
THE SIGHTS THAT SAND HAS SEEN

FOR THE TEACHER

Discipline

Earth Science

Themes

Evolution, Scale & Structure

Key Concept

Waves carve the shape of the shoreline and move sand constantly on and offshore to form seasonal beaches.

Synopsis

Students conduct several wave demonstrations to see how waves work and then follow the journey of a sand grain through seasonal changes in waves, currents, and beaches.

Science Process Skills

observing, comparing, communicating

Vocabulary

kelp wrack, tides, longshore drift current, waves

MATERIALS

- string or yarn, 30-40 feet long
- slinky
- jump rope
- seven 4X6 blank (unlined) index cards per student
- crayons, markers, or colored pencils

INTRODUCTION

Waves are an important influence on life in the ocean. They can easily be observed from a sandy beach where they crash and pound in rhythmic swells throughout the year. There are three types of waves: 1) wind-generated waves along the surface of the sea; 2) internal waves underneath the surface; and 3) tsunamis -- long, sometimes huge waves caused by earthquakes. The waves we see rolling along the beach are wind-driven waves caused by the wind blowing over the ocean surface for many miles. Wind waves begin as small ripples formed by unevenness in air pressure against the ocean surface. These ripples grow into large, steep, crested waves with the force of the wind's energy. Once formed, these swells can continue to travel for thousands of miles even after the wind dies down. Waves hitting the California coast have often traveled thousands of miles across the vast reaches of the Pacific picking up tremendous energy. Storm waves are especially powerful when they hit the shoreline and can cause serious erosion.

Waves in summer and winter are different in size and strength. Winter storms cause large, steep waves that crash close together, pulling sand offshore with the power of their weight and force. Winter beaches are often eroded to become narrow and steep, sometimes reduced to cobbles with no sand. The sand is taken out to sea where it churns in the ocean currents and on the west coast moves south with the longshore drift current. In summer, waves are less steep, shorter, and farther apart. As they roll in gently, the sand is deposited back on shore to form the beach again, now wider and less steep than in winter.

The sand on the beach is in constant motion, due to the intense impact of regular wave action as well as the force of winter storms. Sand grains may be hit by as many as 8000 waves a day! A single sand grain may move on and offshore many times in a day, or it may join the longshore drift current and travel south some distance before washing up again. Beaches are one of the most unstable marine environments, better thought of as rivers of sand than anything permanent.

INTO THE ACTIVITIES

The Shape of Waves

Introduce the idea of waves by a demonstration. Tie a knot in the middle of a rope and tie one end of the rope to a chair or desk. Whip the rope to make a wave-like motion. Have several students try the demonstration. Observe that the wave travels along the rope, but the knot stays in the same place. Explain that waves move through the water, but do not actually move water.

Demonstrate big winter waves close together and small, rolling summer waves.

Repeat the same whip-like motion with a slinky. Lay the slinky on its side and have students line up on either side of it, making a channel with their hands. Generate a wave and have students feel the wave as it passes by their hands. Again demonstrate both winter and summer waves.

To make a human wave, have students line up side by side, facing forward in one long line. Connect everyone with a length of string or yarn across their hands. Begin the wave at one end by lifting your arms straight overhead, thereby cueing the next person by a tug of the string to lift her arms, and so on down the line. Practice your wave until it rolls along quickly. Have students make both winter and summer waves. Then have five students step off the end of the line out front to see how it looks. Have them step back into the line and replace other students until everyone has had a chance to see how the wave looks.

THROUGH THE ACTIVITIES

The Seasons of a Beach

Have students act out winter and summer wave activity in an open space. Have most of the class represent sand particles, and five students be a wave. Holding hands in a line, have the wave come back and forth quickly to represent fast winter waves, each time taking sand particles with them to the other side of the room (the ocean). Have the wave grab a pile of jackets and deposit them on the beach to represent kelp ripped from its holdfasts and washed up on shore. Now a few students can be shorebirds who peck through the kelp wrack looking of a snack -- beach hoppers, kelp flies, limpets, and etc.

To represent summer, have the wave move slowly, quietly lapping along the shore, pushing the sand particles up onto the beach, spreading them out and leaving them relatively undisturbed.

Discuss the nature of waves and beaches before going on to the story.

Postcard Journey of a Sand Grain

Gather the class into a listening circle, and read the story *The Sights That Sand Has Seen* to them.

When you have finished, pass out a set of seven blank (unlined) 4X6 index cards to each student. One card is a title card and the other six will be scenes from Sandy's travels.

Review the story with the group and agree on these six scenes as topics for the cards:

- 1) the high mountains
- 2) the river journey

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- 3) the winter storm
 - 4) the kelp wrack
 - 5) the ocean drift current
 - 6) the summer beach and sandcastle

Using crayons or markers, have students draw each of these scenes on one of the index cards. Be sure they include Sandy in each picture.

On the back of each card, have students write a postcard message from Sandy. Example: "Hi from the mountains! I'm in a crack by a pine tree. Having a good time. Bye, Sandy."

Complete the set by making a title card, "The Sights That Sand Has Seen". Make a postcard journey that tells the story of change in the life of a sand grain by lining all seven postcards in a row and taping the long edges together, alternating the tape on the front or back so that it will open and close like an accordion.

Make sure that language minority students know that they can write their postcards in their native language.

Pair limited English proficient students with good writers. One can do the artwork, the other can write the message. Or have LEP students tell you their message verbally and you can help them write it. Or let all students present their postcards verbally to the class. Those who write well can also write their message.

Have students work in cooperative groups while making the postcards. The group can decide what should be on each, and then each student can illustrate two cards. Each student should be able to explain any postcard in their group.

DISCUSSION

1. How is sand formed? Where does it come from? What forces break up and transport sand in winter (ice, wind), spring (rain, snowmelt, rivers) and summer (sun, heat)?
2. How are waves different in winter and summer? How do they affect the shape of the beach?
3. How can high tides add to the impact of storm waves? (They can push the water even further up on the beach, taking away more of the sand or seacliff.)

BEYOND THE ACTIVITIES

Go to the beach to watch waves in different seasons. Compare how the beach looks in winter and in late summer/fall. Draw pictures showing the differences, including some landmarks that stay the same in both pictures.

Have a cooperative sand sculpture event at the beach, and see what fantastic shapes and animals you can build in small groups or as a class. If you can't make it to the beach, use your school sand box.

For advanced students, draw a diagram of a wave on the board and explain the parts of the wave: trough, crest, wave length, and height.

Ask your local medical or engineering center for leftover computer printouts of wave patterns (from EKG or EEG tests) and use them to decorate your walls. Have students add colors and enjoy the shape of the patterns.

THE SIGHTS THAT SAND HAS SEEN

Deep in the middle of winter, the storms blow cold on the top of the high peaks of the Sierra Nevada mountains. Here the jagged granite rocks are covered deep in snow and ice for half of the year. Inside one small crack next to a lodgepole pine tree was wedged a small rock named Sandy, about the size of your thumbnail. It had broken off from a big mountain boulder and had been there for a very long time, watching the seasons go by and enjoying the scenery. But lately, as the pine tree grew, Sandy noticed that the crack was getting wider and she did not seem to be quite so stuck in her place any more. She rattled about a tiny bit and wondered if she would be there forever.

One fine spring day, when the sun was out and beaming its hot rays onto the snow, a trickle of water crept underneath Sandy's underside. It tickled a little bit and Sandy smiled. As the day grew hotter, the little trickle turned to a rushing stream and much to Sandy's surprise, she was lifted up out of her familiar crack and carried off over the edge of the granite and into a roaring waterfall. Crash, bang! Sandy landed at the bottom of the waterfall in a deep pool, a little dazed. She barely caught her breath and was whooshed away on down the racing river. As the melting snow poured into the river, Sandy was carried fast and furiously out of the high mountains down to the valley below.

All through that summer and fall, Sandy traveled down the river, stopping in pools and taking in the sights. Finally, Sandy settled out on a flat spot, perched on the side of the river not far from the sea. She noticed that some of her sharp edges had worn away in the rushing river and now she had one side which was smooth and almost shiny. After such an exciting journey, she thought she might stay there for awhile and rest. She hardly remembered her old crack for she was completely dazzled by the silver beauty of the full moon which was just beginning to rise over the horizon. In the early morning hours, the ocean's roar sounded very far away.

But six hours later as the moon was directly overhead, the ocean was suddenly at her feet! High tide! And winter storm waves were rolling in fast and hard. The rain was pounding down and the ocean was wild and loud. Before she knew it, Sandy was washed out to sea in a great tumble of stones and sand. The bumping and grinding of all the rocks together broke off bits and pieces from her until only a small sand grain was left. Sandy tumbled around in the huge ocean, dancing and spinning on the roller coaster waves, surrounded by the vast Pacific Ocean.

After a few weeks of black skies and rain, the storms cleared and spring came and Sandy sloshed back up on the beach, stuck to a big stalk of kelp which had been ripped loose in the storm. She was pushed high above the tideline,

out of the reach of the waves. As the sun grew hot, the kelp began to feel sticky and start to rot. Sandy was quite stuck, but at least she had many visitors. The kelp wrack attracted flies, beach hoppers, worms and crabs, as well as many gulls and shorebirds. There was always a party going on at the kelp wrack.

As spring changed to summer, the kelp dried up and Sandy fell off onto the beach. People and dogs came by and scuffled the sand so one day she found herself at the edge of the ocean again. The waves were gentle now, and at high tide, she was scooped up in a quiet, rocking motion and carried into the longshore current. Each day at high tide the ocean picked her up and carried her south to a new beach where she was left at low tide. Sandy saw a lot of new beaches this way. Sandy drifted, pushed along by the ocean and the tides all summer, heading south with not much to do except go with the flow.

By the end of the fall, Sandy had traveled quite a few miles from the kelp wrack beach. Now she was near a small coastal town around the bend of a large point of land. The nearshore current caught her up and pushed her on shore right next to a child who was building a sandcastle. Scoop! The shovel picked her up and she landed at the bottom of the bucket. Splat! The bucket dumped her onto the top of the castle. And then she felt the child's warm hands pushing her around to make a beautiful shape. Oh! How lovely! She could feel the child smiling, and she was glad to be there -- at least, for awhile.