Ocean Oasis™ Teacher's Guide

CONTENTS

Dear Teacher ,

Welcome to *Ocean Oasis*, a stunning film about the magic of Baja California, Mexico, and the Gulf of California—one of the richest seas in the world. The film explores this area through several themes that have global, as well as local, implications. On a geological level, tectonic forces and weathering shape and change the entire globe. The film illustrates how geographical location and circulation of the atmosphere affect climate. Life forms adapt to their diverse habitats in amazing ways. Many human activities affect local ecosystems, and the consequences of these activities can be far-reaching.

While the activities in this guide explore these themes with reference to the film, each activity also has a local connection to help students make conceptual bridges between their immediate region and *Ocean Oasis*. Many of the activities provide an opportunity to discuss conservation and the human impact on natural resources, regardless of locale.

Targeted for grades 4-8, the activities in the Teacher's Guide can be adapted for higher or lower grade levels. All activities have been correlated with the National Science Education Standards. In addition, many activities are interdisciplinary, involving language arts, mathematics, and history/social studies, as well as science knowledge and skills. Each activity is designed to stand alone. Activities may be used to prepare your students for viewing the film or as a post-film experience.

Each activity begins with one or more questions. Use the questions to introduce concepts and to assess what your students already know. Encourage questions and explorations. Keep in mind that *how* to find out is as important as *what* you know.

Please see the *Ocean Oasis* website at

www.oceanoasis.org

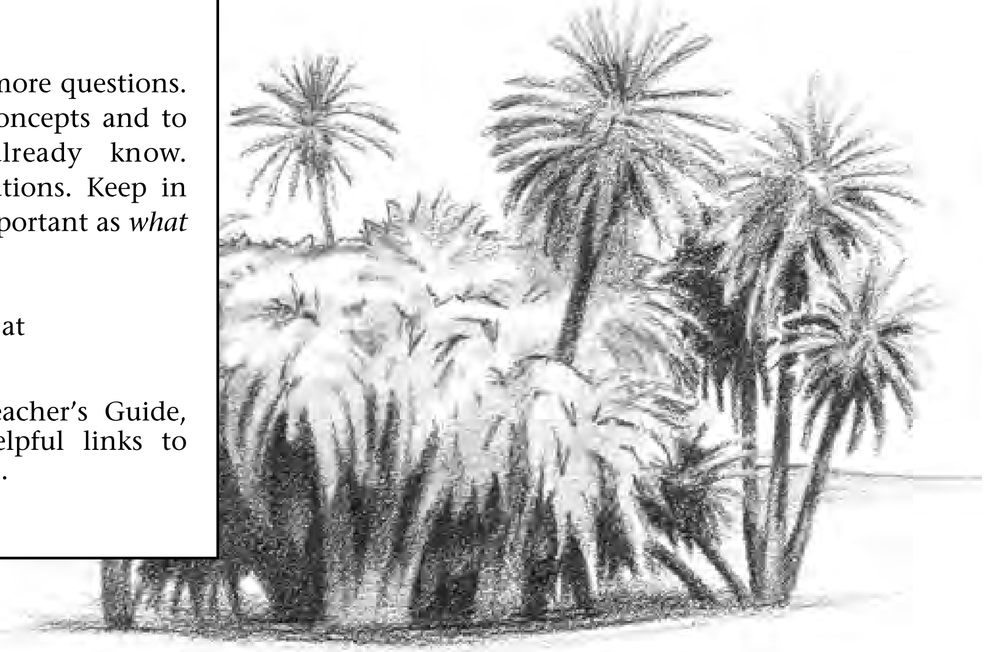
for an online version of the Teacher's Guide, where each activity includes helpful links to pages with additional information.

Ocean Oasis Background

Introduction

An oasis is usually thought of as a green, wet place in the desert. In broader terms, it is a place of abundance—a pleasant change from the usual. Thus, an oasis may be in the desert, the sea, or the middle of a city. It is a place that provides for one's needs.

Wherever it is found, an oasis is special. A combination of factors such as geological processes, geographical location, climate, weathering, and the presence of life forms contributes to the overall uniqueness of an area. Baja California, Mexico, with its offshore islands bears witness to the influence of these factors.



Geographical Location

Baja California, at the southern tip of North America, lies between the north latitudes of 32 degrees 30 minutes and 23 degrees—a range where deserts occur worldwide. The Baja California peninsula, about 760 miles (over 1220 kilometers) in length, is almost surrounded by water with the Gulf of California (Sea of Cortés) to the east and the Pacific Ocean to the west. It is Earth's second-longest peninsula—only the Malay Peninsula is longer.

Geology

Torn away from mainland Mexico and the North American Plate by the San Andreas Fault, the Baja California peninsula rides on the eastern edge of the Pacific Plate. Over the last four to six million years, the peninsula has slid northwesterly about 185 miles (about 300 kilometers). The eastern side of the peninsula has uplifted, and the region of the gulf has sunk and filled with seawater to form the Gulf of California. The close proximity to plate boundaries has contributed to a diversity of landforms, including mountains, canyons, and volcanic areas, both on land and under the sea.

Climate

Influenced by the Pacific Ocean with its cool California Current and by high mountain ranges, the climate of Baja California varies from hot and dry in the desert lowlands to cool and moist at some of the higher elevations. The combination of tectonic forces, climate, and geographical position creates the physical environment and habitats of the region's life forms.

Living Things

Life forms in and around Baja California are many and varied. Survival, whether on land or in the sea, depends on the ability to adapt to environmental conditions. In Baja California, survival on land often means enduring hot and dry conditions. While in the surrounding Pacific Ocean and Gulf of California, organisms thrive in a range of conditions from warm to cold, shallow to deep, clear to turbid. However, conditions around the mid-gulf region are ideal for an abundance of life forms, an ocean oasis. Baja California's long shoreline provides a habitat for organisms that use both the land and the sea for their survival.

Human Presence

Humans have been in Baja California for perhaps 12,000 years. Early people probably followed a nomadic lifestyle, searching for sources of food and water. They fished, gathered food, and eventually grew crops. People continued to arrive, including the Europeans in the 1500s. They introduced their own crops, domestic animals, farming practices, and technologies. While the peninsula has been inhabited for thousands of years, long-term habitation of the islands was and still is limited by the lack of potable water. Over the years the peninsula and its islands have felt the presence of humans through such activities as fishing, tourism, mining, collecting sea bird eggs and guano, and hunting green sea turtles. Deserts and oceans are ecologically sensitive areas that are affected by human activities. Like all areas of the world, the need for conservation and an understanding of global and local environmental problems are critical to the preservation of the Baja California peninsula and its ocean oasis.

Activity 1

WHERE IN THE WORLD

How do you locate a specific place on Earth? How do animals find a place?

In the Film

A satellite view of the west coast of North America zooms in on the Baja California peninsula, the Gulf of California, and the mainland of Mexico. This area is the destination for a number of migratory species. Several of these species, such as the Elegant Tern, Heermann's Gull, elephant seal, and gray whale, are featured in the film.

Concepts

Any place on Earth can be identified using a coordinate grid system of latitude and longitude. Some animals migrate great distances between specific places.

Objectives

To locate places in Baja California and elsewhere using latitude and longitude; to explore animal migration

Content

Science, history/social studies, mathematics, language arts

Background

Mapmakers think of the world as a globe divided by vertical and horizontal lines. The lines running north and south are lines of **longitude**, or **meridians**. These lines of longitude come together at the North and South Poles, and the distance between them is greatest at the equator. The Prime Meridian, 0 degrees, passes through Greenwich, England. Measurements are then made 180 degrees to the west and 180 degrees to the east from Greenwich. East-west lines of **latitude** circle the Earth parallel to the equator, which is 0 degrees. The poles are 90 degrees north and 90 degrees south latitude. Like an hour of a time, a degree of latitude or longitude is divided into 60 minutes, and a minute is divided into 60 seconds. Any point on Earth can be identified using this **coordinate** system of longitude and latitude. For example, Washington, D.C., has the coordinates 38° 53´ north, 77° west.

For various reasons humans have been moving from place to place for thousands of years. They have found their way using the sun and stars, sextants, maps, charts, compasses, and recently the Global Positioning System, or GPS.

Many animals **migrate**, or move from one place to another place on a seasonal basis, seeking food or places to breed. Unlike humans, they do not use charts or instruments. How do they find their way? In *Ocean Oasis*, several migratory animals are featured. Gray whales, for example, migrate from summer feeding grounds around the Bering Sea near Alaska to lagoons along the west coast of Baja California—a journey that, in each direction, takes nearly four months and spans approximately 5500 miles (9000 km). The fact that animals migrate is well documented. However, much work needs to be done to understand how they find their way to the same area year after year and generation after generation.

Materials

Part A—Location
map of Baja California (page 6), pencil, graph paper

Part B—Migration
map of Western Hemisphere (page 7), ruler, pencil, graph paper

Procedure

Part A—Location (individuals, small groups)
- Discuss the concept of longitude and latitude.
- Use the map of Baja California on page 6. Locate the town identified by the coordinates 31° north latitude, 114° 52´ west longitude. Record the name of this town.
- Select a different place in Baja California. Determine its coordinates and record them.
- On a piece of graph paper set up a grid, marking latitude on the vertical axis and longitude on the horizontal axis. On the grid plot and label the two Baja California sites. Is the second site north or south, east or west of the first site? How many degrees north or south? How many degrees east or west? .

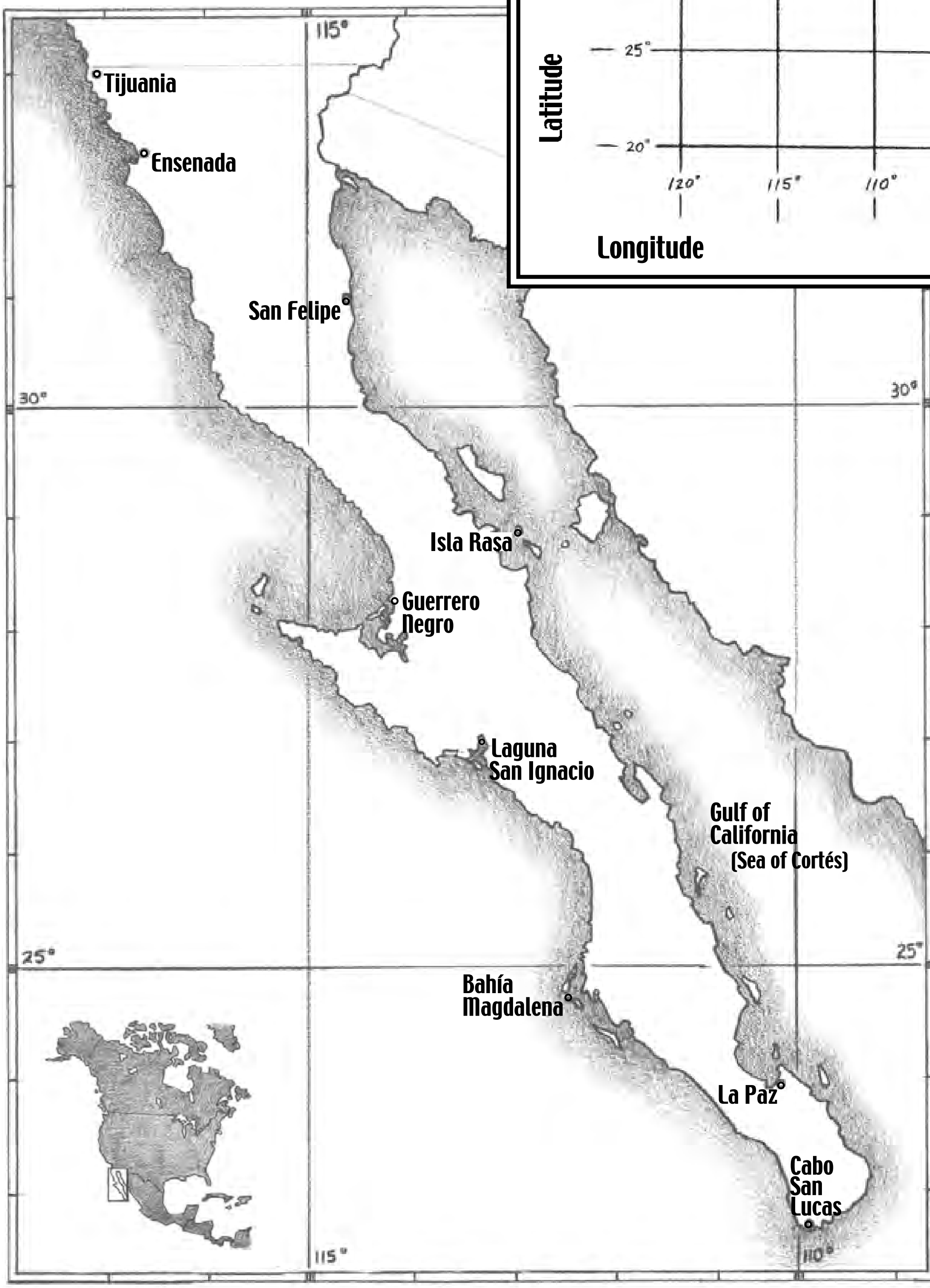
Part B—Migration (individuals, small groups)
- Discuss animal migrations, noting reasons for migrating and some well-known migratory animals.
- Find the migration chart on the map of the Western Hemisphere (page 7). Select one of the following animals: gray whale, Heermann's Gull, Elegant Tern, or elephant seal. On the map, locate the start and end destinations of its migration. Draw a line connecting the two points—representing a possible migratory route.
- Use the mileage/kilometer key to estimate the number of miles/kilometers covered in this migratory route.
- If a habitat at one end of a migratory route is altered or destroyed, what might the consequences be for that animal?

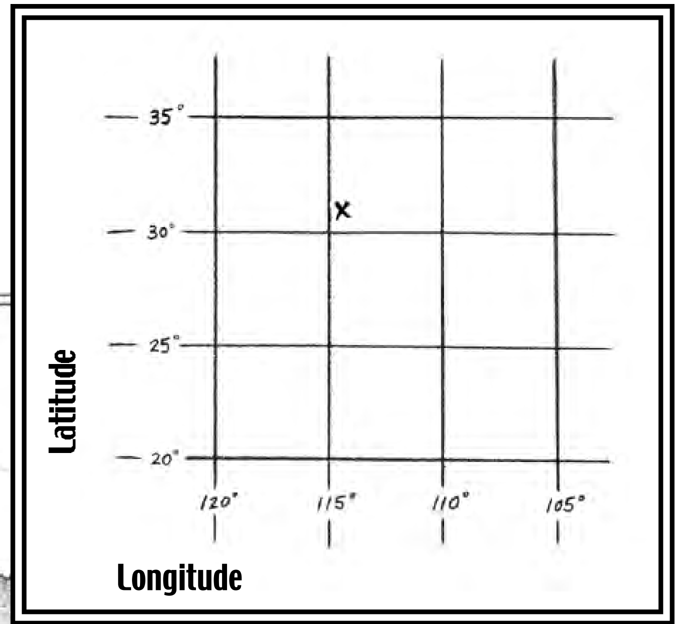
Local Connection
Using a map of your local area, select a place and determine its coordinates.
Refer to Part A. How many degrees north or south, east or west is this town in relationship to 31° north, 114° 52´ west—the town in Baja California?
Investigate:

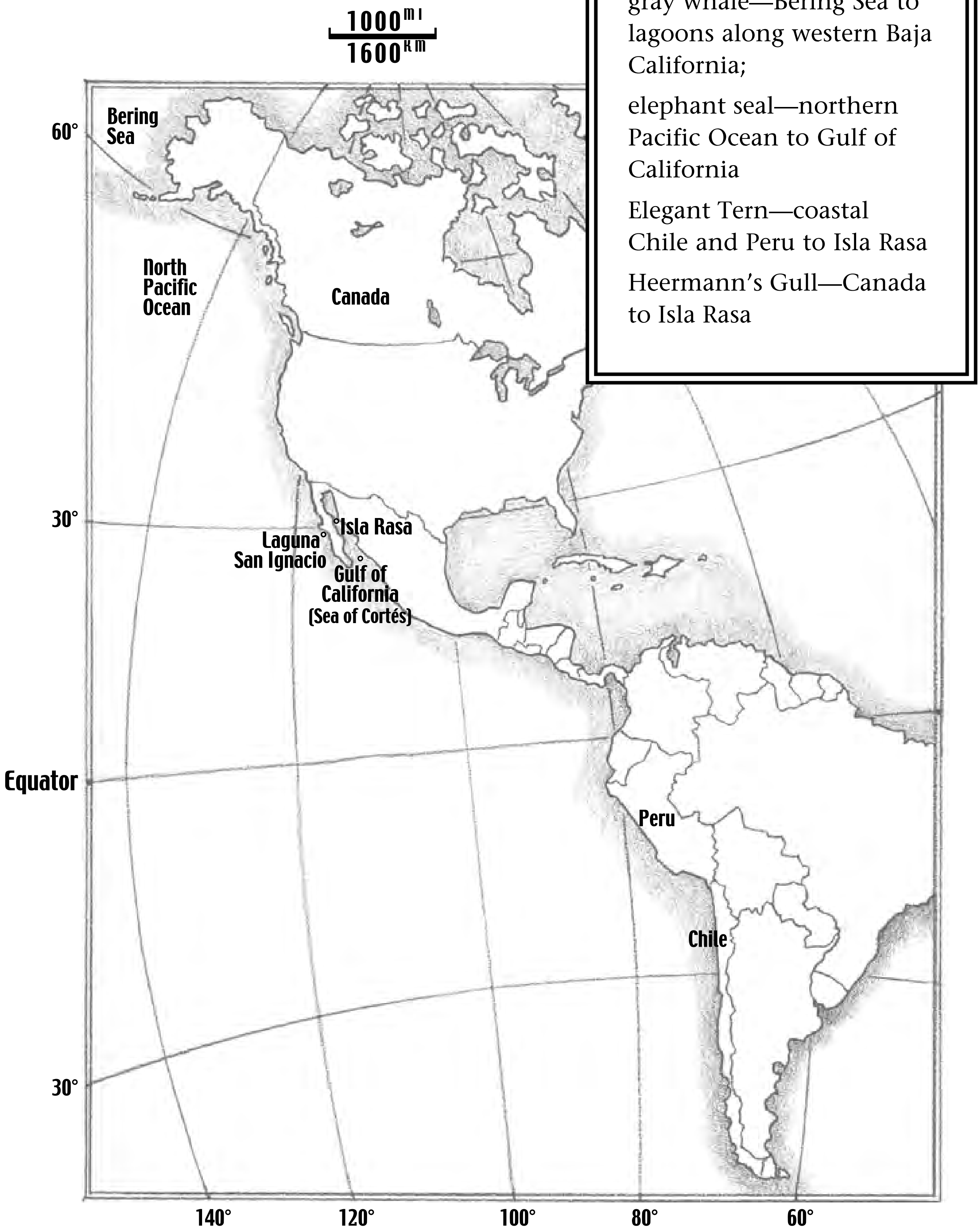
a. the use of the Global Positioning System to determine latitude and longitude
b. the history of mapmaking
c. other animals known for migrating
d. how animals find their way over migratory routes

Key Words: latitude, longitude, meridian, coordinate, migrate

Baja California







gray whale—Bering Sea to lagoons along western Baja California;

elephant seal—northern Pacific Ocean to Gulf of California

Elegant Tern—coastal Chile and Peru to Isla Rasa

Heermann's Gull—Canada to Isla Rasa

Activity 2

What's an Oasis?

How would you describe an oasis?

In the Film There are many underwater scenes portraying a profusion of life around the islands and reefs of the Gulf of California. Such places that provide an abundance of resources and shelter are often referred to as oases. In a broader context, an oasis can be more than a physical place, and in the film the area is described as an oasis for the heart.

Concept An oasis is a place of abundance and shelter.

Objective To explore the concept of an oasis

Content Science, history/social studies, language arts

Background Traditionally, an **oasis** is a wet, green area in the desert. It is a fertile habitat for plants and animals—a place of abundance. In a broader sense, an oasis is a refuge, a pleasant place—a contrast to the surrounding area. It is a place that offers quiet and solitude while providing one's basic needs. As a source of food and water, oases have played a role in the development of civilizations. Today, through irrigation, deserts are sometimes converted into farmlands—a kind of man-made oasis.

Materials

Paper, pencils, art supplies, reference materials

Procedure

(individuals, small groups)

- Discuss the basic needs of plants and animals and the functions of a habitat.
- Discuss the concept of an oasis.
- Draw a picture, write a story, or create a play set in an oasis.
- Research and write a report about an oasis such as Isfahan, Palmyra, Faya-Largeau, El Menia, or any oasis such as those associated with one of the following rivers: Nile, Indus, Tigris, Euphrates, Rio Grande, or Colorado.
- Describe human activities that might create an oasis. What would be the advantages or disadvantages of deliberately creating an oasis? What human activities might destroy an oasis?

Local Connection

Write a description of your own personal oasis—your special retreat or place of refuge. It might be a park in an urban setting, a tree in a field, or even your room. Tell why it is special and which of your needs it satisfies.

Key Word: oasis

Activity 3

Plate Boundaries: Cookie Crust and Pudding Magma

What are the plates of Earth's lithosphere? What causes them to move? In what directions do these plates move?

In the Film

Animated graphics portray the planet's mantle churning with heat. On Earth's surface, leading-edge, cool pieces of the lithosphere are shown sinking into the mantle dragging their plates behind them. Other animation shows the Baja California peninsula being pulled away from mainland Mexico and the peninsula drifting northwestward.

Concept

Plates (sections) of Earth's lithosphere move slowly over the mantle, pressing against one another, sliding by each other, or pulling apart.

Objective

To demonstrate movements at plate boundaries

Content

Science, language arts

Background

Earth's **lithosphere** (crust and upper mantle) is cracked into pieces, called plates. These plates, driven by **convection currents**, drift across the underlying mantle. Some plates pull apart (**diverge**), and some collide (**converge**). One plate may slide by another in a lateral (**transform**) movement. These movements cause earthquakes and contribute to the formation of mountains, volcanoes, and seas. The theory of plate tectonics explains the concept of Earth's lithosphere as being constructed of moving plates.

Seafloor spreading, a divergent activity, takes place at mid-oceanic ridges as magma pushes up through cracks in the crust, pushing plates apart and forming new ocean crust. The mid-Atlantic ridge is the best known spreading zone. A smaller spreading zone is found in the middle of the Gulf of California, moving Baja California away from mainland Mexico.

Subduction, a convergent activity, occurs as a plate with heavier ocean crust collides with a plate of lighter, continental crust. The ocean crust pushes under and sinks into the mantle. Ocean trenches, volcanoes, and island arcs are associated with subduction zones.

Another type of convergent activity occurs when two plates carrying continental crust converge. Mountains may be thrust up at the boundaries. An example would be the formation of the Himalayan mountains.

At **transform** boundaries one plate slips and grinds against another. It is a place where earthquakes occur as pressure builds, and then releases with the shifting crust. The **San Andreas Fault**, which extends from Northern California to the Gulf of California, is one of the most famous transform faults. It is along this fault that Baja California and part of Southern California are shifting northwestward.

Materials

Part A—Plate Boundaries
no materials

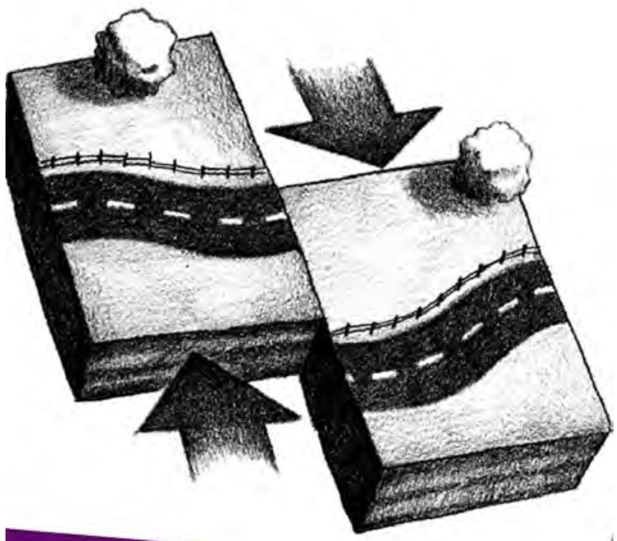
Part B—Seafloor Spreading
per group—1 plastic cup of snack-style chocolate pudding, 2 sugar wafer cookies (or any rectangular-shaped cookies), one 6-inch square of thin cardboard, scissors, tape

Part C—Transform Faults
per group—2 sugar wafer cookies, 5" x 8" piece of paper, pencil, small amount of frosting

Procedure

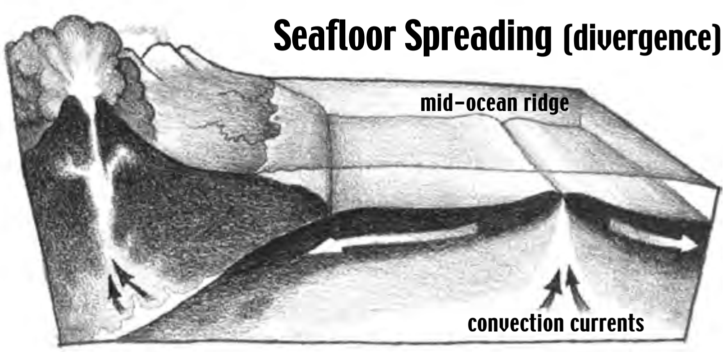
Part A—Plate Boundaries (whole class)

- Review or discuss the plates of Earth's crust and their various motions. Include in your discussion: seafloor spreading (divergence), subduction (convergence), and transform or lateral movement.
- Hand movements can be used to illustrate these motions (see illustrations).



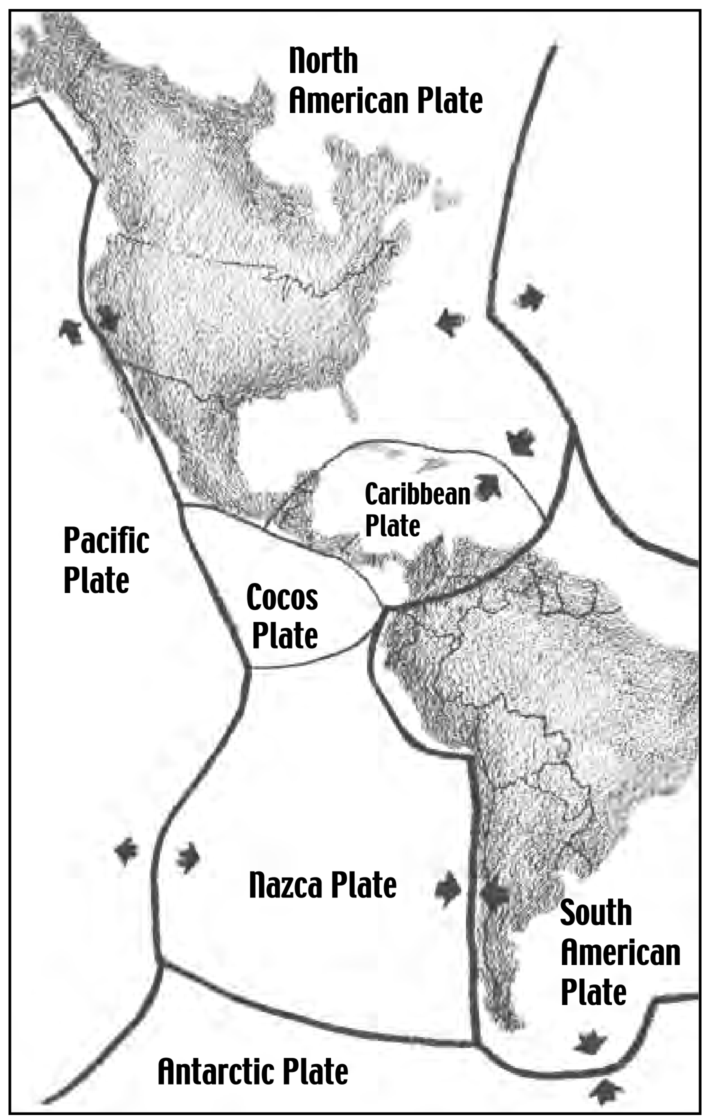
Transform or Lateral Movement

Seafloor Spreading (divergence)



Subduction (convergence)

Plate Boundaries

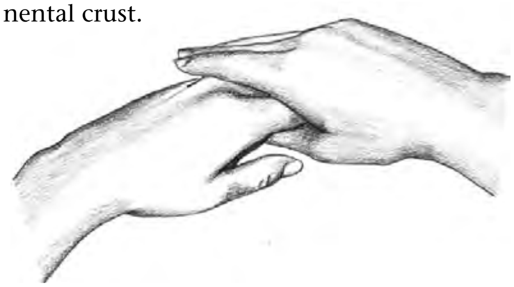


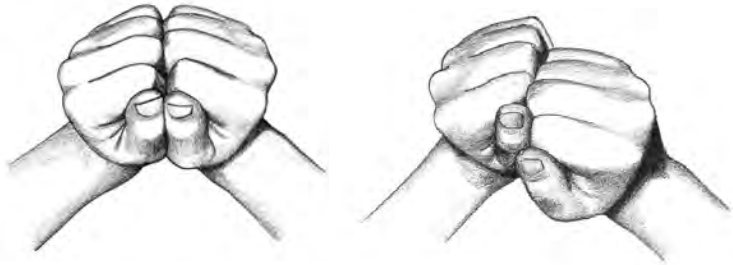
Seafloor Spreading

Hold hands side by side with thumbs below index fingers. Hands represent two oceanic plates, and thumbs represent magma. As the magma pushes up, the plates move apart. Move thumbs up, and let hands move apart.

Subduction

Hold one hand at right angles to the other, about two inches away. Let the thumb of your right hand extend down. The gap between thumb and fingers represents a trench. Fingers of the left hand should be close together. This hand represents a plate of ocean crust. As the ocean crust converges on the continental plate, represented by the fingers of the right hand, it dives into the trench under the continental crust.



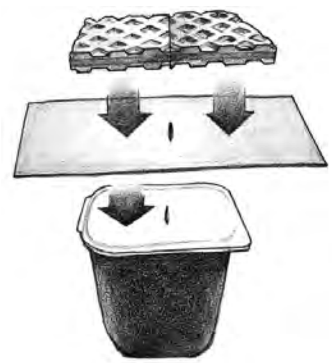


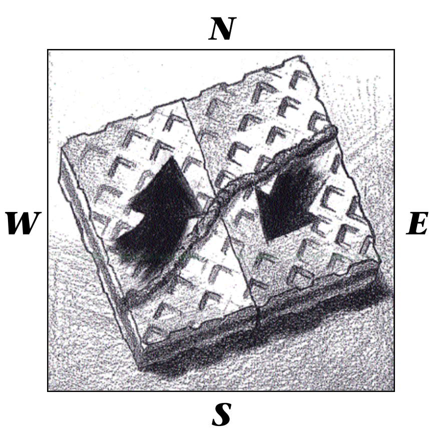
Transform or Lateral Movement

Make fists and hold knuckles together; note line-up of fingers. Press knuckles together to build up pressure, then let one hand slip by the other relieving the pressure. Again note the line-up of fingers.

Part B—Seafloor Spreading (small groups)

- Cut a hole in the center of the cardboard about 1" x 1/2". Poke a small hole in the top of the pudding cup. Tape the cardboard to the top of the pudding cup, centering the slit in the board over the hole in the cup. The pudding represents magma.
- Center cookie wafers plates, lengthwise, over the hole in the card.
- Keep the set-up on the table. One student steadies the cardboard with the cookies, while another student gently squeezes the pudding cup. Observe and record the results. Compare the movement of the pudding with the magma welling up at mid oceanic ridges.





Part C—Transform Faults (small groups)

- Discuss the San Andreas Fault. Tell what and where it is.
- Mark directional points (north, south, east, west) on a piece of paper. On paper, line up two cookie wafers side by side, lengthwise in a north westerly direction. The cookies represent the Pacific Plate and the North American Plate. Spread a line of frosting horizontally across the cookies to represent a road.
- One student gently pushes the cookie on the west side (Pacific Plate) in a northwesterly direction while a second student presses the other cookie (North American Plate) in a westerly direction. Do the plates stick? Is there sideways motion? What happens to the road? Do the edges crumble?
- Discuss your results. Compare them to the movement of the Pacific and North American Plates along the San Andreas Fault.

Local Connection

Do you live near the edge of a plate? Have you ever felt an earthquake? What type of landforms are around you? Mountains? Volcanoes? Hills? Plains? Tell how they might be related to the movement of Earth's crust.

Key Words: lithosphere, convection currents, seafloor spreading, diverge, subduction, converge, transform, San Andreas Fault

Activity 4

CONVECTION CURRENTS

What causes fluids to circulate?

In the Film

Convection currents are identified in Earth's mantle. Heated mantle material is shown rising from deep inside the mantle, while cooler mantle material sinks, creating a convection current. It is thought that this type of current is responsible for the movements of the plates of Earth's crust.

In the ocean, warm water is normally found near the surface while the deeper water is usually cold. Deep, cold-water currents play an important role in creating the ocean oasis of the film.

Concept

Convection currents play a role in the circulation of fluids.

Objective

To observe convection as a result of differential heating

Content

Science, language arts

Background

Convection currents are the result of differential heating. Lighter (less dense), warm material rises while heavier (more dense) cool material sinks. It is this movement that creates circulation patterns known as convection currents in the atmosphere, in water, and in the mantle of Earth.

In the atmosphere, as air warms it rises, allowing cooler air to flow in underneath. Along with the turning of the Earth, this movement of air creates winds. Winds, in turn, create surface waves on the ocean.

Convection also plays a role in the movement of deep ocean waters and contributes to oceanic currents.

Inside Earth, the convection of mantle material is thought to cause the movement of the overriding crustal plates, resulting in events such as earthquakes and volcanic eruptions.

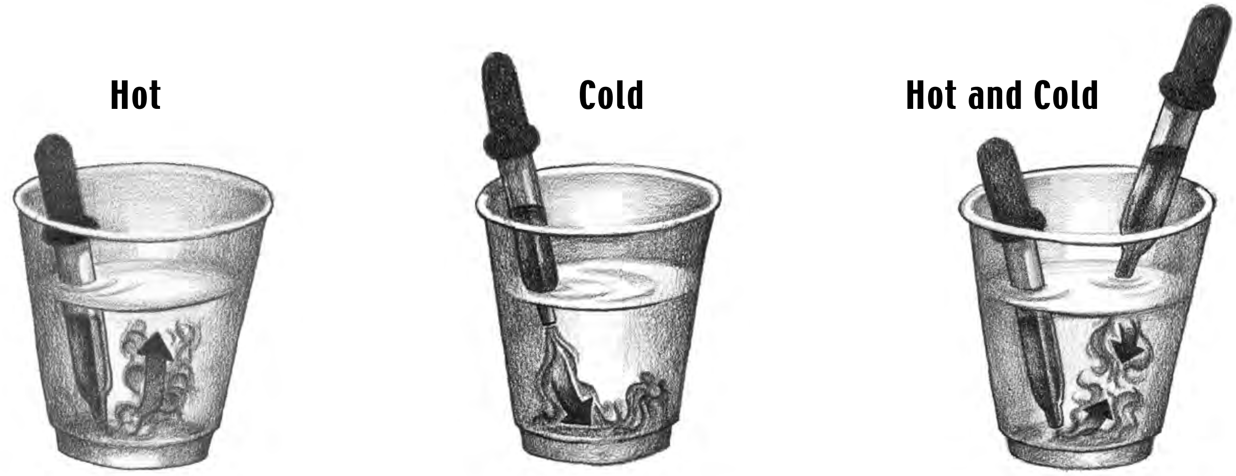
Materials

Part A—Density and Convection

Per student or pair of students: three 8 oz. clear plastic cups, 2 medicine droppers, blue and red food color, small containers for ice water and hot water, ice, hot water, room-temperature water

Part B—Convection Current Class Demonstration

Small aquarium, water immersion heater, blue ice cubes, red food color, medicine dropper, small paper cup, tape



Procedure

Part A—Density and Convection (small groups)

- Discuss or review the concept of density relative to temperature.
- Fill each plastic cup with 6 ounces (200 ml) of water. Allow the water to stand about 5 minutes.
- Fill a small container with very cold water. Add a drop of blue food color.
- Fill another small container with hot water. Add a drop of red food color.
- Use a medicine dropper to release a drop of hot, red water at the bottom of one cup. Observe and record the results. Repeat, releasing the water on the surface. Record the results.
- In the second cup, repeat the process using the cold, blue water. Observe and record the results. What can you determine about warm water? Cold water? Which is more dense?
- In the third cup, simultaneously release hot, red water on the bottom and cold, blue water at the surface. Observe and record the results.

Part B—Convection Current Class Demonstration

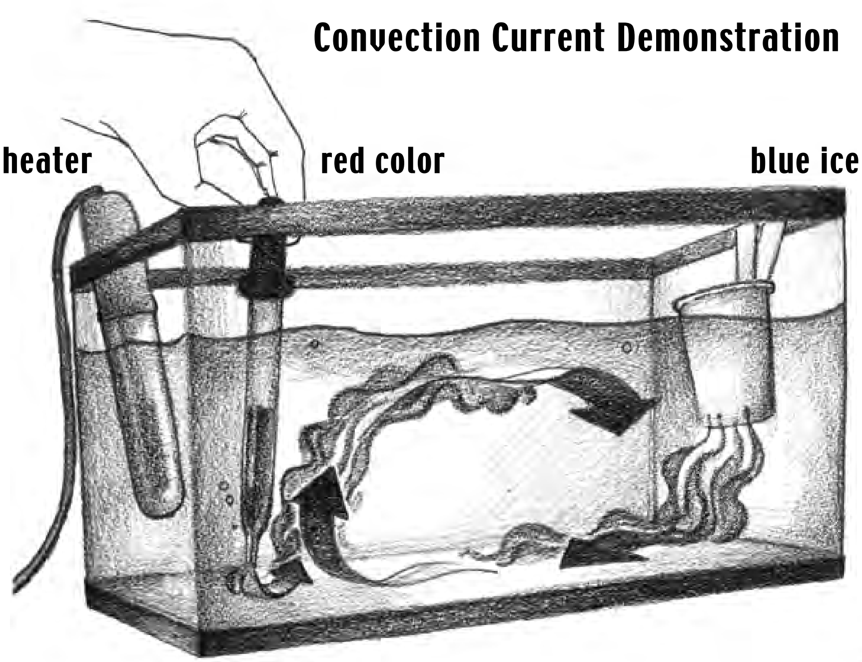
- Set up the equipment according to the diagram. Poke a few small holes in the paper cup. Put the blue ice cubes in the paper cup. Tape the cup to the side of the aquarium. Turn the heater on. Release a few drops of red color at the bottom of the aquarium near the heat. Observe by looking through the side of the aquarium. Which is heavier, cold or warm water? Record your observations.

Local Connection

Observe local wind patterns. Where is the air warm? Where is the air cold? Which direction does the wind usually blow?

Do you live near the ocean or other large body of water? If so, find out about local currents. Do you ever swim or wade in a stream or river? Is the water colder at the surface or near the bottom?

Key Word:
convection current



Activity 5

Onshore and Offshore Winds

Why do winds blow from the ocean to the land or from the land to the ocean?

In the Film The relationship of cold water and hot, dry land creates many wonders. Winds are a natural outcome of differential heating between hot desert and cold water. Winds cause the movement of the surface water that allows cool water to well up from the ocean depths. This cool, nutrient-rich water is the basis of the marine food web.

Concept Winds are the result of differential heating.

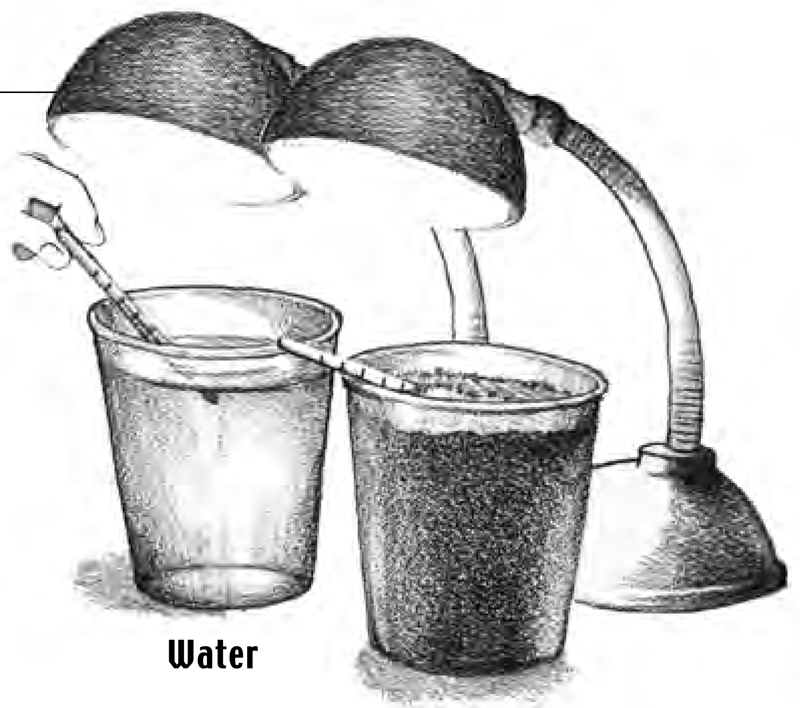
Objective To demonstrate the relative heating and cooling of dirt and water

Content Science, language arts

Background When exposed to the heat of the sun, soil warms more quickly than water. As the land warms, so does the air directly above it. As this warm air rises, cooler air from over the ocean flows toward the land. This **onshore** wind may provide a cooling effect for what would otherwise be an extremely hot region. As the sun goes down, the land cools more rapidly than the water. In early evening the air over the ocean is warmer than the air over the land, and the flow of air is reversed producing an **offshore** wind.

Materials

Per group: two 8 oz. plastic cups, dirt, water, 2 thermometers, 2 goosenecked lamps with 60-watt bulbs, pencil, paper, crayons



Procedure

(teams, small groups)

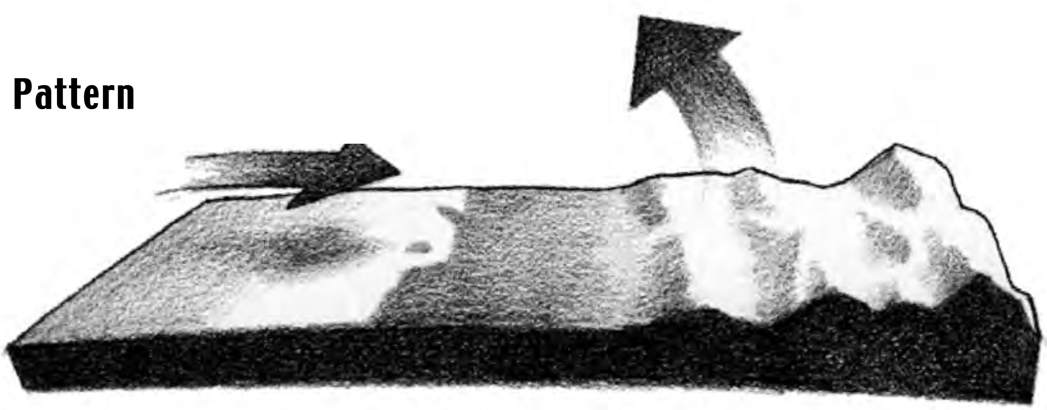
- Review or discuss the circulation patterns of warm and cold air.
- Fill one cup with water, the other cup with dirt.
- Hold a thermometer just below the surface of each. Observe and record the readings. Remove the thermometers.
- Place a lamp over each cup, about two inches above the surface. Turn the lamps on. Wait five minutes. Again, take and record the temperature of the water and the dirt.
- Continue recording at five-minute intervals for 15 minutes.
- Turn off the lights. Continue observing and recording the temperatures at 5-minute intervals for another 15 minutes.
- Arrange your data in chart or graph form, plotting temperature and time.
- Compare the respective heating and cooling of the dirt and the water.
- Draw a picture showing land with ocean water next to it. Use your observations from above and draw arrows to show the direction of an offshore wind. Repeat, showing an onshore wind pattern.

Local Connection

Investigate wind patterns in your local area; air circulation in your classroom.

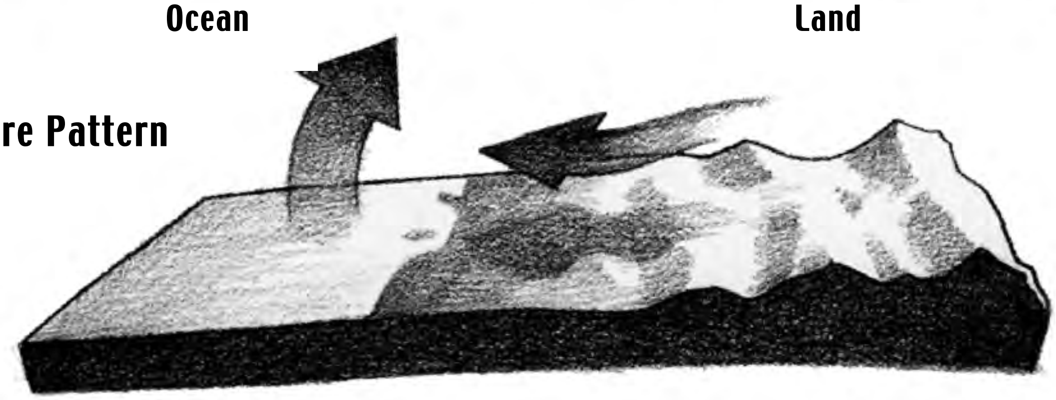
Key Words: onshore, offshore

Onshore Pattern



Ocean **Land**

Offshore Pattern



Ocean **Land**

Activity 6

UPWELLING

What happens to cool, deep water when the warm surface water is moved away?

In the Film Winds near the peninsula push warm water away from the surface allowing deep, cool, nutrient-rich water to rise, bringing nourishment to plankton, the basis of the oceanic food web. This process of upwelling is essential to the ocean oasis.

Concept Wind patterns and currents may cause cold water to rise from deeper areas.

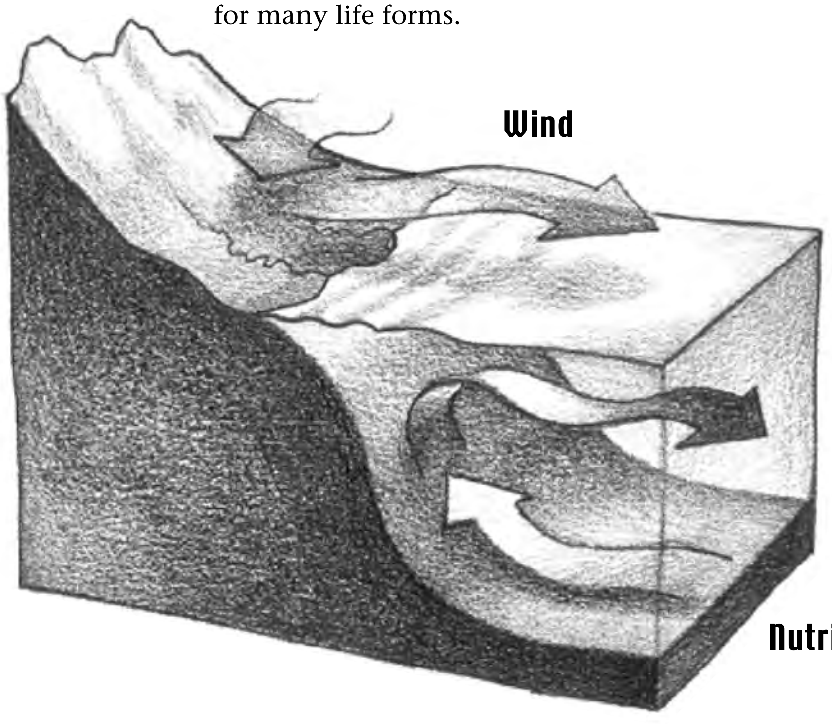
Objective To demonstrate the process of upwelling

Content Science, language arts

Background Dense, cold water is normally found deep in the ocean. Remains of dead, decomposing organisms sink to the ocean bottom making these deep, cold waters rich in **nutrients**. However, it is in the upper, sunlit layers of the ocean that **phytoplankton** (very small drifting plants) are able to utilize these nutrients with energy from the sun, and thus create a basis for oceanic food webs.

The process of **upwelling** brings nutrients nearer to the surface. Upwelling occurs near some continental areas when offshore winds move surface water away from the shoreline, allowing cooler water to rise or upwell. Where upwelling occurs, marine life is rich.

Periodically, the winds that move surface water away from the shore cease to blow. Upwelling fails, and the marine food web is disrupted. In addition, warmer surface water creates clouds, leading to increased rainfall over the land. This phenomenon, known as El Niño, creates situations of global consequence for many life forms.



Materials

Per group of 2-4 students: 2 transparent pans at least 5" x 9" x 2" deep, food color, ice, water, medicine dropper, water pitcher, small container, flexible plastic drinking straws for each student

Procedure

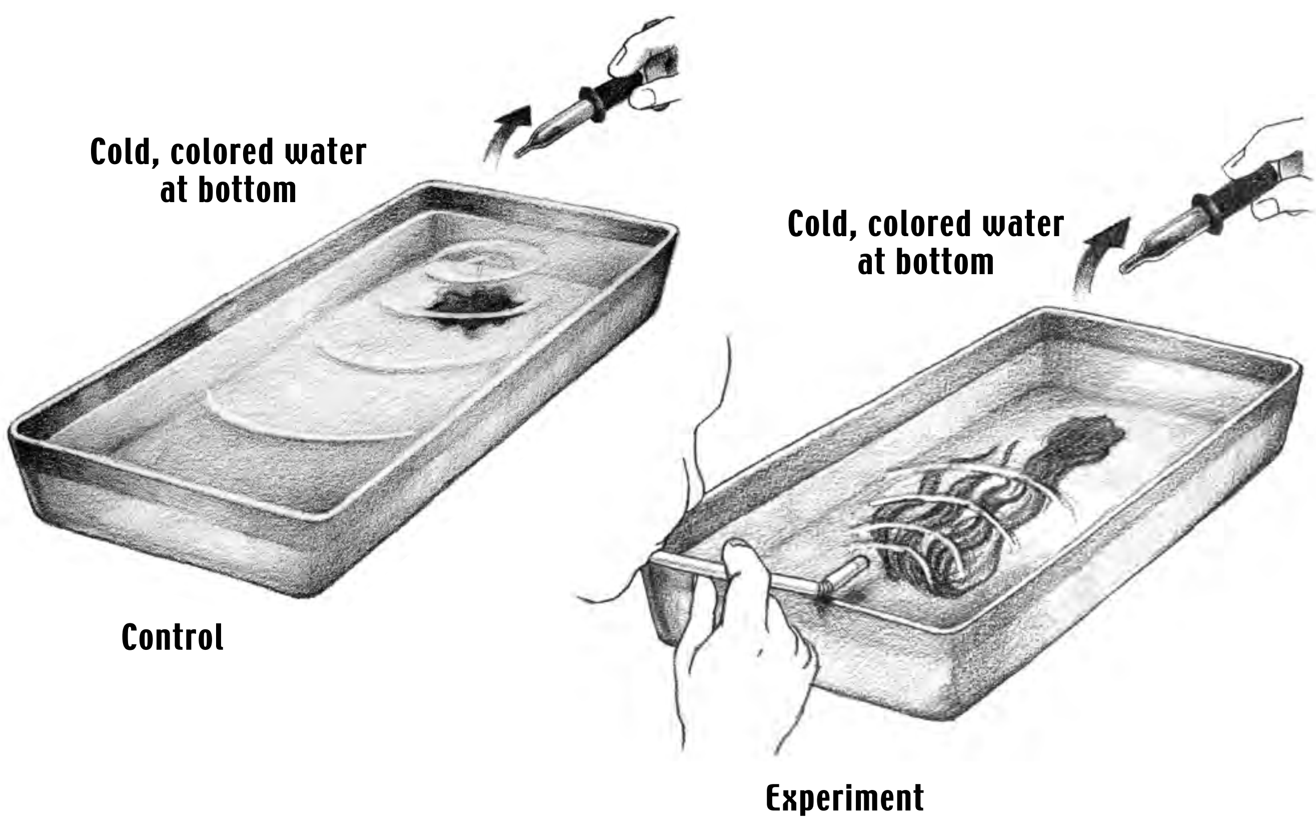
(teams, small groups)

- From the pitcher, fill both pans with room-temperature water to about 1/2 inch from the top. One pan will be a control.
- Let the pans sit undisturbed until the water is quiet, about 5 minutes.
- Prepare colored ice water in the small container.
- Slowly release a few drops of cold, colored water at the bottom (near one end) of each pan. This will represent nutrient-rich water. Where is the cold water? Record your observations.
- Rest the straw on the end (opposite the colored water) of one pan. Gently blow across (not into) the water, creating offshore waves.
- Compare the results with the control pan. Record your observations.
- Have one person in each group report the observations. Compare these results. What happens to the "nutrient-rich" water when the surface water is moved away by the wind?

Local Connection

In recent years, has your local area been affected by an El Niño weather pattern? How?

Key Words: upwelling, nutrients, phytoplankton



Activity 7

COOL IT: AN ANIMAL ADAPTATION

How do animals keep cool in the desert?

In the Film A nighttime scene shows a kangaroo rat going in and out of a burrow. The rat never drinks, but manufactures water through its metabolic processes. The rat takes advantage of ways to keep cool, including moving about during the night and living in a burrow during the day.

Concept Desert animals have adapted to hot, dry conditions.

Objective To explore ways desert animals keep cool

Content Science, mathematics, language arts

Background Surface temperatures of desert soil can be extremely hot. Desert vegetation is sparse and cloud cover minimal. Thus, the sun shines unobstructed onto the soil. About half of the sun's heat is absorbed by the first few inches of soil and the other half is reflected back into the atmosphere. The temperature of the soil is also affected by dryness—there is little water to evaporate and thus dissipate the heat.

While desert daytime temperatures may be high, nighttime temperatures may drop dramatically. Radiant heat from the sun rapidly warms the soil and air during the day, but then escapes without barriers into the atmosphere at night.

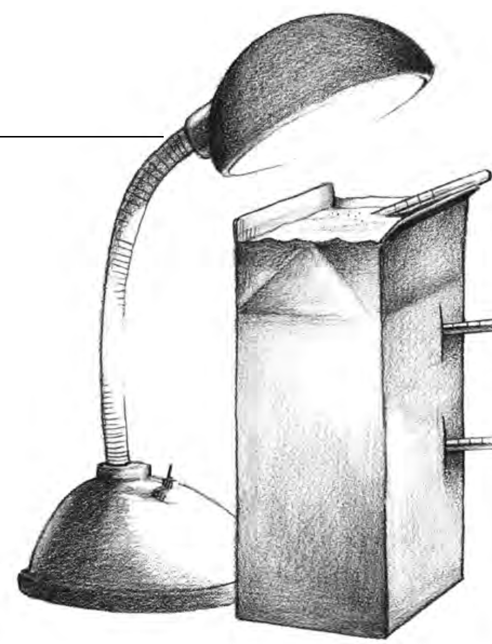
Desert animals have **adapted** to hot, dry conditions in a number of ways. Hot, exposed desert soils can be avoided by resting in the shade of a bush, on branches above ground, or in underground burrows. Moving about at night—being **nocturnal**—is another way to avoid the heat and conserve body fluids.

Materials

Part A—Adaptations
no materials

Part B—Kangaroo Rat Burrow Box
half-gallon plastic or paper milk container (with top cut off), three thermometers, coarse-grain sand or dirt, sharp knife, goosenecked lamp with 60-watt bulb, paper, pencils

Activity C—Night and Day
five or more high/low temperature readings from a desert area, graph paper, red and black markers



Kangaroo Rat Burrow Box

Procedure

Part A—Adaptations (whole class)

- Discuss the need for animals to adapt to environmental conditions. What are the conditions of a desert environment during the day and night?
- What adaptations might animals have for living in hot places? What adaptations might animals have for living in dry places?

Part B—Kangaroo Rat Burrow Box (small groups)

- Mark the milk container 3 inches (7.5 cm) and 6 inches (15 cm) from the bottom. Cut a slit at each mark, large enough to insert a thermometer.
- Fill the container with sand.
- Insert a thermometer into the sand at each slit. Place the third thermometer on top, just under the surface of the sand.
- Position the lamp directly over the top of the sand. Record the temperature on all three thermometers.
- Turn the lamp on. Record the temperature at each level in 10 minutes, 20 minutes, and 30 minutes.
- Why would desert animals live in burrows?

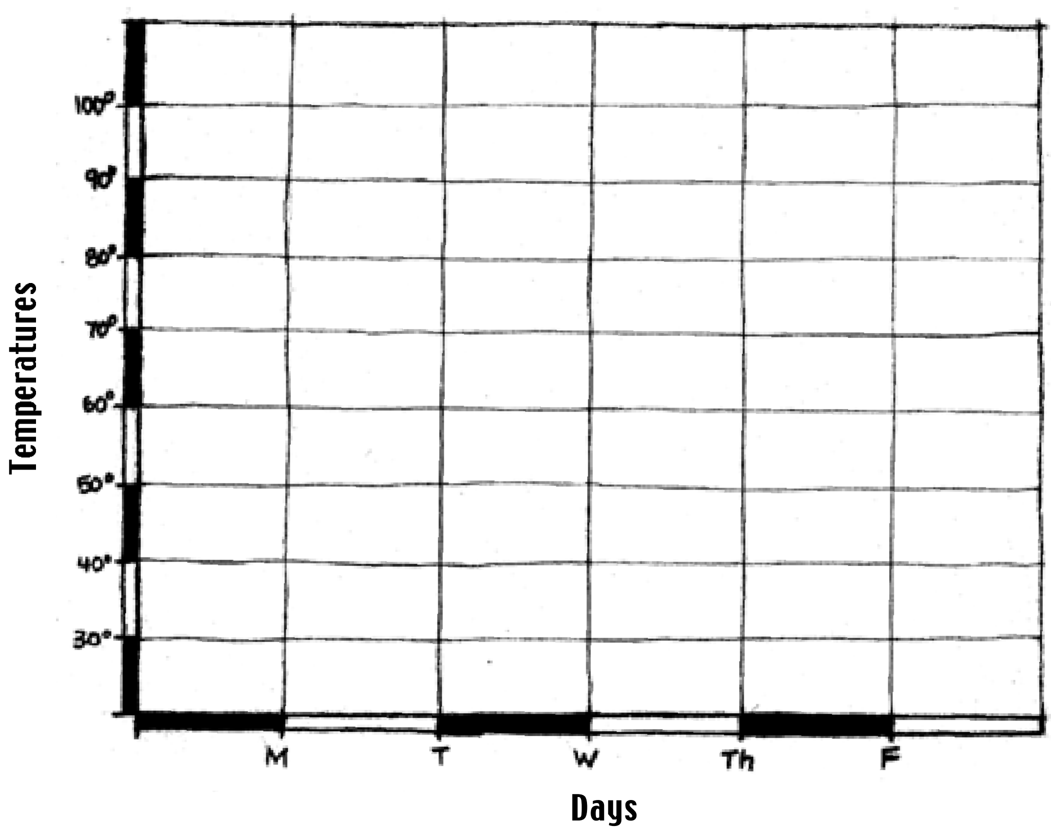
Part C—Night and Day (individuals, small groups)

- Construct a graph showing temperature on the vertical axis and days on the horizontal axis.
- Using the high/low temperature readings from a desert area, plot low temperatures in black and connect the points.
- Plot the high temperatures with a red marker and connect the points.
- When is it cooler? How much cooler?
- Why are some desert animals nocturnal?

Local Connection

Graph high/low temperatures for your local area. If you live in a desert, use temperatures from a temperate area. Compare the difference between daytime and nighttime temperatures in a desert area with the difference between daytime and nighttime temperatures in a temperate area.

Key Word: adapt, nocturnal



Activity 8

THE WATER STORERS: CACTUS ADAPTATIONS

How do desert plants conserve water?

In the Film Most of the Baja California peninsula is desert. In this dry environment, plants have developed ways to use every available drop of water. Storing water, as cactus does, is an obvious solution. But even an adaptation such as slow growth serves to conserve energy in this parched land.

Concept Desert plants store and conserve water.

