EcoVentures™:

Learning in Florida's Environment

Laboratory Manual

Interactive Media Science Project
Florida State University
Tallahassee, Florida

EcoVentures™: Learning in Florida's Environment

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EcoVentures™: Learning in Florida’s Environment was designed and developed by a large number of people. These include graphic designers, videographers, programmers, middle and high school students, teachers, scientists, science educators, staff members of the Department of Environmental Protection, and a number of other agencies and businesses. These people share a love for Florida’s environment and a commitment to protecting it for future generations. This program has benefited from their concern and expertise.

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Angler in boat at marina	-	Arthur McConnell
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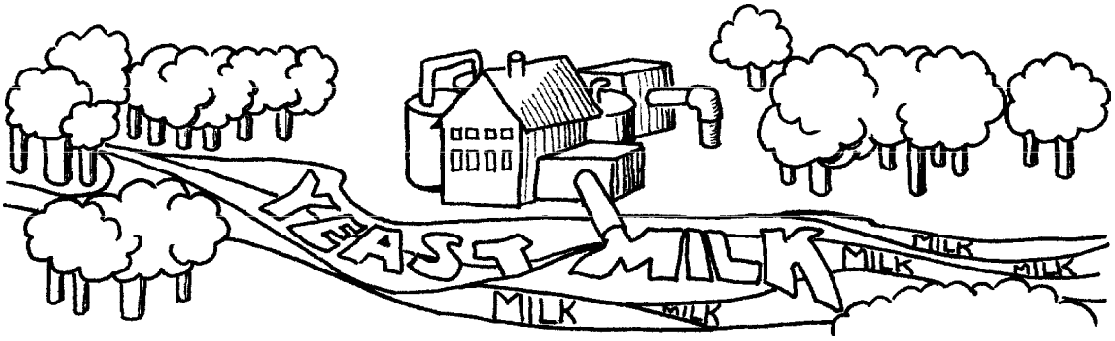
Contents

BIOCHEMICAL OXYGEN DEMAND

Almost all natural surface waters of the earth contain bacteria and other microorganisms. Decomposers, mostly microorganisms in land and water, use dead organic materials and wastes of other creatures as their source of food and energy. As they do this, they take in oxygen from their surroundings and release carbon dioxide.

Most living things must have some oxygen to live. Oxygen is an important reactant in many chemical changes that occur in the cells of living organisms. Therefore, oxygen gas must be available in the water environment. The need for oxygen by living things is known as the biochemical oxygen demand (B.O.D.).

In the laboratory activity that follows, you will investigate how the B.O.D. of microorganisms is affected by changes in the water surrounding them. Then you may see that B.O.D., in turn, affects the water.



Organisms which feed on waste material are called decomposers. Sewage can be a source of their food supply. You could investigate the effects of sewage on decomposer microorganisms.

Rather than work with such an unpleasant material, you will investigate a similar system that is more sanitary. Yeast, a type of fungi, represents the decomposers in the river water. Powdered milk contains sugar and represents the sewage that is dumped into the river.

Objective:

To investigate how increasing the amount of milk affects the oxygen demand of yeast.

Materials:

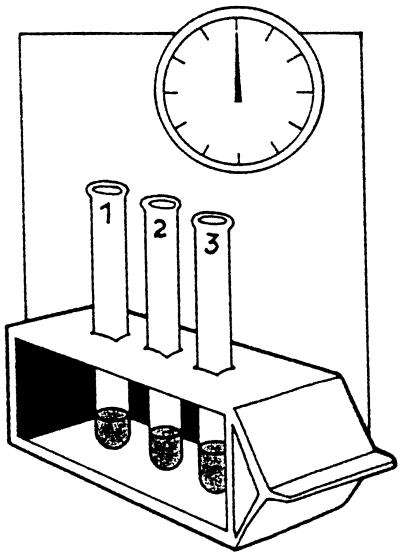
1 plastic spoon
2 beakers
Powdered milk
Dry yeast
Methylene blue solution
3 graduated cylinders (10 ml)
Stirring rod
3 test tubes (all the same size)
Test tube rack
Marking pencil
Watch or clock
1 eye dropper

Procedure:

1. Prepare a sample of milk by slowly stirring 1 level teaspoon of powdered milk into 20 ml of tap water in a small beaker. Mark this beaker with an "M."

2. In another beaker, prepare a sample of yeast by slowly stirring 1 level teaspoon of dry yeast into 20 ml of warm water and mixing thoroughly. Wait a minute or so and stir the mixture again. Be sure the yeast is well mixed and has not settled to the bottom. Label this beaker with a "Y."

3. Use the marking pencil to number three clean test tubes "1" through "3." These test tubes should hold at least 10 ml of liquid.



4. Using one graduated cylinder for water and the second for milk, add to the three test tubes the exact amounts called for in the following table. Stir each mixture thoroughly.

Test Tube	Milk (ml)	Water (ml)	Concentration of Milk (%)
1	0.5	5.5	12%
2	3.0	3.0	50%
3	6.0	0	100%

5. Add 2 drops of methylene blue solution to each tube. Mix thoroughly.

6. Add 2 ml of yeast solution to the first test tube.

7. Record in the data chart the exact time the mixing starts. Once the timing has begun, don't disturb the tube. Jostling it will introduce air into the liquid.

   While you are waiting for a color change in the first test tube, you should repeat this procedure for the other two tubes. Be sure to record the exact starting time in the data chart.

DATA CHART

Test Tube	Time of Mixing	Time of Change	Total time for Change
1	*Answers will vary.*		
2			
3			

Interpretation:

Compare and contrast the observations you made in the three test tubes.

The tubes with the greatest concentration of sewage (milk) will clear up first. The BOD by the decomposers is greater, so the blue color intensity will decrease.

Review for you:

Q1. What do the milk and yeast represent in this activity?

Milk = sewage

Yeast= decomposers

Q2. What did the methylene blue indicate within the mixture?

Oxygen amounts. The deeper the color the more oxygen.

Q3. What color was the mixture at the surface? Explain.

There is blue color at the top. This represents the oxygen getting into the solution from the air.

Q4. How do you account for the difference in time required for the color changes to occur?

The amount of milk in the water will determine how rapidly the yeast consumes the oxygen in the liquid.

Think about this:

Q5. How are the test tubes like a river polluted with sewage?

Rivers contain food compounds, including plant and animal matter, which is broken down and eaten by decomposers who use up the oxygen in the water.

Q6. Suppose the amount of sewage being added to a river were increased. What effect do you predict this would have on the B.O.D. of the decomposers?

As more sewage is added to a river, the number of decomposers increases and the BOD increases. Excessive BOD will cause the water to become hypoxic and possibly even anoxic.

Q7. What effect does increasing the food supply of an organism have on the size of the population of that specific organism?

It will increase the number of organisms or population up to the limits of the food supply.

Q8. Spotted Seatrout need from 3 to 9 parts per million of dissolved oxygen to live. Florida Gar, on the other hand, are able to tolerate much lower levels of dissolved oxygen partly due to the fact that they can breathe surface air. If sewage is dumped into the bay, which of these two species of fish will be most harmed? Why?

The Seatrout will be harmed first because the organisms that use sewage as a food source will increase in number. They use oxygen in order to survive, leaving little for higher organisms.

BLADES OF GRASS

Have you ever wondered how many blades of grass are found in the yard around your home? In this activity, you will estimate the number of blades of grass found on the school yard near your classroom. How would you determine the number of blades of grass? You might want to ask your teacher, but he/she may not know the number. You could go outside on a sunny day and count each and every blade of grass, but that would take a very long time — and you would likely make mistakes counting such large numbers. Can you think of a better way to determine how many blades of grass make up the school lawn?

For many years, scientists have tried to determine the number of plants or animals that live in a certain area. For example, plant ecologists might want to know how many trees exist in a tropical rain forest or biologists may wish to know how many bald eagles live in North America.

To answer these kinds of questions, scientists have created an accurate method of estimating a population. This method is called sampling. Sampling involves counting a representative fraction of the population, then making a prediction of the whole population. When using sampling methods to estimate a population, you do not have to count each individual blade of grass, animal or grain of sand to find the total number.

In this activity, you will collect a sample and estimate the total number of blades of grass in a given area.

Objective:

To accurately estimate the number of blades of grass that exist in a square meter of a school yard through the use of sampling methods.

Materials:

4 meter sticks
4 metric rulers

Procedure:

1. Locate a grassy area in the school yard that is at least one meter square.

2. Place the four meter sticks on the ground in such a way as to make a one-meter square.

3. Place the four metric rulers within the one meter square so that the insides of the rulers form a small square 10 cm X 10 cm. (**see Figure 1**).

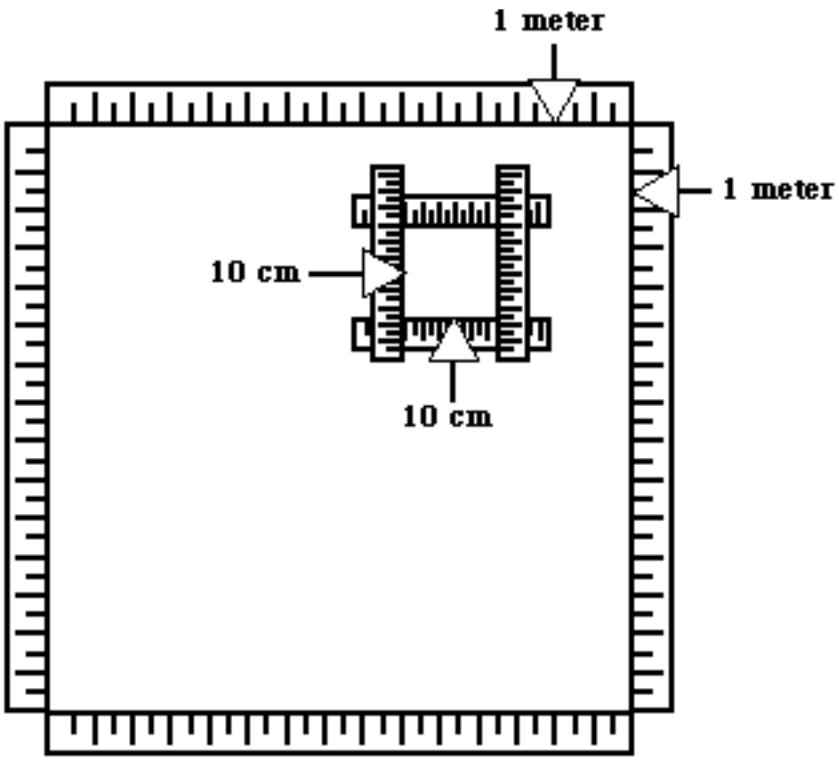


Figure 1

4. Count the number of blades of grass within the 100 cm^2 square. Record your answer in the data table.

5. Repeat step 4, placing the 100 cm^2 square in another part of the larger square. Record your answer in the data table.

6. Repeat step 5 and record your answer in the data table.

7. Add the number of blades of grass in each of the three samples, and then divide by 3. Record your answer in the data table.

8. You have obtained a representative sample number of blades of grass in the 10 cm X 10 cm square. Next, multiply this number by 100 to obtain the number of blades of grass in a square meter. Record your answer below the data table.

DATA TABLE

Square Number	Number of blades of grass
1	*Answers will vary.*
2	
3	
Average	

Total number of blades of grass: _____

Interpretation:

What is the purpose of taking three representative samples in estimating the population of something?

Three is a minimum number of samples to collect. The more samples you take the more representative the samples will be, which will enable you to make estimates of the population over the entire area being studied.

Review for you:

Q1. What is a representative sample?

One that is large enough that it gives a picture of the total area. If the sampling is accurate then the researcher has some degree of confidence that the sample averages reflect the averages of the entire area.

Q2. Instead of using a representative sample to determine the size of a population, why not just count the individuals to determine the total number?

Too much time is required. In an area as big as Sarasota Bay, or some similar area, it would be impossible for a small team of students to count the individual blades over a lifetime.

Q3. How do you think the Florida Game and Fresh Water Fish Commission determined that there are over one million alligators in the state?

They sampled aquatic areas and then projected the counts over the state as they know the number of hectares of habitat for the state.

Think about this:

Q4. You have been asked to determine the number of pencils in the school. How might you estimate the total number of pencils? List the steps that you will take to calculate the number of pencils. Include a description of how you will obtain an accurate sample.

Count the pencils in a few rooms, determine the average per room, count the rooms in the school and multiply by the average.

Q5. Estimate the number of blades of grass that might exist in a football field. Assume the field has the same kind of grass as in the school yard, and is roughly 2,000 square meters?

Their answer will be 2,000 times greater than the number recorded as the average on the data table on page 9 of this document.

Q6. Spotted Seatrout spawn over seagrass beds. The seagrasses provide protection for young Spotted Seatrout and many other kinds of fish. How might knowledge of the number and density of seagrass beds help fish biologists estimate the future number of Spotted Seatrout?

Assuming there is a positive correlation between the number of organisms (Spotted Seatrout) and the amount of available habitat (seagrass beds), a concept referred to as "carrying capacity", fisheries biologists may predict that an increase or decrease in seagrass bed habitat will be followed by an associated increase or decrease in Spotted Seatrout.

BUILDING SEASHORES

Sand is all around us. In the bare patches in the school yard you can see it mixed with dirt and organic material to make soil. On a windy day you can sometimes see it being blown along with the wind. If you have ever been to the beach, you have seen a great deal of sand.

Beach sand has some things in it that other sand does not have. All sand is made up largely of the mineral quartz. Beach sand, in addition, contains shell and shell fragments. In some parts of Florida, beach sand is predominantly shell and coral fragments. This affects the color of the beach sand. Along the Gulf of Mexico, near Panama City and Pensacola, the sand is very white because it is almost pure quartz. The beaches around Fort Lauderdale are a golden tan because of the shell fragments in the sand. At Jacksonville Beach, the blackish sparkling color results from the presence of heavy minerals such as rutile (titanium oxide) and zircon.

Much of the sand on North Florida's beaches came from the Appalachian mountains. It was originally made from rocks that were broken into tiny pieces by the action of wind and water. Rivers and streams carried the sand to the ocean or the Gulf of Mexico, and then it was carried southward by longshore currents. Longshore currents are those currents that run parallel to the shore. How do these longshore currents change the shape of our beaches and shores? This activity will help you understand this question.

Objective:

To examine the effects of longshore currents and high (strong or big) and low-energy (weak or little) waves on beaches.

