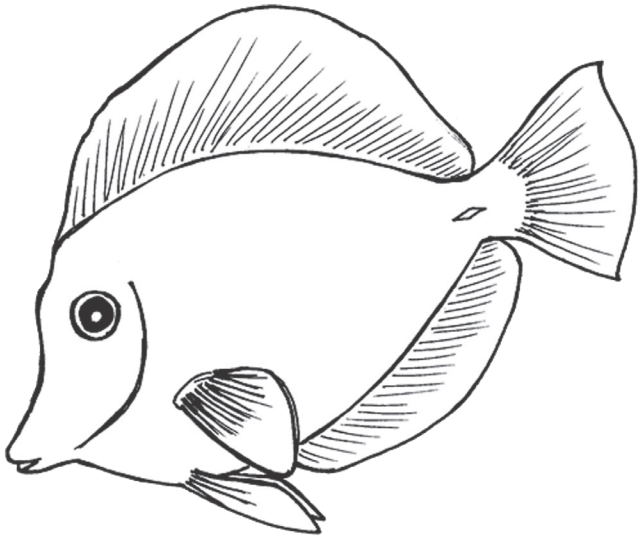


Hanauma Bay Education Program

Grade 7
Interactions of Organisms in the Marine Environment

Tool Kit

UNIHI-SEAGRANT-EE-08-01

Grade 7 Conceptual Statements for SEEI Strategy

- Solar energy that enters the ecosystem is converted into chemical energy that moves through the ecosystem by way of food webs.

- Matter in an ecosystem (i.e. food, water, air) is constantly being changed in form and recycled through the environment.

- Energy stored in the cells and tissues of organisms is passed through the ecosystem by way of the food chain / webs.

- Organisms at each level use chemical energy to carry out their life processes. In addition, energy is lost at each level as heat to the environment. Consequently only 10% of the energy present at one level is passed to the next feeding level.

- Plants, algae and some bacteria take in carbon dioxide from the environment and use it to make food through the process of photosynthesis. Oxygen is released back to the environment as a waste product of this process.

- Most organisms get energy by combining oxygen from the air with food in a process known as cellular respiration. Carbon dioxide is released back into the environment as a waste product of respiration.

- Food webs show transfers of matter and energy in interconnected feeding relationships.

- Photosynthesis converts light energy into chemical energy to support survival of life forms on Earth.

- Cellular respiration converts chemical energy from food to appropriate energy forms to support life processes.

- Photosynthesis and cellular respiration support movement of energy through food webs in Hanauma Bay.

- Marine organisms interact and depend on each other for survival in a variety of ways at Hanauma Bay.

• Biotic and abiotic factors affect the carrying capacity and sustainability in the Hanauma Bay ecosystem. In other words, factors like available resources, disease, competition, predation, climate, and habitat affect the health and carrying capacity of the ecosystem at Hanauma Bay.

• Carrying capacity of an ecosystem is determined by the availability of food, water and favorable habitat.

• The carrying capacity of an ecosystem is the size of the population that can be supported indefinitely upon the available resources and services of that ecosystem.

• Sustainability involves the long-term interaction of humans and nature without damage to the environment or society.

• Living within the limits of an ecosystem depends on the amount of resources available in the ecosystem, the size of the population, and the amount of resources each individual is consuming.

• Sustainable development meets the needs of the present without compromising the needs of future generations to meet their own needs.

• Sustainable development improves the quality of human life while living within the carrying capacity of the ecosystems.

• A sustainable community is one which recognizes that growth occurs within some limits and is ultimately limited by the carrying capacity of the environment.

Hanauma Bay Grade 7

Carrying Capacity

STATE:

The carrying capacity of an ecosystem is determined by the availability of food, water and habitat/shelter.

ELABORATE:

In other words…

The number of living organisms that can be supported by a particular ecosystem is influenced by three basic factors. One of the crucial factors is the availability of food -- quantity as well as type of food. The presence or quantity of available water is another important factor that determines the number of individuals that are able to survive in that environment . Finally, all organisms require a specific space in order for them to survive. These three factors – food, water, shelter—will determine the carrying capacity of an ecosystem.

