FISHING LINKS

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

HAWAIʻI DOE STANDARD BENCHMARKS

Science 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT
Cycles of Matter and Energy

- **SC.7.3.2** Explain the interaction and dependence of organisms on one another.

Language Arts 4: Writing: CONVENTIONS AND SKILLS
Range of Writing

- **LA.7.4.1** Write in a variety of grade-appropriate formats for a variety of purposes and audiences such as poems or pieces to reflect on learning and to solve problems.

STANDARD PRACTICED

Language Arts 3: Reading: LITERARY RESPONSE AND ANALYSIS
Interpretive Stance

- **LA.7.3.3** Describe how historical or cultural influences help explain a text.

NĀ HONUA MAULI OLA 8 – 4

- Apply cultural and traditional knowledge of the past to the present.

ACTIVITY AT A GLANCE

Students explore relationships among coral reef organisms, Hawaiian *ʻaumakua* (family guardians), and their own relationship to the marine environment. After viewing a video clip of fish in the Northwestern Hawaiian Islands, students play a "Fishing Links" game using coral reef cards to make food chains.

MATERIALS

Provided:

- ✓ Learning Log cover (provided in the Unit Introduction)
- ✓ Student Assessment Overview (provided in the Unit Introduction)
- ✓ coral reef cards (provided in Unit Resources)
- ✓ Challenge Cards
- ✓ Student Readings 1 and 2
- ✓ Learning Logs - 1 and 2
- ✓ movie clip (LottaFish.mov provided on *Navigating Change* Video Clips CD)
- ✓ *Save Haven* DVD
- ✓ map of Hawaiian Archipelago

Needed:

- ✓ folders (one per student for Learning Logs)
- ✓ large envelopes (to hold coral reef card sets)
- ✓ paper clips

ASSESSMENT

Students:

- Complete Learning Logs that show how coral reef organisms are interdependent, and compare and contrast predator/prey and symbiotic relationships.
- Write a reflection about their personal relationship with the marine environment.

TIME

2 class periods

SKILLS

analyzing, classifying, comparing and contrasting, writing

Key Concepts

- Coral reef organisms are dependent on one another in a number of ways including predator/prey relationships, parasitism, and mutually beneficial symbiotic relationships.
- Apex predators at the top of the food chain are found in greater numbers in healthy reef ecosystems.
- Hawaiians have personal and spiritual relationships with land and sea organisms that represent their family *ʻaumakua* (spiritual guardians). The names of these particular family *ʻaumakua* are still passed from generation to generation.

Advance Preparation

- ☐ Make a copy of the Learning Log cover and Student Assessment Overview (provided in the Unit Introduction) for each student.
- ☐ Make a copy of the Student Readings and Learning Logs for each student.
- ☐ Copy the Challenge Cards and cut them out.
- ☐ Preview the *Safe Haven* DVD and the movie clip (Lottafish.mov) provided with this unit.
- ☐ Refer to the chart below and make a copy of each of the coral reef cards indicated on the chart (cards provided in the Unit Resources). Six groups of students will each need one set of six cards (one food chain from producers - decomposers). If you have a large class, make some extra sets of food chain cards.
- ☐ Place each food chain set in an envelope with the apex predator card clipped to the outside. Write a team number on each envelope.

Vocabulary

apex predator – the carnivore at the top of the food chain, such as a *manō* (shark), *ulua* (giant trevally) or *kākū* (great barracuda)

ʻaumakua – family or personal gods spiritual guides; deified Hawaiian ancestors or guardians

coral polyp – a tiny animal with a soft body and feeding tentacles that surround the mouth

food chain – a series of organisms interrelated in their feeding habits, the smallest being fed upon by a larger one, which in turn is eaten by an even larger one

food web – a series of organisms related by predator/prey activities; a pattern of predator/prey relationships in a community of organisms

interdependence – a relationship of mutual need

producers - organisms that use energy from the sun to produce their own food

phytoplankton – tiny floating or drifting plant organisms in the water

symbiotic relationship – a relationship of mutual benefit; a close ecological relationship between the individuals of two or more individual species

zooxanthellae – algae that live in the tissues of coral polyps

Hawaiʻi DOE Rubrics

Advanced	Proficient	Partially Proficient	Novice
Science			
Evaluate and explain how organisms interact with and depend on one another.	Explain how organisms interact with and depend on one another	Identify how organisms interact with and depend on one another	Recognize that organisms interact with and depend on one another

Language Arts

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

Coral Reef Card Food Chains

Producers	**Herbivores**	**Omnivores**	**Carnivores**	**Apex Predator Carnivores**	**Scavengers / Decomposers**
phytoplankton → **(copy 2)**	*kio poʻapoʻai* (feather duster worm) →	*pāpaʻi* (blue pincher crab) →	*weke ʻula* (goatfish) → **(copy 2)**	*ulua* (giant trevally) **(copy 4)**	*ula* (banded spiny lobster) ←
limu manauea (algae) →	*leho kupa* (cowry snail) →	*heʻe* (octopus) →	*pūhi* (moray eel) → **(copy 2)**	*ulua* (giant trevally) →	*pokipoki* (common box crab) ←
rice coral → **(copy 2)**	*uhu* (parrotfish) →		*pūhi* (moray eel) →	*ulua* (giant trevally) →	*loli* (sea cucumber) ←
limu (spiny seaweed) →	*ina* (sea urchin) →	*hīnālea lau-wili* (saddleback wrasse) →	*weke ʻula* (goatfish) →	*manō* (shark) → **(copy 2)**	*ula* (banded spiny lobster) ←
rice coral →	*kīkākapu* (ornate butterflyfish) →	roi (peacock grouper) or *toʻau* (snapper) →	*pāpio* (young *ulua*) →	*manō* (shark) →	*peʻa* (brittle star) ← **(copy 2)**
phytoplankton →	zooplankton →	*mamo* (banded damsel fish) →	*kākū* (barracuda) →	*ulua* (giant trevally) →	*peʻa* (brittle star) ←

(The arrows in the chart on the previous page indicate the flow of nutrients from the producers through the consumers and back into the ecosystem through the decomposers. Some of the decomposers are also carnivores, feeding on small shrimp or fish in addition to dead plants and animals.)

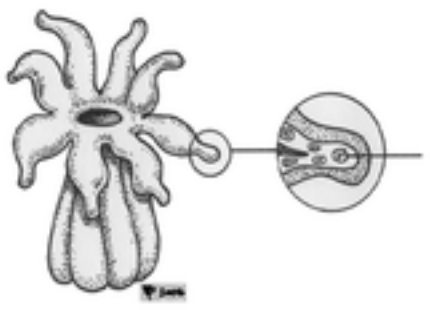
Teacher Background Information

The coral reef ecosystem is a beautiful and complex community with abundant examples of interdependence among plants and animals. This activity introduces students to the Papahānaumokuākea Marine National Monument that was established by President George W. Bush on June 15, 2006. This is one of the largest marine protected areas in the world, covering 1,200 miles of ocean wilderness. The Monument's reefs provide habitat to more than 7,000 marine species; a quarter of which are found only in the Hawaiian Archipelago. As students become more

familiar with the Monument, they will see how it provides us with a baseline with which to measure change to our reefs in the Main Hawaiian Islands (MHI). The *Safe Haven* DVD provided with this unit will introduce your students to the cultural and ecological significance of this protected area.

Symbiotic Relationships

The corals, which form the physical basis of this ecosystem, are unique in the dual role they play as both producers and carnivores. Corals also display symbiotic relationships, which are relationships of mutual benefit between individuals of two or more species. Corals are made up of tiny polyps that have a sac-like gut with an opening surrounded by tentacles with tiny stinging cells. These cells capture zooplanktons that drift in the currents. Within the tissues of the polyps are zooxanthellae—the single-celled algae that have a symbiotic relationship with the coral polyp. Through the process of photosynthesis, these algae use the sun's energy to convert water and carbon dioxide into sugar. The coral polyp benefits from this food production and the algae benefits from the protective habitat the polyp provides.



