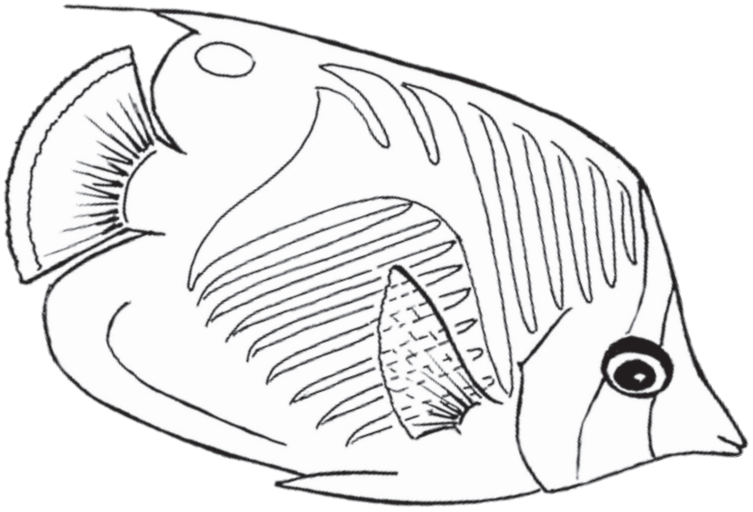

Hanauma Bay Education Program

Grade 6
Matter and Energy Transfers

Tool Kit

UNIHI-SEAGRANT-EE-08-01

Hanauma Bay Grade 6

Cellular Respiration

STATE:

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

ELABORATE:

In other words…

cellular respiration is the process (occurring in mitochondria of cells), that chemically combines oxygen with food molecules (sugar) to release energy. Both plant and animal cells need chemical energy in the form of a molecule called ATP (adenosine triphosphate) and cellular respiration is the process that produces / replenishes the ATP supply in the cell. The cell is then able to conduct cellular activities using this available ATP. These activities include making molecules the cell needs (e.g., enzymes, hormones, cell structures, etc.), getting rid of wastes, contraction of muscles for movement, cell reproduction for growth, development or maintenance of structures.

EXEMPLIFY:

For example…

Shrimp, snails and herbivore fish (e.g. butterflyfish and tangs) eat algae growing in the reef ecosystem. Cellular respiration chemically combines the digested plant material (glucose) with oxygen (diffusing into the cells from the water), to release energy that is used to produce ATP molecules and waste products of carbon dioxide and water. The ATP is now available for the animals to move muscles to escape from predators, move in the environment to find more food, produce more cells through mitosis to grow or replace damaged cells, produce gametes (sperm and eggs) for reproduction. These are examples of some of the many activities that occur as a result of the energy that the mitochondria release through cellular respiration.

ILLUSTRATE:

$C_6H_{12}O_6 + O2 \rightarrow CO_2 + H_2O +$ ATP energy

Glucose + Oxygen → carbon dioxide + water + adenosine triphosphate

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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.

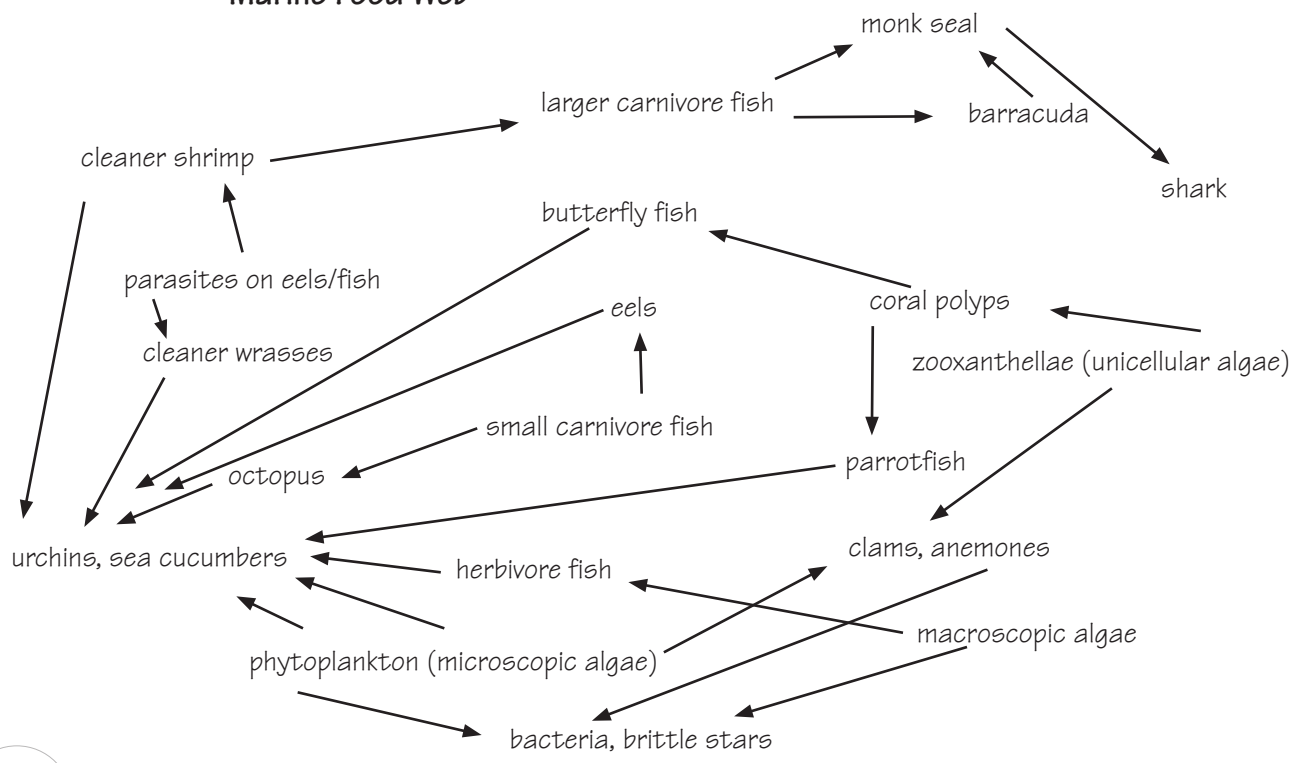
EXEMPLIFY:

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.

Marine Food Web



Hanauma Bay Grade 6

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: