

Hanauma Bay Education Program

Grade 6
Matter and Energy Transfers



Matter and Energy Transfers

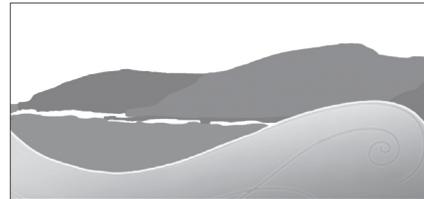
BENCHMARKS:

6.3.1 Describe how matter and energy are transferred within and among living systems and their physical environment.

6.6.1 Compare how heat energy can be transferred through conduction, convection, and radiation. (Observe examples of energy transfer during visit; post-visit classroom activity can investigate heat energy transfer questions).

GLOS:

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



BIG IDEA(S)

The goal of the Hanauma Bay Education Program (HBEP) for grade 6 is to clarify how matter (i.e., chemical energy) and energy (i.e., light and heat) can be transformed and transferred through and between organisms and the physical environment at Hanauma Bay.

Another critical observation at the bay is how heat energy is transferred through radiation, conduction and convection in the terrestrial and aquatic environments.

EVIDENCE/CRITERIA:

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

1. Describe how living organisms at Hanauma Bay transfer matter and energy to survive in their physical environment.
2. Compare the different ways heat energy is transferred through radiation, conduction and convection at Hanauma Bay.

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 (e.g., 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.
- Introduction to and adequate preparation on specific, relevant science concepts will maximize the value of the HBEP experience.
- Precise group protocols and safety directions (e.g., on the bay ledge area) will be clarified before the walking tour.

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: matter, energy, food web, photosynthesis, cellular respiration, types of energy - mechanical, potential, chemical, wave, light, heat (radiation, conduction, convection).

TEACHER PREPARATION:

Teacher will introduce students to the concepts discussed in standards 6.3.1 and 6.6.1 in the classroom prior to the Hanauma Bay trip. Refer to the worksheets provided in the grade 6 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:

Living systems- Groups of living things that are self-organizing and that exchange energy and matter with their environment.

Physical environment- The surroundings in which a living organism exists. The physical environment includes water, land forms, sand, soil, climate.

Matter- Matter occupies space, has mass, and is composed predominantly of atoms consisting of protons, neutrons, and electrons. Atoms make up elements like carbon, hydrogen, oxygen and nitrogen.

Energy- The ability to do work. The ability to make things move or to make new chemical compounds. Work is done when a force (a push or a pull) acts on something for a distance. Energy can transform from one type of energy (chemical energy) to another type of energy (mechanical energy). Energy never goes away, it just transforms from one type of energy to another type of energy. Living organisms use energy to grow (make new molecules), reproduce, move (contract muscles), breathe, etc.

Food web- A network of feeding relationships. Food chains are a sequence of transfers of matter and energy from organism to organism in the form of food (chemical energy). Plants, which convert solar energy to food by photosynthesis, are the primary food source. In a



predator chain, a plant-eating animal (herbivore) is eaten by a carnivore. The final link is made up of decomposers that break down dead organisms and organic waste (detritus). Food chains overlap and interconnect into a food web because most organisms consume more than one type of animal or plant.

Photosynthesis- The process that plants use to make food. 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.

Cellular respiration- The process that cells use to produce the energy that they need for reproduction, growth, movement etc. Sugar and oxygen are converted to energy and waste products of carbon dioxide and water.

Types of energy Mechanical energy/kinetic energy (wind energy, wave energy), light energy, radiation, heat energy, chemical energy, electrical energy.

Mechanical energy- This is the most common type of energy that we see around us. All moving objects have a type of mechanical energy called kinetic energy. When objects move, some of this energy can turn into heat energy. When a fish is swimming, this movement is mechanical energy. In this process the fish also generates heat.

Potential energy- Stored energy that can be translated into other forms of energy, such as kinetic energy. The food that the fish eats is potential energy which then can be converted to other forms of energy.

Chemical energy- Energy stored in matter in the form of chemical bonds between atoms and molecules. Chemical energy can be used by living things to move, reproduce, grow, etc.

Wave energy- Energy can travel in the form of waves. At Hanauma Bay we can observe ocean waves. Movement in the water due to wave energy can influence the types of fish, invertebrates, and limu (algae) living in an area. For example, in an area with lots of wave energy "surge zone" fish have different swimming adaptations.

Light energy- The transfer of energy as electromagnetic waves. Only part of the electromagnetic spectrum is visible (i.e., red, orange, yellow, green, blue, indigo, violet). UV light has shorter wavelengths compared to visible light. Radiation of light energy can occur through empty space (e.g., sun heats Earth through radiation.) When light hits the surface of matter it is reflected (bounced off), refracted (deflected slightly as it passes through), or absorbed (by atoms and usually converted to another form e.g., thermal energy).

Heat energy- Energy moving from a higher temperature object to a lower temperature object. The heat energy of a substance is determined by how active its atoms and molecules are. A hotter object is one whose atoms and molecules are excited and show rapid movement. A cooler object's atoms and molecules will be less excited and show less movement.

Conduction- The transfer of heat from a warmer substance to a cooler substance through direct contact. On contact, the energy from the faster-moving particles is transferred to the



slower-moving particles until the particles in both substances are moving at the same speed and their temperature has equalized.

Convection- The transfer of heat in a fluid through currents (particles move because of temperature differences. Molecules in hot medium move fast therefore density decreases and molecules rise. Conversely, molecules in a cold medium sink because density is higher. These temperature/density differences create circulation of molecules (i.e., currents). Therefore, convection currents transfer thermal energy throughout the water.

Additional Resources:

Fitting Algae into the Food Web- Energy Flow thru the Ecosystem:

http://www.bigelow.org/edhab/fitting_algae.html

INSTRUCTIONAL STRATEGIES (At the Bay):

The 2-hour field trip to Hanauma Bay will provide relevant ecosystem connections to the benchmarks being addressed. After the initial orientation to appreciate the uniqueness of the facility, students will review prior knowledge relevant to their bay experiences before taking a structured walking tour of key areas.

Classroom Activities: (30 minutes)

- View Hanauma Bay Education video (10 minutes)
- Pre-assessment of energy knowledge in small groups, using a KWL
- Class review of definitions and key concepts for energy and matter flow through the ecosystem
- Trace matter and energy flow interactions in the environment
- Supplies needed: grade level benchmarks on chart paper, blank chart paper, marker pens, blank laminated cards, overhead pens, copies of partially completed student KWL worksheets, class charts of key concepts.

Walking Tour / Field Observations: (30 minutes)

- Clarify field observation protocols/ distribute data sheets
- Walking tour in assigned groups
- Observations on the near shore ledge
- Observations in the parking lot
- Supplies needed: clipboards, pencils, observation data sheets for tour, fish/invertebrate ID cards or books

After the walking tour, assemble back in the classroom and utilize observation data to build food webs. Chart agreements. *Supplies needed for classroom activities: benchmarks written on chart paper, laminated organism and arrow cards with velcro backing, chart paper, pens, colored dots, blank laminated cards, overhead pens, camera (optional).*



If time allows, implement the following extension or optional activities:

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. Trace the energy and matter flow through a food web at Hanauma Bay. Begin with the following conceptual statement: *Living organisms at Hanauma Bay transfer matter and energy to survive in their physical environment.*

Or start with the energy statement: *Heat energy is transferred in a variety of ways at Hanauma Bay through radiation, conduction and convection.*

- **Inquiry Investigations** are a variety of independent inquiries to answer the heat transfer questions generated from the walking tour data collection at Hanauma Bay. In other words, use the inquiry process to answer student wonderings about radiation, conduction or convection in the transfer of heat energy.

- **Supplemental Activity.** Focus on human impact by adding humans to the food chain. Contrast the energy and matter flow through the ecosystem at Hanauma Bay with and without fish feeding. *Resources: fish feeding pictures and history. Pre and post feeding estimates of fish biomass, fish diversity information, amount of food added to the system by humans, online web sites with relevant data. Follow the logic template (sample attached).*

ASSESSMENTS (FORMATIVE):

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

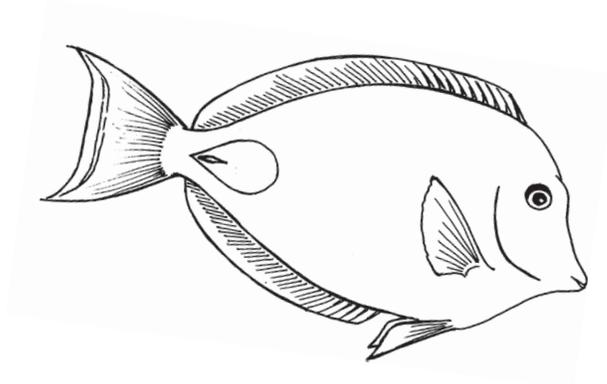
- Prior knowledge check: KWL on energy and/or matter flow
- Class review of relevant science concepts
- Typical (generic) food web interactions
- Unique (specific) food web(s) at Hanauma Bay
- Energy transformations observed at Hanauma Bay



EVALUATION (SUMMATIVE)

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

- Completion and refinement of original KWL sheets.
- Diagram and description of Hanauma Bay food webs as examples of matter/energy flow within/ among living systems and their physical environment.
- Narratives using the SEEI format: the flow of matter or energy transformations and transfers that affect survival of organisms at Hanauma Bay or heat energy transfers through radiation, conduction or convection.
- Optional extensions: logic of human impact at Hanauma Bay (refer to attached template) or inquiry investigations related to heat energy transfers.



Grade 6 Shoreline Observation: Food Chains and Webs

Name: Date:

1. Place a check mark next to each type of marine life that you observed today.

Producers-Photosynthetic:

Limu: Algae

Ko'a: Coral

Algae Eaters-Herbivores:

Amaama: Striped Mullet

Manini: Convict Tang

Wana: Rock Boring Sea Urchin

'A'ama: Flat Rock Crab

Pipipi: Black Nerite

Pūpū Kōlea: Dotted Periwinkle

Pāku'iku'i: Achilles Tang

Umaumalei: Orangespine Unicornfish

Uhu: Redlip Parrotfish

Pāo'o: Zebra Blenny

Kūpīpī: Blackspot Sergeant

Unauna: Hermit Crab

2. Add any other marine life that you observed that is not on the list.

Animal Eaters-Carnivores:

'Ōmilu: Bluefin Trevally

Puhi: Snowflake Moray Eel

Moano: Manybar Goatfish

Hinālea: Saddleback Wrasse

'Āwela: Christmas Wrasse

Humuhumunukunukuāpua'a: Reef

Triggerfish(*eats algae too)

Plankton Eaters:

Āholehole: Hawaiian Flagtail

Mamo: Hawaiian Sergeant

Coral Eaters:

Lauhau: Fourspot Butterflyfish

Kikākapu: Threadfin Butterflyfish

Kikākapu: Raccoon Butterflyfish

Sponge Eaters:

Kihikihi: Moorish Idol

3. Did you observe any marine life feeding or near its food source?

If yes, note them below:

Type of Marine Life

Food Source



Grade 6 Shoreline Observations



Grade 6 Shoreline Observation: Energy Observations

Name: Date:

Describe and give example(s) of each type of energy or energy transfer that you observe at the bay.

1. Describe each type of Energy:

Solar Energy-

Mechanical Energy-

Heat Energy-

Wave Energy-

Wind Energy-

Electrical Energy-

2. Example of each type of Energy:

Solar Energy-

Mechanical Energy-

Heat Energy-

Wave Energy-

Wind Energy-

Electrical Energy-

3. Describe Heat Energy Transfer:

Conduction-

Convection-

Radiation-

4. Example of Heat Energy Transfer:

Conduction-

Convection-

Radiation-



Grade 6 Shoreline Observations



Logic of Human Impact at Hanauma Bay

<p>Point of View</p> <p>Human actions will always have consequences for the environment, both positive and negative.</p>	<p>Purpose</p> <p>To determine the impact of humans on the marine and terrestrial ecosystems at Hanauma Bay.</p>	<p>Assumptions</p> <ul style="list-style-type: none">• Awareness and anticipation of the implications of certain actions are valuable proactive strategies.• Humans can control how their actions will impact the environment.
<p>Questions</p> <ul style="list-style-type: none">• How has modifying the energy and matter flow (e.g., fish feeding ban) affected the marine ecosystem, specifically the homeostasis?• How has the management of visitor numbers affected the terrestrial and aquatic ecosystems at the bay?• How has fish biomass and diversity changed with the implementation of visitor guidelines?	<p>Information</p>	



Concepts

Conclusions

Implications

Reflections