Predator/Prey Relationships

Predator/prey relationships maintain balance in the coral reef community. Although, as students will discover in this unit, human activities are upsetting this balance. The movie clip provided with this lesson shows the large number of apex predators - *ulua* and sharks – in the coral reefs in the Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands (NWHI). To sustain this high number of apex predators, there needs to be a healthy reef with plenty of herbivores, omnivores and low-level carnivores. Exploring relationships between marine plants and animals and between ourselves and the coral reef lays a foundation of knowledge for understanding how we can better care for the marine environment.

Hawaiian Relationships – *ʻAumakua*

As a language arts connection to the science presented in this activity, students are presented with a story about a family's relationship to its *ʻaumakua* — the *manō* (shark). The story provides insight into important cultural beliefs and a way for students to examine different types of human relationships with other organisms.

In Hawaiian cultural beliefs, *ʻaumakua* have the ability to take many forms such as a shark, owl, mudhen, lizard, eel, caterpillar and even a rock or a plant. Their forms would often change from marine life to a terrestrial plant or animal form or non-living matter. One example is the *peʻelua* (caterpillar) who would often become the *loli* (sea cucumber) in the ocean. "The *ʻaumakua* inhabiting the body of a certain animal might also inhabit a plant that had either visual resemblance, similar characteristics (slippery, clinging, rough or smooth) or symbolic resemblance because of similar name" (Pukui et al., 1972).

Teaching Suggestions

1. **Introduce students to the essential question for the unit and hand out the student assessment overview and review it.**
   - Distribute the materials for the Learning Logs.
   - Have students glue the Learning Log cover to the folder and glue the assessment overview to the inside cover.
   - Review the unit culminating projects and assign due dates.

2. **Show the video clip of fish from the NWHI (Lottafish.mov) and discuss it.**

   Discussion Questions
   - How is this reef different from areas where you go swimming or fishing?
   - Why do you think there are so many large apex (top of the food chain) predators – *ulua* and sharks? (Record students' ideas on the board.)
   - Where do you think this reef is located?

3. **Show the map of the Hawaiian Archipelago and the Safe Haven DVD.**
   - Point out the NWHI where this movie was recorded and explain that this is now the Papahānaumokuākea Marine National Monument.
   - Show the Safe Haven DVD and ask students to watch for ways that the NWHI are different from the Main Hawaiian Islands (MHI).
   - Discuss how human impact would be different in this isolated region of the archipelago compared to the MHI.

4. **Distribute Learning Log – 1 about relationships and ask students to complete it in preparation for a "Fishing Links" game.**

   Discussion Questions
   - What species do you think are needed on the reef for the *manō* (shark) to survive?
   - How is the relationship between coral and zooxanthellae symbiotic?
   - What is another example of a symbiotic relationship?
   - How would you describe your relationship to the marine environment?

5. **Go over the rules to play a Fishing Links game with the coral reef cards.**
   - Divide the class into six teams (or more if the class is large). Ask each team to have paper and pen ready.
   - Distribute an apex predator coral reef card to each team. Show them that there is text on the back of the cards.

- Explain that the objective of the game is to complete a food chain that shows the species needed to support the team's apex predator.
- Tell teams that you have the cards that each team needs to complete a food chain and review food chains with the class (producers, herbivores, omnivores, carnivores and decomposers).
- Explain that to receive a coral reef card, teams must correctly answer a challenge card. They will have one minute to write a response.
- The first team to create the longest food chain (in the correct order) wins.

6. Play the Fishing Links game.

- Ask a volunteer to draw a challenge card and read it to the class.
- Give teams one minute to write the answer to the challenge card.
- Go around the room and read the teams' responses. Give a coral reef card from the team's envelope to each team with a correct response.
- If a team doesn't answer the challenge card correctly, no food chain card is given.
- Once all challenge cards are read, stop distributing food chain cards and challenge teams to create a food chain with no missing links.
- Declare the team with the longest food chain the winner. (To check for accuracy, review the Coral Reef Card Food Chains chart.)

7. Hand out the remaining coral reef cards and ask teams to complete the food chains.

- Review their food chains.
- Have teams share at least one of the "Did you know?" facts from their coral reef cards that they found to be interesting.
- Have students revisit their responses on Learning Log – 1 and update it with the species needed to support the apex predators.
- Use the challenge cards from the game to assess students' knowledge, either by conducting interviews with students, or by having students select a card and write an answer.