EXEMPLIFY: *For example…*

at Hanauma Bay the different fish populations are affected by the quantity of food available to each species. If the population increases, the food supply decreases; consequently the population of fish is affected. Or if the fish require a specific habitat to live in and the space is destroyed or occupied by others, that would affect population numbers.

ILLUSTRATE:

"*Oh Fish*" scenario demonstrates the effects of food, water, shelter/habitat on the carrying capacity of the environment for a population of fish (first without fishermen, and later with fishermen introduced to the environment).

Hanauma Bay Grade 7

Food Webs

STATE:

Food webs show transfers of matter and energy in interconnected feeding relationships.

ELABORATE:

In other words…

a food web is a system of several overlapping food chains. A food chain shows only one energy path in an ecosystem. But most organisms are part of more than one food chain. Food webs show a more complete picture of the flow of energy in an ecosystem.

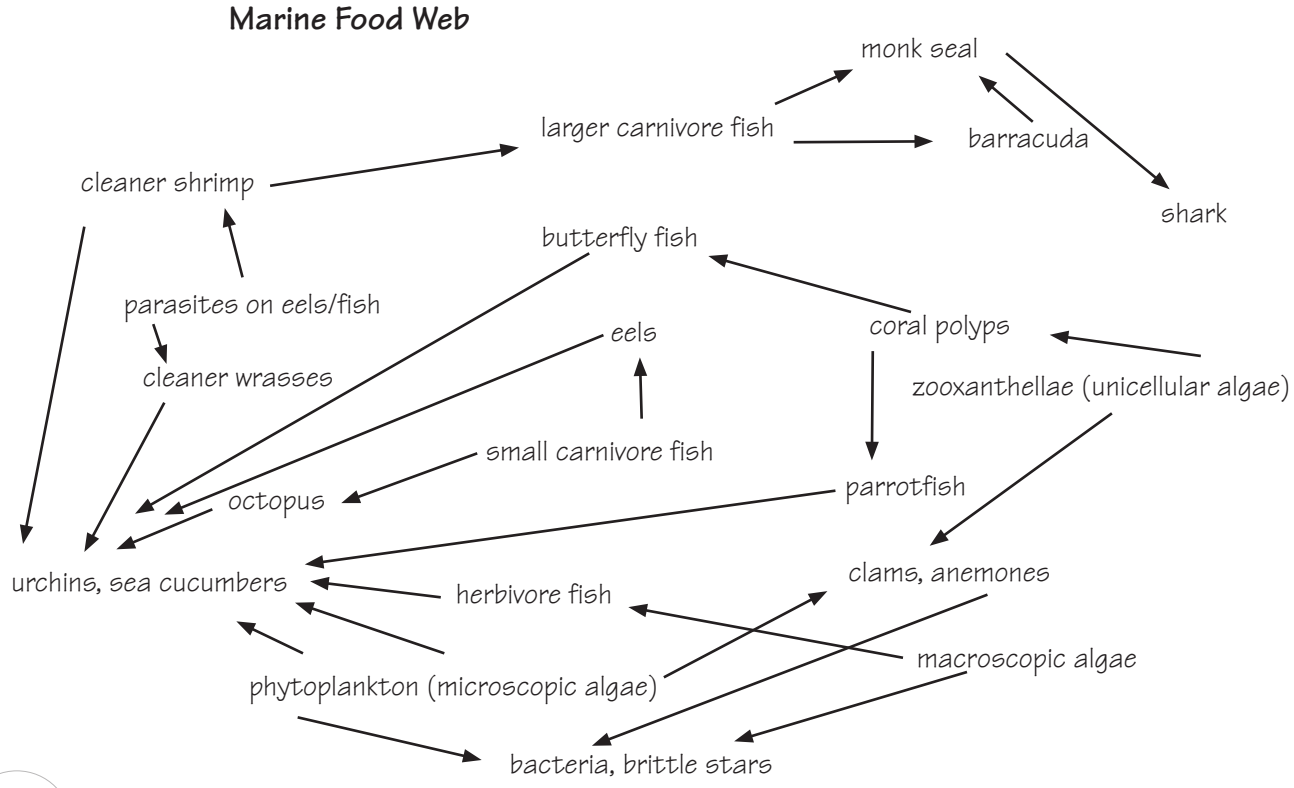
All organisms need energy from food to survive. Organisms (producers, consumers, decomposers) are grouped based on how they get the energy they need to live. A food chain traces the path of energy as it moves from one organism to the next in the ecosystem. As with most ecosystems, the energy in Hanauma Bay starts with the sun. This light energy is taken in by the producers (e.g. algae, plants, bacteria) and converted to food energy through photosynthesis. The chemical energy in the food then moves through different levels of consumers (herbivores: plant-eaters, carnivores: eat herbivores and other carnivores, omnivores: feed on producers and consumers). Arrows show the direction of energy movement in a food chain or web. The movement of energy ends with the many bacteria and fungi that live in the substrate (sand, mud, reef) at the bottom of the bay. These decomposers feed on the wastes and remains of marine organisms. As they feed, they break down the organisms' tissues into valuable materials that are then returned to the ocean ecosystem.

EXEMPLIFY:

For example…typical food webs in Hanauma Bay start with producers (*e.g.* phytoplankton,limu) that are eaten by herbivores (*e.g.* zooplankton, featherduster worms, surgeonfish, sea urchins, tangs, snails, butterflyfish) which are then eaten by carnivores or omnivores (*e.g.* mamo, crabs, eels, octopus, snappers, goatfish, barracuda, wrasse)…..the apex predator carnivore being the ulua or shark. Decomposers include organisms like crabs, sea cucumbers, urchins, brittle stars and bacteria will break down waste and marine organism remains into useable materials in the ecosystem.

ILLUSTRATE:

(draw food web using arrows to show direction of energy / matter movement from producers to consumers (herbivores, carnivores or omnivores) and finally to decomposers.



Hanauma Bay Grade 7

Photosynthesis

STATE:

Photosynthesis converts light energy into chemical energy to support survival of life forms on Earth.

ELABORATE:

In other words…

photosynthesis is the process that happens in green plants (and some other organisms) that uses sun energy to combine inorganic molecules (carbon dioxide and water) to form an organic molecule (glucose) and a waste product of oxygen (gas). Photosynthetic cells contain the green pigment, chlorophyll, which traps energy from the sun to conduct the process of photosynthesis. The glucose produced in the process is the chemical energy source that is transferred to other living things in food chains/webs through predator-prey interactions. Therefore, light energy is transformed to chemical energy in photosynthesis. Photosynthetic organisms are the **producers**. Chemical energy (glucose) is passed on to primary (herbivores), secondary (carnivores) and tertiary (apex) **consumers** and used to produce the ATP energy they need for survival. *The process that produces ATP for all living things is cellular respiration (see separate SEEI for cellular respiration).*

EXEMPLIFY: *For example…*

Macro algae (limu) and microscopic algae floating in the water (phytoplankton) trap sun energy with their chlorophyll molecules. Through photosynthesis these producers (algae) transform light energy into chemical energy (glucose). When the algae are eaten by herbivores (e.g manini, butterflyfish, snails) or omnivores (e.g. nenue, crabs ,shrimp) the chemical energy is tranfered to the consumer to be used for all the cell activities necessary for survival. These activities include making enzymes and hormones, cell division to grow larger or repair body parts, using the ATP energy to move muscles to search for food or escape from predators.

ILLUSTRATE:

$CO_2 + H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + O_2$

carbon dioxide + water + sunlight → glucose + oxygen

STATE:

ELABORATE:

EXEMPLIFY:

ILLUSTRATE: