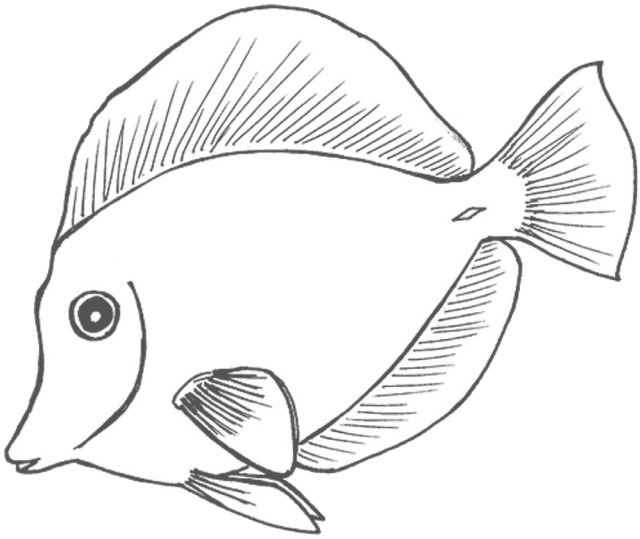


Hanauma Bay Education Program

Grade 7
Interactions of Organisms in the Marine Environment

UNIHI-SEAGRANT-EE-08-01

Interactions of Organisms in the Marine Environment

BENCHMARKS:
7.3.1-Explain how energy moves through food webs, including roles of photosynthesis and cellular respiration.

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

7.3.3-Explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem

GLOS:
2. Community Contributor
3. Complex Thinker
4. Quality Producer
5. Effective Communicator

BIG IDEA(S)
Grade 7 Hanauma Bay Education Program (HBEP) curriculum clarifies various processes, relationships, and factors that may affect the survival of organisms, carrying capacity of the environmental niche, and sustainability of the marine ecosystem.

EVIDENCE/CRITERIA:
Students should know and be able to do the following as a result of the teaching strategies in this lesson:

1. Use examples of creatures living in Hanauma Bay to explain how energy moves through food webs, including roles of photosynthesis and cellular respiration.

2. Use examples of creatures living in Hanauma Bay to explain the interaction and dependence of organisms on one another.

3. Use examples from the Hanauma Bay ecosystem to explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem.

The quality of the formative and summative tasks will be assessed by the teacher (or peers) as an indicator of student learning and achievement of benchmarks (group and individual charting of ideas, completion of learning sheets, KWL, SEEI of different concepts, Hanauma Bay food web).

LEARNING EXPERIENCES:
• To engage students, the field trip will begin with a walking tour of selected areas of Hanauma Bay. Careful observations (using worksheets and appropriate prompts) will be supplemented with visuals, manipulatives and interactive experiences in the Hanauma Bay Education Program (HBEP) classroom.

• Learning activities will vary instructional and learning strategies to address all learning styles (e.g., verbal/linguistic, visual, kinesthetic, interpersonal).

• If necessary, teachers will organize teams (prior to the field trip) to ensure appropriate pairing of special needs students. Precise group protocols and safety directions (e.g., on the bay ledge area) will be clarified before the walking tour.

• Introduction to and adequate preparation on specific, relevant science concepts will maximize the value of the HBEP experience. Group collaboration on concept clarification (refer to underlined terms in definition section of teacher preparation) prior to the field trip; charting of understandings; sharing with peers; and completion of selected Tool Kit worksheets will facilitate student preparation for the field trip. Completed student work should be brought to the bay to post in the HBEP classroom.

PRIOR KNOWLEDGE:

• Students' current/prior knowledge, dispositions, misconceptions, and skills can be assessed with the worksheets provided in the Tool Kit (e.g. KWL sheets and concept summary pages).

• Definitions and concepts to cover before the field trip: Food web, photosynthesis, cellular respiration, carrying capacity, sustainability, ecosystem, biotic, abiotic, interaction, dependence.

TEACHER PREPARATION:

Teacher will introduce students to the concepts discussed in standards 7.3.1, 7.3.2, 7.3.3 in the classroom prior to the Hanauma Bay trip.

