Mighty Microscopes

A collection of lessons for elementary students

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Funded by Ford Family Foundation
Award for National Board Certified Teachers

Table of Contents

Using a Microscope

Letter 'e' Lab

SUBJECT(S): Science Process Skills

OVERVIEW:
This activity is designed to be used as an introduction to the use and care of microscopes.

PURPOSE:
To develop the students' understanding of microscopes.

OBJECTIVES:

1. Students will demonstrate their knowledge of the parts of the microscope and their definitions.
2. Students will label a large diagram of a microscope.
3. Students will be able to create their own wet mount slides of newsprint.
4. Students will demonstrate their knowledge of microscope care and maintenance.

MATERIALS:

Microscopes	Letter 'e' cut from newspaper	Eye droppers
Slides and cover slips	Water	Diagram of Microscope

PROCEDURE:

Introduction:
Ask students, "What instrument is used to see things very far away?" (telescope or binoculars) What instrument is used to see small objects up close? (magnifying glass) What instrument is used to see very, very small objects such as cells? (microscope) Who has used a microscope in the past? What did you look at?"

Content Focus:
"Today we are going to learn about microscopes. Can anyone give me the definition of the word microscope?" (microscope - an optical instrument that uses two convex lenses with relatively short focal lengths to magnify small, close-up objects)

Divide the class into groups, with two or three students per group. Students will pick colored popsicle sticks from a cup. The color of the stick will determine which group they are in. Distribute microscope vocabulary and definitions; allow students time to look at the large diagram of a microscope. Have students present their words and definitions to the class. Then label the diagram.

Experiment:

Explain a wet mount slide: the specimen is placed on the slide and one drop of water is added. The cover is added by placing it at an angle and slowly letting it meet the slide. Show this a few times with your hands so students can see it and understand it. Have students make a slide with a letter ‘e’ on it cut from newspapert. Have students look at the slide under the low power objective first. Students should draw what they see. Have the students look at the slide under the high power objective. Again, students draw what they see. Have other slides prepared for students to view.

Closure:
Have students play the "What's under your seat?" game. Before class, place questions under random seats in the classroom. These questions will pertain to the parts of the microscope. At the end of class, have students look under their seat for a piece of paper. Have them read the question aloud and answer the question if they can. If not, then have the rest of the class help the student. Hand out a worksheet for the students to complete. On this worksheet they will name all the parts of the microscope.

Lesson Extensions:

- Have students find an object in the class to make their own wet mount slide; other students can try to guess what it is.
- Students could research the history of microscopes and explore how they have changed over the years.
- Prepare a microscope scavenger hunt for the students to complete.

ASSESSMENT:

Evaluate how well students were able to answer the questions in the "What's under your seat?" game. Grade the worksheet. On the following day, have students take you through the steps to making a wet mount slide to see if they totally grasped the idea. Also, check to see if they remember the proper way to carry a microscope.

Observing a Spider Web

SUBJECT(S): Science Process Skills, Biology

OVERVIEW:
This activity can be used as an introduction to the use and care of microscopes. It is also a great lesson to integrate into the study of arthropods (insects and spiders).

PURPOSE:
To develop the students' understanding of microscopes.

OBJECTIVES:

1. Students will be able to create their own wet mount slides of a spider web.
2. Students will demonstrate their knowledge of microscope care and maintenance.

MATERIALS:

Clear, colorless nail polish Slide and coverslip Dry spider web

PROCEDURE:

1. Find a complete, dry spider web. Observe the web for patterns. Different types of spiders use different types of construction techniques. Sketch your builder's style.
2. Take note of the spider on the web (if it is still there). If you have a spider book, see if you can identify it.
3. Paint the center of a slide with clear nail polish. Don't goop it on, just a thin layer is needed! The area painted should be about the size of a cover slip. Let it dry for about a minute, but not much longer. Do not touch the nail polish or you will spoil the surface meant to capture the web.
4. Holding firmly, place the slide on an interesting part of the web (usually the center of the web is the most interesting). Now pull the slide towards you (with the web attached we hope!), then carefully remove the rest of the web with a stick or a brave finger, being careful not to get it stuck to the polish area.
5. Without delay, cover the slide with the cover slip. Press it down carefully so as not to break the delicate cover slip.
6. Take the slide inside to the microscope. Make notes and sketches on what you see at each magnification available on your scope.

QUESTIONS FOR THOUGHT

- From what you saw under the microscope, why do you think an insect cannot escape from a spider web?

- How do you think a spider learns to spin a web?
- Find a book or encyclopedia and see what you can learn about different types of webs.

Hooked on Feathers

SUBJECT(S): Biology, Ornithology

OVERVIEW: Students will explore the amazing construction of feathers through the use of microscopes.

OBJECTIVES:

1. Students will become familiar with feather construction.
2. Students will become familiar with how birds are adapted for flight.

MATERIALS:

Microscopes	Flight or tail feathers	Velcro
Paper	Colored pencils or crayons	

PROCEDURE:

Background Feathers have a unique construction of barbs and barbules that act like Velcro and hold the feather together. Birds groom and clean their feathers daily to lock together the barbules for a smooth flying surface. This activity is called preening.

Set up microscopes at several different tables along with a feather and a piece of Velcro.

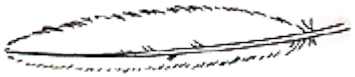
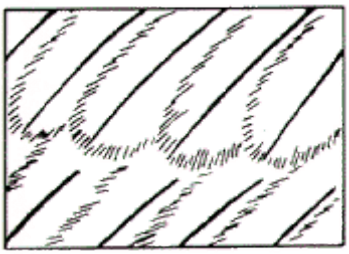
Have the students compare and contrast the feathers and the Velcro under the microscope.

Have the students draw a picture of what each looks like under the microscope and compare the drawings.

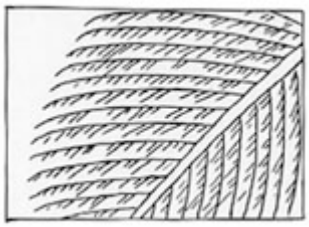
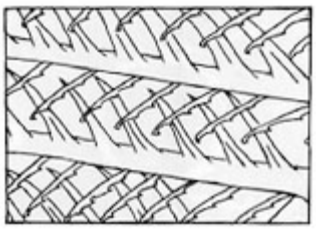
AN ENGINEERING MARVEL

Feathers are unique to birds: all birds and only birds have them. They evolved from the scales of birds' reptilian ancestors. Feathers are made of keratin, just like your hair and fingernails, and are lightweight, yet strong.

TYPES OF FEATHERS

Flight feathers are straight and stiff. They overlap to provide a surface to push against the air on the down stroke, but separate on the upstroke to reduce drag during the wing's recovery.	
The tail feathers are used for lift, balance, steering, and braking.	
The feathers covering the body overlap like shingles to give the bird an aerodynamic shape for efficient flight, added insulation, and to keep out wind and water.	
Birds wore down jackets before we did! Down feathers provide insulation by trapping body heat close to the skin. The feathers and the trapped air layer also keep the skin from getting wet.	

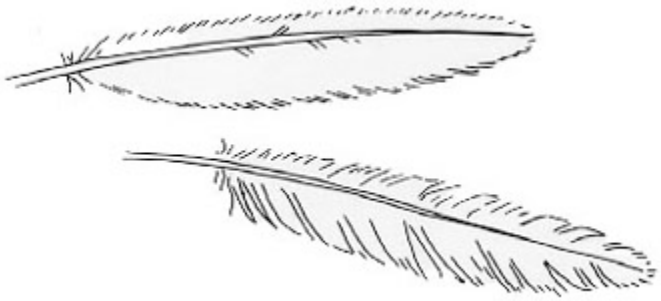
FEATHER STRUCTURE

The hard central shaft of a feather is the rachis. Parallel rows of barbs make up the feather vane.	
In turn, several hundred tiny barbules branch off from each barb. These overlap with barbules from the neighboring barbs.	

The barbules on the outer side of the barb have microscopic hooklets to help interlock the barbs, like velcro, and hold the vane together.	

CLEANING AND PREENING

Because feathers are critical for flight and insulation, birds keep them well-maintained. A good portion of a bird's day is spent cleaning and grooming its feathers by applying oil, bathing in water or dust, scratching, and preening. Preening straightens out the barbs so they lock neatly together. The preened feather presents a solid surface to push against air during flight.



The uropygial gland, or preen gland, secretes an oil birds use to groom and waterproof their feathers. Birds obtain the oil with their bills and spread it over their feathers.

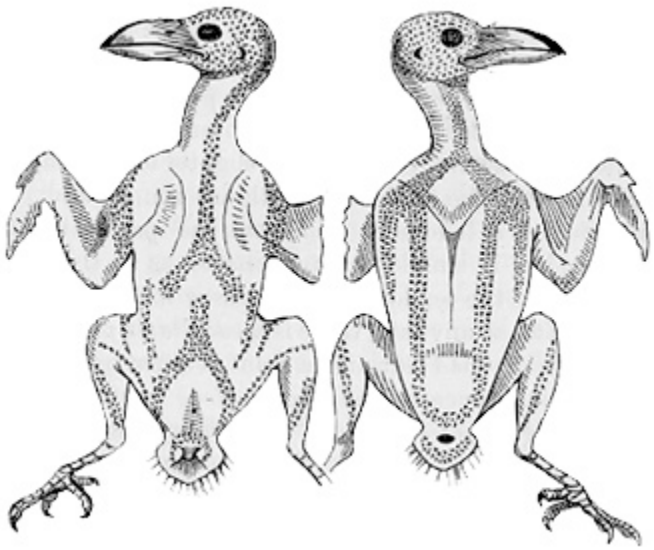
MOLTING

Birds replace old feathers with new ones in a process called molting. Molting occurs one or more times a year. It takes a lot of energy to grow new feathers, so molting usually does not coincide with other annual events that require a large energy investment, such as migration or rearing young.

During molt, feathers are usually replaced in an orderly, predictable sequence. This is especially true of wing and tail feathers, where symmetry must be maintained for balanced flight.

GOOSE BUMPS

Look at the skin of a chicken or turkey before it is cooked. Notice the "goose bumps)" Each bump is where a feather was attached. Notice how the bumps, or feather follicles, are arranged in precise patterns or "feather tracts." Different kinds of birds have different patterns of feather tracts.



Each feather may have 40 or more tiny muscles attached to its base. Birds raise and lower feathers during courtship displays and to control body temperature. Have you ever seen a puffed-up sparrow in winter! Its fluffed feathers offer insulation, like a thick sweater.

Parts of a Flower

SUBJECT(S): Biology, Botany

OVERVIEW: Children will dissect a flower and investigate each part.

PURPOSE: Students will gain an appreciation of flowers by identifying the major parts. Students will also use lab tools fit for their grade level.

OBJECTIVES:

1. Students will be able to identify the parts of a flower.
2. Students will be able to create a microscope slide of flower parts.

MATERIALS:

Index card strips	Fresh Flowers	Index cards
Flower chart / Student handout	Tape	

PROCEDURE:

- Students will be given three handouts with the vocabulary necessary to complete this lesson
- Ask: "What do the petals do for the flower? Accept all reasonable answers. Explain what the petal does for the flower."
- Say: "Carefully pull all the petals off your flower and place it on the flower part chart."
- Ask: "What are you left with?
- Say: "You are looking at two major parts of the flower, the stamen and the pistil. The anther and the filament make up the stamen. Pull the anther and the filament from your flower and place each part in the appropriate box on your chart."
- Say: "The next major part of the flower is the pistil. The stigma, style, and ovary make up the pistil. Carefully make a hole in the bottom of the flower almost near the stem, open up and you will find something in the shape of either an n or u. This is called the ovary. Explain the function of the ovary."
- Say: "The top part of that long piece is called the stigma. Pull it off and place it in the appropriate box. Explain the function of the stigma."
- Say: "The long piece that connects the stigma to the ovary is called the style. Explain the function of the style. Pull the style off and place it in the appropriate box."
- Say: "Another important part of the flower is the sepal. Explain the function. Pull the sepal off and place it in the appropriate box."

- Ask: "Why do you think the flower has so many different parts?"

ASSESSMENT:

- Students have already broken the flower down into parts and the parts are visible to them on their chart.
- Now they will create microscope slides using a small piece of each flower part, index card strips, and tape.
- Ask: "How does each part look under the microscope? Not under the microscope?"
- Draw a picture or each part as you see it under the microscope, and not under the microscope.

Comparing Plant and Animal Cells

SUBJECT(S): Science Process Skills, Biology

OVERVIEW:
These activities are used to introduce students to cellular structure. I use it to give the students the opportunity to see cells and to discover the difference between plant and animal cells.

PURPOSE:
To further the students understanding of cells and to give them the experience of using a microscope.

OBJECTIVES:

1. Students will be able to describe the differences between plant and animal cells.
2. Students will be able to operate a microscope.
3. Students will be able to examine cheek cells, onion cells, and potato cells.

MATERIALS:

Microscopes	Potato	Toothpicks
Slides and coverslips	Onion	Knife
Iodine stain or blue stain	Worksheets	

PROCEDURE:

Observing and Comparing Cells:
Depending on the age of the students the teacher may choose to read the following directions to his/her students or share them on a worksheet:

Onion Skin
a. First take a piece of onion skin off the onion.
b. Put it flat on a slide.
c. Bring the slide to the leader for a drop of iodine stain.
d. Carefully put on a cover slip remembering to angle it.
e. Examine the cell under low then medium power.
f. Ask the teacher to put it on high power.
g. Draw a few cells showing what you observed in the space provided.
h. Describe in a few sentences what you saw while looking at the cell through the microscope.

Cheek Cells
a. Using a toothpick scrape the inside of your mouth.
b. Place it carefully on the center of the slide.

c. Bring it to the leader for a drop of blue stain.
d. Repeat steps d-h from onion skin directions.

Potato Cells
a. Using a knife carefully cut a very thin slice of potato.
b. Have the leader add a drop of iodine stain.
c. Repeat steps d-e from onion skin directions.
d. Draw a few cells in the space provided and describe what you saw.

Now the teacher facilitates a discussion comparing and contrasting what the students observed. The following vocabulary should be discussed and or defined:

Cell Walls: Plants have thick cell walls to strengthen the plant stem.
Cell Membranes: Animals have thin membranes because they have other forms of skeletons.
Chloroplasts: Green colored structures that produce food.
Nucleus: Both plants and animals have these; they control heredity and cell division.
Cytoplasm: A clear liquid where most of the cells life functions occur.

After the discussion the students should have the opportunity to observe the slides again so they may observe the items discussed.

TYING IT ALL TOGETHER:
This activity has been used in cooperative learning groups consisting of students of mixed ages grades 1-5. Also it has been used several times in fifth grade classrooms. The students enjoyed the experience and were able to learn the use of a microscope and depending on the age, gain a better understanding of cells. This is the best beginning microscope lesson I have found. It is especially useful for the fifth grade unit on cells. The students learn more about cells through actual observations than looking at textbook pictures.

Staining Cells

Introduction

Many samples, particularly cells, can appear quite transparent under the microscope. The internal parts of the cells, the organelles, are so transparent that they are often difficult to see. Biologists have developed a number of stains that help them see the cells and their organelles by adding color to their transparent parts.

While many biological stains are for advanced study only, there are some that are easy to obtain and use. Some readily available stains are: food coloring, iodine, malachite green (ick fish cure), and methylene blue. Food coloring can be found at a grocery store, and iodine can be found at a pharmacy. The last two stains, malachite green and methylene blue, can be purchased at aquarium shops.

Interestingly, certain stains color certain parts of a cell. Scientists choose specific stains when they want to look at a particular part of a cell. You can experiment with the stains listed above to see which parts of the cell each one colors.

Warning

Make sure you have an adult to supervise before you use stains. Stains not only add color to cells, but also hands, clothes, and nearly everything else. Use with caution and prepare your work area first with layers of newspaper.

Challenge

Stain cells and compare to unstained cells.

Tools & Materials

- microscope
- eyedropper
- 2 flat slides
- 2 cover slips
- toothpick
- cheek cells
- stain (food coloring, iodine, malachite green or methylene blue)
- paper towel
- water
- pencil
- paper
- eraser

Elodea Cells: Plant Cell

SUBJECT(S): Science Process Skills, Biology

OVERVIEW:
This activity can be used as an introduction to the use and care of microscopes. It is also a great lesson to integrate into the study of arthropods (insects and spiders).

PURPOSE:

The purpose of this lab investigation is to prepare a wet mount of an elodea leaf in order to examine a plant cell.

OBJECTIVES:

1. Students will be able to create their own wet mount slides of a small aquatic plant leaf.
2. Students will demonstrate their knowledge of microscope care and maintenance.

MATERIALS:

Microscopes	Elodea	Eyedroppers
Slides and over slips	Forceps or tweezers	Lens paper

PROCEDURE:

Prepare a wet mount using one leaf from the elodea vine. Use forceps to remove a leaf from the elodea leaf and place it onto the slide. Add a drop of water and then lower a cover slip over the leaf and water. (Lower the cover slip by first placing one edge against the drop of water at about 45 degrees.)

Experiment: Find the cells on low power, but make your observations using the high power objective. Be sure to adjust the lighting with the iris diaphragm.

Locate the following: cell wall, central vacuole, chloroplasts, and cytoplasm. Often the cytoplasm and chloroplasts will be moving around within the cell. This is a process called cytoplasmic streaming.

Make a sketch of a typical cell and label the parts.

Conclusion: What features did you observe that are unique to the plant cell?

What Lives in Pond Water?

SUBJECT(S): Science Process Skills, Biology

OVERVIEW:
This activity can be used as an introduction to the use and care of microscopes. It is also a great lesson to integrate into the study of arthropods (insects and spiders).

PURPOSE:

The purpose of this lab investigation is to prepare a wet mount of an elodea leaf in order to examine a plant cell.

OBJECTIVES:

1. Students will be able to create their own wet mount slides of a small aquatic plant leaf.
2. Students will demonstrate their knowledge of microscope care and maintenance.

MATERIALS:

Microscope	Containers of pond water
Slides and cover slips	Tweezers
Eyedroppers	Protoslo solution

PROCEDURE:

The first thing you need to do is collect and culture pond water. Once ready, spend some time just looking at the pond water under the microscope and trying to identify things in the water. You may first wish to look at algae and microscopic animals under the microscope from preserved slides to provide students with the background to identify some of the critters they find. Then we tried to identify them in the pond water. Protoslo solution can be used to make some of the microscopic animals move slower and thereby easier to see.

Upper grade students may wish to design an experiment to answer a question. Doing so will provide each student with a work sample for their science portfolio. Students first need to come up with a question. Then turn the question into a hypothesis, which is a guess of what the answer to the question is. Next, describe the procedure you will follow to prove the hypothesis. Then each student performs his or her experiment at least five times to gather data. Lastly, write a conclusion based on the results of the experiment. This will likely be the first time many of the students have designed their own experiments!

Here are several questions your students may wish to consider:

- How many microscopic animals are in a drop of pond water?
- What do microscopic animals in ponds eat?
- What lives in pond water?

- How do stains affect which cells or body parts I can see?
- How do animals move that live in pond water?

It is difficult to ask the right question that can be answered with the tools you have. And it is also hard to design the experiment to answer the question you have asked. After you finished your experiments, go back and talk about them. Decide how you could have done a better job in asking the right questions, and in designing your experiments.

Mystery Powders

SUBJECT(S): Science Process Skills, Chemistry

OVERVIEW:

Given a set of known characteristics, students will apply their observational skills to identify the powders in an unknown mixture. This hands-on activity will help to develop an understanding of chemical and physical changes and enable students to experience the *real-world* science of chemistry.

PURPOSE:

In an effort to reduce anxiety and help students understand the techniques utilized by Hazmat personnel to test unknown substances in response to potential Anthrax threats.

OBJECTIVES:

1. Students will be able to create their own dry mount slides of a powdered substance.
2. Students will demonstrate their knowledge of microscope care and maintenance.

MATERIALS:

Variety of white household powders	Tray wells for mixing	Water
Aluminum Foil	Iodine	Vinegar
Tea light candles	Lighter	Clothes Pins
Eye Droppers		

PROCEDURE:

One of the important tasks of a chemist is to make observations of unknown substances. Performing several tests, students will examine six different substances by observing and recording their reactions to three different liquids (water, vinegar, and iodine), litmus test, and the effects of heating. Each test is explained in detail on the student handout.

ASSESSMENT:

Evaluation is based upon each group's knowledge of the scientific method, observing how each member of the group performs each step of the experiment, and the data that students recorded. Points are also given to groups who share the work evenly, stay on task, participate in class discussion, and follow the safety procedures.

Students may utilize the Internet and other resource materials to research other careers in chemistry. With the information they collect, students work in pairs to create a career poster.

Mystery Powders

Part I ~ Purpose / Problem Statement: You will be given five unlabeled white powders. It is your job to examine and identify each. To do so, you will need to test a small amount of each powder in six ways. When finished, you will be given a sixth powder that is a mixture. It is your job to determine what two powders were used to make the mixture. To do so, test it the same way and compare your results.

Part II ~ Materials:
A variety of white household powders, Tray wells for mixing, Water, Iodine, Vinegar, Candles, Lighter, Aluminum Foil, Clothes Pins, and Eye Droppers.

Part III ~ Procedure: Test one powder at a time. When finished, clean the cup and dry it well before testing the next powder. Follow the instructions carefully.

Senses & Physical Properties
Ask students to use their sense of sight (with and without magnifying glass/microscope), touch, and smell. Record data.

Solubility (water) Test (Cup #1)
Put equal amounts of each powder into wells. Add twenty drops of water. "Did the powders dissolve? Is the water clear? Is it cloudy?" If the solution is clear and the powder has disappeared, than the powder has dissolved. If the solution is cloudy, than the substance is insoluble. Record data.

ph Test (Cup #1)
Dip one end of each color of litmus paper into test cup #1. "Does the paper change color?" Record data.

Vinegar Test (Cup #2)
Repeat powder procedure. Dispense two drops of vinegar into each well. "Did the powder fizz?" A fizzing indicates a chemical reaction. Record data. Clean wells.

Iodine Test (Cup #3)
Repeat powder procedure. Dispense two drops of iodine into each well "Was there a change in color?" Record data. Clean wells.

Heat Test
Make a small foil cup. Place a small amount of powder into cup. Light candle and use clothes pin to hold cup over the flame. Heat for up to two minutes if necessary. Repeat procedure for each powder. "Did any powders change? Form new substances? Give off an odor?" Record data.

Clean and dry each cup before you test another powder.

Part IV ~ Data / Results: Here you will need to record your results and observations as you carry out the experiment. Take good notes!

Powder Number	Drawing of Each	Physical Properties	Solubility (water) Test	ph Test	Vinegar Test	Iodine Test	Heat Test
1							
2							
3							
4							
5							

Part V ~ Hypothesis: Using your observational skills (senses), what two powders do you think were used to create the mixture?

Mix							

Part VII ~ Conclusion: Now look at your results and answer the following questions.

1. The mystery powder sample I tested was labeled _____ .

2. Name the other four powders.
   _____

3. What do you think the mystery powder is composed of? Tell what evidence you have discovered that makes you feel this way (sometimes it is important to tell what it could not be).