Materials:

Stream table with clamp
1 brick
1 wooden block
Silt-sand mixture
Water
Blocks of wood
Plaster blocks
Gravel

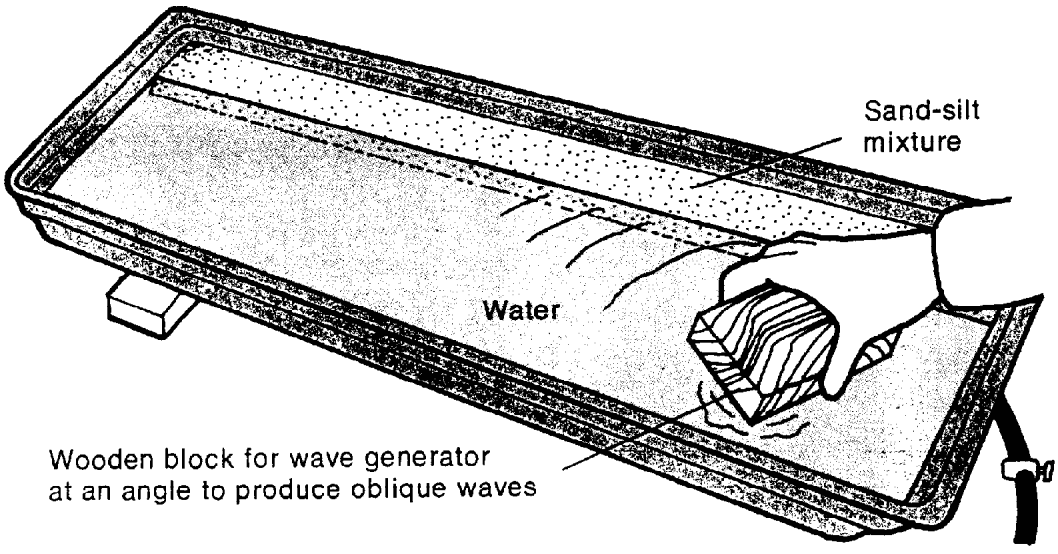
Procedure:

1. Set up the stream table with a sloping sand beach along one side. (**Figure 1**)

2. Pour water into the table to a depth of about 3 cm.

3. Generate waves by gently pushing a wooden block up and down rhythmically every 3 seconds for 3-5 minutes. The piece of wood you are using as a wave generator should be at an angle to the shore. Watch the wave pattern and the erosion effect carefully. In your simulation, the wave pattern curves into the beach, and the sand is shifted steadily by longshore currents parallelling the shore. This process is called longshore drift.

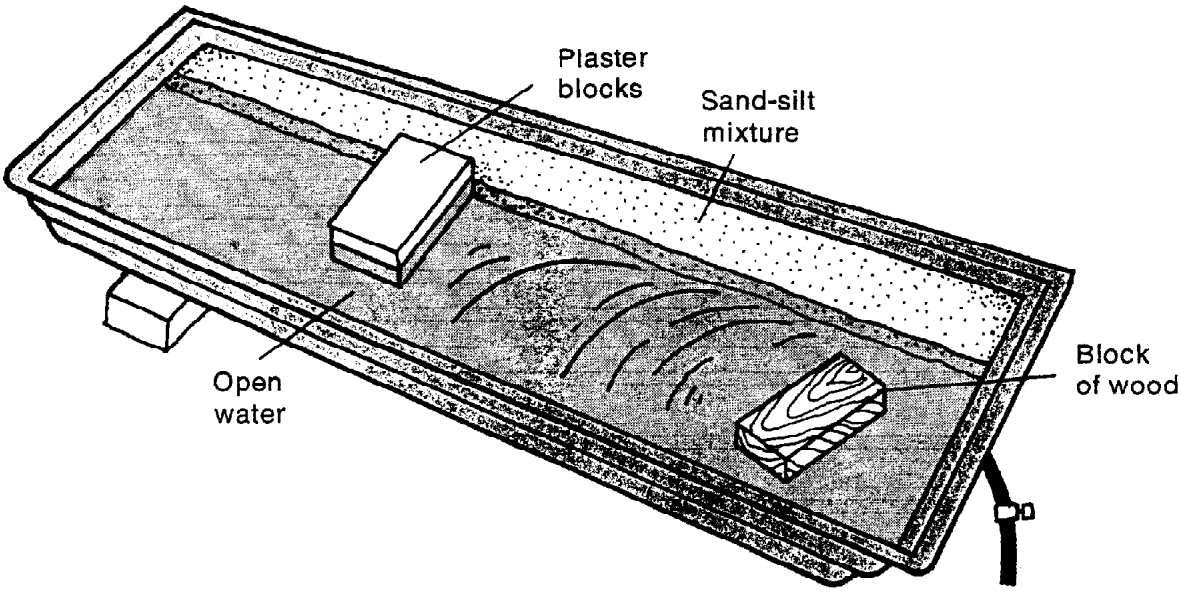
Figure 1



4. Obtain a block and set it at right angles to the beach. (**Figure 2**)

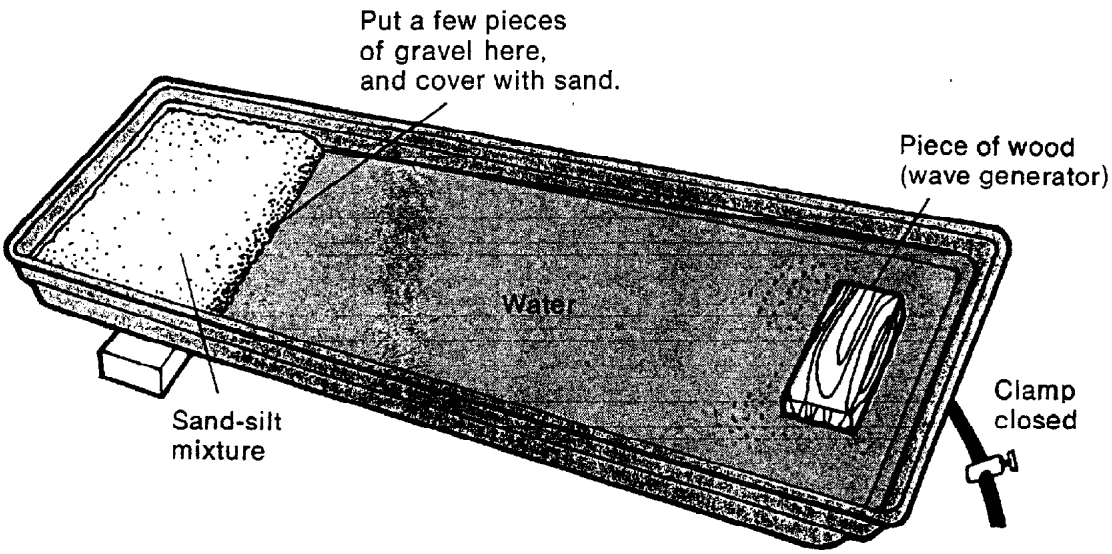
5. Place a block of wood in the water at an angle to the beach. Press down on it once every 3 seconds for 3-5 minutes. This should create a longshore drift. Where does the sand build up in your stream table?

Figure 2



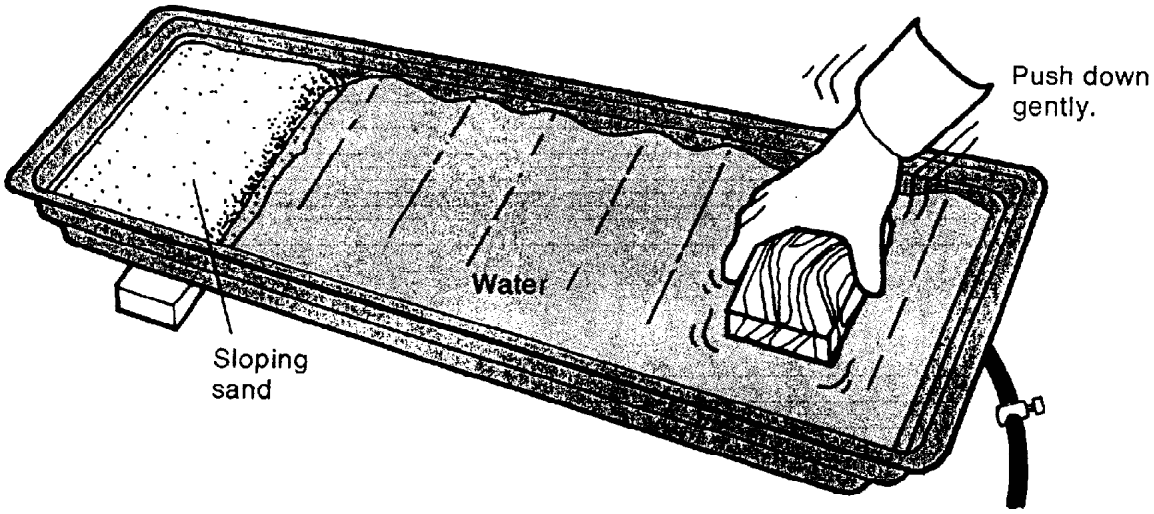
6. Pile the silt-sand mixture at one end of the stream table to make a sloping surface. Use a block to tilt the table. Fill with water until the bottom edge of the sand is covered to a depth of about 3 cm. Put a few small pieces of gravel near the water's edge and cover them with sand. (**Figure 3**)

Figure 3



7. Produce storm waves (high energy waves) by pressing down firmly on a piece of wood with the palm of your hand, as shown. Do this once every three seconds. Continue for about five minutes and carefully observe the sand-silt mixture. Then let the water settle for a few minutes. (**Figure 4**)

Figure 4



8. Now expose the beach to low-energy, gentle waves. Use the same stream table that you used for the high-energy waves. Leave everything as it was. This time push very gently so that you produce low-energy, gentle waves. Continue this for at least five minutes. Watch what happens when the waves reach the shore. What effect do low-energy waves have on the beach? How is this different from the high-energy storm waves crashing onto the beach?

Interpretation:

What happens to a coastline when the wave pattern reaches the shore at an angle most of the time?

The coastline erodes and sand moves in the direction of wave motion. The greater the angle of wave approach, the stronger the longshore current. Sand is transported parrallel to the shore in the direction of the prevailing longshore current. The coastline is eroded and built in different areas depending on the longshore and current.

Review for you:

Q1. Beach sand is made of what types of particles?

Beach sand can be almost pure quartx (silicon dioxide) but usually it is mixed with many tiny pieces of shells (calicum carbonate) and coral. Some beaches have minerals like Zircon (Zirconium silicate and rutile (titanium dioxide). Small amounts of clay and organic material may also be mixed in beach sand.

Q2. What are some of the sources of Florida beach sand?

Weathered rock materials and the calcium carbonate skeletal remains of plants and animals.

Q3. Why is beach sand in southeast Florida a different color than the sand in northwest Florida?

It is made up of different materials. In the southeast the sand is made up mostly of calcium carbonate while the northwest is mostly quartz.

Q4. What is the cause of longshore drift?

Prevailing winds cause waves to strike a beach and release energy that can generate currents which flow parallel to the shoreline. The flow of a longshore current can vary from day to day, depending on the direction of the wave approach. Longshore currents continually transport sand.

Q5. Winter winds in Florida often blow from the north-west. What effect do you think this will have on the beaches of the Gulf Coast?

The winds will remove sand from the beaches in the panhandle and build beaches along the southwest gulf coast.

Think about this:

Q6. If the summer's prevailing breeze on the eastern coast of Florida is from the southeast, which way is the sand moving?

Northwest (in the same direction that the wind is blowing).

Q7. Why is the sand on Florida's Panhandle coast mainly composed of quartz?

Granitic rocks in the Appalachian Mountains were weathered into quartz sand as it was carried by rivers to the Panhandle coast.

Q8. Predict what happens to a beach when hurricane-force winds reach it.

Hurricane-force winds cause high, steep waves and storm surge. The beach is flooded and eroded.

Q9. If you were responsible for building a jetty to protect a beach, what effects would this have on the flow of sand?

Building a jetty would cut off the flow of sand. Beaches below the jetty are eroded, and expensive beach replenishment projects are then conducted. There is much controversy as to whether beach replenishment works. Many engineers believe that we are wasting money attempting to stabilize beaches. Most believe that building should be prohibited on beaches. If building is permitted, then it is up to the owners to assume the cost of replenishment.

Q10. Gulf Flounder are often found close to shore on sandy or muddy bottoms. Describe what might happen to the Gulf Flounder in a region where tropical storm or hurricane force winds and waves struck the mainland.

They could be killed as they are buried under shifting sands. They can move into deep water where it is calmer. Storms alter feeding areas, destroying some and opening up new areas to forage. Storms aften introduce more nutrients which assist in survivial of larvae and adults.

CLASSY CLASSIFICATION

When you try to organize many items, it is often useful to arrange them in some kind of order. Think about your wardrobe. How do you organize your clothes at home? Do you store your socks in one place, shirts in another, skirts in another? And if not, do you sometimes have trouble locating an item you want to wear?

Or, imagine that you are in a huge library and find that all the books are placed on the shelves at random. Where would you look for a book on history, or painting, or baseball? You would probably spend many hours looking for the book you wanted. You probably already know that, in fact, librarians do classify books. How are books in your library arranged?

Biologists classify organisms in much the same way as librarians organize books. Biologists classify organisms based on the characteristics they share.

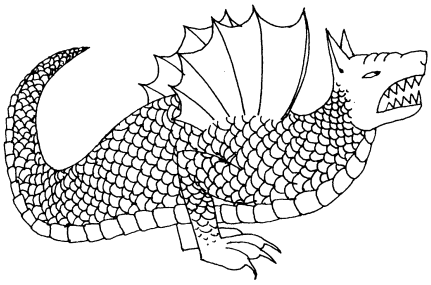
Objective:

To teach the science process of classification.

Procedure:

The thirteen organisms in this lab are all make-believe. Even so, they probably look no stranger than some real organisms that have been discovered!

Like a biologist who is classifying real animals, you will have to decide what will be the basis for your various groupings. You may want to group together all those mythical organisms which look like horses, or have hair, or have wings. One of your groupings might include three organisms, another only two, and so on (that is, perhaps only three of the thirteen organisms would share the particular characteristics that determines your grouping, whatever that characteristic happens to be). Or you may wish to use a variety of different characteristics and groupings. Certainly, different students in your class will choose different characteristics for their groupings. When you have had a chance to use your scientific imaginations and set up your groupings (classifications), it should prove interesting to have a class discussion about advantages of the different methods for grouping.



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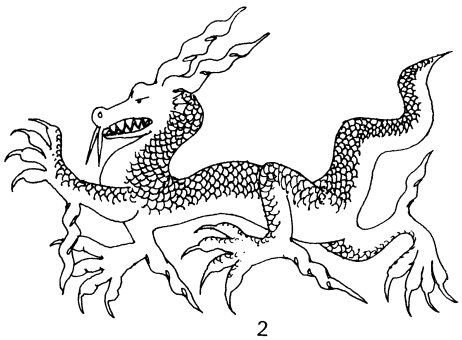

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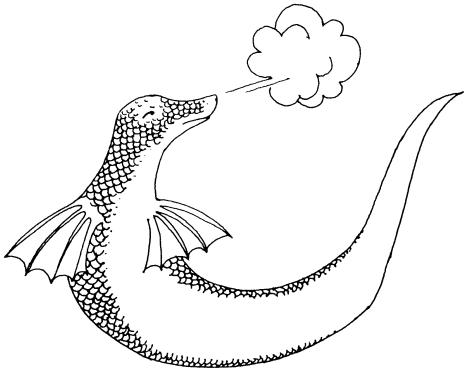

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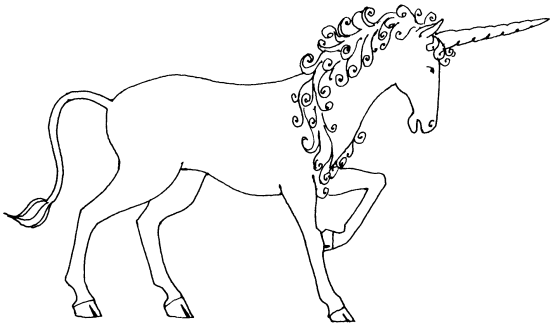

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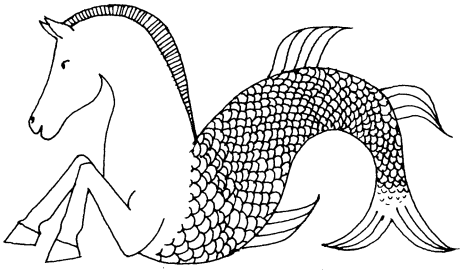

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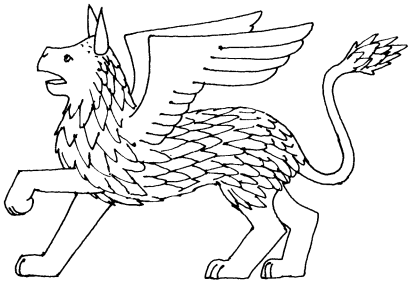

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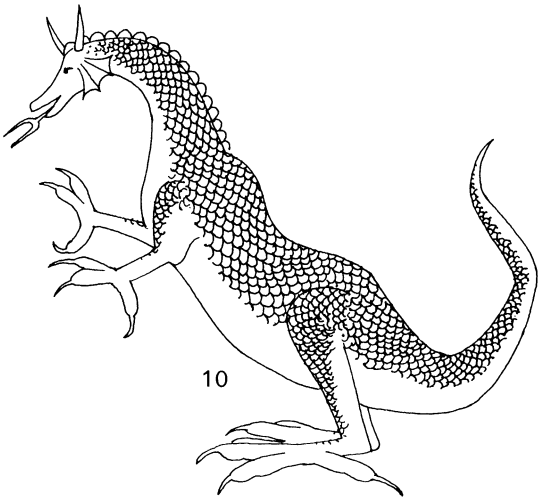

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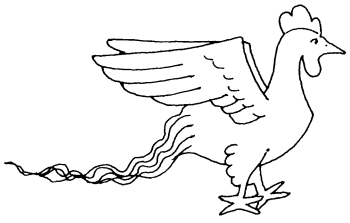

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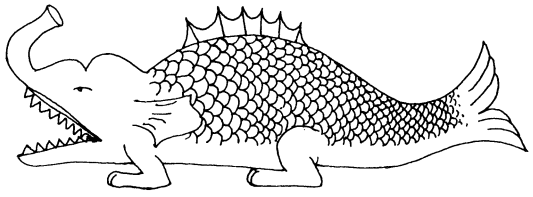

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Interpretation:

Compare and contrast the classification schemes created by your team and those of other student groups.

Answers may vary, but comparisons should be based on the characteristics rather than clothing such as the cape on the human-like character.

Review for you:

Q1. How do libraries organize books and why?

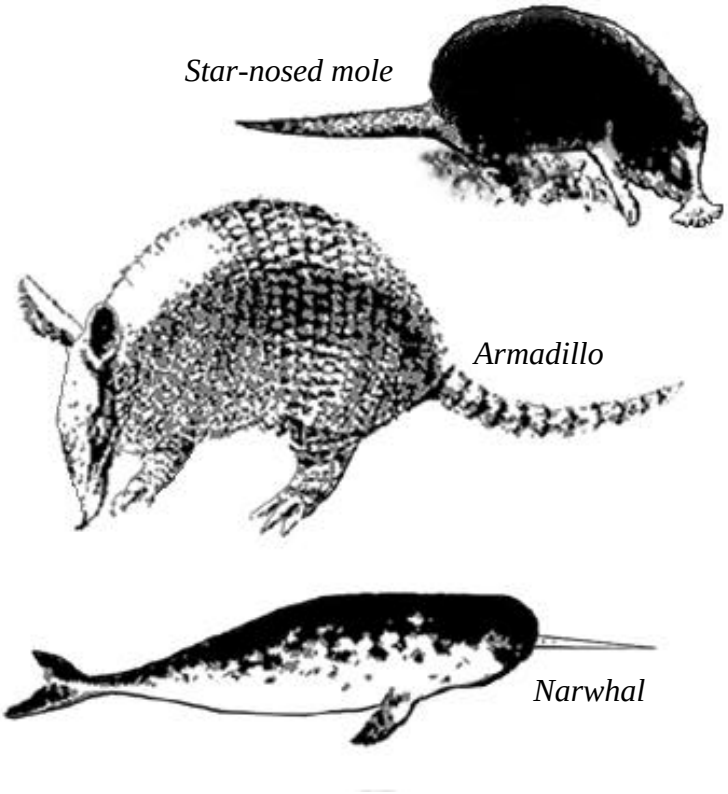
Libraries organize books based on similarity of content. This makes it easier to find books on particular topics.

Q2. What is biological classification based on?

Biological classification is based primarily upon physical characteristics of organisms.

More:

Now look at the three animals below. These are somewhat unusual-looking, yet they actually exist. Although it may be difficult to believe, these animals have all been classified as mammals.



Q3. Where would you place these three animals in your classification system for the make-believe creatures? Explain why.

Answers will vary.

Q4. Check a science book or encyclopedia and describe why these animals are classified as mammals.

Answers will vary, but students should discover that mammals are warm-blooded vertebrates that have hair at some point in their development or life cycle and give birth to live young.

Think About this:

Q5. Suppose a new organism is discovered in the Amazon jungle. How might biologists go about classifying it?

They would have to classify it based upon its physical characteristics.

Q6. Why do you think it important for biologists to classify a newly discovered organism?

So that they will be able to communicate about the same organism to other biologists.

Q7. Use library reference books to find out why the Blue Marlin is not classified in the same family as Porpoises.

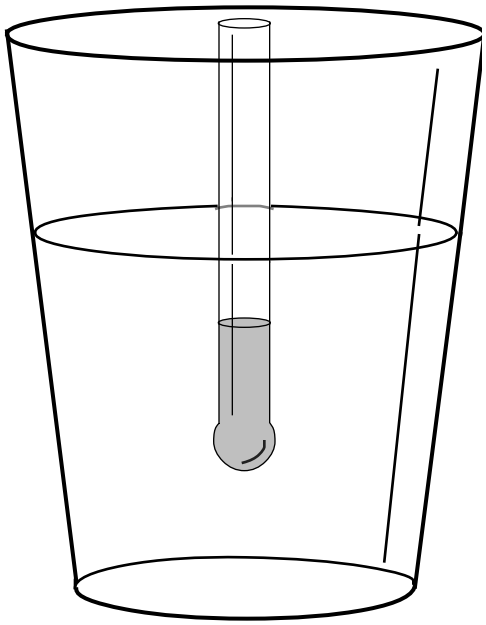
Blue Marlin are fish. Porpoises are mammals. Porpoises are warm blooded, have hair, give live birth, and nurse their young. Blue Marlin have none of these characteristics.

DARE TO BE DENSE

Suppose you are holding two boxes of equal size and mass. One box contains a kilogram of feathers and the other a kilogram of rocks. The masses of the boxes are the same. Does the box with rocks weigh more than the box with feathers? If you said they are equal in weight, you are right. This example demonstrates that a unit of mass, like the kilogram, is the same whether dealing with feathers or rocks.

Now think of the amount of space which would be taken up by the kilogram of rocks and the kilogram of feathers in the boxes. Which would have the greater volume? As you can imagine, the amount of space or volume of one kilogram of feathers, will be much greater than the amount of space taken up by one kilogram of rocks. This is because rocks are more dense than feathers.

The concept for dealing with both mass and volume is density. Density is the ratio of mass to volume in matter. A good reference material for understanding density is water. The density of water is 1.0 gm mass/ml (volume). If some form of matter (liquid, solid, gas) has a greater density than 1.0, then it is more dense than water and will sink in water. Matter less dense than water, with density less than 1.0, will float on water. Objects that float on water are called buoyant.



The instrument you will construct in this laboratory will be used to compare the density of water when different amounts of salt are added. Scientists call such an instrument a **hydrometer**. Hydro means water or liquid, and the suffix meter means a measuring device. Scientists use the hydrometer to compare densities of different liquids. You might call it a “densimeter”.

Objective:

To see how the density of water is affected by adding salt.

Materials:

Clear plastic straw
Pea-size lump of modeling clay
8 oz. clear plastic cup
Waterproof marker
Candle/paraffin
Plastic spoon
2 tablespoons of coarse salt
Teaspoon of sand
Matches

Procedure:

1. Cut a small plastic straw to a length of 10 centimeters (cm). Close one end of the straw with a small bit of modeling clay. Water-seal the clay end of the straw with molten candle wax or paraffin. Using a waterproof marker, draw a line around the straw at 5 cm below the open end (top) of the straw. This is your hydrometer.

2. Pour 200 ml of water in a tall plastic cup. Place your hydrometer in the water. Use a ruler to measure the length of the straw above the water level. Record your measurement in Data Table 1.

3. Add sand, a little at a time, to the mouth of the straw until the line on the straw is exactly at water level. (It should be at 5 cm if your hydrometer is properly adjusted.) Remove the hydrometer. Add 1 tablespoon of salt to the water. Stir until completely dissolved. Again measure the length of the straw above the water level and record your results in Data Table 1. Increase the amount of salt to 2 tablespoons and measure the length of the straw above water level. Record your results in Data Table 1.

DATA TABLE 1

Amount of Salt	Total Length of Straw	Above Water Length	Below Water Length	Ratio Above/Below
None	*Answers will vary but the straw should rise in the water as salt is added.*			
5 grams				
10 grams				

Interpretation:

How does the amount of added salt affect the density of the liquid?

As salt is added to the liquid, the density of the liquid increases and the buoyant force increases.

Review for You:

Q1. Define density and give an example of how the density of a piece of matter may be determined.

Density is the ratio of mass to volume in matter. Objects that float have a density less than 1.0 gm/ml. Objects that sink have a density greater than 1.0gm/ml. This is because the density of water is 1.0 gm/ml at 20 degrees C. The density of an object may be determined by finding the mass and volume. Calculate the density using the formula: D=M/V

Q2. Explain what buoyancy is and tell how buoyancy is related to the density of a liquid.

Objects that float are said to be buoyant. The denser the liquid, the higher the buoyancy of a specified object (or the higher the object will appear to float in the liquid relative to the liquid's surface). This relationship is called the Archimedes' principle, which states that the buoyant force on an object is equal to the weight of the fluid displaced by the object.

Q3. Predict how far the hydrometer would sink as more and more salt is added to the water. Test your prediction.

Answers will vary, but the hydrometer will sink less (or float higher) as the water becomes more dense or as more salt is added.

Think about this:

Q4. In which body of water would your body be more buoyant: a freshwater lake or the open ocean? Explain why.

Open ocean, because of the concentration of dissolved solids in the water. The average salinity of sea water is 35 parts per thousand, so the sea water is more dense than fresh water as dissolved solids have a greater mass than water. Therefore, an equal amount of sea water has a greater density than fresh.

Q5. During the spring and summer months, manatees often swim upriver from saltwater bays into freshwater areas. As these animals swim upstream, what happens to their buoyancy?

Their buoyancy decreases because the freshwater is less dense than saltwater.

Q6. If gasoline or oil is spilled on the water, it remains at the surface. This accounts for the oily rainbow that you often see on the surface of the water in mud puddles or near boat marinas. Are gasoline and oil more or less dense than water and why?

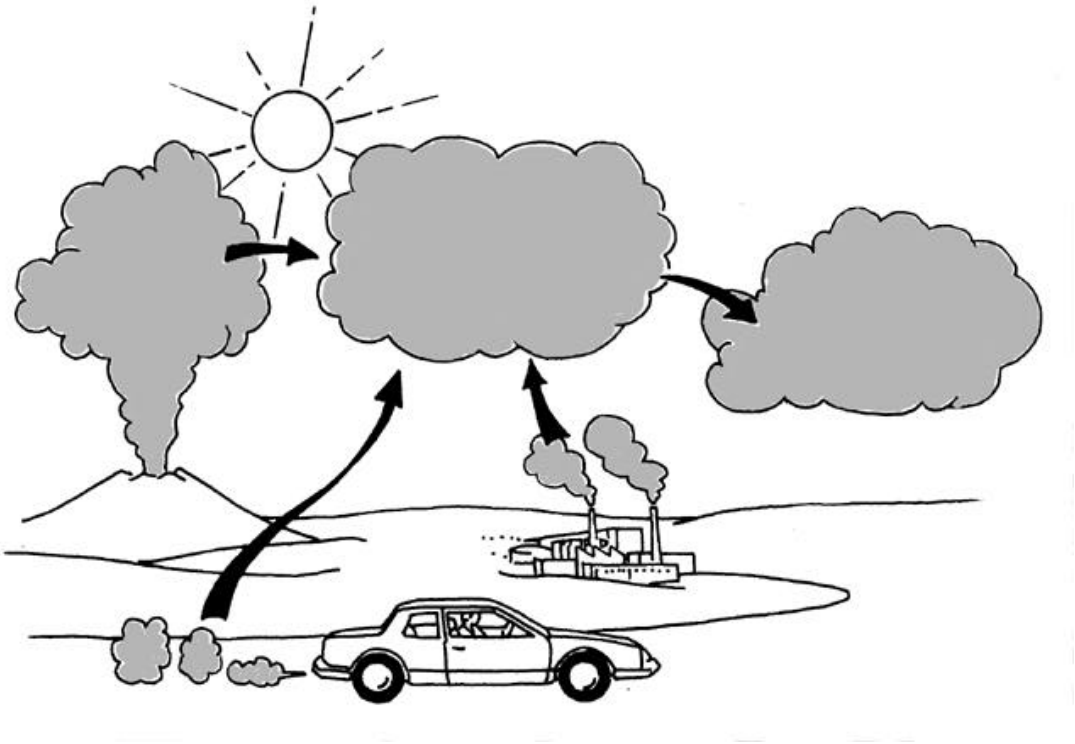
Gasoline and most oils are less dense than water; hence they float. However, as the lighter molecules of gas and oil evaporate, the heavier molecules sink causing underwater pollution.

Q7. Adult Red Drum can tolerate salt water concentrations of 32 parts per thousand. Where are adult Red Drum most likely to be found?

Adult Red Drum would be found in the ocean or gulf, but not in brackish estuaries.

DIRTY AIR

How much air pollution is occurring in your neighborhood or community? You can get a rough idea through observation. On your way to school, observe any smoke or dust in the air. Try to locate its source. Find out what kind of material is being burned and the sort of smoke produced by the burning.



Don't forget, not all air pollution is visible. As you may know, gases are not the only product of burning — various particles also result. There are many forms of solid matter in the air — dust, smoke, soot, ash, pollen, etc. These particles, or particulate content, may stay suspended in the air or settle to the ground. They dirty many objects and darken the sky. Solid particles can also interfere with normal breathing.

Since two-thirds of the earth's surface is covered with water, much of the pollution in the atmosphere ends up in the sea. Air pollution, along with water pollution, is a major problem for our nation.

Objective:

To measure the particulate content of air in the classroom and outdoor locations.

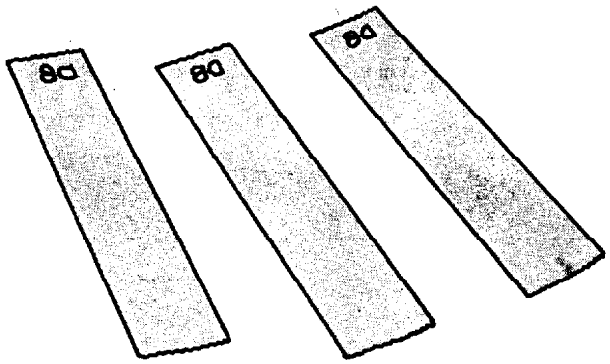
Materials:

Microscope slide
Petroleum jelly
Clear tape
Small piece of paper
Hand lens

Procedure:

PART 1.

1. Place your initials on three small pieces of paper and use clear tape to tape the paper to one end of the microscope slides. Apply a thin coating of petroleum jelly to one side of the slides.



2. Place one of the prepared slides in a protected place (a clean box or drawer) for experimental control. Place the other two slides in different locations in the classroom.

3. After two days, examine the slides with a magnifying lens to see what changes have occurred.

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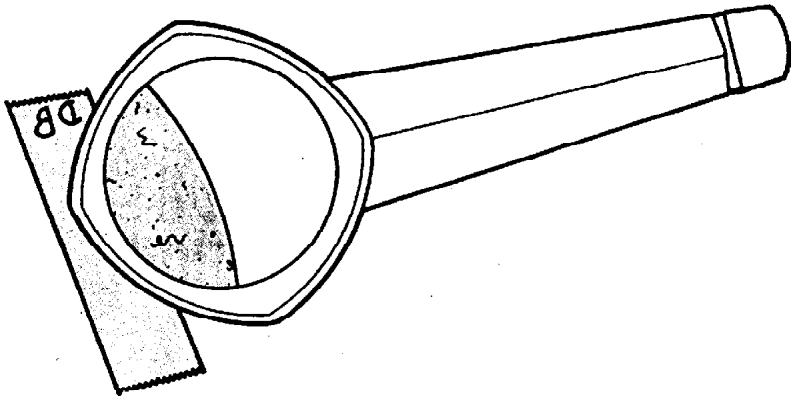


4. Calculate the surface area of the microscope slide by measuring the length and width of the slide (in centimeters) that is covered with petroleum jelly. Then count the number of particles collected on the petroleum jelly and note any other changes. Next calculate the number of particles per square centimeter. Record the results on your data sheet.

5. Data sheet for classroom air:

Particle concentration in classroom air

Slide Number	Location	Total Number of Particles on Slide	Surface Area of Slide (cm2)	Particles/ cm2	Other Changes
1 Control		*Answers will vary.*			
2					
3					

PART 2.

6. Prepare a total of three slides as you did for Part 1 and place them in locations outside the classroom (the parking lot would be a good choice). Also prepare a control slide as before.

7. After two days, observe the slides with the magnifying lens and calculate the number of particles per square centimeter. Record your results on the data sheet.

8. Data sheet for outside air:

Particle concentration in outside air

Slide Number	Location	Total Number of Particles on Slide	Surface Area of Slide (cm2)	Particles/ cm2	Other Changes
1 Control		*Answers will vary.*			
2					
3					

Interpretation:

Compare and contrast the observations you made for classroom air and outside air. Can you tell where most of the particles came from?

Answers will vary depending upon indoor and outdoor quality.

Review for you:

Q1. Compare the slides placed in the classroom with the control slide. Describe differences you observed.

Answers will vary but the control slide should have fewer particles.

Q2. Compare the slides placed outside with the control slide. Describe differences you observed.

Answers will vary but the control slide should have fewer particles.

Q3. Compare the number of particles trapped in the petroleum jelly on slides exposed at different locations in the classroom. Explain the differences.

Answers will vary.

Q4. Compare the number of particles trapped in the petroleum jelly on slides exposed at different outdoor locations. Explain the differences.

Answers will vary.

Q5. What do you think could be the source of particulates in the classroom air?

Answers will vary. However answers may include outdoor air coming inside (air pollutants), dust from student traffic, and pollen.

Q6. What are some possible sources of particulates in the outdoor air?

The burning of coal in power plants and gasoline in cars are sources of airborne particulates. Also, natural sources include windblown silt and sand.

Think about this:

Q7. As you may know, automobiles and air pollution are closely related. What do you think the particle concentration would be for air at the end of an automobile tail pipe?

Answers will vary but students should indicate it would be very high (more concentrated near a pollution source).

Q8. What are some of the things automobile manufacturers have done to reduce exhaust emissions?

Answers will vary but may include such things as installing catalytic converters on vehicles and other emission control devices.

Q9. It is known that many dirty air particles are absorbed in raindrops and fall to the Earth when it rains. How might air pollution cause harm to fish populations?

The particles may consist of toxic heavy metals that fall with rain into the water or run off the land with the water and into streams, ponds, and lakes. Such pollutants can enter the food web and become concentrated in predators, such as fish. This process, known as bioaccumulation, results in increased levels of toxins such as heavy metals such as mercury that can poison fish or humans or other high order predators that eat them. Sulfur and nitrogen oxides from factories and automobile exhausts may also fall as precipitation, known as acid rain.

DUNES ON THE MOVE

Sand dunes are not common in all areas. Dunes are formed in areas where the beach is flat behind the high tide level and where a good supply of sand is being transported along the coast by long-shore currents. Sand and litter are pushed onto the beach by spring tides. Litter is any man-made or natural item not common to the beach. It acts as a shelter for sand. Wind moves the sand and piles it up covering the litter. When the wind is slowed by litter, sand is deposited, and a mound slowly begins to build.

As the mound of sand grows, it becomes a more efficient wind breaker. This increases the amount of sand being deposited. The mound grows and more sand is deposited behind it. Growing larger and higher, the mound becomes a small hill, a ridge, and finally a dune. Windblown sand, blowing up the face of the dune and falling down the crest, gives the dune its characteristic shape — a long sloping windward side and a steeper slope on the leeward side.

If nothing interferes with the wind or if nothing anchors the sand, the dune creeps inland as the wind moves sand from the windward to the leeward side. The rate at which a dune advances can vary from a few centimeters to many meters per year. A fast moving dune can bury everything in its path.

Dune migration will continue until it becomes covered with vegetation, which will protect the sand from the wind. Dunes of this type are said to be fixed or stabilized.

Dunes are valuable to us because they protect our beach shorelines from erosion. Dune life tends to progress from sand to dense woodland. This progression can be halted and hundreds of years of growth destroyed in a very short time. Hurricanes, fires, or construction (the building of homes, cottages, or roads) can disrupt the stability that took so long to establish. When a break in the dune vegetation occurs, the wind can quickly rip through it, tearing at the roots of nearby plants. As successive clumps of plants are exposed, more and more sand is released, and the dune begins to move again.

The loss of a healthy dune system can cause the beach to become narrow or disappear. When this happens, the natural protection from waves and storms is lost.

Objective:

To demonstrate the formation and migration of sand dunes.

Materials:

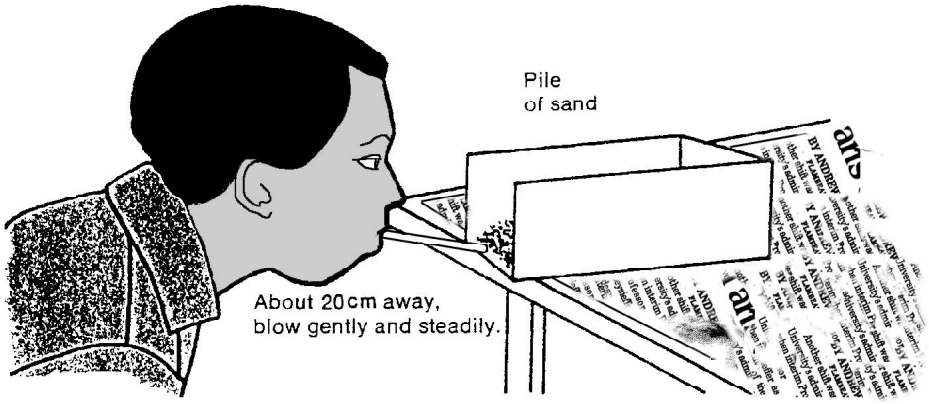
Cardboard box (size of shoe box)
Dry clean sand
Soda straw
Newspaper

Procedure:

1. Remove one end of the shoe box. Place a handful of clean dry sand in the box. Place newspaper under the box to catch loose sand.

2. Build a small sand dune near the open end of your box.

3. With your mouth level with the bottom of the box, blow gently - but steadily — through a soda straw. Move the straw from side-to-side to distribute the wind evenly across the pile of sand.



4. Keep blowing until the sand pile moves about 5 cm. What happens to the sand on the side of the pile facing you? What happens on the other side?

Interpretation:

What is dune migration? How does it happen?

Dune migration is the movement of a sand dune inland. If nothing interferes with the wind or if nothing anchors the sand, a dune creeps inland as the wind moves sand from the windward to the leeward side.

Review for you:

Q1. How are dunes formed?

Sand dunes are formed in areas where the beach is flat behind the high tide level and where a good supply of sand is being moved along the coast by longshore currents (currents that run parallel with the coast) . Sand and litter are pushed onto the beach by spring tides. Litter acts as a shelter or trap for sand. Wind moves the sand and piles it up over the litter; and a mound slowly grows to form a small hill, then a ridge, and finally a dune.

Q2. What is the importance of dunes to coastal erosion?

Dunes protect our beach shores against wind and water erosion. The loss of a healthy dune system can cause a beach to become narrow or disappear, because the natural protection from waves and storms is lost.

Q3. Why should you not walk across dunes?

Walking across dunes can cause fixed or stabilized dunes to erode, which can eventually expose other areas to erosion. High winds can move sand from under plants at the edge of the foot path resulting in "blowouts," which are areas devoid of plants.

Think about this:

Q4. If the winds were stronger, would the dunes have a different shape? In what way?

Stronger winds could result in dunes that are both flatter and longer. (Students can experiment with the dunes they've built in their boxes to determine the effects of stronger winds on dune shape.)

Q5. If possible, compare old maps and/or aerial photographs to new ones to see if stable dunes have been damaged or destroyed.

Observations will vary.

Q6. As a planner for a coastal county, what would you propose to do to save the dunes from destruction?

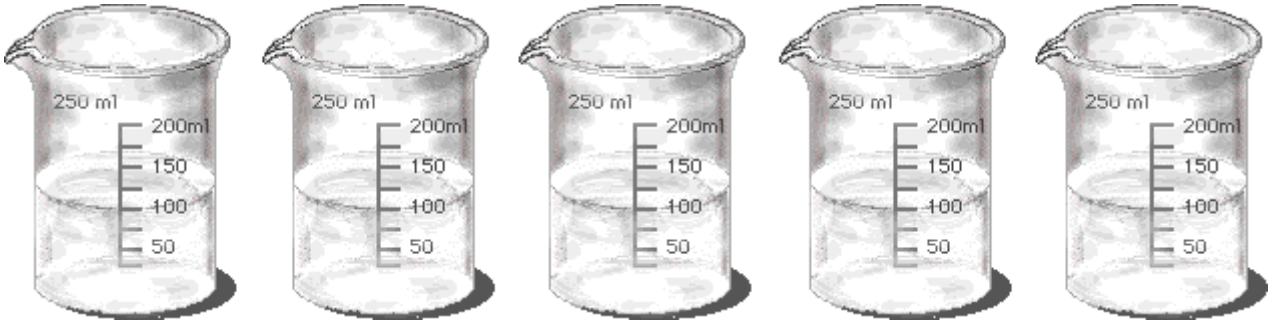
Answers will vary but should include such things as protecting dunes by not walking on them, by not disturbing dune vegetation, and by not allowing construction that would disrupt dune stability.

Q7. Dunes on barrier islands are part of the ecosystem. Bays and salt marshes appear and disappear with changes in sand bars, dunes and islands. What are some changes in bays and marshes as barrier islands shift from place to place?

An overwash event resulting from a dune blowout can benefit the estuaries by delivering new sediment for the creation of salt marshes and seagrass beds, or by increasing flushing. A breach in the dunes and flooding of freshwater coastal lakes in the Panhandle will cause short term changes in the ecosystem and kill some freshwater species. But that's part of the system!

ENVIRONMENTAL RESISTANCE

Environmental resistance describes biotic(living) and abiotic (non-living) factors which limit the growth of populations. Examples of these factors include predation, availability of food and space, and the amount of pollution. When such a factor limits, or restricts, the growth of a population, it is called a "limiting factor." An overabundance or lack of a substance might serve as a limiting factor.



A pond water sample includes several populations of organisms. However, in this exercise all the microorganisms in each jar will be treated as a single population. What are some of the factors that you think would affect population growth among microscopic freshwater organisms?

Objective:

To investigate some examples of environmental resistance.

Materials:

5 Beakers (250 ml)
Pond water (500 ml)
Cooking oil (1 tablespoon)
Laundry detergent (15 grams)
Sugar (15 grams)
Salt (15 grams)
Wax pencil
Microscope

Procedure:

1. With a wax pencil, label the 250 ml beakers from 1 to 5. Pour about 100 ml of pond water into each beaker.

2. Add one of the four materials to each of the beakers: cooking oil, laundry detergent, sugar, salt as listed in Table 1. Record the treatment for each beaker on the data sheet.