Refer to the worksheets provided in the grade 7 tool kit to facilitate student learning prior to the field trip. Summarizing student understanding on chart paper will support review of selected concepts in the HBEP classroom (bring charts and worksheets on the day of the field trip).

Definitions:

Food Web- A network of interconnected feeding relationships. Food chains are a sequence of transfers of matter and energy from organism to organism in the form of food. Plants, which convert solar energy to food by photosynthesis, are the primary food source. In a predator chain, a plant-eating animal is eaten by a larger animal. The final link is made up of decomposers that break down dead organisms and organic wastes. Food chains overlap and interconnect into a food web because most organisms consume more than one type of animal or plant.

Photosynthesis- The process by which plants convert energy from sunlight into chemical energy that they can use. Using the energy from sunlight plants convert water and carbon dioxide into sugar. Oxygen is also produced.
Marine example: Energy from the sun can be used by the zooxanthellae in coral.These unicellular algae that live in the coral polyps use the light energy (trapped by the chlorophyll) to change inorganic molecules of water and carbon dioxide into organic sugar (glucose) that can be used by the coral animals as chemical energy for survival.

Cellular Respiration- The process that cells use to produce the energy they need to survive. Sugar and oxygen is converted to energy for growth, reproduction, movement, etc., with waste

products of carbon dioxide, water, and heat. Marine example: The manini eats algae, and uses the sugars from the algae to survive. In other words, the sugar combines with oxygen (absorbed from the water) to change sugar molecules into energy that the manini can use to grow and develop, swim from predators, search for food, reproduce, repair damaged body cells, etc.

Carrying Capacity- The population of living things that an ecosystem can support, given the amount of food, water, and habitat available in that ecosystem.

Sustainability- Degree to which present interactions between human society and nature can continue over the long term without significant damage or impact to the environment, individuals or society.

Ecosystem- A unit consisting of all of the living (biotic) and non-living (abiotic) parts of the environment (e.g., coral reef ecosystem; rocky shoreline; sandy/muddy bottoms; open ocean; marine/brackish/fresh water ecosystems).

Biotic- The living parts of the environment (animals, plants, bacteria, fungi).

Abiotic- The non-living parts of the environment (soil, minerals, rocks, water, sunlight, wind, temperature atmospheric gases like oxygen and carbon dioxide).

Interaction-mutual or reciprocal action/influence. Different species of organisms living together in the environment interact with one another. They interact with each other in three main ways:

(1) Competition (food, water, space resources determine survival of certain organisms)
(2) Predation (predator/prey feeding relationships keep populations in check)
(3) Symbiosis (mutualism, commensalism & parasitism describe close relationships between two species)

Dependence- Relying on another for support/survival. In feeding relationships, herbivores (plant-eaters) are consumers who are dependent on producers (plants) for food/survival. Carnivores are consumers who are dependent on herbivores or other carnivores for food. Omnivores are dependent on both producers and consumers. All symbiotic relationships are examples of dependence but vary in which organisms are dependent. In parasitism, one organism is dependent on the other for survival, harming the host organism in the process. Commensalism involves one organism being dependent on the other, not harming or helping the other organism (only one benefits). Finally, mutualism is a relationship where both organisms are dependent on each other for survival (both benefit from the interaction).

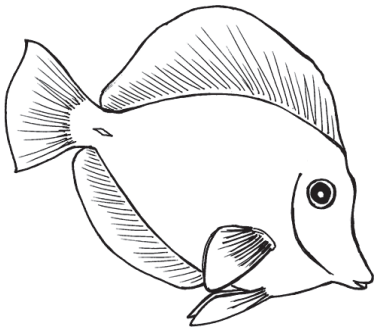
General Overview of the Animal Kingdom:

Invertebrates (sponges, cnidaria, flatworms, roundworms, segmented worms, mollusks, arthropods, echinoderms)

Vertebrates (fish, amphibians, reptiles, birds, mammals)

Hanauma Bay Invertebrates (herbivores, carnivores, omnivores):
• Worms: Feather duster, Christmas tree worm, flatworms
• Molluscs: Box jelly, Portuguese man-o-war, day octopus, oval squid, horned helmet, cowry, cone shell
• Arthropods: Banded coral shrimp, spiny lobster, black/rock crab, hermit crab
• Echinoderms: Sea urchins (echinothrix, echinometra, colobocentrotus, tripneustes), sea cucumber, sea stars, brittle stars

Hanauma Bay Fish Families (herbivores, carnivores, omnivores):
• Blenny (zebra, shortbodied)
• Boxfish (spotted, cowfish)
• Butterfly fish (fourspot, forceps, milletseed)
• Damselfish (kupipi)
• Flagtail (aholehole)
• Goatfish (weke, kumu)
• Milkfish (awa)
• Mullet
• Parrotfish (uhu)
• Rudderfish (nenue)
• Surgeonfish/tangs (palani, yellow tang, manini)
• Wrasse (hinalea)
• Ladyfish (awaawa)
• Hawkfish
• Frogfish
• Lizardfish



• Sharks and Rays

Hanauma Bay Reptiles and Mammals:
• Green, and hawksbill turtles
• Spinner dolphins
• Monk seal
• Humpback whales

Hanauma Bay Producers:
• Phytoplankton
• Microscopic/macroscopic green, brown, red algae (limu) attached to reef
• Macroscopic (benthic and floating algae): Halimeda, sargassum, padina, turbinaria

INSTRUCTIONAL STRATEGIES (At the Bay):
The 2-hour field trip to Hanauma Bay will provide relevant ecosystem connections to the benchmarks being addressed.

Site Observations: After the initial park orientation to appreciate the uniqueness of the nature preserve, students will observe key areas from the upper park lookout to identify different areas that will be referenced in the HBEP classroom. Students will assemble in the classroom to review relevant concepts learned previously and to continue learning activities focused on the grade 7 benchmarks.

Classroom Activities:

- View Hanauma Bay Education Video (10 minutes)
- Assessment of ecosystem knowledge in small groups, using a KWL
- Class review of definitions and food web interaction concepts in the ecosystem (e.g., photosynthesis, cellular respiration, interaction vs. dependence, carrying capacity, sustainability)
- Group work to construct a marine food web using laminated pictures connected with arrows to show the direction of energy flow. Utilize observation data to build food webs.
- Focus on matter and energy flow interactions of zooxanthellae and coral reefs, metabolic processes influencing organism survival, factors affecting optimum coral reef growth, conditions affecting carrying capacity and sustainability of the reef ecosystem at Hanauma Bay.
- If time permits, utilize relevant visuals to describe symbiotic relationships typically found in the marine ecosystem; factors influencing optimum growth of different coral species; or human activities affecting carrying capacity and sustainability of the Hanauma Bay ecosystem.
- Supplies needed: *Grade level benchmarks on chart paper, blank chart paper, marker pens, laminated organism and arrow cards with velcro backing, blank laminated cards, overhead pens, copies of partially completed student KWL worksheets, class charts of key concepts.*

http://oceanservice.noaa.gov/education/kits/corals/media/supp_coral02a.html

Extensions:

- Optimum growth conditions (coral reefs)
- Impact of humans and environmental conditions on Hanauma Bay populations
    - o Fish feeding
    - o Predictions of reef with more/fewer algae-eaters

INSTRUCTIONAL STRATEGIES (Back at the school)

- **Extension Activity:** Identify how the food web uses different types of energy. Using colored dots to represent each different type of energy (e.g., light, chemical, mechanical, heat), identify where in the food web each type of energy is being transferred or transformed and explain the process and/or end results.

- **Summative SEEI** (State, Elaborate, Exemplify, Illustrate): In narrative form to determine the quality of student understanding. Select one of the SEEI statements provided in the grade 7 tool kit or create a focused statement that students will demonstrate their understanding of the benchmark concepts after visiting Hanauma Bay.

- **Long-term Inquiry Investigations:** Independent inquiries to investigate factors that influence coral larvae growth (per Gerry Davis, NOAA). In other words, use the inquiry process to answer student wonderings about the effects of different environmental conditions on optimum coral larvae survival. Alternative inquiries could also focus on biotic and abiotic factors influencing the growth of specific macroscopic algae species in Hanauma Bay (e.g. turbinaria, the preferred food of turtles).

• **Supplemental Activity:** Review of the literature comparing the Northwest Hawaiian Islands and the main Hawaiian Islands to support a point of view for the following question, "What would a reef be like if there were less top predators or carnivores like ulua, sharks, etc. vs. more top predators or carnivores?"

• **Social Studies Learning Activity:** Keeping in mind the food web concepts learned and the discussions of how people may affect food webs, students will research the positive and negative impacts (historically and currently) that humans have on Hanauma Bay. In other words, summarize the events that have previously occurred and the current practices that govern the management of the Hanauma Bay Nature Preserve.

ASSESSMENTS (FORMATIVE):

The following formative assessments help to inform instruction and provide learner feedback during the learning activities at the bay:

• KWL worksheets completed at the school (focused on 3 different benchmarks).

• SEEI worksheets to clarify concepts prior to field trip (refer to tool kit).

• Group review in the HBEP classroom (charting) of photosynthesis vs. respiration, interaction vs. dependence, carrying capacity vs. sustainability.

• Group charts of major concepts such as the food web, photosynthesis, cellular respiration, carrying capacity, sustainability, interaction, dependence (to post in the HBEP classroom).

• HBEP classroom discussion including the definitions of biotic/abiotic and identification examples of each in the bay's ecosystem.

• Group charting of food web definition.

• Collaborative creation of food web (wall with cards, arrows and yarn).

• Group definitions of cellular respiration.

• SEEI of benchmarks 7.3.1 and 7.3.2.

• Factors/optimum conditions for coral survival.

• Drawing/description of reefs where algae-eater populations vary (more/less).

EVALUATION (SUMMATIVE):

Student work can be evaluated to make judgments on learning results using the following tasks:

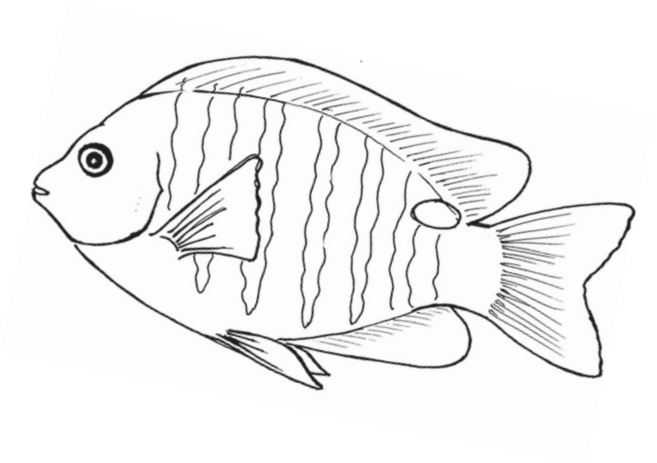
• Use the SEEI model/criteria to show learning. Teacher provides the appropriate food web conceptual statement and students input additional information to clarify and elaborate (give more detail) on the statement. Give an example of an authentic food web found in Hanauma Bay and describe how the organisms in your food web interact. Create a labeled diagram to illustrate the food web described.

• Use SEEI to connect benchmarks 7.3.1 and 7.3.2 in a narrative format.

• Complete and refine the original KWL sheets

• Optional extensions: Logic of human impact at Hanauma Bay (refer to attached template) or lab reports of inquiries on the factors affecting optimum growth of algae or coral larvae.

• Essential question: What is the carrying capacity of people at Hanauma Bay?



Grade 7 Hanauma Bay Observations

Name: ..... Date: .....

Key Points of Reference:

- Reef
- Key hole / Open Water
- Rocky shoreline

Essential Question: How do interactions of organisms in different areas of Hanauma Bay vary?

Observations:

Wonderings / Questions: