette lighters and other plastics. But probably the greatest threat to the successful breeding of these seabirds is the introduction of alien species such as rats, cats, dogs, and mongoose that kill the birds and eat their eggs. These non-native predators prevent seabirds from nesting in most areas of the main Hawaiian Islands, where they were once thought to be quite numerous. Sharks are a natural reef predator for young seabirds learning how to fly.

Green Sea Turtles

Green sea turtles are air-breathing, cold-blooded reptiles. Adults can weigh up to 400 lbs. Their name comes from the color of the fat found inside their body rather than the color of their shell or skin. Ninety percent of Hawaiian green sea turtles rely on the sandy islets of the French Frigate Shoals as their breeding and nesting grounds. Sea turtles do not reach breeding age until 25 years of age.

Young turtles have a hard time and only one out of every thousand survive to adulthood. Young turtles that survive the crabs, seabirds, and ocean predators in their dash from nest to deeper waters disappear at sea for several years. No one knows where the young turtles go! They arrive in the main Hawaiian Islands around the age of

seven. Juvenile green sea turtles eat sponges, seaweed, jellyfish, sea slugs, and violet snails. Adult turtles are almost exclusively herbivores. They feed on both sea grasses and algae, but occasionally will enthusiastically feed upon a large mass of invertebrates. They mostly feed on marine plants growing in shallow coastal waters. Hawaiian green sea turtles are found throughout the entire Hawaiian archipelago, a range of approximately 1,500 miles. Most Hawaiian green sea turtles seem to settle at a specific foraging ground and leave only to reproduce. It is believed that every nesting season, green sea turtles return to nest on the beach where they were born.

When they are active, Hawaiian green sea turtles must swim to the ocean surface to breathe every few minutes. When they are resting, they can remain underwater for as long as two and a half hours without breathing. Green sea turtles often rest in caves or under ledges in deep water. Hawaiian green sea turtles migrate up to 800 miles from their feeding areas near the coast of the main islands to nesting beaches in the NWHI. The males accompany the females in this migration and mate with them offshore from the nesting beaches.

One interesting behavior of the Hawaiian green sea turtle is its fondness for crawling ashore at isolated sites in order to bask in the sun. Hawaiian green sea turtles bask, but this behavior seems to be more prevalent in the Northwestern Hawaiian Islands. It is thought that they do this to warm up in the sun, rest, and perhaps to avoid tiger sharks. Two other threats to the survival of the green sea turtle are marine debris and a disease called Fibropapilloma. Marine debris, like nets, cigarette lighters, plastic bags, and ballpoint pens can clog their digestive system and cause turtles to starve to death. Fibropapilloma is a viral disease that causes large tumors to grow on the turtles, often to a size that obscures their vision or interferes with avoiding predators and with feeding.

Teaching Suggestions

1. Show the Navigating Change "Land to Sea Connection" video segment on the DVD and discuss it.

Discussion Questions

- How are seabirds an important part of the circle of life? (They contribute guano to the water, which provides nutrients for plants. Plants are the base of the food chain for reef animals, providing food for a variety of fishes.)
- Why do monk seals and green sea turtles need healthy beaches?
- How are the animals' behaviors, such as nesting and feeding, determined by the beach and ocean environment?
- What is the "land to sea connection"?

2. Have students make food chains using the animal cards provided with this activity.

- Review what students learned about interdependence in the Circle of Life activity.
- Display the cards provided with this activity and have students line up the cards to form food chains.

  Sample food chains:
  algae (limu) > green sea turtle (honu) > shark (manō)
  eel (puhi) > monk seal (ʻīlioholoikauaua) > shark (manō)
  octopus (heʻe) > monk seal (ʻīlioholoikauaua) > shark (manō)

3. Introduce the Land to Sea Survival Shuffle game using the game instructions provided at the end of this activity.

- Present the objective and assign a role to each student.
- Assign one or two students to be sharks (boy or girl) and have a third of the remaining students be turtles, a third be seabirds, and a third be monk seals.
- Review the rules and then take students outside to play the game.

4. After the game, discuss the importance of healthy land and sea environments to the survival of monk seals, seabirds, and green sea turtles.

Discussion Questions

- How many seals, seabirds, and turtles were killed by the shark(s)? Should we get rid of sharks?
- Why or why not? (Predators help the prey species by eliminating injured or sick animals and by controlling populations.)
- What specific environmental conditions do the animals need to survive?
- How does human activity on the beach increase the chances for seals/seabirds/turtles to fall prey to sharks?
- Is there a reason to limit human access to Papahānaumokuākea Marine National Monument?

5. Discuss how to improve the chances for monk seal, seabirds, and sea turtle survival.

- Eliminating or controlling human disturbance in wildlife refuges;
- Protecting seals from human interference when they come ashore on main Hawaiian Islands;
- Enforcing laws protecting these animals; Expanding wildlife refuges;
- Continuing research to understand monk seal, seabird, and sea turtle biology, diseases, and problems;
- Eliminating marine debris;

Unit Culminating Activity: Students interview a Hawaiian kupuna to find out how Hawaiians understand the connection between themselves and all living things and the connection between life on land and life in the sea. They write a story to summarize what they learn from the kupuna and how it applies to what they have learned in this unit. Their stories should:

- Answer the unit essential question
- Include drawings showing the connection between life on land and life in the sea
- Explain the "circle of life" showing the relationships between plants and animals in a coral reef food web
- Explain the Hawaiian view of the connections between life on land and life in the sea.

protecting pups, especially females, that have lost their mothers or been weaned early, and returning them to the wild.

6. Have students complete the culminating activity for the unit.

- Review the unit essential question and the unit culminating activity described in the Student Assessment Overview (in Unit Introduction).
- If your school has a kūpuna program, invite a kupuna to come and spend time with your class.
- Work with students on developing interview questions and discuss ways that we show hōʻihi (respect) and appreciation for kūpuna and the knowledge they share.

7. Ask students to share their completed stories with one another and/or with other classes.

- Invite the kupuna to come and listen to the students' stories.

Extended Activities

Have students write an imaginary story from the perspective of a Hawaiian monk seal, a seabird, or a green sea turtle. The story must describe what the animal eats, its predator, the habitat on land and sea needed for survival, and how the animal adapts to human changes to the land and sea environment.

Encourage students to research and report on sea turtles in the Islands. A web site with excellent information is: *http://www.earthtrust.org/wlcurric/turtles.html.*

Order a copy of the KidScience telecast "Land to Sea Connections" from the DOE Teleschool Office and view it with your class to reinforce concepts presented in this activity. See: *http://www.teleschool.k12.hi.us/express/.*

Borrow the video *Midway Island of Life*, from the U.S. Fish and Wildlife Service by calling 808.792.9532. It has spectacular wildlife footage particularly highlighting life cycles and food webs.

Land to Sea Survival Shuffle — Game Instructions

Objective:

To find enough food and return to the beach resting area (cardboard, canvas, or carpet square) before being eaten by a shark

Game Set-up:

- Give each student a cardboard, canvas, or carpet square and bring the class to a grassy area suitable for running. If it's a windy day and canvas or cardboard is used, try wetting these squares to prevent them from blowing.
- Students form a circle where they can just brush elbows with students next to them, place their squares on the ground in front of them, and sit down on the squares.
- Teacher stands in the center of the circle and introduces the game, while someone distributes the food cards randomly and widely around the outside of the circle.

Introduction

- Explain that the circle students have formed represents your island and that each turtle, sea bird, and monk seal has a safe place (carpet square) on this beach. This beach has a good reef offshore that prevents the shark from coming too close.
- The food cards spread around the "reef" are the foods that the turtles, seabirds, and monk seals need. The foods cards each animal needs match the color of the cards students are wearing.
- When given the signal to go, everyone must leave the beach and find a food card and then return to the beach (any carpet) without being eaten by a shark. Seals and turtles are solitary animals, so only one animal per square. Despite the fact that seabirds usually live in colonies, for the purpose of the game, there can only be one bird per square.
- Sharks may tag animals in the ocean but not on the beach. One touch is enough by the shark. Tagged animals must sit out and watch (designate an area).

To Play:

- Give the signal for round one.
- Continue playing until a whistle is blown or teacher calls time. At that time, the shark stops hunting and animals not tagged by the shark return to the beach.
- Look at the food cards and be sure that turtles, seabirds, and seals found their types of food. If they have the wrong type of food, they need to sit out the next round.
- Count how many seals, seabirds, and turtles were eliminated by the shark.
- Play a second round and repeat the steps above.

Play a third round but add another challenge—people wandering on the beach. This will eliminate some safe beach area so remove squares not in use and 4 or 5 more during the round. Explain that if animals can't find a square on the beach, they need to stay in the water with the shark.

Play enough rounds that the monk seal, seabird, and turtle populations are seriously depleted or endangered.

Source: Mahalo to the Waikīkī Aquarium Education Department, the University of Hawai'i. This activity is adapted from the Monk Seal Survival Shuffle.

Land to Sea Connections

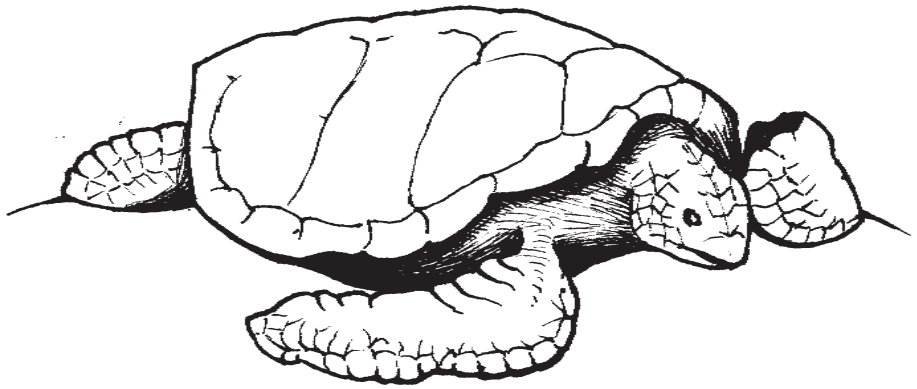
Name:_____ **Date:**_____

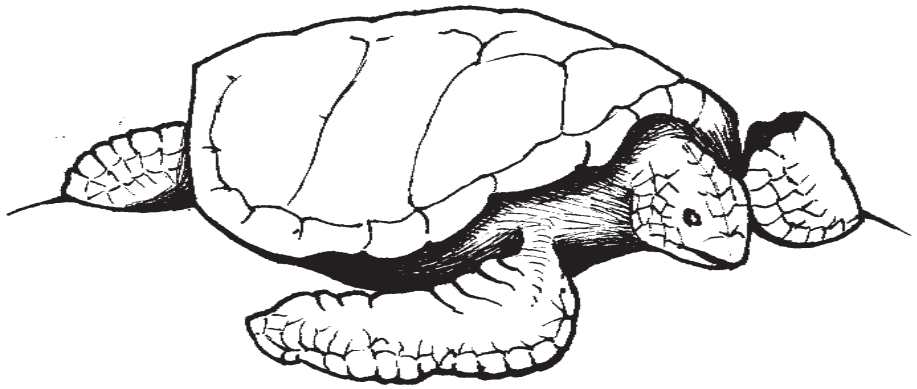
Draw a picture of the land and sea habitats used by turtles, seabirds, and monk seals. Include their food sources and predators in your drawing.

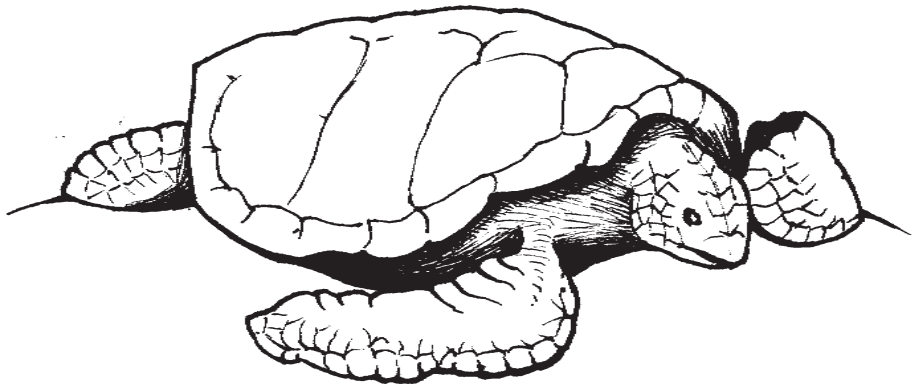
- Draw arrows and label them on your drawing to show the cycle of energy among producers, consumers, and decomposers.
- Describe how the animals' behaviors, such as nesting and feeding, are determined by the beach and ocean environment.

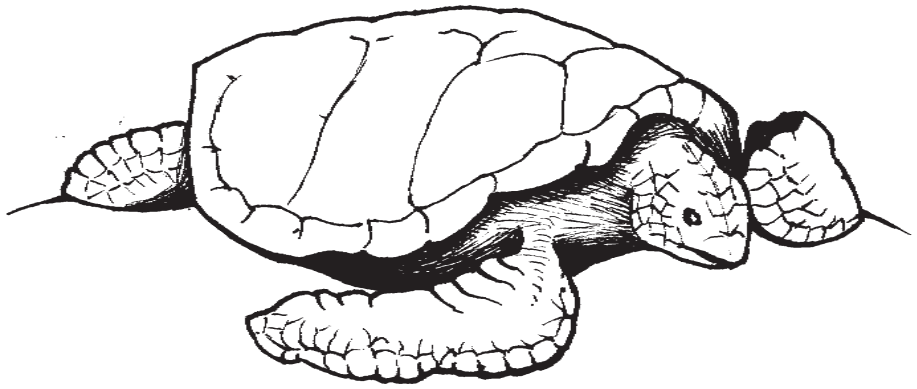
- On the back of this page, describe what people can do to help turtles, seabirds, and monk seals survive. Include the specific conditions that these animals need for their survival.