8. Distribute Learning Log – 2 and ask students to complete it with the missing links in the food chains.

9. Distribute the Student Readings about sharks as *ʻaumakua*.

- Ask students to read the story and the article and write a reflection about the symbiotic relationship of Hawaiians who had *manō* as *ʻaumakua*.
- Discuss students' reflections and reinforce the concept of caring for something that cares for you.

REFERENCES

Dudley, Michael Kioni. 1990. *A Hawaiian Nation – Man, Gods, and Nature*. Nā Kāne O Ka Malo Press. Honolulu, HI.

Hobson, Edmund and E.H. Chave. 1972. *Hawaiian Reef Animals*. The University of Hawai'i Press. Honolulu, HI.

Kupihea, Moke. 2001. *The Seven Dawns of the Aumakua – The Ancestral Spirit Tradition of Hawaii*. Inner Works International. Rochester, VT.

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Pukui, Mary Kawena, E.W. Haertig and Catherine Lee. 1972. *Nānā I Ke Kumu*. Hui Hānai. Honolulu, HI.

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ADAPTATIONS / EXTENSIONS

Science 3: Organisms and the Environment - Cycles of Matter and Energy - Have students place the coral reef cards face down and take turns turning over cards and trying to make matches between predators and prey.

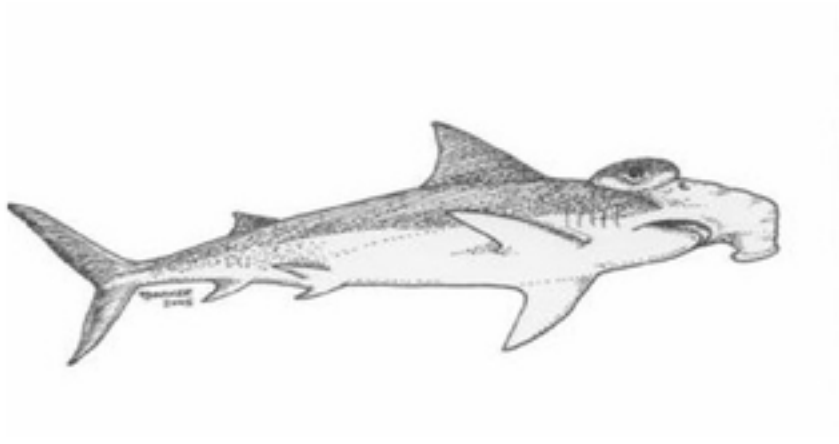
Science 3: Organisms and the Environment - Have students design ways to create three-dimensional coral reef food chains and display them in the school. Challenge them to make the organisms to scale using the actual size or a scaled-down version. Create some math challenges where students compare the relative sizes of organisms from the producers through the apex predators.

Language Arts 3: Reading - Have students read the story "Aku Fishing with Palila" from the book The *Water of Kāne* and summarize the story. See: Pukui, Mary K., 1994. *The Water of Kāne and Other Legends of the Hawaiian Islands*. Kamehameha Schools Press. Honolulu, HI.

Science 3: Organisms and the Environment - Challenge students to research another type of symbiosis such as commensalism, where the organisms live together, either with, on, or in another without causing injury to either; amensalism, where neither species benefits and one is harmed; parasitism where one species benefits and the other is harmed; or mutualism, where each species benefits.

Web sites with information on coral reefs are listed below.

- http://www.waquarium.org/
- http://www.coralreefnetwork.com/
- http://www.hawaiireef.noaa.gov/about/welcome.html
- http://www.bishopmuseum.org/research/natsci/fish/fishimages.html
- http://www.cals.ncsu.edu/course/ent591k/symbiosis.html

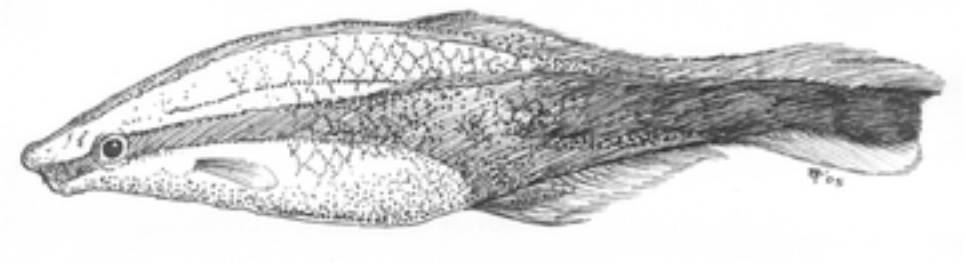


FISHING LINKS

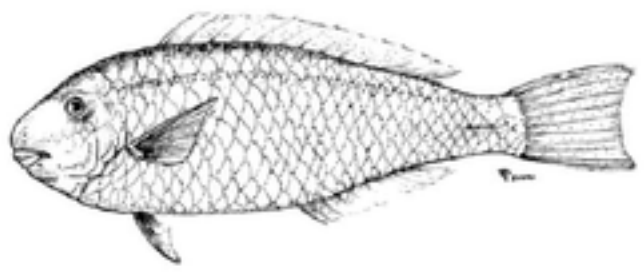
CHALLENGE CARDS

Instructions: Copy one set of Challenge Cards and cut them out.

An herbivore on the reef has parasites on its scales. Describe the relationship and name the fish that will help this herbivore.



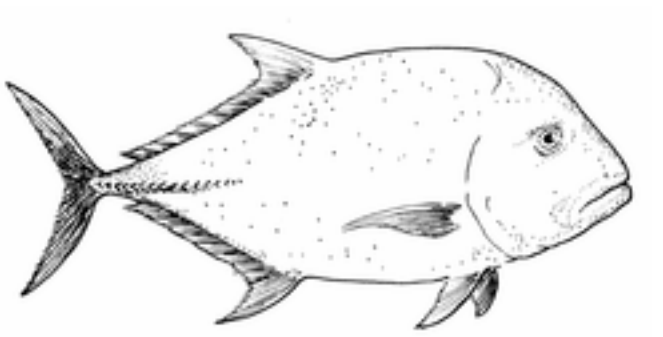
Divers who do not clean their gear can unintentionally introduce a non-native *limu* to the reef. This *limu* grows quickly and smothers some of the coral. How would this affect the reef?



You hear from your *kūpuna* that there used to be many more *uhu* (parrotfish) on the reef than there are today. How might the decline in these fish affect the coral reef community?

Global warming increases water temperatures during the summer and can cause some coral bleaching on the reef. The bleached coral usually dies. What organism that had a symbiotic relationship with the coral must now find a new home?

The reefs surrounding the Northwestern Hawaiian Islands have many more apex predators than the reefs surrounding the main Hawaiian Islands. Why do you think there is such a difference?



The producers in the coral community need nutrients to survive. Nutrients are made available by organisms that feed on dead or decaying plants and animals. Give an example of one of these scavengers or decomposers.

FISHING LINKS GAME — CHALLENGE CARD ANSWERS

An herbivore on the reef has parasites on its scales. Describe the relationship and name the fish that will help this herbivore. **(Answer: Cleaner wrasse feeds on the parasites – symbiotic relationship.)**

Global warming increases water temperatures during the summer and can cause some coral bleaching on the reef. The bleached coral usually dies. What organism that had a symbiotic relationship with the coral must now find a new home? **(Answer: zooxanthellae)**

Divers who did not clean their gear can unintentionally introduce a non-native *limu* to the reef. This *limu* grows quickly and smothers some of the coral. How would this affect the reef? **(Answer: Corals would die and fish that feed on coral or animals that live on the reef would decline.)**

The reefs surrounding the Northwestern Hawaiian Islands have many more apex predators than the reefs surrounding the main Hawaiian Islands. Why do you think there is such a difference? **(Answer: Reefs in the main Islands have been overfished so there are not enough smaller fish to support many apex predators.)**

You hear from your *kūpuna* that there used to be many more *uhu* (parrotfish) on the reef than there are today. How might the decline in these fish affect the coral reef community? **(Answer: There would be fewer fish for carnivores to eat and the *limu* (seaweed) that the fish eat could overgrow the coral.)**

The producers in the coral community need nutrients to survive. Nutrients are made available by organisms that feed on dead or decaying plants and animals. Give an example of one of these scavengers or decomposers. **(Answer: crabs, shrimp, lobster, brittle stars)**