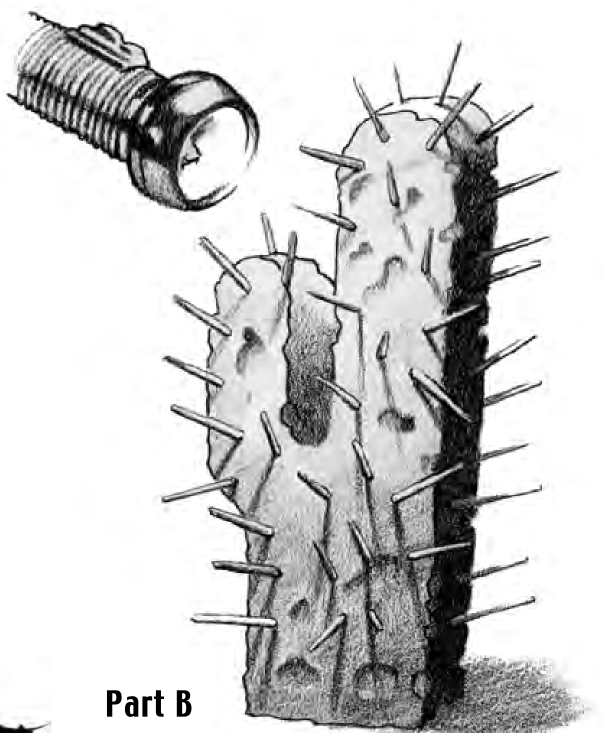
Objective To demonstrate absorption of water and other water conservation strategies

Content Science, mathematics, language arts

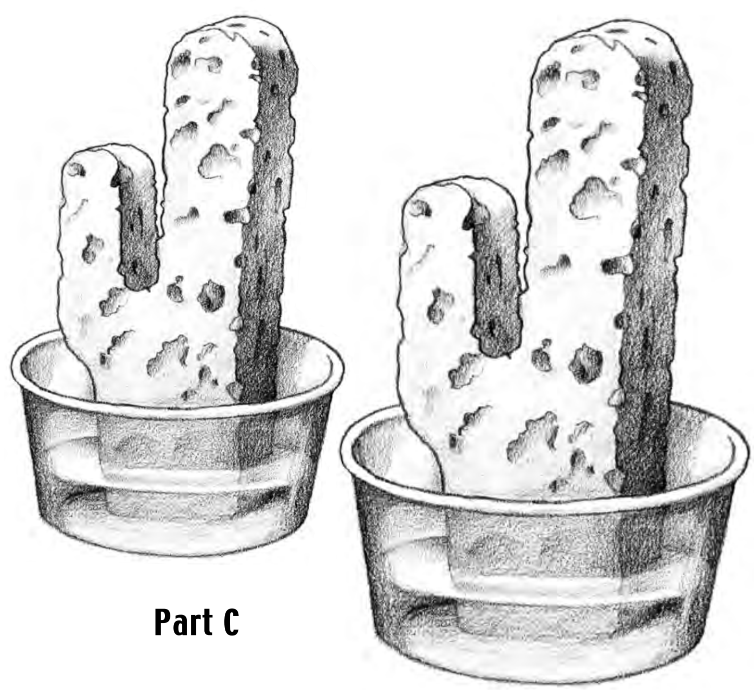
Background Desert plants have **evolved** various ways to conserve water. Cactus is well known for its ability to store water. A waxy coating on the stem and pads helps to reduce water loss. Further **adaptations** include spines, which are thought to help shade the plant by creating shadows, and plant orientation to sun exposure.

Materials

Sponge (expanding type best, ordinary kitchen sponge will work), waxed paper, toothpicks, flashlight, 8 oz. plastic cups, water, scissors, scales (postage type will work), modeling clay



Part B



Part C

Procedure

Part A—Plant Adaptations (whole class)

- Discuss the need for plants to adapt to environmental conditions. Explore conditions in a desert environment such as hot, dry, wide range of temperatures, high rate of evaporation.

Part B—Sun Shade (small groups)

- Cut two sponges of equal size to resemble a cactus.
- Take one of the dry sponge “cacti." Place toothpicks in it to represent spines. Stand it up with a piece of clay. Shine a flashlight (sun) on the spines. Do you see shadows? How might shadows help to cool the plant?
- Turn the plant so that the flat, wide part of the pad faces away from the flashlight (sun). Estimate the surface area exposed (thin, narrow edge) to light (sun) versus the surface area not exposed to the sun. How might orientation to sunlight affect a cactus?

Part C—Storing Water (small groups)

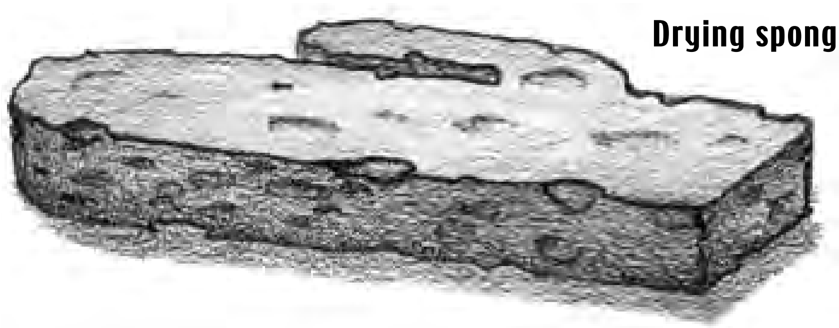
- Remove the toothpicks and clay from the "cactus" used in part B.
- Weigh each "cactus." Record the weights.
- Put 2 ounces (60 milliliters) of water in each plastic cup and add a sponge "cactus" to each cup. Set aside for one hour. Observe the results.
- Carefully remove each sponge and weigh it. Record the weights. How much weight did each sponge gain? Compare the weights.
- Set each sponge aside to dry. Cover the top of one with a piece of waxed paper. Check daily for several days. Weigh and record the weights. Note the differences in the weights. Which one dried out faster? How would a waxy covering help a desert plant?

Local Connection

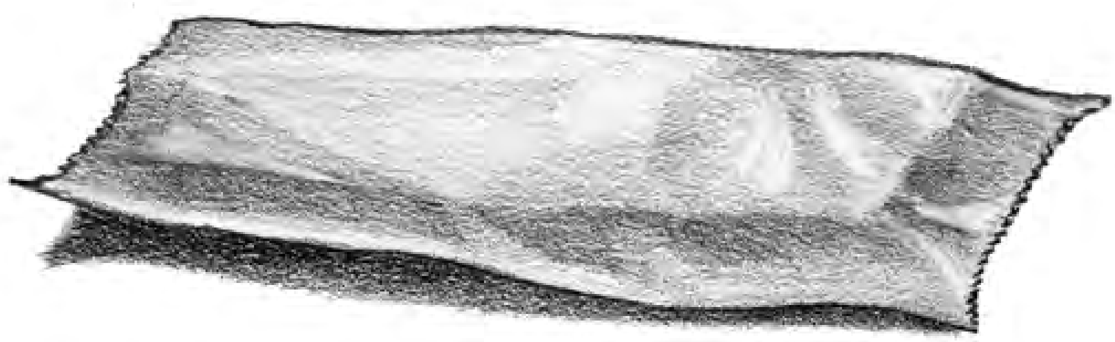
Do you live in a wet, dry, or moderate climate? Select some plants that are native to your area. What kind of adaptations do they exhibit that help them survive in your climate?

Key Words: adaptation, evolve

Drying sponge “cactus”



Drying sponge “cactus” covered with wax paper



Activity 9

Shark Sense

How do sharks find food?

In the Film

Sharks are a vital link in the food chain. They are described as wolves of the sea seeking sick and injured animals. A shark is seen feeding on a dead whale. In addition to possessing a keen sense of smell, a shark's awareness of vibration and electroconductivity also serve it well in its search for prey.

Concept

Animals use their senses to locate food and find their way.

Objective

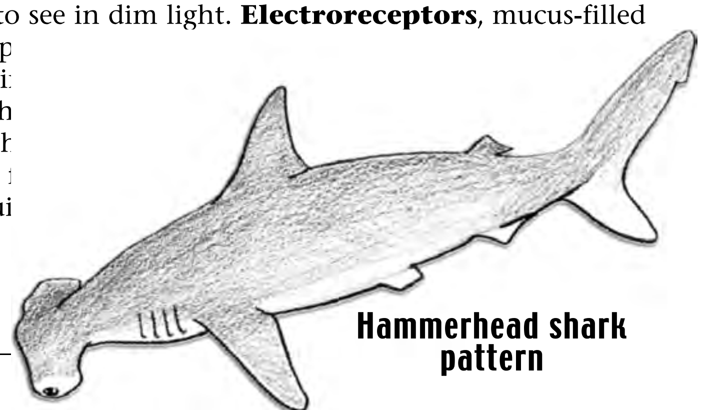
To explore the use of various senses

Content

Science, language arts

Background

Like most animals, sharks rely on their senses to find their way and seek prey. Odor-detecting cells are located in the nostrils, which are not used for breathing. Sharks can detect odors in very low concentrations—perhaps even one part per million. Sharks, along with most other fish, possess a **lateral line**, a series of horizontal pores on the head and sides of the body. These pores are sensitive to vibrations, movement, and pressure changes. Since the deeper the water the darker it is, the sense of vision is more useful at close range or near the surface. However, some sharks have a layer of **reflective** cells at the back of the eye that enhances their ability to see in dim light. **Electroreceptors**, mucus-filled pits on the snout called amp
fields produced by animals i
electroreceptors may help sh
very close range. It is though
sharks use **magnetic** fields
undersea formations as a gui
migration.



Hammerhead shark pattern

Materials

Part A—Smell

14 small containers (film canisters), lemon and peppermint flavoring (or two flavors of your choice), water, 2 medicine droppers, markers, labels, cotton balls

Part B—Sight

6"-square of aluminum foil, 6"-square blue construction paper, 12" x 6" piece of blue construction paper, flashlight, tape

Part C—Magnetic Migration

For each group of students: 10 or 12 paper clips, one large bar magnet, 12" x 18" sheet of cardboard, 2 sheets of 12" x 18" paper, pencil, scissors, tagboard, shark pattern, glue or tape

Procedure

Part A—Smell (whole class)

Students will use their sense of smell to find a feeding ground.

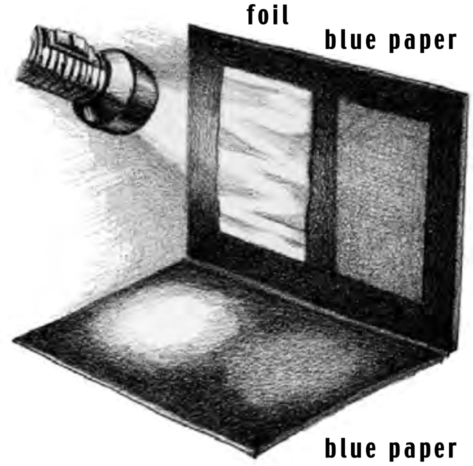
- Label the underside of the containers to identify dilution and flavoring. The labels will be used to self-correct. Mark the sides of the canisters with a color code. This will help students find the correct sequence of dilutions.

Color	Number of canisters	Dilution	Amount
red	3	#1L	one dropper of pure lemon flavoring
green	2	#2L	2 drops of dilution #1L, 18 drops of water
blue	2	#3L	2 drops of dilution #2L, 18 drops of water

- Prepare dilutions.
- Repeat the above directions using peppermint flavoring, #1P, #2P, #3P. This is a minimum number of dilutions and flavorings. You may add more.
- To prevent the possibility of spills, add a small cotton ball to each canister. Cap all canisters until you are ready to set up the game.
- Set up the feeding field. Place one pure scent (red canister) at each corner of the room. These will be used to introduce the scent. Now position all #2 dilutions (green) in a ring around the room, but inside the pure scent. Place the #3 dilutions (blue) inside that ring. Place the remaining pure scents (red) near the center of the room.
- Play the Feeding Game. Uncover all the canisters. Divide the class into four groups—one group at each corner of the room. Each group starts by smelling the pure scent in their corner. They look at the bottom of the canister to identify themselves as lemon sharks or peppermint sharks. Sharks work their way toward the central feeding ground by searching for their scent from the green dilution to the blue dilution to red (pure scent) in the center of the room. Is it easy to find something using your sense of smell? The weakest dilution, #3, is approximately 1:100. Remember that sharks can smell dilutions of 1:1,000,000.

  Note: Preparation and set-up should be done while the class is out of the room.

