Seashore Sleuthing

Overview

In this activity, students investigate rocks and sand. They study the forces of erosion that turn rocks and shells into sand; look closely at the rocks, shells and beach drift that will eventually become sand; and then they observe a demonstration that simulates the effect of wave shock on a variety of beach substrates.

In Session 1, students make some observations of rocks, and shake hard candies in a jar to simulate erosion at the seashore. In Session 2, students cycle through three stations looking closely at sand, gravel and beach drift. At one of the stations, they experiment to find out how the rising and falling tides "behave" differently in sand versus gravel. In Session 3, students hide several plastic seashore animals under sand, gravel and rocks then observe which substrate is safest when hit by thundering waves (buckets of water!). Students discover that rocks, shells and other beach drift become sand as they are broken into smaller pieces by the crashing waves. They also discover that different types of animals, seaweed and plants are adapted to live at different types of seashores.

What You Need

Session 1
For the class:

- several slides, posters, or pictures of sandy beaches and rocky seashores, such as selected slides from the MARE *Seashore Charades* and *Sandy Beach* slide shows
- chalk board, white board or butcher paper and markers
- about 10-20 rocks of various sizes and colors
- 1 sheet of sand paper cut into 2" squares
- several paperclips
- several coins
- 10-20 hand lenses
- 1 package of Jolly Ranchers or other hard candy such as butterscotch or peppermints—Jolly Ranchers work great!
- 1-2 small plastic containers with tight fitting lid (tupperware or plastic peanut butter jars work great)
- 1 Beach Bucket (see below)

For each student:

- drawing paper
- markers or crayons

Session 2

For Station 1: Beach Buckets

- station instruction sheet
- 2-3 plastic shoe boxes or other similar size containers (plastic shoe boxes are ideal for durability and may also be used for the Hidden Animal activity in Session 3)
- sand to make a two inch layer in each shoe box
- shells, rocks, feathers, driftwood, seaweed, aluminum cans (crushed), fishing line, paper and other items found on a beach for each shoe box
- large sheet of chart paper and colored markers
- 2 or more hand lenses

Optional

- rocky seashore and sandy beach reference books with colored pictures

For Station 2: Microscopic Investigations

- station instruction sheet
- one hand lens per student (can be the same as those used for class above)
- about 2 tbsp each of 4-6 different sand samples (1 sand sample for each student in the small group); each in a heavy-duty ziplock bag
- 1 small box of different kinds and colors of rocks or a commercial rock/mineral kit
- 1 small box of different kinds and colors of shells
- 2-3 small bottles of white glue
- globe or wall map
- 2-3 microscopes-- optional but recommended (see Getting Ready)

For each student:

- drawing paper
- markers or crayons
- 3X5 inch index card

For Station 3: Going With the Flow

- station instruction sheet
- four identical approx. 12 ounce small, narrow, tall, clear plastic containers (such as small bottled water bottles with the tops cut off)
- one quart of sand (to fill three of the clear containers about two thirds full)
- approx. 2 cups gravel (to fill one of the clear containers two thirds full)
- quart (approximately) of water in a pitcher
- two clear plastic measuring cups

- plastic tub to catch water spills
- data sheet and pencil

optional

- watch, clock, or stopwatch

Session 3: Hidden Animals

- 10-20 baseball to softball sized rocks
- 1-2 quarts of sand
- 1-2 quarts of small rocks/gravel
- 3 plastic shoeboxes
- 10-20 small (about 1–2 inch big) plastic sea animals
- bucket of water
- water to fill bucket three times
- Key Concepts written in large letters on butcher or chart paper

Getting Ready

For Session 1

1. Unwrap 7-10 Jolly Ranchers and place in plastic jar with lid.
2. Locate slides, posters, videos or other images of sandy beaches and rocky seashores.

For Session 2

1. Make 2-3 beach buckets as follows: Place 2-3 inches of sand in a plastic shoe box and add shells, small rocks, sand dollars, and trash to the surface of the sand.
2. Fold a sheet of chart paper into four sections and label each section with one of the following categories: animal; plant or seaweed; people; and unknown.
3. Obtain 4-6 sand samples for Microscopic Investigations from different locations. You can collect these yourself or ask students, parents or friends to bring samples back from their vacations. Sand kits can also be ordered from Math/Science Nucleus, 3710 Yale Way, Fremont, CA 94538, (510) 790-6284. Put 2 tablespoons of sand from one location in a ziplock bag and label it with its place of origin. Repeat for each type of sand you have.
4. Obtain one or more rock and mineral kits. Track down existing kits in your school or order from a scientific supply company.
5. Locate or purchase microscopes for the Microscopic Investigations station. This is optional but will greatly magnify the drama of the activity! You won't regret having some scopes around your classroom. We recommend Magiscopes by Brock Optical in Maitland, FL (800) 780-9111

6. Assemble the materials for each of the three stations onto trays so that you can quickly carry them to the location of the station in your room.
7. Cut the tops off of four clear, tall plastic water bottles. Fill three of these containers with dry sand and the fourth with gravel.
8. Arrange to have an adult or older student at each of the three stations is Session 2. They will need a brief orientation to their duties before the session begins. This is an ideal role for parent volunteers to become involved in classroom instruction.

For Session 3

1. Find a spot outside where you can throw three buckets full of water around.
2. Fill one of the plastic shoeboxes 3/4 full of sand, another 3/4 full of gravel and the third 3/4 full with baseball-sized rocks.

Key Concepts
Write out the key concepts on chart paper with colored markers in large bold letters.

Rocks, shells and other beach drift become sand as they are broken into smaller pieces by the crashing waves.

There are different kinds of seashores—some are sand, some are gravel and some are rocky.

Different types of animals and plants are adapted to live at different types of seashores.

Session 1: I Am a Rock

1. Show a few slides, posters, or pictures of sandy beaches and rocky seashores. It may also be useful to show the students different sizes and colors of rocks and various sand samples.
2. Do a class brainstorm, or My Buddy Says about the differences between the two habitats using the following questions to help guide the students:
   1) What kinds of animals do you think live at the sandy beach? At the rocky seashore?
   2) What do you think animals at the seashore do to protect themselves from the crashing waves?
   3) Do all seashores look the same? How are they different?

4) Seashores have high and low tides everyday. In what ways do beaches look different at high and low tides? When do you think would be the best time to visit the seashore?

3. Record the responses on the board or butcher paper using three columns, one titled "Sandy Beaches," the second "Rocky Seashores," and the third "Both Sandy Beaches and Rocky Seashores."

Students may suggest the following:

- Sandy Beach animals are mostly hidden beneath the sand and very few plants grow on the beach (kelp may be thrown up on the beach, but it doesn't live there).
- At high tide the beach looks narrow and at low tide it looks wide.
- Waves crash on the beach and there is no place to hide except to dig down into the sand. Birds can be seen poking their beak in the sand or under the kelp looking for the hidden animals to eat.
- At the Rocky Seashore, plants and animals seem to live and grow on almost every surface.
- Rocky seashores have tidepools that hold water even when the tide is out.

Rock On

1. Have students sit in a circle. Pass out a rock and a hand lens to every student or two, and have them make some detailed observations of the size, shape, and color of their rock. Then have them investigate the relative hardness of the rocks by trying to scratch the surface of the rock first with their fingernail and then with other items such as a coin, paper clip, and sand paper. Remind them to use the hand lens to look for scratches.

2. Do a class brainstorm of all the words they could use to describe the colors, shapes, and sizes of their rocks or other rocks they have seen. Record their words on the board or a large sheet of paper. Have them use the words from the brainstorm to make as many additional observations of their rocks as they can.

3. Have them put their rocks into the center of the circle and mix them up. Ask one student to try to sequence them from lightest to darkest, another student to sequence them biggest to smallest, a third from smoothest to roughest, etc. Then see if they can each find their own rock again. Ask them to describe the details that helped them to identify it.

4. Have each student take their rock to their desks. Distribute a sheet of drawing paper and crayons and have them draw their rock and color it as accurately as possible.

Shake, Rattle, Rock and Roll

1. Ask the students if they know where sand comes from. Students may come up with the idea that sand comes from rocks and/or shells that are banged together and broken apart into smaller pieces. Tell them that we are going to try to figure out how that might happen.

2. Show students one Beach Bucket. Point out some of the things that wash up on beaches (shells, rocks, cans, seaweed, plastic, etc). Ask students what would happen to those objects if 10,000 waves a day pounded on them? [They will break up into ever-smaller pieces.]

3. In this investigation, they will pretend that the different colors of Jolly Ranchers or other hard candies are going to represent different objects that wash up on a beach and are tossed about by the waves: red candies can be rocks; pink can be shells; green can be plants; etc. Have students watch you fill a small plastic container with a lid about a third full of hard candies. Have students imagine the power of a wave crashing on a beach. They will take turns being waves–shaking the container vigorously about 5 times and then passing it to the next student.

4. After everyone has had a turn, ask the students if there is any "sand" in the container? Have a look. What do the "rocks" look like now? Ask the students if they can figure out just by looking at the "sand" which colors or flavors the "rocks" were. Have them look closely to see that there are several different colors. Compare this to real sand, and note that the colors give us clues about what the sand is made of.

(Through the Activity)

Session 2: Sand Stations

This session is organized into three stations (Beach Buckets, Microscopic Investigations and Going with the Flow). You will need to organize your class into three groups that will spend 15 minutes or so at each station before rotating to the next. If you have a large class, you may want to set up two of each station and break students into six groups. We recommend that groups not be any larger than six students.

You should have an adult or older student at each station repeating the instructions and helping out.

(sidebar) Be sure to coach station helpers on how to guide students and to ask questions, but not to "do" the activity for them or give them the answers.

1. Put the materials for each station at a separate table Don't forget the station information cards for the adult volunteer to refer to.

1. Gather students together as a whole group. Explain that they will spend 15 minutes at each station, and perhaps another 10-15 at the end of this session (or the next day) with the whole group sharing what they have learned.

3. Give a very brief overview and simple directions for each station. An overview might go as follows:

> "When you go to *Station 1: Beach Buckets,* you will be examining a beach like the one I showed you earlier. You will look over everything that washed up on your beach that will eventually become sand (just like the Jolly Ranchers!) You'll try to decide if it each item came from a plant/seaweed, an ocean animal or a human.
>
> When you go to *Station 2: Microscopic Investigations,* you will get to look at sand samples from all over the world under a microscope! You'll be a detective trying to compare the sand with some rocks and shells to figure out what types of things might have washed ashore there. You'll be amazed at how beautiful your sand looks under a microscope.
>
> At *Station 3: Go with the Flow* you are going to do an experiment to see how well different types of beaches hold water. At the end you can say which type of seashore you'd like to live in, that is, if you were a clam or an anemone!"

4. Break the class into three small groups and assign each group to a different station. Tell them that you will call time after about 15 minutes and they will then rotate clockwise to the next station. Send each group off to a station to begin. Every 12-15 minutes ask the groups to rotate.

Station 1: Beach Buckets

At this station, students investigate items that might be found on a sandy beach.

1. Tell the students that even though they can't go to a real beach today, they will now have a chance to examine what a real beach might look like—right here in class. Ask every 2-3 students to gather around a Beach Bucket at the table and give them time to freely explore the buckets. You might also have them look closely at the items using a hand lens.

2. After five minutes or so, ask the students to find three different kinds of things on their beach as follows:
    - things that show that an animal was there
    - things that show that a plant was there
    - things that show that a person (which is also a type of animal) was there

These things could also be described as clues or evidence.

3. Show students the chart paper labeled with the names of the three categories above. Model how to remove items from the bucket and place them on the chart paper within one of the categories. Also model for them how they could label the chart paper with the names of each of the items within the category.

4. Give the groups further time to explore their beaches with the idea of looking for clues or evidence. Have them take turns removing items from the buckets and placing them in one of the categories. Ask them to describe why they decided to place an item in a particular category. What is their "evidence" that it belongs with others in that group? Are there some items that might fit into two of the categories? Are there some items they are unsure about? Have them set aside things they are unsure about into a fourth category.

5. Have each student hold up an example from each of the three categories. Have them identify as many as possible. If there are things that none of the students can identify, help them to figure out how they might go about finding out about the item, using books or other resources.

6. Ask the students if everything from animals, seaweed and plants, and people was taken out of their beaches, what would be left? *(sand and rocks)*

7. Have students look closely at the rocks in their buckets. Ask them to use their descriptive rock words (from Session 1) to describe the sizes, shapes, and colors of the rocks. Have them also notice whether the edges are jagged or smooth. What are some possible reasons that the rocks are all so different? Hold up the container of hard candy "sand" to compare with the beach bucket sand.

8. Tell the students that the animals and plants that live at the beach will live on, in, or under the rocks or sand, and scientists call that rock and sand the **substrate**. We will be comparing different types of substrate—rocks and sand.

Station 2: Microscopic Investigations

At this station, students will look closely at the various shapes and colors of sand and investigate what it is made of.

1. Place the rock and shell samples in the center of the table. Place samples of sand in plastic bags around the table and direct the students to each sit down in front of one of the samples.

2. Tell the students to take an index card, dip their pinky finger in the white glue and spread a circle of glue on their card the size of a quarter. Have them carefully open their bag of sand and take out one pinch and sprinkle it over the glue. Tap off any excess sand back into the bag and zip it up again. Have each student write their name and the place their sand is from on the card. Remind them to leave the plastic bag closed up tightly for the rest of the activity.

3. Tell them that they get to look very closely at some sand with a hand lens or a microscope and try to figure out what it is made of. Give each student a hand lens and have him or her look at the sand. Ask them what colors they see? What do they think their sand is made of? Have them compare their sand grains with the examples of rocks and shells on the table. If you have microscopes, show students how to use them and be prepared for ooohs and aaaahs!

4. After the students have had a few minutes to look at the sand, ask them to find a shell that has some of the same colors on it as they found in their sand. Then have them find a rock that has the same color. Ask the students if they think their sand is made mostly of rocks or of shells?

5. When they have finished, have them switch samples with someone else in the group, and repeat their observations. It

is important to see at least three different samples to get a sense of the incredible diversity found in sand.

6. Help the students to locate where the sand came from on the globe or wall map.

7. If there is time, have them choose one of the samples to draw and color what they see. Remind them to draw the sand grains bigger than life-size. Each grain should be drawn about the size of their fist.

Station 3: Going with the Flow

An adult or older student needs to lead this station. Tell the students at this station they are going to conduct an experiment to see 1) how **fast** water travels through rocks and sand, and 2) how much water will **stay** in the rocks and sand.

1. Place one of the clear, tall containers of sand and one of the gravel containers side-by-side where the students can see them. It is important that they are filled to the same level exactly.

2. Assign two students to be water measurers and two to be water pourers—two for the sand and two for the gravel. Assign another two students to be timers—one for each. Have all students predict through which container water will travel from the top to the bottom the fastest—or if they will travel at the same rate. How long do they predict it will take?

3. Lead a discussion about how to ensure you will get consistent results and why that might be important. Students usually will equate it with being FAIR! Some of the variables to control include: pouring the same amount of water the same way and speed each time, and counting or timing the same way each time. You might even practice pouring once into the tub and practice timing once.

4. Run the experiment! Put the sand bottle in the plastic tub to catch overflow. Have one student measure out 1/2 cup of water or mark on the water container the height of the water so it can be compared before and after. Have one pourer pour water into the sand. The timer times or counts how long it takes for the water to touch the bottom of the bottle. Record the results on the data sheet.

5. Place the gravel container in the plastic tub. Ask the students if they would like to change their prediction about how long it will take the gravel to get wet on the bottom of the bottle. Have one student measure out 1/2 cup of water. Have the pourer pour the water into the gravel container and have the second timer time or count how long it takes for the water to touch the bottom of the bottle. How long did it take? Record the results on the data chart. Compare the two results.

6. Now have the students predict if more water will stay in the rocks or in the sand when you pour it back—or if the same amount of water will stay in both. The adult supervisor can pour the water from the gravel bottle back into the original water container and measure the difference in the amount of water before and after it traveled through the gravel. Remember to include any water, which spilled into the overflow tub. How much water returned from the gravel? [Almost all the water returns] Record the results on the data chart.

7. Now the adult pours the water from the sand container back into the original water container and measures the difference in the amount of water before and after it traveled through the sand. Remember to include any water, which spilled into the overflow tub. How much water was left in the sand? [Usually not a drop will come out of the sand] Record the results on the data chart.

8. Do a quick simulation activity with the students to help them understand the concept of surface area and how sand can hold onto the water.

1) First have the students pretend to be sand grains and stand *very* close together. Pretend you're the water trying to get from one side of the sand to the other. Show how it is almost impossible to work your way to the other side through them since they are packed so closely together.
2) Now have them pretend to be pieces of gravel with rough shapes (have them stick their elbows and knees out) and stand a foot away from each other. Now pretend to be water going from one side to the other. Now it is a cinch to move between the pieces of gravel.

9. Ask the students:
- Did the water flow through the gravel or the sand the fastest? (*gravel because it has bigger spaces or holes between each of the pieces*)

- Did more water stay in the sand or in the gravel? (*sand, because it has more surface area for the water to cling to*)
- If you were a land plant that needs fresh water, would you rather live in sand or gravel? Why? (*Sand because it can hold more water for your roots.*
- If you were an animal that lived where the tides changed from high to low, would you stay wet longer in the rocks or sand? Why? (*plants and animals stay wet longer in the sand because it holds onto or retains more water longer; animals that live on or under rocks at the rocky seashore will get wet faster at high tide but also dry out sooner at low tide than animals and plants in the sand. If you live in the sand you won't get wet as fast or as often, but when you do, you'll stay wet for a long time.*
- How do you think rocky seashore animals might cope with the problem or challenge of drying out? (*close up tightly, shells that retain water*)

Be sure to use dry sand for each group; the wet gravel can be used again for the next group.

Wrapping Up the Stations

After each group has visited each of the three stations, bring them back together to discuss what they learned at each station. Present the Key Concepts that are relevant to the stations.

At *Beach Buckets* they discovered that nearly anything can wash up on a beach, and that everything that does will eventually become sand. Beach drift can include evidence of plants, animals and humans (animals, too).

At *Microscopic Investigations* they found that by looking closely at sand grains they can guess what types of things wash up on different beaches. Sand can be made of rocks or shells, and sand grains are different colors and shapes.

At *Going with the Flow* they discovered that animals that live among rocks get wet very quickly at high tide but dry out very quickly at low tide. Animals that burrow in the sand don't get wet as fast or as often as those in the rocks, but stay wet for a long time once they do.

Session 3: Hidden Animals

This is a demonstration conducted by the teacher outside in front of the entire class. Some particularly brave teachers may choose to allow particularly strong and trustworthy students to throw buckets of water on the "seashores," but proceed with caution and at your own risk! Students will observe the effects of wave shock on animals living in three different seashore substrates: sand, gravel, and rocks.

1. Tell the students they are going to see where seashore animals can stay the most protected from the waves. Show them three different beaches, each in a shoe box. One is filled 3/4-full with sand, one with gravel and one with rocks. Divide the class into three groups, one for each substrate.

2. Give each student a plastic sea animal. Have each student hide/bury their animal in their respective substrate. Be sure that the same number of animals is hidden in each beach and that they are well hidden!

3. Lead a discussion comparing the three kinds of substrates:
   - Which was easier to dig in?
   - Which is now easier to see the animals in?
   - What kind of animal would be best suited to survive in each type of home?
   - Which substrate do you think gives the most protection from crashing waves to the animals living there?

4. Ask the students to predict which substrate will provide the most and least protection from crashing waves. Go outside with your beaches and bucket of water. You will need to be in a spot near running water to re-fill the bucket (or use three already filled buckets). Line up the beaches on the ground about 5 feet apart. Have your class gather around in a semi-circle behind you so they can all clearly see the unfolding of this life and death drama. Tell them that any animals dislodged by the wave will very likely die, either from injuries or by being exposed to predators.

5. Drum role please! Dump a bucket of water (a pretend wave) directly and with force on one the three substrates. When dust settles, count the number of animals dislodged by the wave and record the number. Re-fill your bucket and repeat the experiment on a second substrate. Repeat the whole thing on the third substrate.

6. Ask how close were the results to your predictions? (Many children predict that the rocks will provide the most protection.) *In reality sand provides the most protection, gravel the least and rocks somewhere in-between. The "wave" should*

have the least disruptive impact on the "animals" living in the sand and under the larger rocks. In these cases, the animal remains hidden and protected even after the wave hits the substrate. The gravel, which is neither as heavy as the rocks nor as compact as the sand tends to be moved and dislodged by each wave. The animals are often brought to the surface where they are unprotected from further waves and predators.

Wrapping Up Seashore Sleuthing

1. Gather the class back together. Have the classes' original lists of differences between the rocky seashores and sandy beaches posted in front of the room.

2. Ask the students to add to their lists of differences between rocky seashore and sandy beaches. *Be sure they mention something about the differences in the amount of water that will stay in the sand even when the tide goes out, and the effects of waves on the different substrates.* If they are already familiar with rocky seashore animals and plants, ask them to list some of the adaptations these creatures use to be able to live on the rocky seashore.

3. Hold up each of the Key Concepts and have one or two students read them aloud as a review for the class. Post them near other work from this activity.

(Beyond the Activity)

Going Further

Field Trip

Take a trip to a rocky seashore where there is also a sandy beach. Do a scavenger hunt on the beach to find all the things the waves have washed up from the ocean or the rocky seashore. Try to visit the rocky seashore at different times of the year to see how it changes with the seasons.

Design an Animal

Have students create a 3D animal, real or imaginary, that could withstand all the extremes of waves and tides at the rocky seashore or the sandy beach. For example, create an animal that is mobile enough to dig itself out of the sand-covered beach, and yet has the ability to stick itself to rocks to stay in one place against the pull of the tides. It could be armor-plated to withstand the crashing waves and sand scouring, and could carry a water reserve to keep it moist in the hot sun or allow it to stay buried for a few weeks. The organisms could be drawn on paper with adaptations labeled, then built in 3-dimensions from classroom junk, vegetables and art supplies.

Have the students include a one or two sentence description of the adaptations that help it live successfully at the rocky seashore. They can either write it themselves or dictate it to an older student. Students might even have their 3-D creature tested to see if it can actually withstand the crash of a "wave" (dump water on it) or being buried by sand.

Station 1: Beach Buckets
Instruction Sheet

At this station, students investigate items that might be found on a sandy beach.

1. Tell the students that even though they can't go to a real beach today, they will now have a chance to examine what a real beach might look like—right here in class. Ask every 2-3 students to gather around a Beach Bucket at the table and give them time to freely explore the buckets. You might also have them look closely at the items using a hand lens.

2. After five minutes or so, ask the students to find three different kinds of things on their beach as follows:
• things that show that an animal was there
• things that show that a plant was there
• things that show that a person (which is also a type of animal) was there
These things could also be described as clues or evidence.

3. Show students the chart paper labeled with the names of the three categories above. Model how to remove items from the bucket and place them on the chart paper within one of the categories. Also model for them how they could also label the chart paper with the names of each of the items within the category.

4. Give the groups further time to explore their beaches with the idea of looking for clues or evidence. Have them take turns removing items from the buckets and placing them in one of the categories. Ask them to describe why they decided to place an item in a particular category. What is their "evidence" that it

belongs with others in that group? Are there some items that might fit into two of the categories?

5. Have each student hold up an example from each of the three categories. Have them identify as many as possible. Are there some items they are unsure about? Have them set aside things they are unsure about into a fourth category. Help them to figure out how they might go about finding out about the item, using books or other resources.

6. Ask the students if everything from animals, seaweed and plants, and people was taken out of their beaches, what would be left? (*sand and rocks*)

7. Have students look closely at the rocks in their buckets. Ask them to use their descriptive rock words to describe the sizes, shapes, and colors of the rocks. Have them also notice whether the edges are jagged or smooth. What are some possible reasons that the rocks are all so different? Hold up the container of hard candy "sand" to compare with the beach bucket sand.

8. Tell the students that the animals and plants that live at the beach will live on, in, or under the rocks or sand, and scientists call that rock and sand the **substrate**. We will be comparing different types of substrate—rocks and sand.

Station 2: Microscopic Investigations
Instruction Sheet

At this station, students will look closely at the various shapes and colors of sand and investigate what it is made of.

1. Place the rock and shell samples in the center of the table. Place samples of sand in plastic bags around the table and direct the students to each sit down in front of one of the samples.

2. Tell the students to take an index card, dip their pinky finger in the white glue and spread a circle of glue on their card the size of a quarter. Have them carefully open their bag of sand and take out one pinch and sprinkle it over the glue. Tap off any excess sand back into the bag and zip it up again. Have each student write their name and the place their sand is from on the card. Remind them to leave the plastic bag closed up tightly for the rest of the activity.

3. Tell them that they get to look very closely at some sand with a hand lens or a microscope and try to figure out what it is made of. Give each student a hand lens and have him or her look at the sand. Ask them what colors they see? What do they think their sand is made of? Have them compare their sand grains with the examples of rocks and shells on the table. If you have microscopes, show students how to use them and be prepared for ooohs and aaaahs!

4. After the students have had a few minutes to look at the sand, ask them to find a shell that has some of the same colors on it as they found in their sand. Then have them find a rock that has the same color. Ask the students if they think their sand is made mostly of rocks or of shells?

5. When they have finished, have them switch samples with someone else in the group, and repeat their observations. It is important to see at least three different samples to get a sense of the incredible diversity found in sand.

6. Help the students to locate where the sand came from on the globe or wall map.

7. If there is time, have them choose one of the samples to draw and color what they see. Remind them to draw the sand grains bigger than life-size. Each grain should be drawn about the size of their fist.

Station 3: Going With the Flow
Instruction Sheet

1. An adult or older student needs to lead this station. Tell the students at this station they are going to conduct an experiment to see 1) how fast water travels through rocks and sand, and 2) how much water will stay in the rocks and sand.

2. Place one of the clear, tall containers of sand and one of the gravel containers side-by-side where the students can see them. It is important that they are filled to the same level exactly.

3. Assign two students to be water measurers and two to be water pourers—two for the sand and two for the gravel. Assign another two students to be timers—one for each. Have all students predict through which container water will travel from the top to the bottom the fastest—or if they will travel at the same rate. How long do they predict it will take?

4. Lead a discussion about how to ensure you will get consistent results and why that might be important. Students usually will equate it with being FAIR! Some of the variables to control include: pouring the same amount of water the same way and speed each time, and counting or timing the same way each time. You might even practice pouring once into the tub and practice timing once.

5. Run the experiment! Put the sand bottle in the plastic tub to catch overflow. Have one student measure out 1/2 cup of water or mark on the water container the height of the water so it can be compared before and after. Have one pourer pour water into the sand. The timer times or counts how long it takes for the water

to touch the bottom of the bottle. Record the results on the data sheet.

6. Place the gravel container in the plastic tub. Ask the students if they would like to change their prediction about how long it will take the gravel to get wet on the bottom of the bottle. Have one student measure out 1/2 cup of water. Have the pourer pour the water into the gravel container and have the second timer time or count how long it takes for the water to touch the bottom of the bottle. How long did it take? Record the results on the data chart. Compare the two results.

7. Now have the students predict if more water will stay in the rocks or in the sand when you pour it back—or if the same amount of water will stay in both. The adult supervisor can pour the water from the gravel bottle back into the original water container and measure the difference in the amount of water before and after it traveled through the gravel. Remember to include any water, which spilled into the overflow tub. How much water returned from the gravel? [Almost all the water returns] Record the results on the data chart.

8. Now the adult pours the water from the sand container back into the original water container and measures the difference in the amount of water before and after it traveled through the sand. Remember to include any water, which spilled into the overflow tub. How much water was left in the sand? [Usually not a drop will come out of the sand] Record the results on the data chart.

9. Do a quick simulation activity with the students to help them understand the concept of surface area and how sand can hold onto the water.

1) First have the students pretend to be sand grains and stand *very* close together. Pretend you're the water trying to get from one side of the sand to the other. Show how it is almost impossible to work your way to the other side through them since they are packed so closely together.
2) Now have them pretend to be pieces of gravel with rough shapes (have them stick their elbows and knees out) and stand a foot away from each other. Now pretend to be water going from one side to the other. Now it is a cinch to move between the pieces of gravel.

10. Ask the students:

• Did the water flow through the gravel or the sand the fastest? (*gravel because it has bigger spaces or holes between each of the pieces*)

• Did more water stay in the sand or in the gravel? (*sand, because it has more surface area for the water to cling to*)

• If you were a land plant that needs fresh water, would you rather live in sand or gravel? Why? (*Sand because it can hold more water for your roots.*

• If you were an animal that lived where the tides changed from high to low, would you stay wet longer in the rocks or sand? Why? (*plants and animals stay wet longer in the sand because it holds onto or retains more water longer; animals that live on or under rocks at the rocky seashore will get wet faster at high tide but also dry out sooner at low tide than animals and plants in the sand. If you live in the sand you won't get wet as fast or as often, but when you do, you'll stay wet for a long time.*

• How do you think rocky seashore animals might cope with the problem or challenge of drying out? (*close up tightly, shells that retain water*)

11. **Be sure to use dry sand for each group; the wet gravel can be used again for the next group.**

Data Sheet for Station 3: Going With the Flow

How long did it take for water to go through the **gravel**?	How long did it take for water to go through the **sand**?
How much water came back from the **gravel**?	How much came back from the **sand**?