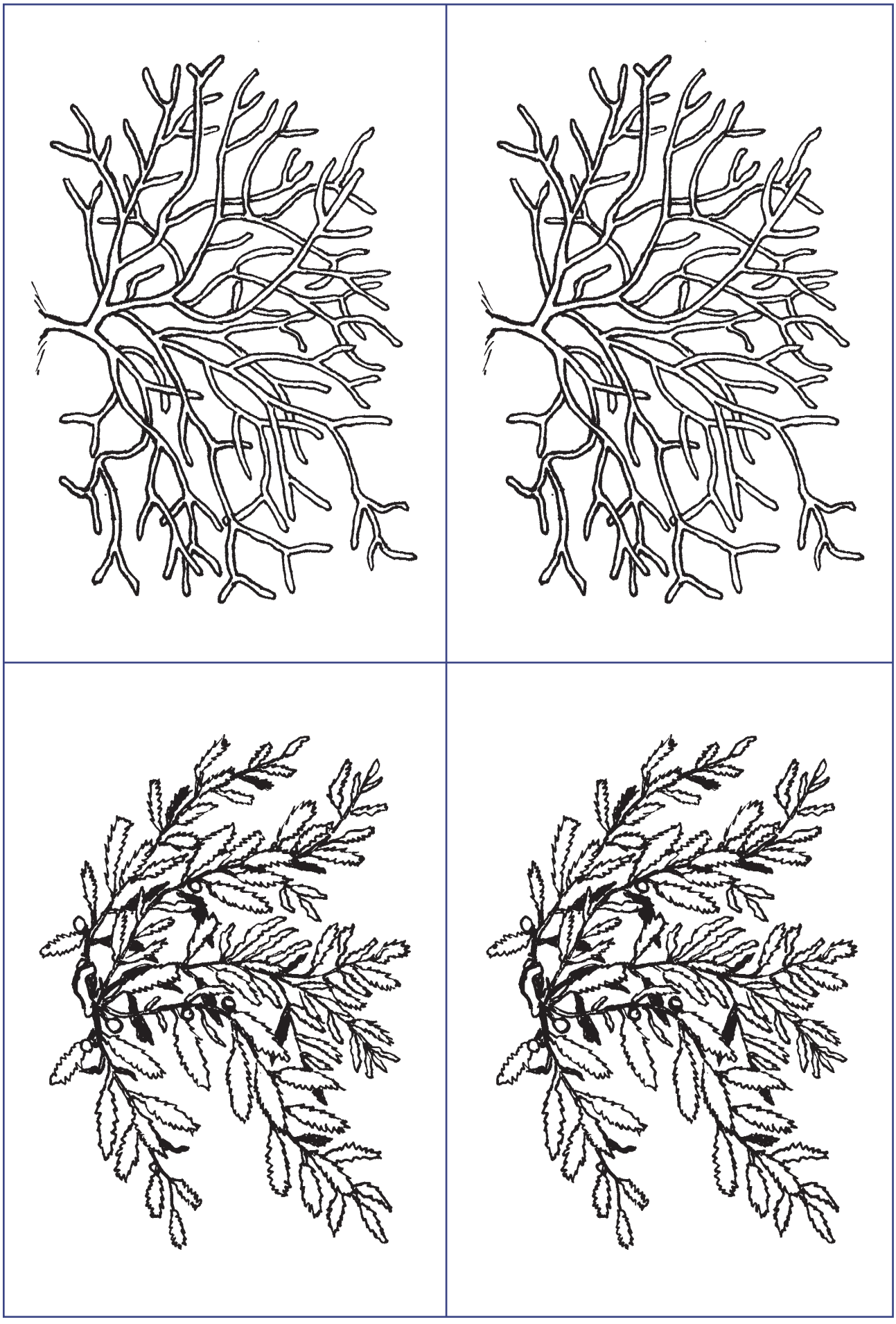
Sea Turtle Cards





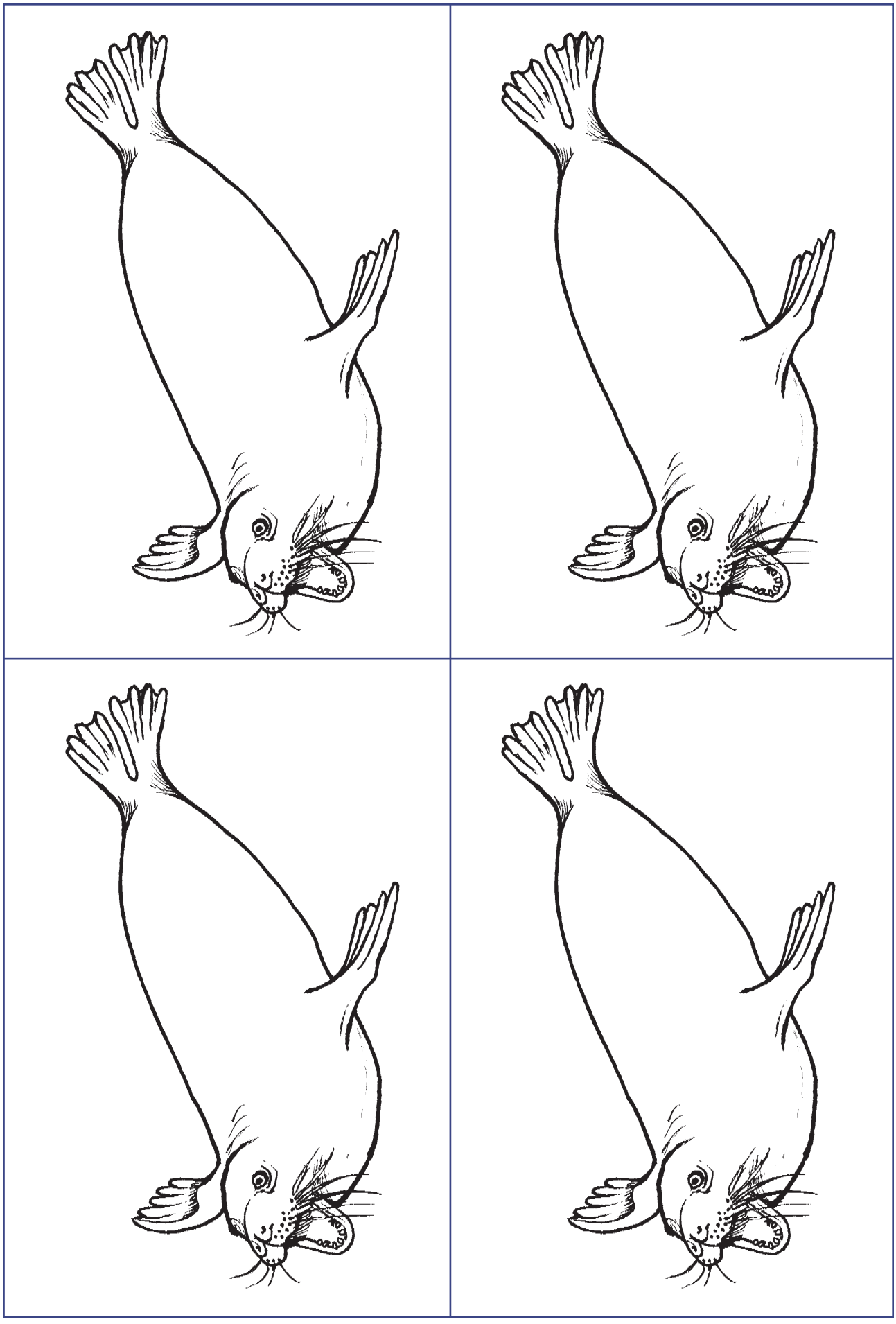


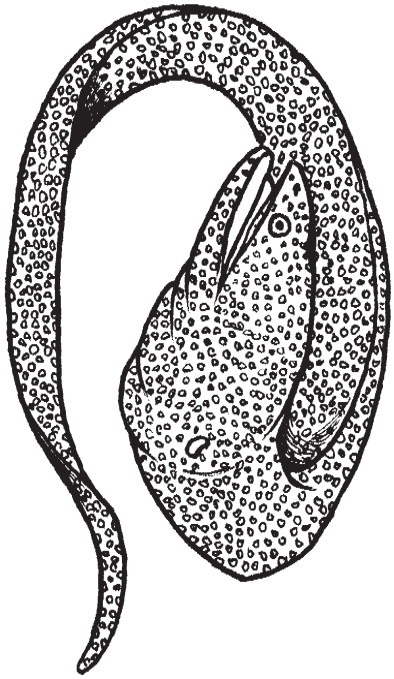


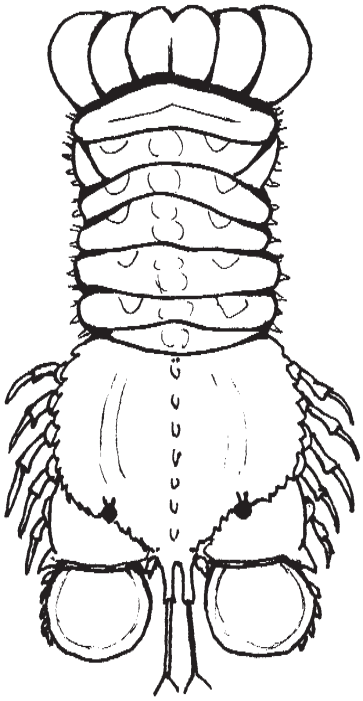


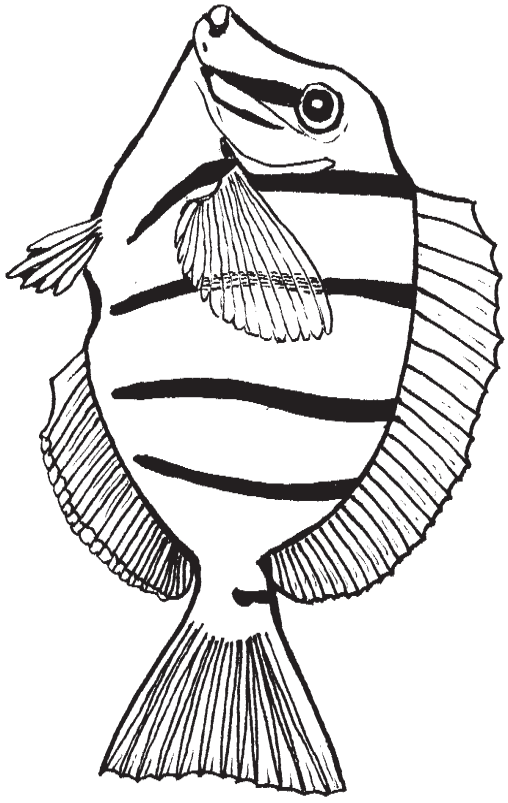
Turtle Food Cards

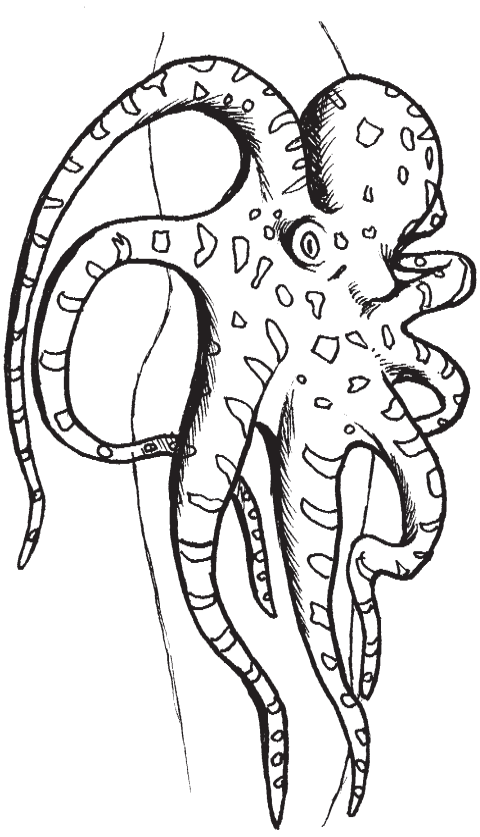
Monk Seal Cards





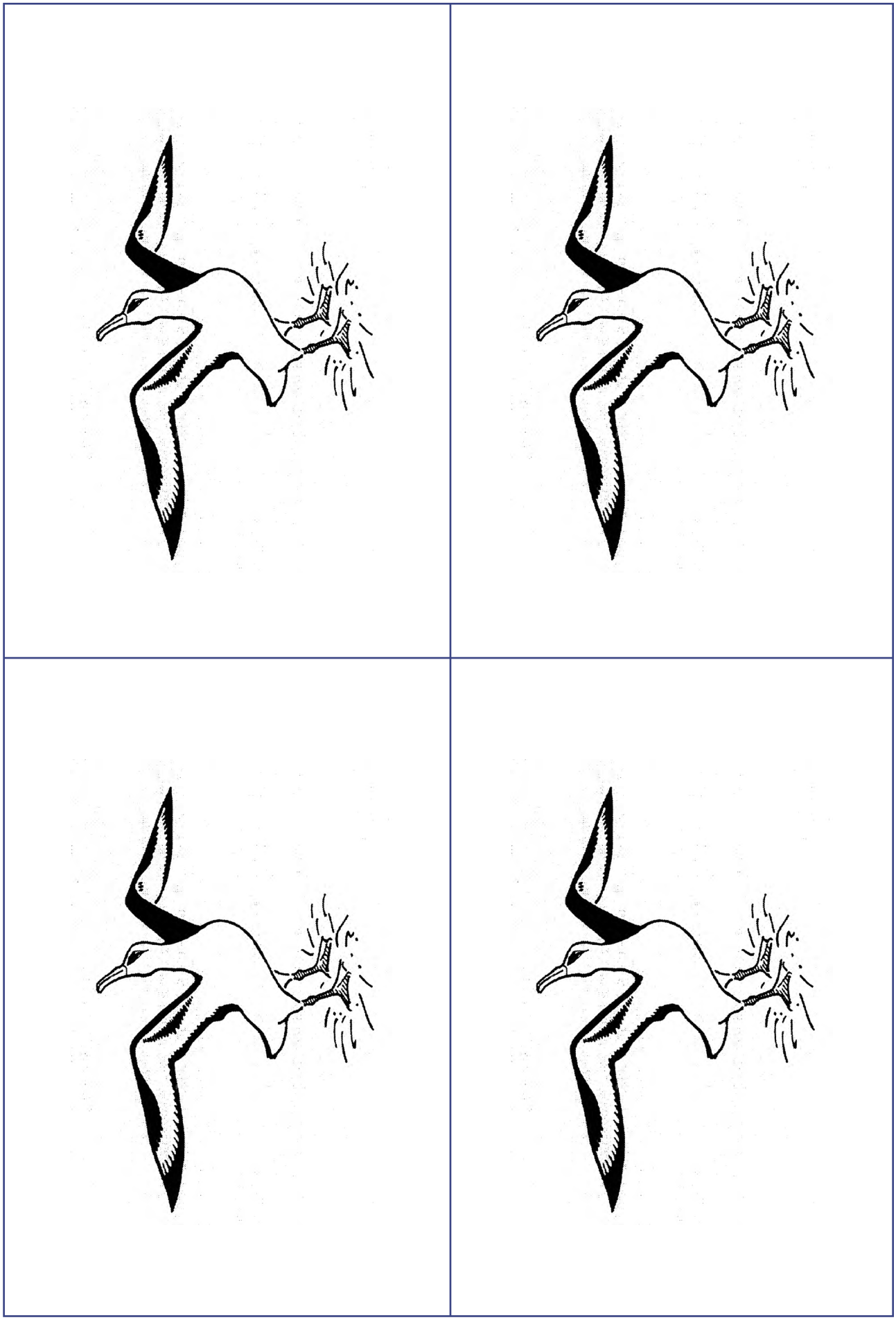


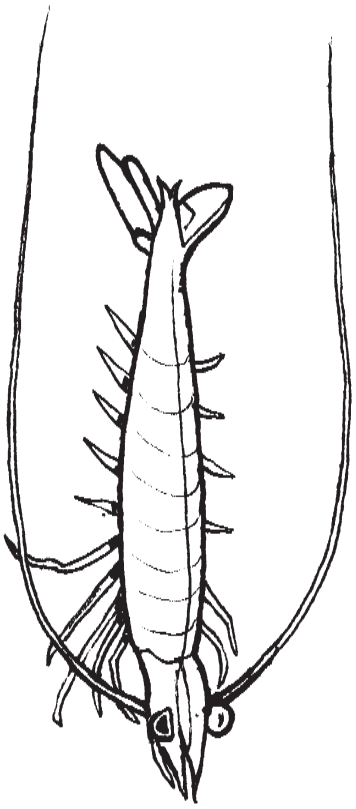