Part B—Sight (whole class)



- Place the large piece of construction paper on a counter, next to a wall. Tape a square of foil and blue paper onto the wall, above paper.
- Darken the room. Shine the flashlight, at an angle, on the foil. Choose an angle that allows the light to reflect from the foil onto the flat paper. Observe the brightness of the reflection. Repeat, shining the light on the blue square next to the foil. Again note the brightness of the reflection.
- Which reflection appears to be brighter? Could you see better in the dark if your eyes had light-reflective cells?

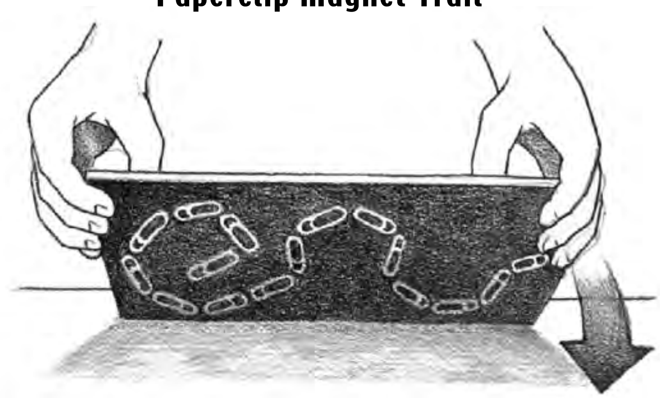
Part C—Magnetic Migration (small groups)

- Each team prepares a migration route and a shark. Draw a migration route on the cardboard.

  Glue or tape paper clips along the route. The paper clips represent iron particles imbedded in the ocean floor. Cover the clips with a piece of paper. Use a pencil and your sense of feel to trace the route. Label the paper and the cardboard (on the paper clip side) with your group name. Turn the cardboard over. The migration route is no longer visible. Cut out the hammerhead pattern on tag board. Glue a strong bar magnet to the underside. Save your map.
- Keep the clip side down while you exchange migration routes with another team.
- Lay a piece of paper on top of the new cardboard. Hold the paper in place with a few pieces of tape. Use the magnetic hammerhead shark to find the migration trail. Trace the trail on the paper. Mark the map "unknown" trail.
- Compare results. Take your "unknown" map and visit the other groups. Which group made the original migration map that looks like your "unknown"trail?

How would magnetic receptors help a shark to find its way?

Paperclip Magnet Trail



Local Connection

Take a sensory walk in your neighborhood. Note what you see, hear, smell, and feel. Which of your senses do you use most?

Key words: lateral line, reflective, electroreceptors, magnetic, migration

Activity 10

Ocean Life Food Web

How would you describe a marine food web? What would be in it?

In the Film Cool water and an abundance of plankton in the Gulf of California contribute to the formation of an ocean oasis. The concentration of life around some of the reefs is compared to a city—with opportunities, risks, and competition. Various organisms of the community are shown feeding upon other members of the community, creating a marine food web.

Concept Organisms interact with one another in various ways.

Objective To construct a food web representative of the Gulf of California

Content Science, language arts

Background The interactions of organisms with other organisms and with their physical environment form the basis of the study of ecology. Food chains and webs are often used to portray these interactions. Plants (**producers**) use sunlight and inorganic materials to produce the organic compounds that become food and nutrients for other organisms—the **consumers**. Those animals that feed upon plants are called **primary** consumers, while animals that eat other animals are **secondary** or even **tertiary** consumers. **Scavengers** feed on dead organisms, while **decomposers** break down nonliving organic matter into materials that again are available to enter the food chain as **nutrients**. Nutrients of the marine ecosystem tend to settle to the bottom. Upwelling (see Activity 6) of cool water brings the nutrients closer to the surface where they are available to **phytoplankton** (very small plants drifting in the sea). The phytoplankton, in turn, become food for **zooplankton** (very small ocean animals) and larger organisms. Mysids (tiny shrimp), barnacles, fish, sponges, sharks, dolphins, and sea birds are just some of the many animals seen in *Ocean Oasis*.

Materials

Pictures from page 25, art supplies, paper, glue, scissors, resource materials

Procedure

(individuals, small groups)

- Discuss the basic concept of food chains and food webs, including nutrients, sun, oxygen, carbon dioxide, decomposers, producers, and consumers at different levels.
- Use pictures from page 25 to create a marine food web. Be sure to put organisms in the appropriate level of the web—producer, primary consumer (level 1), secondary consumer (level 2), etc. Put the phytoplankton near the surface, draw the sun above the water, and show bacteria, dead organisms, and nutrients on the ocean floor.
- Challenge—connect various organisms with arrows to show food chains within the web.
- Would humans fit in the food web? Where?
- Where are the nutrients? How do they reach the surface?
- What would happen to the web if one or more organisms were removed?
- Which level in the web do you think is most important? Why?
- To learn more about the organisms in your food web, visit the *Ocean Oasis* website at www.oceanoasis.org, Field Guide Section.

Local Connection

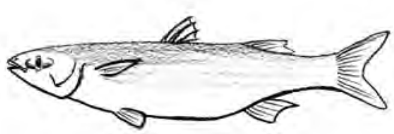
Think of the wild animals that live near you. Use sketches or pictures of these animals and other appropriate organisms to create a **terrestrial** (land) food web. Even urban areas have wild organisms (e.g., birds, rats, mice, snails, insects, plants) that may be used to create a food web. Compare the marine and terrestrial webs. How are they alike? How are they different?

Key Words: nutrients, producer, consumer, primary, secondary, tertiary, scavenger, decomposer, marine, terrestrial, phytoplankton, zooplankton

phytoplankton
producer
food:
nutrients,
sun's energy

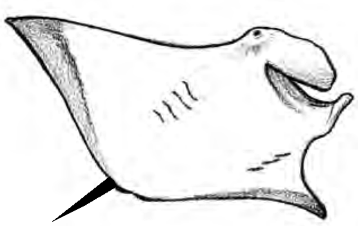
barnacle
level 2
consumer
food:
zooplankton

zooplankton
level 1
consumer
food:
phytoplankton



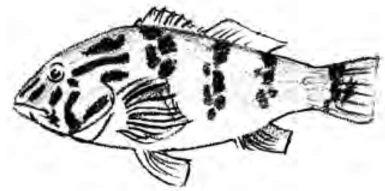
mullet
level 1
consumer
food:
phytoplankton

blenny
level 2
consumer
food:
zooplankton



manta
level 2 or 3
consumer
food:
zooplankton,
small fish

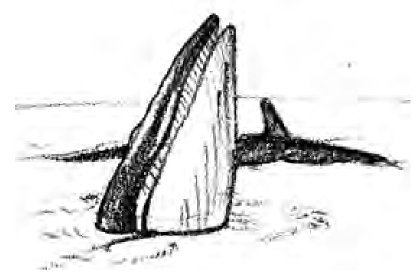
hawkfish
level 3
consumer
food:
barnacle, blenny



scorpion fish
level 4
consumer
food:
hawkfish

tern
level 2
consumer
food:
mullet

fin whale
level 2
consumer
food:
zooplankton



shark
level 3 or 4
consumer, some-
times
scavenger
food:
fish,
dead animals

moray eel
level 5
consumer
food:
scorpion fish

Activity 11

MARINE MATCHMAKERS

How do different organisms living in the same community help each other?

In the Film Terns gain protection from predators by living among a colony of gulls. A baby leather bass fish finds protection among sea urchins. Small jack fish swim, unharmed, among the tentacles of the lion's mane jellyfish, while angelfish clean parasites off a manta ray.

Concept Organisms of different species may live together in beneficial relationships.

Objective To invent two organisms with attributes that allow them to live together as helpful partners

Content Science, language arts, visual arts

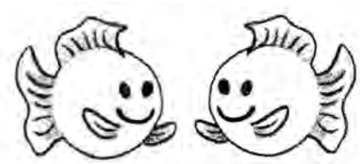
Background Within communities, organisms of different species may exist in some form of partnership. These relationships are generally referred to as **symbiotic**. **Mutualism** refers to relationships that are beneficial to both organisms. The relationship of flowers and bees is an example of mutualism. A bee moves pollen from one flower to another, thus fertilizing the flowers. At the same time, the bee satisfies its need for food by feeding on nectar produced by the flower. In some relationships, one organism may benefit while the other organism neither gains nor loses. Referred to as **commensalism**, an example of this type of relationship might be a bird nest in a tree. The bird finds a place to build a nest (benefits), while the tree neither gains nor loses. **Parasitism**, a third type of relationship, is beneficial to one organism at the expense of another. Fleas on a dog would be an example of parasitism.

Materials

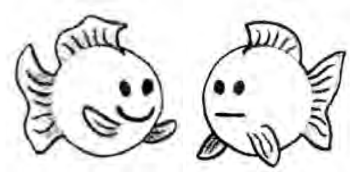
Description of organisms, paper, pencil, art supplies

Procedures

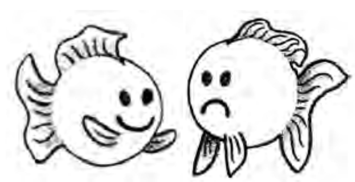
(six groups)
- Discuss the types of partnerships that might exist between some organisms in a community—mutualism, commensalism, parasitism.
- Explain that the class will pretend to operate a "dating service" for marine animals. Requests have been received from six animals seeking helpful relationships. Divide the class into six groups. Give each group one of the request sheets.
- Each group designs a poster portraying their client with a list of attributes.
- Display the finished posters.
- Challenge each group to find a partner for their animal that will result in a beneficial relationship for one or both members.
- Describe the relationship between your two partners.



Mutualism



Commensalism

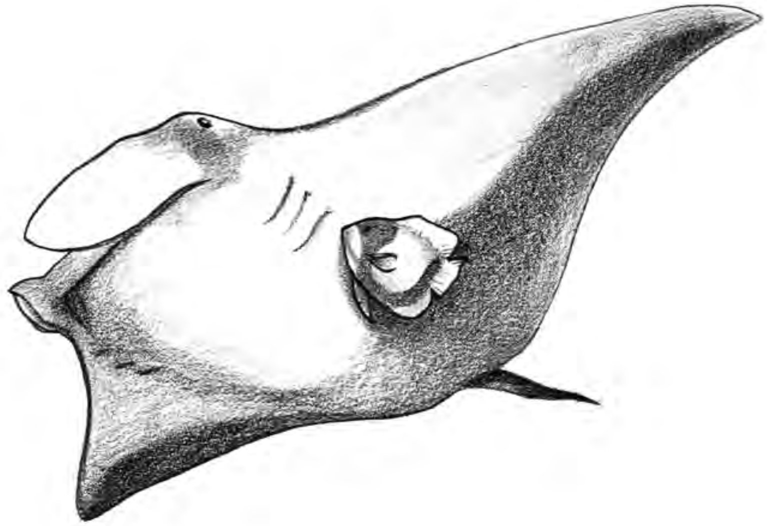


Parasitism

Note: The descriptions are based on real animals seen in the film. However, details have been omitted to encourage creativity. For a list of species appearing in the film, visit the Ocean Oasis *web - site at* www.oceanoasis.org, *Field Guide Section.*

Local Connection
Describe some relationships between organisms in your area that exhibit mutualism, commensalism, or parasitism.

Key Words: symbiotic, mutualism, commensalism, parasitism



Suggested Pairings
1. manta with 2. young angelfish (mutualism)
3. sea urchin with 4. baby leather bass (commensalism)
5. jack with 6. lion's mane jellyfish (mutualism)

Dear Marine Matchmakers,
I have enclosed a description of myself. Please help me find a partner.

1. Fish
Size: flat,
20 feet across
Color: blackish back,
gray underside
Diet: plankton
Motion: slow to fast
Other features: rough skin
Need: removal of parasites

2. Young fish
Size: 6 inches
Color: blue bars
on orange body
Diet: algae, parasites
Motion: moderately fast
Other features: lives around reefs
Need: safe place to eat

3. Invertebrate
Size: ball-like, 5 inches across,
spines up to 10 inches
Color: dark purple
Diet: algae
Motion: slow
Other features: long, slender,
toxic spines
Need: nothing special

4. Baby fish
Size: 6 inches
Color: white with dark bars
Diet: small fish, crustaceans
Motion: fast
Other features: lives around reefs,
immune to toxins
Need: protection from predators

5. Fish
Size: 6 inches
Color: silver
Diet: small fish, small shrimp
Motion: fast, agile swimmer
Other features: immune to toxins,
lives around reefs, attracts predators
Need: protection from predators

6. Invertebrate
Size: bowl-shaped, 2 feet across
Color: yellow to red
Diet: small fish, trapped in tentacles
Motion: drifts
Other features: many, very long
toxic tentacles
Need: someone to attract food to my
tentacles

Activity 12

Human Needs and Resources: Comparing Lifestyles

What resources do you need to survive? What is the source for these items?