3. Do not add anything to the fifth beaker. This is the control beaker.

4. Predict what will happen to the microorganism population in the five beakers.

5. Examine the contents of each beaker after about one week. If possible, use a microscope to examine drops taken from the beakers. Record any differences among the five populations.

Table 1

Beaker	Material Added (1 Tbs)	Appearance after 1 week
1	Cooking Oil	*The numbers and types of*
2	Laundry Detergent	*organisms will vary.*
3	Sugar	
4	Salt	
5	Nothing added (Control)	

Conclusion:

Was the environmental resistance lowered in any of the four treated beakers? What, if anything, caused an increase in the environmental resistance? Were you able to predict the observed results? Did different species appear to be affected in the same way?

The addition of oils, detergents, salts, and food (sugar) caused an increase in resistance.

Some students should have been able to predict that oil or detergents might limit population growth. Sugar might be a substance that they would have not predicted well. In many

populations, their numbers will increase with the addition of sugar and decrease with added salt.

More:

If you can obtain a population of single-celled animals (paramecium, for example), divide the population. Put parts into different beakers except the fifth beaker, and add one of several different kinds of chemicals to each beaker. Keep a record of what happens to the populations in the various beakers.

Review for you:

Q1. What effect did the chemicals have on the organisms?

Some species are more affected by certain pollutants than others. Some will be killed while other populations may increase in numbers.

Q2. What happened to the organisms in the fifth beaker? Why was the fifth beaker used?

Answers will vary. The 5th beaker (no material added) was used as a control to compare and /or contrast any changes in the 4 other beakers.

Q3. How would you define a “limiting factor?”

A limiting factor is an abiotic or biotic resource that limits, or restricts, the growth of a population.

Think about this:

Q4. What might be the effects, both good and bad, of spraying for insects that could destroy a farmer's crops?

Good effects - destroy crop-damaging insects.

Bad effects - spray becomes an environmental resistance factor for non-insect species; insecticides could get into groundwater and surface water supplies.

Q5. What are some environmental factors that could limit the number of people that could live in Florida?

Answers will vary but should include statements about available habitat, water, food, polluted air, hurricanes, diseases, and toxic waste. Water is an important limiting factor in Florida because Floridians must depend on rainfall stored in an underground aquifer for their drinking water.

Q6. Can you uncover any examples in your community of human attempts to raise or lower environmental resistance to different organisms?

Lower environmental resistance by treating human disease and injury with medical care.

Using insecticides to control crop-destroying insects and other insect pests, i.e. mosquitoes and fire ants would also lower environmental resistance.

Q7. Fertilizers and pesticides are often sprayed on farm fields to increase the yield of the land. However, if these chemicals make their way into streams and rivers, then fish and other aquatic life might be negatively affected. Describe how fertilizers and pesticides might affect decomposer organisms and fish populations in Florida's waterways.

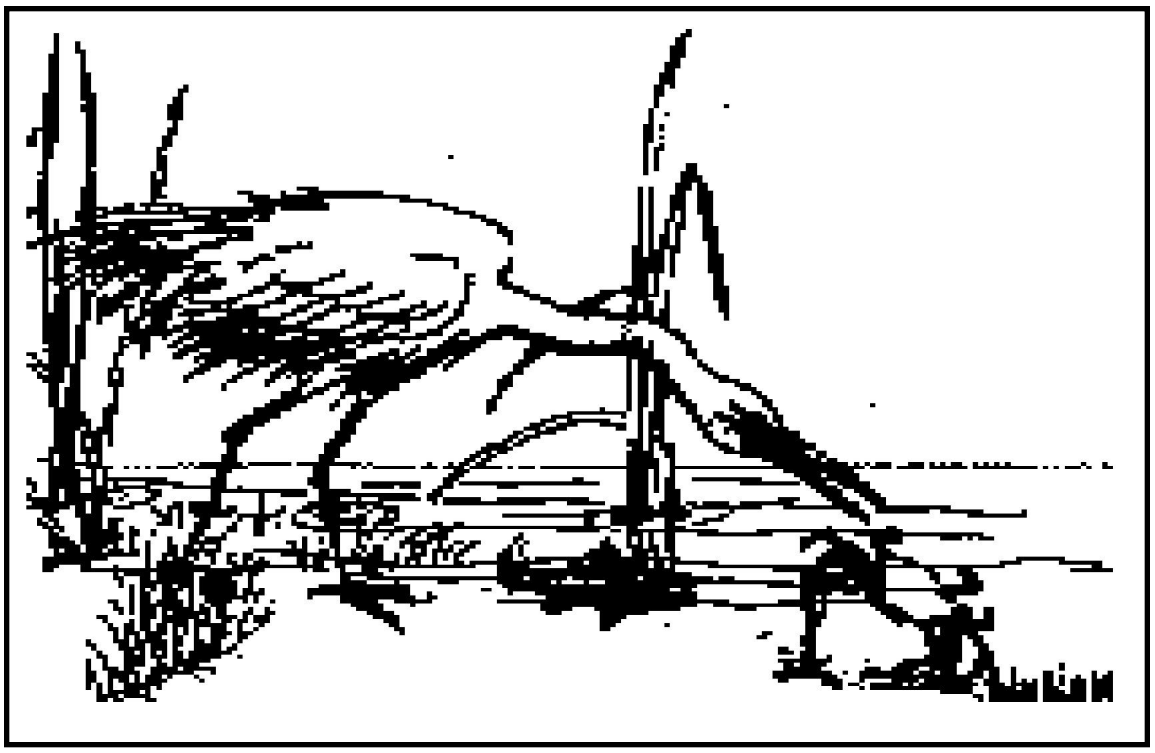
Fertilizers may cause an increase in the algae and other aquatic photosynthesizing organisms. During the night these algae continue to use O_2 and remove it from the water leaving fish short of oxygen, especially in the early morning. If the shortage is too great, the fish may die. Also when algae dies, it is decomposed by bacteria which also depletes the oxygen.

FOOD CHAIN GAME

All living things need energy to survive. The vital link among life forms is the pathway that energy follows. All plants and animals have an important role to play in the distribution of energy to maintain a variety of life on our planet. Food chains and food webs demonstrate how each part of the system is dependent upon other parts. Each life form has its role to play.

A food chain is only one part of a complex interacting web of life. A food chain shows the progression from producer to primary consumer, to secondary consumer, and to decomposers which can act on any trophic level in the chain. A food chain can be represented by a straight line diagram to follow the flow of energy from one life form to another. Food chains combine to create the complex food webs that exist in nature.

In this game, students assume the parts of "producers", "primary consumers", and "secondary consumers" in a Florida estuary.



Estuaries are one of the Gulf of Mexico's major features. Many are located behind Gulf coast barrier islands. An estuary is a semi-enclosed coastal body of water, which has free connection with the open sea. Within this area, sea water is measurably diluted with fresh water from land drainage.

Estuaries and connected mangrove forests and marshes are a major part of the lives of numerous animal species. More than 95 percent of Gulf fish and shellfish species that commercial and recreational anglers catch depend on an estuary at some point in their lives. Many species spend their larval and juvenile stages in the estuaries to find food and shelter.

Many endangered species, such as the American crocodile and the manatee, may be found in South Florida's estuaries. Birds such as the mallard, black duck, egret, and spoonbill also depend on estuaries for food.

Objective:

To demonstrate the interconnection of the parts of an estuarine food chain and to discover the effects of destroying one part of the estuarine food chain.

Materials:

Clear tape
Badges (Producer, Primary Consumer, and Secondary Consumer)
Outside area with room to run
Area for tagged students

> ***Teacher's Note:*** *Teachers' directions for playing the Food Chain Game are found in the Appendix on page 127.*

Playing the game:

1. Go to the area set aside by your teacher for playing the food chain game. This will be known as the bay. Pick a badge out of the badge box. Just reach in and take one without peeking or trading.

2. If you are a producer, you go into the bay first, followed by primary consumers, then secondary consumers.

3. If you are a primary consumer, you are to tag producers, take their tag and tape it to your badge. If you are a producer, and are tagged, your badge is taken away by the consumer and you are to go to the area your teacher has selected as "Decaying Area."

4. If you are a secondary consumer, you are to tag primary consumers who already have at least two producer badges stuck to their badge. Stick their badges to your badge. The dead primary consumer should go to the Decaying Area.

5. If you are in the decaying area and another organism of your same kind comes into the area, touch them and you are rejuvenated and may return to the bay. Pick up a new badge of the same kind you started with before returning to the bay.

6. Continue playing until one of the levels (producer or primary consumer) is wiped out.

More:

This game can be converted into any type of food chain - saltmarsh, mangrove forest, seagrass bed. Bacteria could be added to the game to eat away dead organisms in the decaying area. (If six bacteria tag a dead organism before he/she is reproduced, then he/she is no longer able to return to the game.) Humans could be added to the game as hunters or polluters. They would tag any level of the food web. Humans would wipe themselves out if any other level gets tagged all at once. Design a new game and play it.

Interpretation:

Explain what each part of the food web does for the other parts. What could occur if one part of the food web becomes scarce?

(a) Producers: use carbon dioxide, water, and solar energy to make organic material and release oxygen. Primary consumers: eat producers (usually herbivores) Secondary consumers: eat primary consumers (carnivores) Decomposers: feed on dead organisms from any trophic level. Microbes convert non-living organic matter into inorganic compounds including nutrients and gases.

(b) The populations of the other two levels are affected. In some cases the populations can increase (if predators are removed); in other cases they decrease (if producers decrease) and another energy source is not available.

Review for you:

Q1. What are the main parts of the estuarine food web?

Answers will vary but should include trophic levels discussed in the text (producers, primary consumers, and secondary consumers and decomposers.)

Q2. How would you explain a food chain using yourself and your lunch in the explanation?

Answers will vary.

Q3. What are some species in Florida that depend upon estuaries?

Answers will vary. Many invertebrates, fish, birds, amphibians, and mammals depend on estuaries.

Q4. What would happen to the rest of the food chain if one "link" of the chain gets wiped out by insecticides, pollution or extinction?

The other parts of the food chain would either die or find alternative prey (food sources).

Q5. Categorize the following as producer or consumer: pelican; reeds; wiregrass; shrimp.

Producers: reeds, wiregrass

Consumers: pelican, shrimp

Think about this:

Q6. Write a story that traces energy through a food chain. Use your own paper if the space below is not enough.

Answers will vary. This exercise should be very valuable in assessing whether or not a student understands the concept of energy flow in a biological system. The students could tell of phytoplankton being eaten by zooplankton (primary consumers), zooplankton being eaten by small fish (secondary consumers), small fish being eaten by larger fish (tertiary consumers), that animal then serving as food for another, and so on.

Q7. Why would a factory that is inland affect an estuary?

Because the waste from the factory may get into the watershed, the area of land from which rain and snow melt, drains into streams, rivers, and eventually estuaries. Rivers carry wastes that was not properly disposed of to estuaries. Also, airborne pollutants may drift over the estuary and fall into the water.

Q8. Create a mock estuary in your classroom with three-dimensional animals.

Responses will vary.

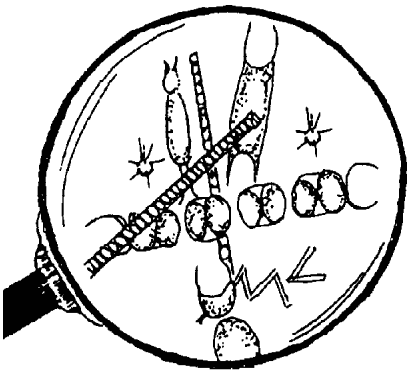
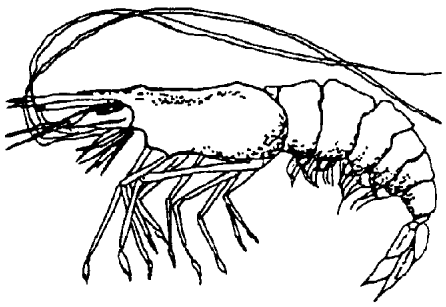
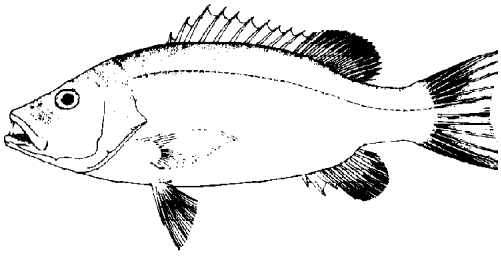
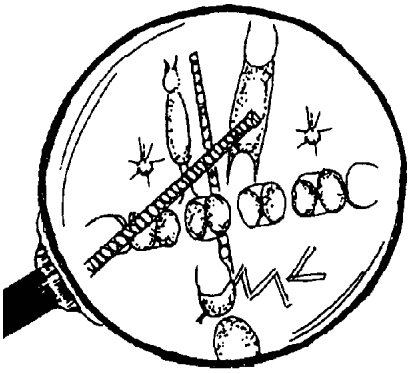
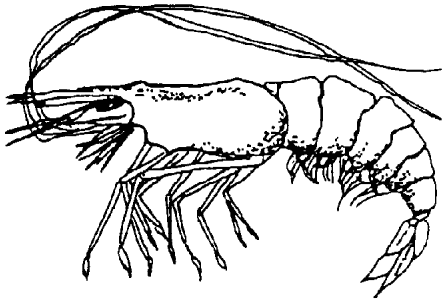
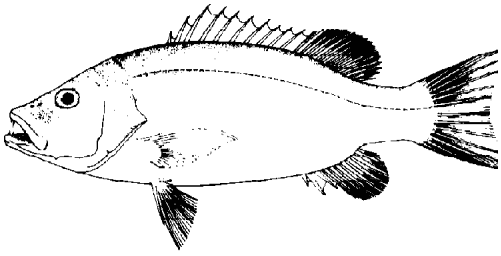
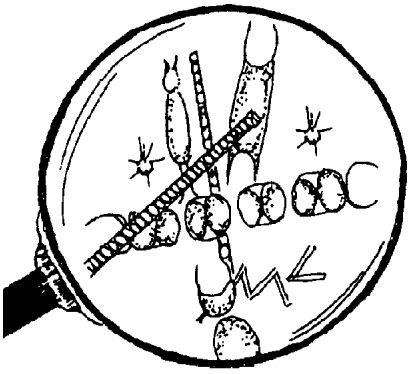
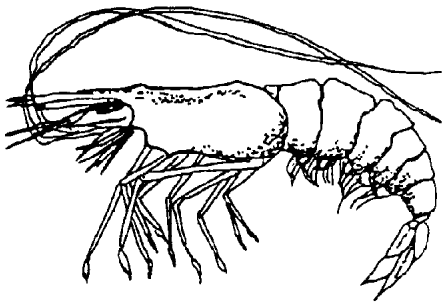
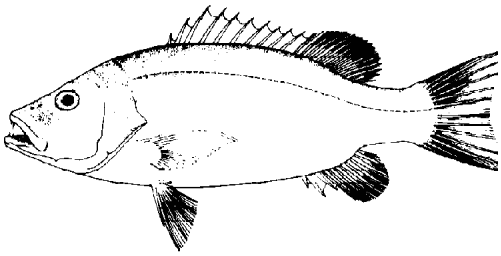
Q9. Have your class figure out a food chain of live organisms they might be able to keep in the classroom. Then set up a terrarium. Examples include: plants-aphids-ladybugs or grass-cricket-lizard.