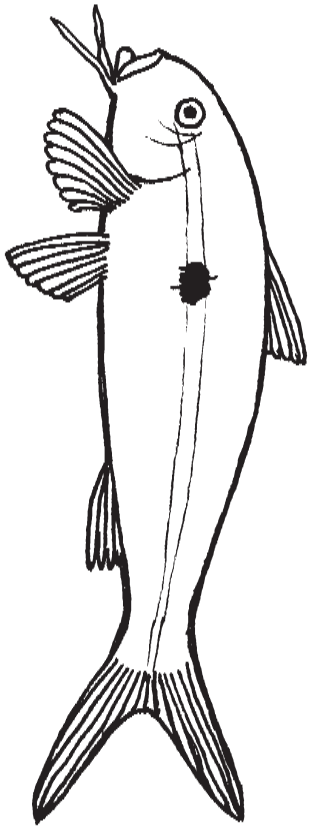


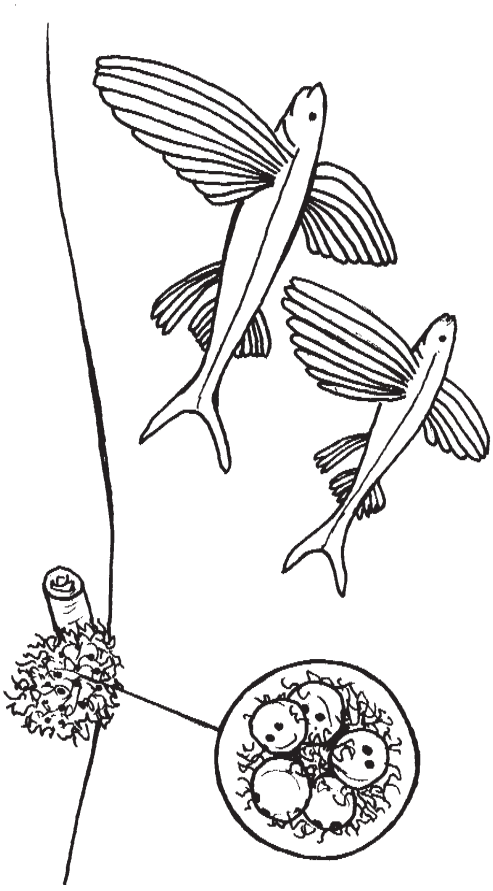
Monk Seal Food Cards

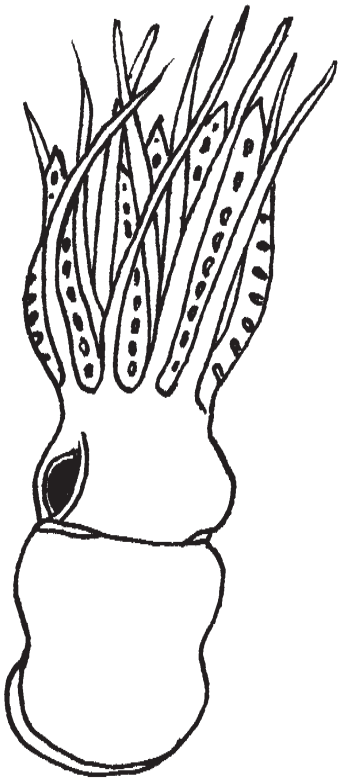
Seabird Cards











Seabird Food Cards

Shark Headband Template

Directions:

1. Cut out the headband and the shark head.
2. Fold the headband in the middle.
3. Tape the headband to the bottom of the shark head.
4. Staple rubber bands or elastic to each end to finish the headband.