In the Film The Baja California peninsula and its surrounding water is depicted as an area that provides resources and shelter for living creatures from near and far. Resources such as food and water are also basic needs of humans. An area of abundant resources is often described as an oasis. Two themes of the film are that this land and its surrounding sea create an oasis, and that people have lived here for thousands of years.

Concept Natural resources are the source of our basic survival needs: food, water, shelter, and space.

Objective To explore the sources of basic needs today and 500 years ago

Content Science, history/social studies, language arts

Background Over the years, basic survival needs have not changed. Food, water, shelter, and space are as necessary now as they were thousands of years ago. However, modern technology has created a gap between the product and the source. It is difficult to recognize the source of many of the things we use. For instance, breakfast cereal bears little resemblance to its parent grains. Not much in a modern house looks like the plant or earthen material from which it originated. For urban dwellers even the connection between rain, rivers, and tap water may be lost. It is important to keep in mind that **natural resources** still supply all of our needs. These resources are limited—some are recycled either naturally or artificially, while others are nonrenewable.

Materials

Paper, pencil, activity sheet on page 29

Procedure

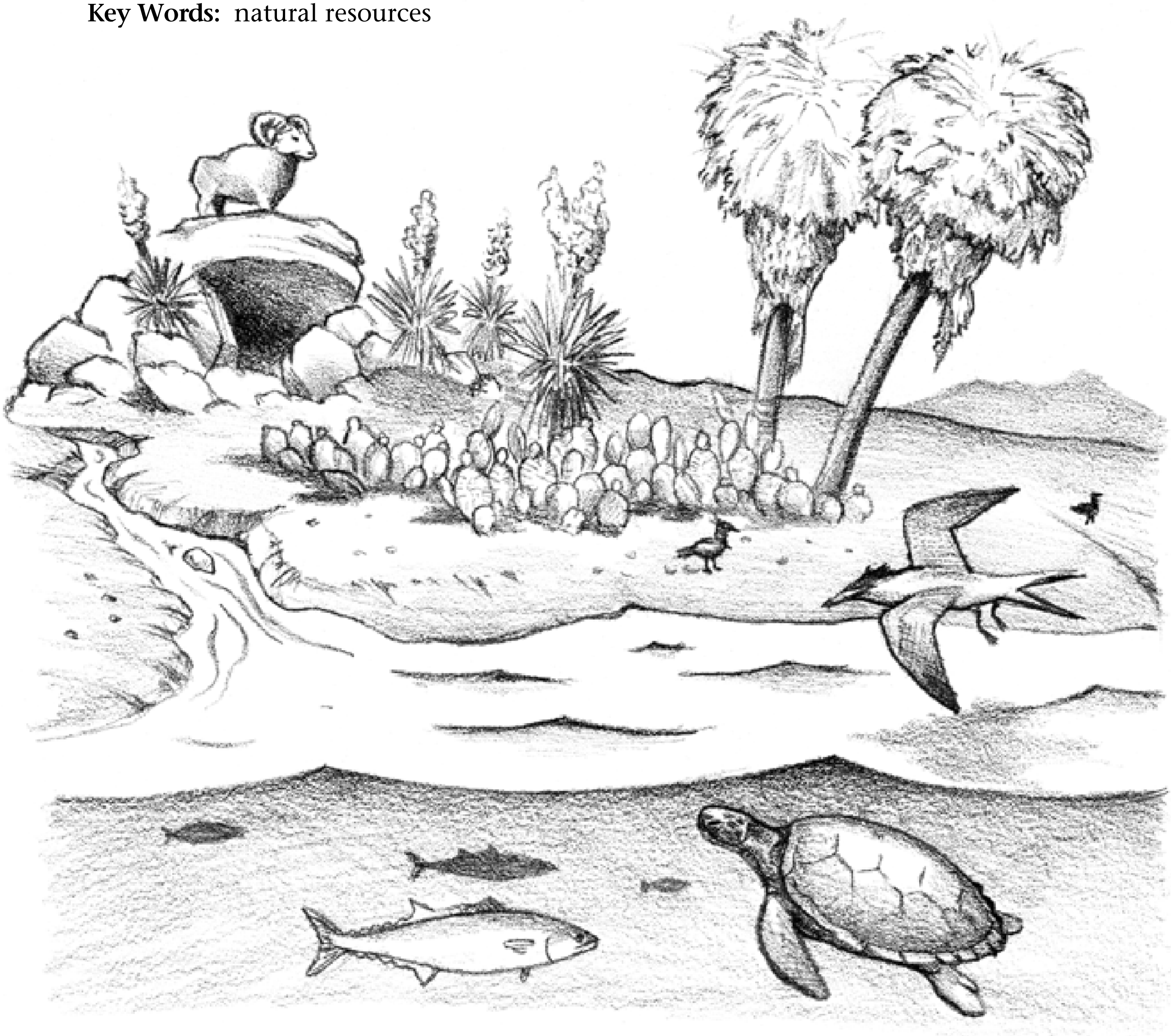
(individuals)

- Discuss the concept of basic needs—what they are and where they come from.
- Use the picture on page 29. Find a shelter, locate a source for water, and plan a menu for three days that would be appropriate for residents in Baja California 500 years ago.
  The menu should consist of food items found in the picture.

Local Connection

- Find out about life in the area of your town about 500 years ago. What items were used for food? Where was the water source? What materials were used for shelter? Draw pictures, write a report, or make a diorama to illustrate your findings.
- List items you use in your everyday life. Trace the sources of these items. Where do they come from? How do they reach you? What do you do with items you no longer use?
- Compare your lifestyle with that of people in your area 500 years ago.

Key Words: natural resources



Activity 13

Art with Natural Materials

Thousands of years ago, what materials might a person have used for painting or drawing?

In the Film A pack train of burros is seen walking up a trail and across a creek, stopping to drink in the shadow of canyon palms. Long ago in caves and on cliff walls above some of these canyons, people depicted a variety of animal and human forms. The paintings were created with charcoal and pigments made from local rocks.

Concept Resources come from natural materials.

Objective To create artwork using natural materials

Content Science, visual arts, history/social studies

Background It is thought that people reached the Baja California peninsula about 12,000 years ago. However, little is known about the people who painted the cave murals in Baja California or how long ago they were painted. Estimates of the age of the paintings, known as **pictographs**, range from 2000 to 10,000 years. The artwork is mostly of humans and assorted animals. The figures are nearly always larger than life-size. It appears that the paintings were outlined with chalk and then filled in with color—mostly pigments from red rock and black from charcoal. In 1993 the cave mural region was designated as a UNESCO World Heritage Site.

Materials

Red or brown clay (commercial modeling type) or dug from the ground, burned wood from a fireplace (charcoal), art paper or brown paper grocery bags, sketches of cave mural figures on page 31, small paintbrush, water

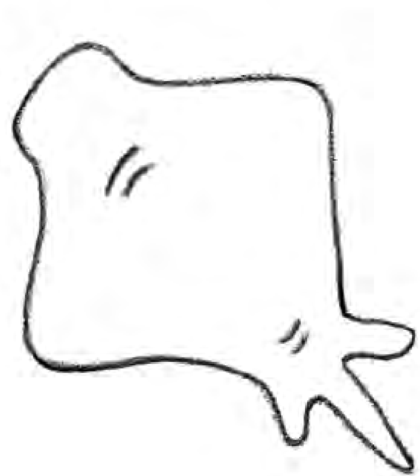
Procedure

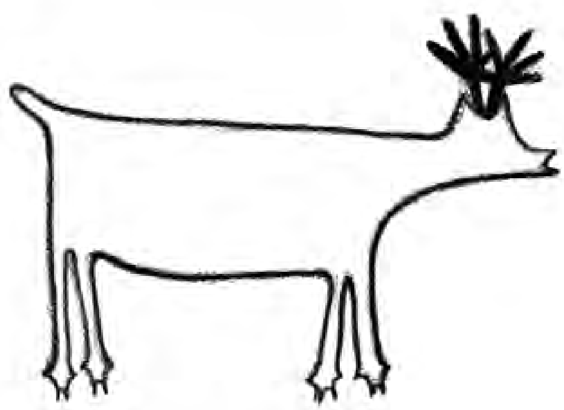
(individuals)

- Discuss the use of natural materials for arts and crafts.
- Mix some mud or mash some commercial clay with water to form paint. Use the charcoal or chalk to draw some of the figures pictured on page 31. Fill in with the paint and charcoal. Use a brush or your fingers. In the black and white pictures on page 31, white represents red paint and black represents charcoal. If red clay is not available, use brown clay.

Local Connection
Research native artwork where you live. What was made long ago or is still made? Baskets? Pottery? Sand paintings? Bark paintings? Wood carvings? Other crafts? What materials were used or are used now? What is the source of these materials?

Key Words: pictographs





STANDARDS CORRELATION

This chart shows the correlation of key concepts from the National Science Education Standards* with activities in the Ocean Oasis Teacher's Guide.

	National Science Education Content Standards	**Activities**
Life Science		
K-4	• characteristics of organisms	1-2, 6-12
	• organisms and environments	2, 6-12
5-8	• structure and function	2, 7-12
	• regulation and behavior	1, 7-9, 11-12
	• populations and ecosystems	2, 7-8, 10, 12
	• diversity and adaptations	7-12
Earth Science		
K-4	• properties of earth materials	2, 12-13
	• objects in the sky	4-5, 7
	• changes in earth and sky	3, 5-6
5-8	• structure of earth system	3-7,12
	• earth's history	3
	• earth in the solar system	4-6
Science as Inquiry		
K-8	• ability to do scientific inquiry	1-13
	• understand scientific inquiry	1-13
Science and Technology		
K-8	• abilities of technological design	1-13
	• implementing proposed solution/design	1-13
Science in Personal and Social Perspectives		
K-4	• types of resources	2, 6, 10, 12, 13
	• changes in environments	3, 6
5-8	• populations, resources, and environments	2, 6, 10, 12
	• natural hazards	2-3, 6
History and Nature of Science		
K-8	• science as a human endeavor	1-13
Unifying Concepts and Processes		
K-8	• systems, order, organization	1-13
	• evidence, models, explanation	2-3, 7-12
	• constancy, change, measurement	1-6, 10, 12
	• evolution, equilibrium	2-3. 7-12
	• form, function	7-9, 11

* National Research Council. *National Science Education Standards*. National Academy Press, Third Printing, July 1996.

For additional activities, bibliography, and educational resources, visit the *Ocean Oasis* website at www.oceanoasis.org

Filming Locations in Baja California

1. **Isla Guadalupe** – elephant seals
2. **Parque Nacional Sierra San Pedro Mártir** – aerials, observatory
3. **Cataviña/Santa Inés** – kangaroo rat and rattlesnake
4. **Bahía de los Angeles** – aerials, cacti, agaves
5. **Isla Rasa** – Elegant Terns, Heermann's Gulls
6. **San Francisco de la Sierra** – cave paintings, palm canyons
7. **Laguna San Ignacio** – gray whales
8. **Isla Santa Catalina** – cacti, plants
9. **Isla Santa Cruz** – underwater locations, sergeant majors
10. **Isla San José** – underwater locations, pargo cave, mysids, gorgonia forests
11. **Isla Espíritu Santo** – aerials
12. **Isla Cerralvo** – underwater locations, frog fish
13. **Islas Revillagigedo** – Manta rays, sharks, pelagics, angelfish

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Acknowledgments

Ocean Oasis Teacher's Guide

was produced by the

San Diego Natural History Museum (SDNHM)

with generous funding from the

Walton Family Foundation

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Ocean Oasis is produced by Summerhays Films, Inc., in association with the San Diego Natural History Museum and PRONATURA A.C., Mexico's oldest and largest conservation organization.

Proceeds from *Ocean Oasis* will support conservation, education, and research in the Baja California peninsula and the Sea of Cortés.

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