Responses will vary. Require them to take proper care of the animals and plants. This is a good opportunity to teach responsibility and to expect them to demonstrate it.

Q10. Would a Hammerhead Shark be at the beginning or end of a food chain? Use a library reference to construct an aquatic food chain that includes a Hammerhead Shark.

Generally a shark of this size will be at the end of a food chain. They could be eaten by some organism such as humans.

Badges

Producers	Primary	Secondary
 Phytoplankton	 Juvenile Pink Shrimp	 Mangrove Snapper
 Phytoplankton	 Juvenile Pink Shrimp	 Mangrove Snapper
 Phytoplankton	 Juvenile Pink Shrimp	 Mangrove Snapper

FOOD WEBS

Food chains consist of plants and animals that have a feeding relationship. At the beginning of the chain are plants that produce their own food through photosynthesis. Animals that only eat plants are called “herbivores.” Biologists call plants “producers” and animals such as herbivores, “primary consumers.” Animals that eat primary consumers are called “secondary consumers.” Secondary consumers are food for a higher level of animal consumers, and so on. Animals that eat only other animals are called “carnivores.” Animals that eat both plants and animals are called “omnivores.” Some species of animals and plants use dead organisms as a source of food. They are called “scavengers” or “decomposers.” Many organisms interacting through several different but connected food chains may form an interconnected food web.

In nature, observing each part of a food web can be difficult. Long periods of observation are necessary to see what organisms are feeding on. Some animals eat only at night; some are so small you need a microscope to see them; others burrow underground; and still others live in brush thickets. In a food web, there are many kinds of plants and animals, and the relationships among these organisms are complex.

Objective:

To construct a model of a food web showing the interdependence of living things.

Materials:

Paper
Quarter (or other small, round object)
Watery Environment or Land Environment list

WATERY ENVIRONMENT

Producer	Primary Consumer	Secondary Consumer	Scavenger
Elodea	Tadpoles	Minnows	Crayfish
Algae	Water Fleas	Bluegills Frogs	
	Snails	Bass	

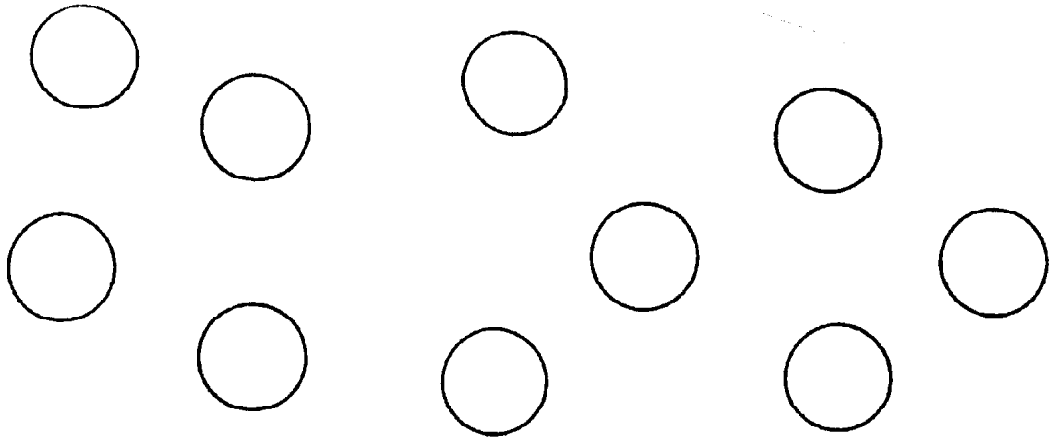
LAND ENVIRONMENT

Producer	Primary Consumer	Secondary Consumer	Scavenger
Trees	Bees Squirrels	Woodpeckers	Termites
Clover	Beetles Mice	Cats Owls	

Procedure:

1. Using the quarter or other small round object, draw ten circles on a sheet of paper. Space the circles so that they are randomly separated (**Figure 1**).

Figure 1

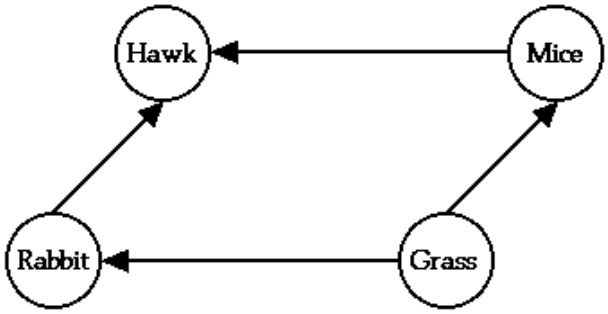


2. In each circle, write the name of an organism from one of the environment lists. Use each name only once, and arrange the names so that animals with similar eating habits (primary consumers, for example) are not clustered together.

3. Familiarize yourself with the eating habits of each organism on your list. You may have to do some library research.

4. Draw an arrow from each organism to every other organism that depends upon it as a source of food. The tip of the arrow should touch the circle of the animal that is eating. Some organisms may have several arrows pointing to and away from themselves (**Figure 2**).

Figure 2



5. Drawing an X through a circle means all the members of that species have been removed from the community. A species might be removed from an area through habitat destruction, over hunting or fishing, or pesticide poisoning. If you are using the watery environment list, draw an X through the circle for the snail. Draw small x's over each arrow pointing away from the snail's circle. If you are using the land environment list, follow the same procedure for the beetles.

Interpretation:

Describe the feeding patterns illustrated in your food web diagram.

Answers will vary. All food webs should show energy flowing from producers (plants) to first-order consumers (herbivores) to second-order consumers (carnivores). Scavengers or decomposers may feed on any (or all) trophic levels.

What happened when you removed the snail from the water community or the beetle from the land community? How many life forms would be either directly or indirectly affected?

The food web broke down. All the other organisms were affected in some way. For example, in the water community, removing snails may cause the producers to increase because snails graze on algae and elodea. The secondary consumers would lose one source of food.

More:

What would happen if you removed the elodea from the water community or the clover from the land community? How many life forms would be either directly or indirectly affected?

All the organisms in the community would be affected either directly or indirectly, because elodea and clover are producers and form the basis of the food web in each community.

Review for you:

Q1. Which animals lost a source of food when the snails were removed from the community? List them below. Next to each of the animals on this list, write the sources of food still available to it.

Organism	***Food source still available***
minnows	*water fleas*
	tadpoles
bluegills	*water fleas*
	tadpoles
	crawfish

Q2. Which organisms might show an increase in number if the snail or beetles were removed from the community? Next to each organism on this list, write the kind of animals that still depend upon it as a source of food.

Food Source	***Consumer***
elodea	*tadpoles*
	water fleas
	crayfish
algae	*tadpoles*
	water fleas
	crayfish

Q3. List primary consumers that are affected when a producer is lost; then list which secondary consumers might also be affected due to this loss.

Primary Consumer	**Secondary Consumer**
Answers will vary based upon	
organisms selected.	

Q4. How do secondary consumers differ from primary consumers?

Primary consumers feed on producers.

Secondary consumers feed on primary consumers.

Q5. In what way do scavengers differ from other consumers?

They eat dead organisms from both the primary and secondary consumer levels and the producers.

Think about this:

Q6. Why might the use of pesticides cause a decrease in the population of eagles, even though the pesticides are not sprayed on the eagles, and the eagles do not eat insects?

Pesticides entering the food chain at the lowest levels are stored in the fat of the consumer. These poisonous substances build up in an animal's tissue as they are passed up the food chain, known as biomagnification. Here is one example of a food chain through which pesticides could affect the eagle population: Dead insect- minnow- bass- eagle.

Q7. What did you eat yesterday? List these foods as those that come from animals and those that come from plants.

Plants	Animals
Answers will vary.	

Q8. What would happen to an existing food web if a new primary consumer was introduced?

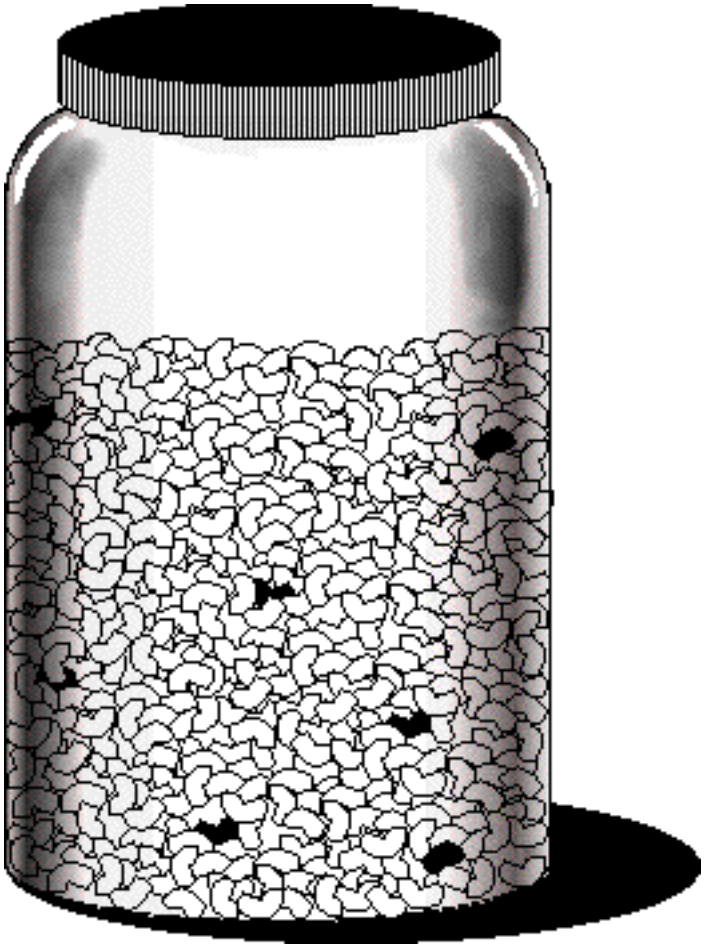
Answers will vary. If there is an abundance of producers and predators, nothing may happen. If the carrying capacity of the community is at its maximum, the "new" organism may not survive or it may compete with an existing organism. Therefore, the presence of exotic (non-native) species threaten native plants and animals. Hydrilla, an exotic plant in the state of Florida, carpets waterways preventing sunlight from reaching plants on the lake or river bottom.

Q9. The Crevalle Jack is a fish that feeds on smaller fish. In turn the Jack may be caught by an angler and served as dinner. Describe the energy flow in this food web involving the angler, small fish, and the Crevalle Jack.

Energy in the small fish flows to Crevalle Jack which flows to the angler.

HOW MANY BEANS?

Have you ever wondered how we know the population of the United States--or other countries? The United States conducts a census every ten years, most recently in 1990. The census is conducted by mail and personal surveys to get an accurate count of the number of people living in this country. Your teachers make population counts when they take attendance. But how would you count the numbers of fish in a lake, the ants on a baseball field or all the grass plants in a lawn? Estimating the populations of organisms is a difficult task. Determining the number of different kinds of organisms in a given area is also difficult. Biologists have come up with some ways to make such population counts, but the counts are seldom exact.



Sometimes a store owner will place a jar of marbles or jelly beans in a display window and offer a prize to the person who can guess how many there are in the jar. During this exercise, you will estimate the number of beans in a jar. You will learn one method scientists use to estimate the number of fish in a lake, ants in an anthill, or mice in a field.

Objective:

To determine the number of beans in a jar using sampling techniques.

Materials:

Jar 3/4 full of white beans
10 red beans

Procedure:

1. Plan 2 or 3 methods for estimating the number of beans without counting them. Describe these methods in the blanks on the following pages. Use each one to make an estimate, and record the results in Chart 1.

2. A population-census method is used by ecologists who must estimate sizes of certain populations. With this method, scientists add some marked individuals to a population. They assume that the marked animals will mix with the animals already there. For example: if 10 marked deer were added to a herd of 90 unmarked deer and then deer from the mixed herd were randomly caught, about 1 out of every 10 deer should be marked.

   Apply the population-census method to your bean count. Add 10 red beans to the jar of white beans. Mix the beans well. A **sample** of beans should contain about the same ratio of red beans/white beans as the whole jar of beans.

   Suppose a sample of 20 beans contains 2 red beans and 18 white beans. The ratio is 2/18. You already know the jar contains 10 red beans. From this information you can set up the following proportion:

$$\frac{\text{2 red}}{\text{18 white}} = \frac{\text{10 red}}{\text{X white}} \qquad 2X = 180 \qquad X = 180/2 = 90 \text{ white beans}$$

   X stands for the total number of white beans. By solving the equation (finding the value of X), you can estimate that the jar contains about 90 white beans--without counting them.

3. Try this method, counting out a sample of 20 beans. Enter the results in the chart.

4. Finally count the white beans one by one. Enter this number in the chart. Compare the count with your various estimates.

Your Method 1

Answers will vary.

Your Method 2

Answers will vary.

Your Method 3

Answers will vary.

Chart 1

Your Method	1	2	3	Procedure B (Population-census method)	Procedure C (Actual count)
Number of Beans					

Interpretation:

Which method of estimating did you find most accurate?

Very likely the population-census method. Some students may have decided upon this technique as one of their methods. While some unorthodox methods may have given a good estimate by chance, the population-census method is more reliable than other methods. This technique is formally known as a Lincoln/Peterson Index.

Review for you:

Q1. Why would it be difficult to count the number of ants on a baseball field?

They are moving, live in burrows and may be able to remove their markings. In addition the ones you catch may not mix well with others deep in the colony.

Q2. What is the purpose of adding ten red beans to the jar of white beans?

You "release" a known number of individuals (the red beans) into the entire population. You assume the red beans will mix with the white beans. A sample is taken and should have approximately the same ratio of red to white beans as the whole jar.

Q3. Describe in your own words the population-census method.

Their response should be a version of step two of this activity.