Seashore Sleuthing Home Activities

DESIGN AN ANIMAL

Have your parents help you create an animal, real or imaginary, which could survive the crashing waves at the rocky seashore or the sandy beach. Think of some special structures or behaviors it might need to survive. Use your imagination! For example, create an animal that can dig itself out of the sand-covered beach, and also stick itself to rocks to stay in one so it doesn't get dragged out to sea. Does it have armor? Does it have suction cups? What about a way to stay wet in the hot sun?

First draw your creature on paper and label its special features, then build it in 3-dimensions from stuff you find at home including junk, vegetables and art supplies.

Finally, add one or two sentences describing the features or behaviors (called adaptations) that help it live successfully at the rocky seashore or sandy beach. You can either write it yourself or dictate it to your parents and they can write it down. Bring your creation to school to share with the class.

ROCK WALK

Take your family on a neighborhood "rock walk" and look for all the different kinds of rocks you can find. How many colors, shapes, and sizes of rocks can you find near your house? Draw three of the rocks in as much detail as possible and bring the rocks and your drawings to school to share with your classmates. You can add your drawings to a class book about rocks in your town. If you have a rock and mineral reference book, have your parents help you to figure out what kind of rock it might be. How do think the rocks got to your neighborhood?

ROCKS and SAND ON VACATION

If you have a chance to go to a different place for a family vacation, keep a lookout for interesting rocks and sand. Do different neighborhoods have different kinds of rocks? Does the sand look different in different parks? Bring your discoveries back to share with your classmates. Of course make sure that it is OK to collect things from your vacation spot. Also, try to keep track of the kind of animals you saw as you collected the rocks and sand.

Background

The rocky shore is a dynamic system. Some changes occur quickly and are easy to observe, whereas other changes can be perceived only over many years of careful observation. Looming cliffs can cave in and turn to rubble under the onslaught of crashing waves in a single winter storm. Tiny grains of sand propelled by wind and waves, wear away even the mightiest boulders, but may take centuries to do so.

Waves cause erosion in many different ways. As a wave breaks on the rocky seashore, air is compressed in cracks and fissures of rocks, and can actually explode away bits of the rock. These "bits" can be of immense size. A storm wave once threw a 135-pound rock 140 feet into the air and through the roof of the Tillamook Rock Lighthouse, near the mouth of the Columbia River in Oregon. Small rocks are reduced to sand by rubbing against each other and the same rock and sand particles may scour the larger rocks or the tidepool walls clean of all organisms at the rocky shore.

The hardness of the rocks is an important factor in how fast erosion occurs. Harder rock (basalt, granite) erodes at a much slower rate than softer sedimentary rock (sandstone, limestone, or mudstone). Animals living on softer rocks must reproduce or at least move before their home is broken away or ground down under them.

Whole cliffs can be undermined by even gentle wave action over many years resulting in sections of the cliff breaking off and falling into the sea. This is known as a "cave in." In some areas of California, cliffs are retreating from wave and wind erosion at a rate of three feet a year. Seashore visitors are admonished to "never turn your back on the ocean," but also "never turn your back on the cliffs." Picnicking or sunbathing at the foot of a cliff is nuts!

Sand, gravel, and rocks are three different substrates found at the seashore. Each of these substrates has a different relative stability and ability to hold onto water. The smaller the particle, the longer water stays in the substrate, since the water has more surface area on which to cling. Sand retains water longer than gravel or rocks. Organisms living among the rocks of the rocky seashore must have special adaptations to retain water during low tide when they are left high and dry. Some of these adaptations include ways of capturing and holding water inside, or having impermeable shells that hold water.

The crashing waves pose a grave danger to all organisms at the seashore. Some animals burrow into sand to escape the crushing force of "wave shock;" others hide under or hang onto large rocks. Gravel however, is very difficult to hide in and doesn't provide much protection. Every crashing wave compacts it, and grinds the individual pieces against each other and against any animals hiding there. Animals are often washed to the surface where they are unprotected from subsequent waves and scavenging predators.

