CHAIN OF LIFE

FOR THE TEACHER

Discipline
Biological Science

Theme
Diversity, Systems and Interactions

Key Concept
All sandy beach organisms are connected to each other and to their habitat. Even a small change in the sandy beach habitat or the action of one of the organisms living there can affect all the other sandy beach organisms.

Synopsis
Students wear pictures of sandy beach organisms and elements of the habitat and then hold hands, building a chain to demonstrate interdependence.

Science Process Skills
observing
communicating
comparing

Social Skills
sharing ideas and information
checking for agreement

Vocabulary
food chain
interdependence
abiotic
biotic
prey
food web
primary producer
herbivore
carnivore
predator
scavenger

MATERIALS

INTO the activities
- 5 sheets of butcher or chart paper and marking pens to record student ideas
- masking tape

Optional
- a picture for each student of one item from the following Living and Nonliving lists or an actual item from the Garbage list. Mount the pictures on pieces of poster board or cardboard to make them durable and easy to see. Put the name of the item and a sentence or two describing it on the back of the board and laminate.

Note: See the Sandy Beach activities "Build A Sandy Beach" for sentence descriptions, illustrations, and information on each of the organisms listed below and "Ears To You" for illustrations of sea lions and harbor seals.

* The numbers in parentheses are how many to make of each item in order to have enough for a class of 36 students (see the eight Potential Chains listed below for a description of how to tailor this activity to your class size).

Living
Plankton
Phytoplankton (2)
Zooplankton (4)
Larger zooplankton—shrimp (1)
Sand (mole) crab (1)
Clam (1)
Sea star (1)
Beach hopper (1)
Rove beetle (1)
Kelp fly (1)
Pseudoscorpion (1)
Bloodworm (1)
Bristle worm (1)
Small fish (herring) (1)
Surfperch (1)
Jellyfish (1)
Willet (2)
Snowy Plover (1)
Turnstone (1)
Peregrine falcon (1)
Sea Turtle (1)
Sea Lion (1)

Nonliving
Sun (1)
Currents (3)
Sand (1)

Waves/Tides (1)
Sea star (dead) (1)
Giant or Feather boa kelp wrack (1)
Beach wrack (1)

Garbage
Plastic bag (1)
Fish entangled in a net (1)
Plastic pieces (1)
Fishing line, nets, or plastic six-pack rings (1)
Silt (6) (add water to small plastic containers with tight-fitting lids—add a couple tablespoons of dirt and shake)

Alternate Illustrations
Bat ray
Native American
Person (other than Native American)
Holdfast
Sanderling
Moon snail
Harbor seal

THROUGH the activities
• paper punch
• string to make the pictures or garbage items into necklaces for students to hang around their necks. To make necklaces, punch holes in the top corners of each picture and tie a piece of string through the holes to form a loop. Necklaces of actual items from the Garbage list can be made, for example, by looping string through a few plastic six-pack rings so that a student can wear the objects around his/her neck and can have his/her hands free.
• blackboard and chalk, or chart paper and marking pens to sketch the food chain as it forms
• masking tape
• paper and pencils or pens for students
• key concept written in large letters on a strip of butcher or chart paper
Optional
• a picture for each student of one item from the "Living" and "Nonliving" lists or an actual item from the "Garbage" list. Mount the pictures on pieces of poster board or cardboard to make them durable and easy to see. Put the name of the item and a sentence or two describing it on the back of the board and laminate.
NOTE: See the end of the activity "Build A Sandy Beach" for sentence descriptions, illustrations, and information on each of the organisms listed in the INTO materials section.

BEYOND the activities
- colored construction paper and other simple craft materials

Optional
- yarn (four different colors)
- large construction paper (11 X 17 inches is ideal) and fine point marking pens or crayons for mini-books

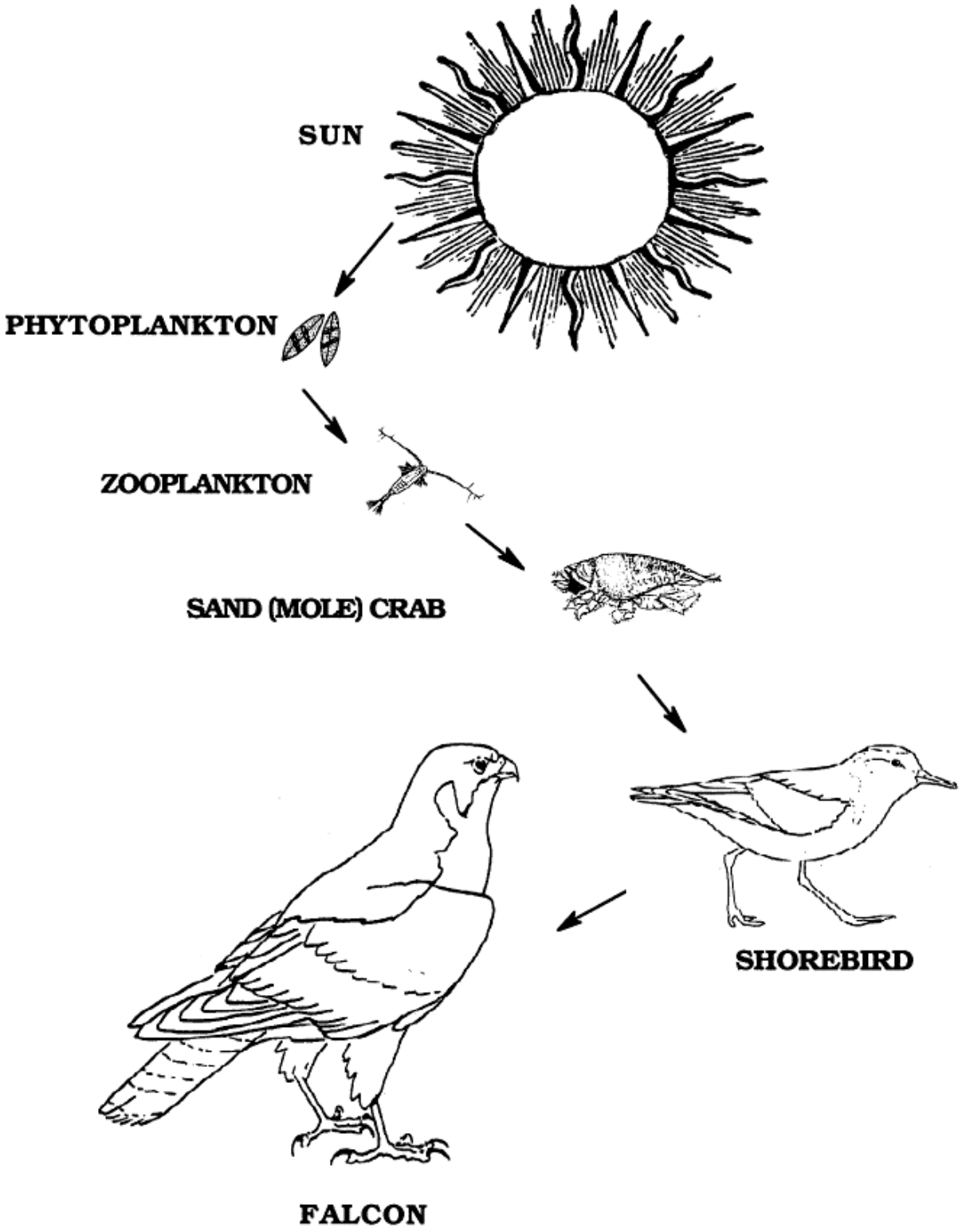
INTRODUCTION

All elements of an ecosystem or habitat are interdependent; they could not survive without each other. At the sandy beach, organisms need both biotic (living) and abiotic (non-living) elements in their surroundings to live. All parts of the sandy beach environment—insects, worms, clams, jellyfish, shorebirds, shells, sand grains, crab molts, plankton, pieces of kelp, and driftwood washed up by the waves—are connected. A change in any one element will have an affect on everything, living and non-living, that shares this habitat.

A **food chain** is a representation or diagram that shows interdependence by outlining the series of steps by which energy is passed in a community. In a drawing of a food chain, interdependence is demonstrated with lines and arrows that connect organisms and abiotic factors or predators and their prey. The pathway described below traces a food chain from primary producer to top predator.

A predator and carnivore, such as a peregrine falcon, is directly and indirectly connected to several biotic and abiotic factors. Here is one possible example of the complex pathway by which a peregrine falcon receives its food. The sun provides energy that allows producers, such as phytoplankton, to generate food. Phytoplankton also rely upon waves and current action to bring them into contact with sunlight, minerals (abiotic) and other materials they need to be able to photosynthesize. Zooplankton feed upon the phytoplankton and other zooplankton and are then washed ashore by waves. Sand (mole) crabs on the beach filter phytoplankton and zooplankton out of the water and feed upon them. Just as they need waves to bring them food, sand crabs rely upon the sand for a place to hide. Shorebirds, such as sanderlings, find and eat the sand crabs. The well-fed shorebirds fly near the cliffs by the beach where peregrine falcons nest. The falcons attack and kill shorebirds in mid-air and then return to their perch to eat them.

The diagram on the next page shows these relationships pictorially.



Since they depend upon small birds as their main food source, peregrine falcons cannot thrive unless all parts of the ecosystem, which results in well-fed shorebirds, are flourishing. The removal or disturbance of any one link in the food chain can disrupt the entire chain or can ultimately cause its collapse. For instance, if silt from construction or agriculture is carried down rivers and deposited on the shore, it can smother and kill barnacles, sand crabs, and other filter feeders. Shorebirds, which rely on sand crabs as a main food source, will not thrive, and peregrine falcons will not have enough to eat and will have to seek an alternate food source.

Human activity onshore or offshore can have detrimental effects on sandy beach food chains. Human garbage dumped near the beach such as plastic bags, six-pack rings, and pieces of plastic may be mistaken by animals for food and they may be strangled or suffocated by it. Animals can also become entangled by drift nets, causing them to drown. Pesticides used on agriculture fields or spilled into rivers may be washed downstream and can kill sandy beach organisms. Oil spills can cover beaches, making them uninhabitable, or can coat animals, inhibiting their ability to feed, keep warm, or reproduce. Whether humans affect specific organisms or all the elements of a food chain, our activity has the potential to disrupt the chain or cause it to break down.

INTO THE ACTIVITIES

What's on the Sandy Beach Brainstorm

1. Divide students into five or six cooperative groups. Tape three sheets of chart paper to the wall and write "Living" at the top of one of the sheets, "Nonliving" on the second, and "Garbage" on the third sheet. Ask students to brainstorm all the organisms (dead or alive), non-living things (sand, waves, minerals, currents, foam), and the human garbage they might see if they took a walk on a sandy beach. As each suggestion is given, ask students to help you decide which chart to list it on. Use a single column for each list.

2. Ask the students:

• What are some of the ways animals use the sandy beach? *[as a home, to find food and mates, to get warm, to give birth, to escape predators, waves wash them ashore].*

• How did some of the other stuff get to the beach? *[garbage dumped off boats and washed ashore by currents and waves, garbage from picnics, dead animals washed ashore].*

As ideas are given, use an icon and/or simple word to list them on another sheet of chart paper.

3. Pass out the pictures, giving several to each group. Give a few students actual items from the garbage list. Have the groups sort their pictures into Living, Non-living, and Garbage categories. Tell the students that for each of

their items, they need to think about how it either uses the sandy beach (for a home, to find food, to escape predators) or how it got to the beach. Have students from each group present their ideas and items to the rest of the class. Help them record the name of the organism and their ideas on a chart at the front of the room.

My Buddy Says
See the Teaching Strategies section for how to present this activity.
Use the following questions/prompts or others you design.
1. Ask students:
• How do you depend on your parents or guardians? *[to give them food, love, a place to live, money].* • In what ways do your parents or guardians depend on you? *[chores, love, do homework, learn]*
In these ways they are interdependent on each other.

2. Now have the students imagine they are a mole crab or a shorebird living on the sandy beach.
• What do they need to survive? What are they dependent on? *[plankton to filter feed, waves to bring the food to them, sand to hide in for protection from the waves and birds].*
• In what way do other organisms at the sandy beach depend on the mole crabs? *[birds living there depend on them for food]*
These are the ways they are interdependent with the sandy beach.

THROUGH
THE ACTIVITIES

Interdependence and Food Chains Talk
Depending on the prior experience of your students and the previous discussions, introduce or review the following ideas:

• Many organisms on the sandy beach depend on non-living things or abiotic factors to survive *[sand gives organisms a place to hide, waves bring food to the shore, minerals help plants and animals to grow].* Some organisms, like phytoplankton and other plants, are primary producers. Primary producers absorb sunlight and use inorganic nutrients, water and dissolved gases found in their habitat, to make their own food.

• Some organisms on the sandy beach eat other living organisms to survive. Animals that eat other animals are carnivores—a bird that eats crabs is a carnivore. Animals that only eat plants are herbivores. Animals that eat dead plants and dead animals are scavengers, such as many crabs. Some animals that eat tiny plankton, such as mole crabs, filter their food out of the water and are known as filter feeders.

• The removal of one organism from the beach may affect all of the other organisms that live there, they are interdependent.

• Food chains show how organisms are interdependent as predator-prey or sun-plant-herbivore. It also shows how energy is transferred within the habitat from one organism to another.

Food Chain Game

1. Tell the students that they have the chance to become a part of the sandy beach food chain. Ask the students to imagine they are sanderlings on the beach.

• What might a sandy beach food chain with a sanderling in it look like?
[Sun—phytoplankton—zooplankton—mole crab—sanderling —peregrine falcon]

2. Divide the students into cooperative groups of three, four, or five students each. Make these groups different from the groups formed previously for the "What's on the Sandy Beach Brainstorm" (see INTO section). Before giving students pictures of items from the Living or Nonliving lists, arrange the pictures in groups of three, four, or five, depending on the size of the group. Each set of pictures should describe a sandy beach food chain so that each group of students can build their own chain. Add or subtract items from any chain to tailor the activity to your number of students.

Potential Chains: use all eight chains for a class of 36 students

• Sun—phytoplankton—zooplankton—mole crab—willet
• Currents—phytoplankton—zooplankton—clam—seastar
• Currents—zooplankton—larger zooplankton (shrimp)—surfperch—sea lion
• Currents—zooplankton—small fish (herring)—jellyfish—sea turtle
• Tides/Waves—dead seastar—gull
• Beach wrack—beach hopper—rove beetle—snowy plover
• Giant kelp wrack—kelp fly—pseudoscorpion—turnstone—peregrine falcon
• Sand—bloodworm—bristle worm—willet

Additional Chains: add these or substitute them for any of the above chains

Remember:
1. Have only **one** sun.
2. Include several chains with items that can be exchanged for garbage during the "Garbage Scenarios."
3. Make a picture card for each item in every chain you decide to use.

• Sun—phytoplankton—zooplankton—sand (mole) crab—willet or sanderling—peregrine falcon
• Sun—beach wrack—beach hopper—sanderling—peregrine falcon
• Currents—zooplankton—larger zooplankton (shrimp)—surfperch—harbor seal or person

- Sand—beach wrack—kelp fly—rove beetle—turnstone or snowy plover
- Sun—beach wrack—beach hopper—willet—peregrine falcon
- Beach wrack—beach hopper —snowy plover—peregrine falcon
- Giant kelp or feather boa kelpwrack—kelp fly—pseudoscorpion—rove beetle—snowy plover
- Holdfast—beach hoppers—snowy plover
- Clam—moon snail—bat ray or Native American

4. Give each student in the group one of the three to five pictures in a set. Have the whole class form a circle and wear their picture around their neck so that everyone can see them. One at a time, have each student hold up his or her picture or item and name it. This will introduce all students to each player in the "Food Chain Game."

5. Have all students sit down in the circle. Have each group, one group at a time, come outside the circle to form a food chain while the other students sit and watch. Choose the group with the sun to begin. Have the student holding the picture of the sun start the food chain by standing apart from the rest of that small group. Ask for a volunteer from the same group to describe how they are dependent directly or indirectly upon the sun. For example, a student with a phytoplankton picture could say, "I depend on the sun for energy so I can grow."

6. After the second student describes their connection to the sun, have them walk over and gently take the hand of the student with the sun picture. Have the two students hold hands and stand at the starting point outside the circle.

7. As the chain starts to form, quickly sketch it on the board by writing the name of the organism and connecting them together with lines and arrows.

8. Now have another student volunteer in the first group join the food chain after describing his or her connection to it. For example, if a student with the phytoplankton picture is already attached to the chain, the mole crab person could say, "I depend on phytoplankton to feed the zooplankton that I eat," and then take the hand of the phytoplankton person. Have the third student come up and hold the free hand of the student upon whom they are dependent. Students may attach to the chain either where a student has a free hand or to anywhere they can come up with a connection. If a student joins the chain where two students are already attached, the original two students should not let go of their original connection—just have the new student join hands at their connection.

9. After all members of one group are connected in a chain, ask them to remember their connections to the others in their chain and then sit down in the class circle. Now have another group form a chain while the class watches. Again sketch the chain on the board. Let each group choose who they want to

start their chain. Continue the game until every group has presented the sequence of their chain. After the last group is done, ask them to sit back down in the original circle with the rest of the class.

10. Now link all the groups or food chains together in a sandy beach food web. First have all students stand in their groups and hold hands as they did when they formed their chains for the rest of the class. Have the group with the sun stand where everyone can see them. Ask for a volunteer from one of the other groups to describe their connection to one of the links in the sun's food chain. After describing the connection, the student joins the sun's chain at the designated link, forming a connection between two groups. Continue building on the sun's chain until all five groups are connected. The class has now formed a complex food chain or web wherein everyone is connected directly or indirectly to each other and the physical environment.

Environmental Hazards: Garbage

1. Once all the students are connected together in a food chain, introduce the garbage items into the game, one at a time. Tell all the students to keep holding hands until you tell them to let go. Exchange the pictures for garbage yourself so the students do not have to let go of their neighbor's hand. You can place the garbage item at the student's feet.

2. After you take off a student's picture and replace it with garbage, relate the corresponding scenario as described below to the students. The student connected to the garbage must drop both their hands, breaking their links on both sides because they have been removed from the food chain.

Garbage Scenarios

1. Exchange the garbage necklaces for the students' cards as follows:

- Replace the jellyfish picture with the plastic bag.

Scenario: Instead of a jellyfish, there is now a plastic bag present in the habitat. Sea turtles love to eat jellyfish. Thinking the plastic bag was a jellyfish, the turtle mistakenly swallowed the bag. Because the esophagus of sea turtles has barbs inside, they are unable to regurgitate food once they swallow it. The turtle starved or choked to death on the plastic bag. Now the sea turtle has been removed from the food chain.

- Replace the surfperch (or other fish) picture with fish entangled in a net.

Scenario: The sea lion was chasing a fish and did not see that the fish was caught in a net. The sea lion then became entangled in the net and was drowned or strangled. Now the sea lion has been removed from the food chain.

- Replace the picture of a live sand (mole) crab with plastic pieces.

Scenario: Birds feeding on crabs mistook the brightly colored plastic pieces for their food items. They fed the plastic to their chicks, who then starved. Now the birds have been removed from the food chain.

- Replace the drift kelp picture with fishing line, nets, or plastic six-pack rings.

Scenario: Gulls scavenging in the drift kelp became entangled in plastic six-pack rings, fishing nets, or hooks and line. They were unable to fly or feed themselves and they died. Now the gulls have been removed from the food chain.

- Replace the plankton pictures with silt.

Scenario: Mole crabs, barnacles, and clams filtering the water for plankton were instead smothered by silt. Now mole crabs, barnacles and clams have been removed from the food chain.

2. As each garbage item is introduced, add it to the food chain sketch on the board.

3. After each student affected by garbage has broken his or her links in the food chain, ask the students to carefully observe the chain, which now lies in broken ruin.

Debriefing

1. Review the food chain diagram on the board with the students. Have students find their organism in the diagram and copy the part of the diagram which includes their organism and four other organisms in both directions. Have them label the diagram with an icon or simple words, such as predator, prey, and habitat, to describe how each of those nine organisms were interdependent or connected to the organisms on each side of them.

2. Now have the students draw a picture which shows how their organism was directly or indirectly affected by one of the garbage items.

3. Ask the students:

- If the chain they formed could have been constructed in a different way, with different connections?
- Have students make suggestions to form a different food chain as you diagram it on the board.
- Is this chain any better?
- Any worse?
- Would it still have been affected by the garbage?

4. Finally, hold up the key concept on butcher paper and have one or more students read it aloud. Post the concept on the wall near the "What's on the Sandy Beach" brainstorm charts.

BEYOND THE ACTIVITIES

3-D Food Chain

Have each student make a three-dimensional representation out of paper and other simple materials of the organism they represented in the "Food Chain

Game" and add it to a class mural on a bulletin board or in a large area in the classroom. Make sure all elements of a sandy beach food chain are constructed and included, even the physical factors and the garbage. Create an actual web by stringing yarn between different items, connecting the organisms and physical factors and showing their interdependence. You can even use four different colors of yarn to designate relationships between producers, herbivores, carnivores, and scavengers.

Mini-Book

See the Teaching Strategies section for how to present this activity.

Have students title their books, "A Sandy Beach Food Chain." Chapter titles can be:

Chapter 1: Living and Nonliving Things at the Beach
Chapter 2: Interdependence at the Beach
Chapter 3: Garbage in the Sandy Beach Food Chain.

Food Chain Mobile

Have students draw the organism they represented in the "Food Chain Game" on a strip of paper about 2" X 11". Loop each strip around the next, gluing the strip to itself to form a link in a growing paper chain. Have students decide and describe which links should be joined to each other.