Think about this:

Q4. You have been asked to determine the number of manatees in Florida waters. How might you estimate the total number of manatees? List the steps you would use to make this prediction.

Capture a sample number of manatees, tag some, release, and recapture. Determine the ratio of marked versus unmarked, and then estimate the total number in the area. Determine the total amount of manatee habitat in the state and then estimate the total number of manatees.

Q5. How do you think the Florida Game and Fresh Water Fish Commission determined there were over one million alligators in the state?

Captured, marked, released, and recaptured alligators. They used the same procedure of estimating alligators as was used to estimate beans in this activity.

Q6. During a fish seining, staff from the Florida Department of Environmental Protection counted the following numbers of fish:

70 Bay Anchovy
2 Gulf Flounder
1 Red Drum
1 Sheephead
3 Spotted Seatrout
3 Striped Mullet
20 Tidewater Mojarra

After seining all fish were returned unharmed into the water.

What is the total number of fish captured in the seining? *100*

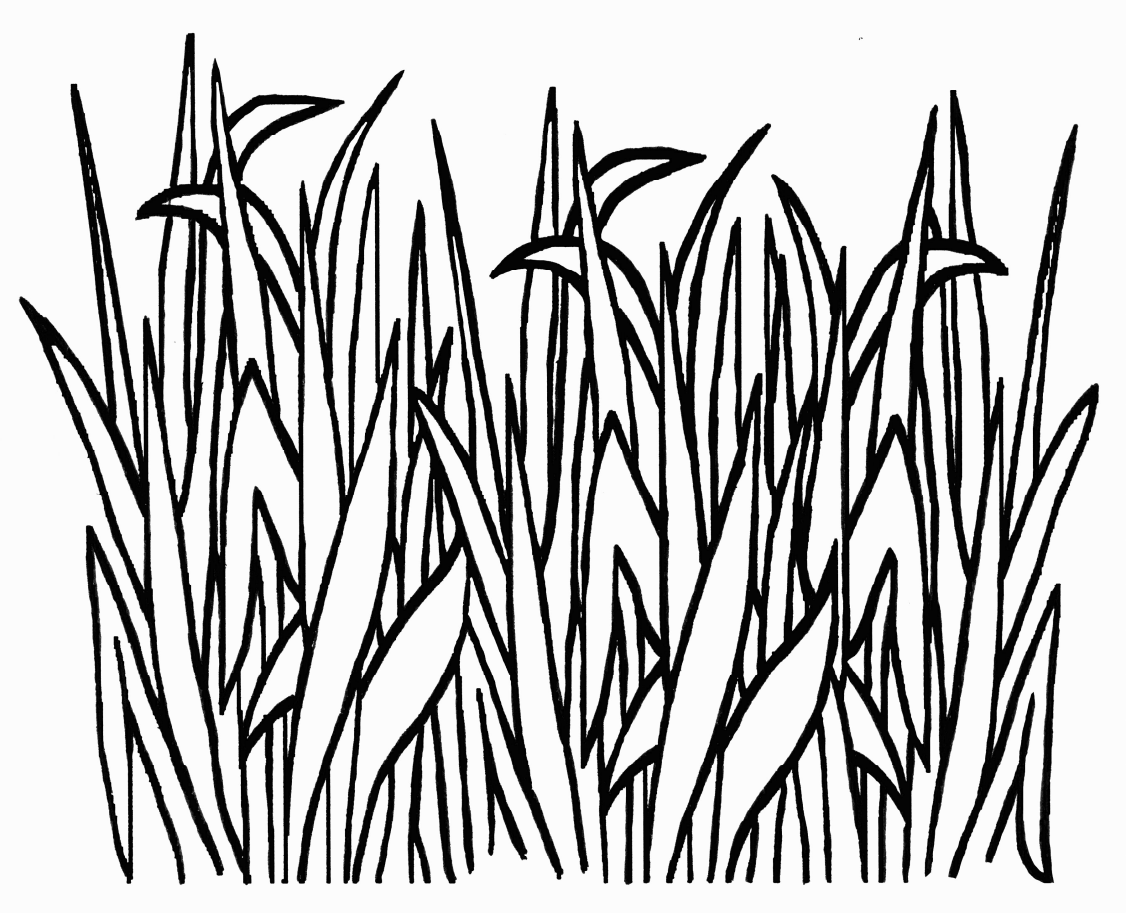
If the seining captures one out of every one hundred fish in the estuary, then how many total fish live there? *100,000*

If the seining sample represents one out of every one hundred fish, then how many total fish of each species live in the estuary?

Bay Anchovy *70,000*
Gulf Flounder *2,000*
Red Drum *1,000*
Sheephead *1,000*
Spotted Seatrout *3,000*
Striped Mullet *3,000*
Tidewater Mojarra *20,000*

I'VE BEEN CLIPPED

How fast does grass grow? If you mow and maintain a lawn, it probably seems like the grass grows too fast. With this laboratory activity, you will measure the rate of grass growth. You will also measure grass growth under various conditions. From this information you will make interpretations about factors influencing plant growth and you will design an experiment to measure the rate of growth of seagrasses.



Like most plants, grasses need the proper amount of sunlight, water, carbon dioxide, temperature, and soil to grow. If one or more of these required environmental conditions is absent, then grass growth may be greatly affected.

Objective:

To determine the growth rate of grass and the relationship of grass growth to the amount of water and sunlight.

Materials:

Scissors
Four stakes
4 Meter sticks
5 oz. paper cups
Metric ruler

Procedure:

1. Locate a grassy area in the school yard that is at least one meter square.

2. Place two meter sticks on the ground parallel to each other and 20 cm apart.

3. Place the other two meter sticks across the first two meter sticks to form a small square 20 cm X 20 cm.

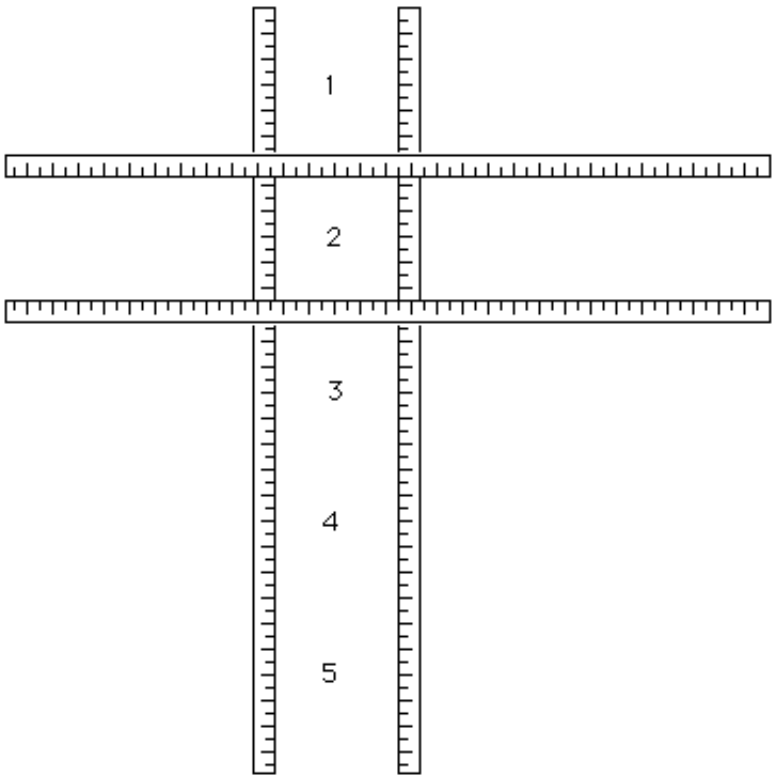


Figure 1

4. Using scissors, clip grass from the plot. Then move the meter sticks to make a new 20 cm square plot and clip the grass in this new plot. Repeat this procedure until you have cut grass from 5 plots within the square meter. When clipping the grass, make sure it is cut level to the ground at 3 cm above the soil level. Use the metric ruler to insure the proper height. Mark the plots so that you can find them next week.

5. After a week has passed go back to the plots and cut the grass again. Place the clippings in cups labeled "Plot 1", "Plot 2", etc.

6. Take these to your classroom and mass each of the cups. Record the masses on Table 1 below and then average the masses.

DATA TABLE 1

	Mass (grams)
Plot 1	*Answers will vary. Look to see that they*
Plot 2	*do their work carefully and that they know*
Plot 3	*how to average.*
Plot 4	
Plot 5	

Average mass = _____ (grams)

7. After another week has passed, return to your sampling site and collect a second sample of fresh grass from each of the 5 plots. Be careful to clip the grass at the same level as before.

8. Place in cups as before, mass them and then record the masses in Data Table 2.

DATA TABLE 2

Sample 2	Mass
Plot 1	*Answers will vary.*
Plot 2	
Plot 3	
Plot 4	
Plot 5	

Average mass = _____ grams.

Interpretation:

How much did the grass grow in a week as measured by the average increase in mass?
Answers will vary. This is a measure of growth rate.

Describe a plan for measuring the growth rate of a species of underwater grass.

Answers will vary.

In the plan for measuring the growth rate of underwater grasses look to see that they are consistent in the way they control for variables such as clipping the grass, depth of water, turbidity, etc. Middle school children have difficulty with variables.

More:

In order to see the role of some abiotic (nonliving) factors in the environment set up the following investigation.

Mark 15, 20 cm x 20 cm plots. Clip them as before, but this time, discard the clippings as you are only going to only to compare growth as measured by any increase in mass. Cover 10 of the plots with a piece of black plastic. Water 5 of the covered plots and the 5 uncovered plots as needed, but always water these plots with the same amount of water. At the end of a week cut the grass from all plots and weigh each of the samples. Determine the average weight of the 5 samples for each setup and record accordingly in Data Table 3, Data Table 4 and Data Table 5.

DATA TABLE 3

	Covered watered
Plot 1	
Plot 2	
Plot 3	
Plot 4	
Plot 5	
Average	

DATA TABLE 4

	Covered not watered
Plot 1	
Plot 2	
Plot 3	
Plot 4	
Plot 5	
Average	

DATA TABLE 5

	Uncovered watered
Plot 1	
Plot 2	
Plot 3	
Plot 4	
Plot 5	
Average	

Compare and contrast the growth of the samples that were covered with black plastic with the growth of the other samples.

At the very least, the grass in the plots covered with black plastic will be more yellow due to the reduction of sunlight. The grass may have died. There are two reasons this could have happened. The temperature under the plastic may have reached lethal levels or the light level could have been very low for too long. The students could compare the temperature of the grass under the plastic and uncovered plots.

Review for you:

Q1. Based upon your research what is the role of sunlight in plant growth?

To contribute to the growth and health of the plants. Sunlight is needed by plants to convert carbon dioxide and water into organic materials and oxygen.

Q2. What is the relationship between grass growth and the availability of water?

No water equals no growth.

Think about this:

Q3. Write down the formula for photosynthesis. Include a description of each of the reactants and the products of this reaction. Consult your science textbook or the library encyclopedias to uncover this information.

Light + water + CO_2 = O_2 + sugar

or

$6H_2O + 3CO_2 = 6O_2 + C_6H_{12}O_6$

H_2O = Water

CO_2 = Carbon dioxide

$C_6H_{12}O_6$ = Sugar

O_2 = Oxygen

Q4. How do carbon dioxide and sunlight effect the growth of plants?

Without carbon dioxide and sunlight, plants will not grow

Q5. In your own words, describe what it would be like if one half of the world's plants were covered with thick black plastic.

Less oxygen would be produced. Less carbon dioxide would be used by the plants for photo-synthesis. An increase in CO_2 would lead to global warming.

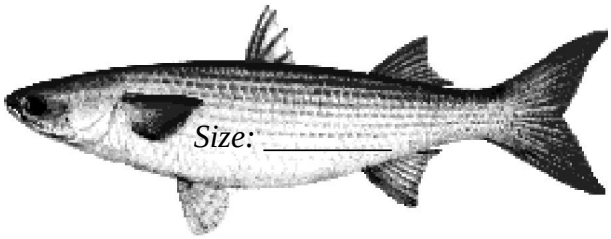
Q6. Which of the following animals depend upon either plants or algae? (Circle the correct choice.)

a. Manatee
b. Striped Mullet
c. Spotted Seatrout
d. All the above

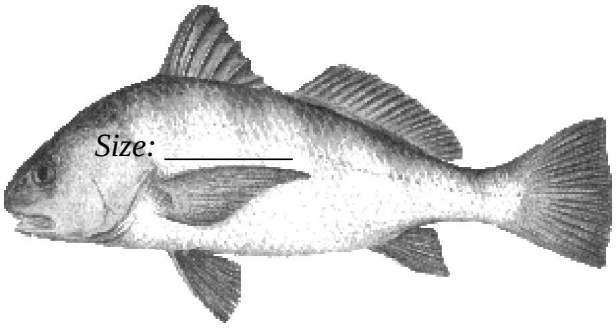
D. All the above. While Manatee and Striped Mullet feed directly on plants or algae, the Spotted Seatrout is a carnivore that feeds on organisms that, in turn, get their energy from plants that captured energy from the sun.

KNOW YOUR LIMIT

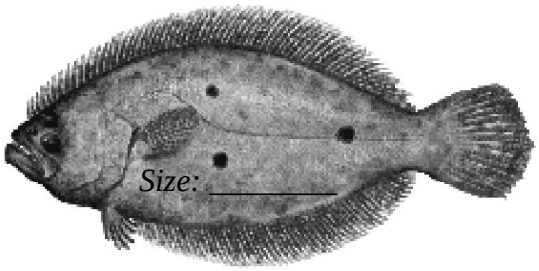
Did you know that there are laws to follow when you go fishing? To help preserve certain species of fish, it is important to set limits on the size and number of fish caught and kept for food or trophies. In this laboratory activity you will catch a number of fish and determine whether you may legally keep the fish or release them into the water. To find this you will refer to the Saltwater Fishing Regulations Table found in this lab handout. Fishing for Florida's saltwater fish is fun and challenging, but don't forget the rules. These rules ensure that enough fish remain in Florida's waters to maintain healthy fish populations for the future.



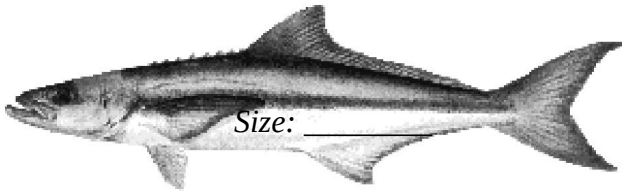
Black Mullet



Black Drum



Flounder



Cobia (Ling)

Objective:

To learn about size limits of Florida fish.