Sand Explorations

SUBJECT(S): Science Process Skills, Geology

OVERVIEW:

PURPOSE:

OBJECTIVES:

1. Students will be able to
2. Students will demonstrate

MATERIALS:

Copy of an outline map of the United States

Labeled map as a reference

Sand samples from different beaches around the United States, labeled with location

Plastic spoons

Shallow glass dishes (one for each sand sample)

White vinegar in a squeeze bottle

Microscopes

Slides

PROCEDURE:

Background Information:

The first thing we come in contact with as we approach the sea from land is the sand. We lay on it, dig in it and often take it home with us in our clothes and swimsuits. But what is sand and where does it come from? How is a sandy beach formed?

Pick up a handful of sand and look closely. Depending on where it came from, you may see stones, coral rubble, bits of shell and other animal remains, the odd cigarette butt, and maybe small pieces of lava rock. Sand can range from white to black with countless variations in between. Why do our beaches look so differently from each other?

A beach is formed from the interaction of land and sea. Topsoil may be blown and washed down from upland regions, particularly when the land near the sea is very steep or near disturbed agricultural areas. The power of wind, rain and wave pounding on a shoreline continue to break down volcanic islands and return them to the sea. This same wave action, sometimes amplified by storms, breaks down coral reefs and grinds the coral rubble into smaller and smaller pieces. The shells and body parts of marine animals and rubbish from humans (broken glass, styrofoam, etc.) also add to the mixture we call sand.

Sand varies not only in composition but in texture. Fine sand is found on beaches where particles have been ground down over a very long period of time by continuous and gentle wave action. Some beaches with a large soil component to the sand have very fine, almost powdery sand. Beaches that are exposed to vigorous wave action or repeated violent storms often have more coarse sand. The texture of sand on a single beach changes as you move from surf line to the upper beach and from the top layer to the deepest layers.

Think about this...What changes in the texture of sand do you observe from the surf zone to the high beach? Do you observe "pockets" or concentrated areas of different textured sand as you walk along the beach? What do you think causes these differences in the size of sand particles?

In these activities, you will examine sand samples from a variety of locations around the United States and create a sand map. Based on your observations of sand samples and knowledge of the physical characteristics of the beaches they were gathered from, you will suggest at least one contributing factor for the formation of each beach sample. Using a weak acid (vinegar), you will test the samples to determine which have a high composition of marine-based components.

What to do:

- Label your map with the locations given on the sand samples. If needed, consult the labeled map. Add a "compass rose" to your map (showing the directions of N-S-E-W) and indicate with arrows the direction of the prevailing tradewinds.
- Discuss the labeled locations on your map. What do you know about these places? Does the land slope gently to the sea, or is it surrounded by steep cliffs? is the nearshore area rural, urban, or agricultrual? is the beach subjected to gently rolling surf or pounding waves? Are there coral reefs offshore? If you like, make notes on your map about the conditions on land and sea near these beaches.
- At each location on the map, spread a small circle of glue (about the size of a quarter) and sprinkle some sand onto the glue from the corresponding sample.
- As you wait for the glue to dry, examine each sample and note the color and texture of the particles you see. What strikes you? Do some samples seem to look more like dirt or soil? Is there a sample that is very light in color, or one with different colored particles? Record your observations.

- Compare your observations with the physical characteristics you noted previously. What connections can you make between the physical characteristics of the land and sea and the appearance of the sand from the same area?
- Place 2-3 spoonfulls of sand from each sample into seperate small glass dishes.
- Squeeze several teaspoons of vinegar onto each sample, one at a time. Note any reaction you see.
- Sand from beaches made up or coral and shell rubble (and some animal parts) contains calcium from these minerals. You can test for the presence of calcium in the sand by adding an acid (vinegar is a weak acid) which will react with the calcium, indicating a marine-based component in the sand.
- Based on your observations, what conclusions can you draw about the composition of the sand in the samples?
- Place a pinch of sand on a microscope slide and observe under magnification. Sketch the sand particles on lab sheet and record any visible characteristics.