Materials:

cutouts of 7 species of Florida fish
string - 3 meters long
pencil
tape
paper clips
small magnets

Procedure:

Teacher note. *Photo copy and cut out the numbers of each species as shown below. Tape a paper clip to the back of each cut out. Use string attached to a pencil for fishing poles and lines. Glue or tape a small magnet to the other end of the line. This is the "hook." Place the fish in a designated fishing area. Make the fishing area as large as you can in the classroom. Place a time limit of two minutes on the fishing trip.*

Black Drum: *5 fish marked with lengths below 36 cm, 10 between 36 and 60 cm and 5 above 60 cm. OK between 25 and 86 cm.*

Black Mullet: *No limits. Just make them various sizes from 10 to about 45 cm in length.*

Cobia: *10 below 84 cm and 10 above.*

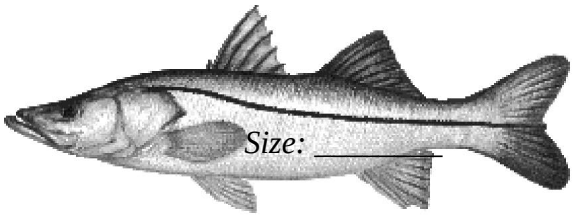
Flounder: *5 below 25 cm, 10 between 25 and 86, and 5 above 86 cm.*

Spanish Mackerel: *10 below 30 cm and 10 above 30cm.*

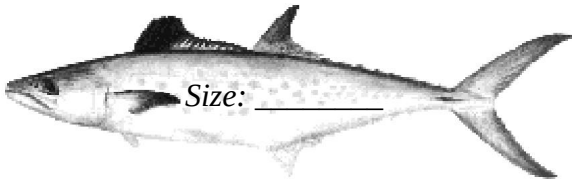
Snook: *Not less than 35 cm or more than 86 cm.*

Spotted Seatrout: *5 below 35 cm, 10 between 35 and 61 cm, and 5 above 61 cm.*

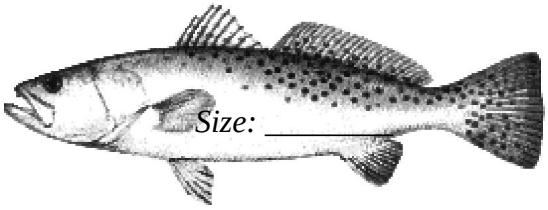
Tape the line to the pencil. Attach a magnet to the other end of the string. When you are ready to fish in the area of the room that the teacher has designated as the fishing area you may begin. You will have two minutes to fish. You will have to check the size of your fish and decide if you can keep the fish by looking at the Salt Water Fishing Regulation Table. If your fish is a "keeper" you can keep it or release it into the fishing area to be caught another day. Record your catch in Data



Snook-Common



Spanish Mackerel



Spotted Seatrout

Table I.

Data Table I

	FISH CAUGHT (species)	SIZE (in centimeters)	ALLOWED TO KEEP (yes or no)
1	*Answers will vary.*		
2			
3			
4			
5			

At the end of the fishing period, gather the remaining fish from Snapper Bay and count the number of each species. Record this number in Data Table II. Next, record the various sizes of the fish on the Data Table.

Data Table II

REMAINING FISH

Fish Species	Total Number	Various Sizes
Black Drum	*Answers will vary.*	
Black Mullet		
Cobia (Ling)		
Flounder		
Spanish Mackerel		
Snook		
Spotted Seatrout		

Teacher Note:
Reproduce Data Table II on the board so the entire class can record the number remaining after the fishing period.

Interpretation:

How has your class's fishing trip affected the fish population in Snapper Bay? (Hint: Explain your answer by comparing the fish that you kept with the total remaining fish after fishing was completed.)

The fish populations should have been reduced. Those with higher bag limits will be reduced more than those with lower bag limits.

Review for you:

Q1. Assume that the section of Snapper Bay that you are fishing in is 100 X 100 meters and has an average depth of 10 meters. What is the volume of this area in cubic meters? *100,000 cubic meters.*

Q2. Population density is the number of an organism in a given unit. For example, if there are 32 people in your classroom, the density is 32 for your classroom. Suppose you counted the number of people in four classrooms in your school and got these figures: 28, 30, 31, and 35. What is the average density per classroom? *31*

Q3. What was the density of snook in Snapper Bay before you started to fish?_____ After the fishing period?_____ Hint: you need the information from your answer to question 1.

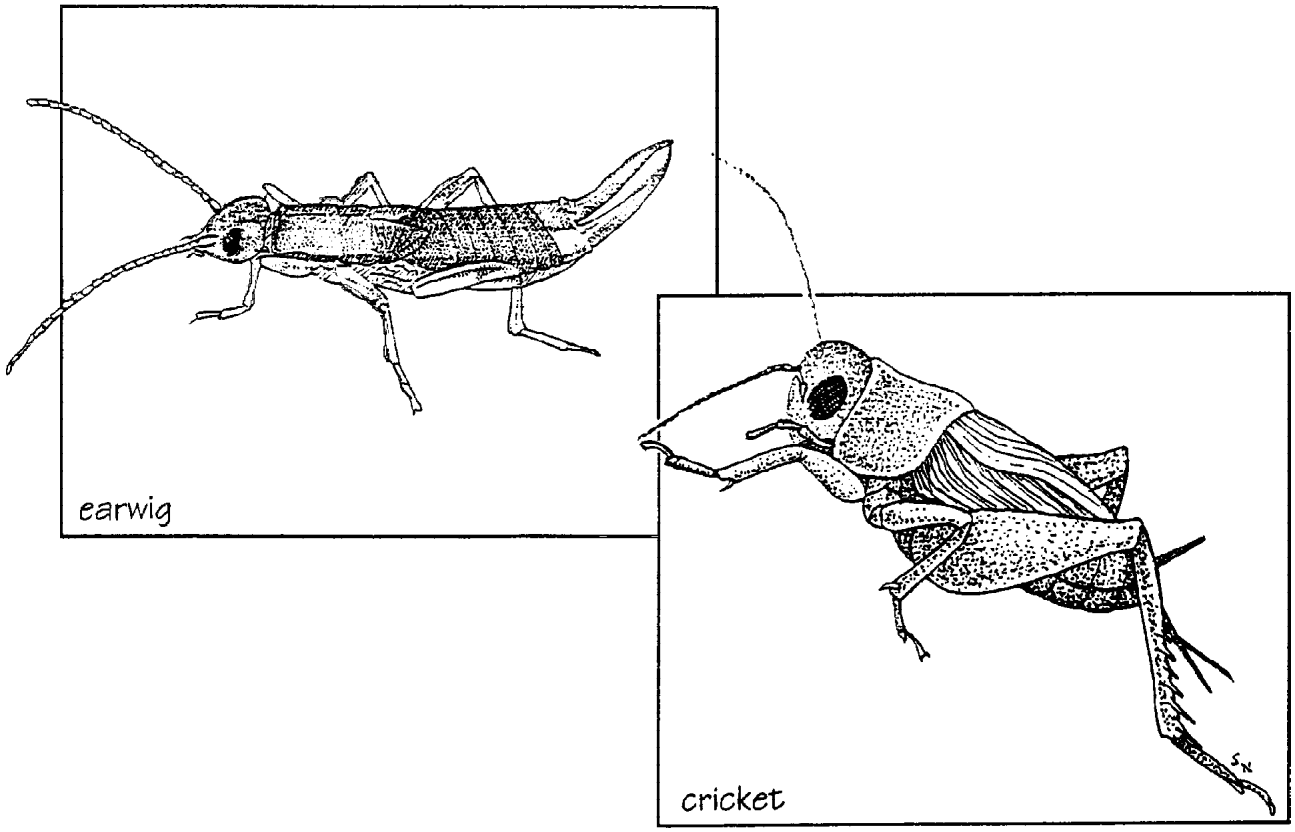
Before the fishing period it was 20 per 100,000 cubic meters. After the fishing period the answers will vary depending upon how many snook are left.

Saltwater Fishing Regulations Table

SPECIES	SIZE LIMIT	DAILY BAG LIMIT
Black Drum	Not less than 36 centimeters or more than 60 centimeters	5
Black Mullet	None	50
Cobia (Ling)	84 centimeters	2
Flounder	28 centimeters	None
Snook	Not less than 25 centimeters or more than 86 centimeters	2
Spanish Mackerel	30 centimeters	10
Spotted Seatrout	Not less than 35 centimeters or more than 61 centimeters	10

LITTERBUGS

Can you predict which schoolyard habitat has the greatest number of different kinds of leaf litter organisms? What types of organisms have you seen living in leaf or pine needle litter on the school grounds?



Many organisms that live in leaf litter depend upon this environment for their food, shelter from harsh environmental conditions such as heat or drought, and protection from predators. In these respects it is much like the seagrass meadows of our bays in Florida. Characteristics influencing the diversity of leaf litter organisms include the thickness of the leaf litter layer, the amount of shade or moisture present, the diversity of plant types growing above the leaf litter, and the presence or absence of human disturbances.

The more diverse habitats have a greater number of different kinds of organisms living in them. For example, a pond containing ten different kinds of fish would be a more diverse habitat than a pond containing only two kinds of fish.

Objective:

To predict which schoolyard habitat has the greatest diversity of leaf litter organisms and make inferences regarding the environmental factors influencing the diversity of leaf litter organisms in different habitats.

Materials:

Aluminum pie pans (one per pair of students)
Hand lens (one per pair of students)
"Litterbug" cards (set of four to five cards per pair of students)
Small metric ruler
A guide to insects
Bug boxes for temporary storage of litter organisms

Teacher Note:
Copy the card from Appendix. You will need 60-70 cards per class of 30. Place these in a box accessible to students.

Procedure:

1. Compile a list of several different schoolyard habitats with at least some leaf litter.

2. Review your list of leaf litter habitats and make a prediction regarding which habitat would have the greatest diversity of leaf litter organisms. Which would have the least diversity of leaf litter organisms?

3. Proceed to the area assigned to your team of two students. Locate a site in your assigned habitat. Quickly scoop up a double handful of leaf litter and place it in the pie pan.

4. When the litter sample has been collected, return to a central work area selected by the teacher.

5. Each team should obtain a hand lens, a set of "Litterbug" cards (see sample on next page), and a small metric ruler.

6. Carefully sort through your litter sample and complete a LITTERBUG CARD for each type of organism found. If some animals are especially active, you can estimate the length of the organism rather than actually measuring it.

7. Use a guide to insects to try to identify the animals in your litter sample.

8. If directed by the teacher, place the insect in a temporary bug box to allow other students to view the organism.

9. Return your litter sample and organisms to the appropriate habitat before returning to the classroom.

10. With the help of your teacher, combine the class. Illustrate the diversity of leaf litter organisms found by each team of students in each habitat sample by completing the whole-class data table.

LITTERBUG CARD

Length (in ml)	
Color(s)	
Wings (Yes or No)	
Number of legs	

Type of movement (Circle one)

Crawling Hopping Flying Running Slithering

Drawing of organism:

SAMPLE WHOLE-CLASS DATA TABLE

NUMBER OF DIFFERENT TYPES OF ORGANISMS FOUND

HABITAT TYPE	TEAM 1	TEAM 2	TEAM 3	TEAM 4	TEAM 5	TEAM 6
1.						
2.						
3.						
4.						
5.						

More:

Investigate the communities of organisms, such as palm trees, living in other habitats.

Interpretation:

What characteristics of the habitats sampled might influence the diversity of leaf litter organisms found?

The more varied the materials the more diverse the organisms found in it. Moist litter usually has a richer habitat than dry litter.

Review for you:

Q1. Which habitat had the greatest diversity of leaf litter organisms? Why?

Answers will vary. Again the more diverse and moist the litter, the more diversity of organisms. Usually in a more diverse habitat the total number of organisms found will be greater.

Q2. Which habitat had the least diversity of leaf litter organisms? Why?

The drier habitat had the least diversity because there are fewer types of organisms that can survive in dry conditions as opposed to moist conditions.

Q3. How well did the actual results compare with your prediction?

Answers will vary depending upon their predictions.

Q4. Why do organisms live in leaf litter?

Leaf litter provides the organisms with food and shelter.

Think about this:

Q5. Would there be a greater diversity of life forms in an estuary or in the open waters of the Gulf of Mexico? Explain your answer.

An estuary is much like a leaf litter habitat as there is plenty of food and shelter among the grasses and mangroves of the estuary. In the open seas, such as the Gulf of Mexico, little shelter is available.

Q6. Describe some of the effects of draining the Everglades on wildlife.

Draining the Everglades reduced the available moisture; hence the number and diversity of organisms the area could support decreased.

Q7. When comparing the waters of a Florida spring river to a coastal bay environment, which area would likely contain the greatest diversity of fish? Why?

Coastal bay environments would probably be the most diverse because the bay is composed of many ecosystems such as salt marshes, seagrass meadows, mangrove forests, open bays and freshwater streams.

NOW YOU SEE IT, NOW YOU DON'T

Composting is one of the oldest forms of recycling. It is based on the scientific principle that nothing ever really disappears, but just changes shape and takes on new forms. When a leaf falls and decomposes, it is broken down over time by weather, microorganisms, and earthworms. Organic wastes (those which were once living material) can be buried in the soil to make compost, or humus, the rich, black dirt formed by the decaying of animal and vegetable wastes.

Compost is formed through the action of certain microbes that increase rapidly when organic waste gets enough air and water. Bacteria, which generate heat up to 75° Celsius, literally cook the wastes. The finished product, high in carbon and nitrogen, looks just like soil and is excellent for growing plants. In addition to being clean and thrifty, composting can also significantly reduce the volume of garbage a family sends to the landfill. Yard trash and food wastes account for one-fourth of the mass of solid waste disposed in Florida. This material can be composted to produce a nutrient-rich enhancer for commercial farms and residential gardens.

Objective:

To classify organic and inorganic objects and construct a mini-compost garden.

Materials:

One wide-mouth, clear-glass, quart jar
Samples of organic materials for each jar
(piece of paper, egg shells, apple cores, potato peels, leaves, cotton rag)
Samples of inorganic materials for each jar
(rock, bottle cap, aluminum foil, small plastic comb, small glass bottle)
One earthworm
Water
Soil (not potting soil) - 1 kg
Labels for jars
Newspaper
Magnifying lens

Procedure:

1. Work in groups of four. You should get an empty wide-mouth jar, samples of organic and inorganic materials, soil, water, earthworm, and a jar label.

2. Put several inches of soil into the jar, followed by the organic and inorganic objects. Cover the objects with soil and add enough water to moisten the soil without making it soggy. Place one worm on top of each mini-compost garden. DON'T COVER.

3. Place the jar in a window or area where it will receive sunlight. Moisten soil regularly to keep it damp, but not soggy.

4. Choose 1 day each week for the next 5 weeks to record observations. On your designated day your group should spread out newspaper and empty the contents of the jars onto the newspaper. Use the magnifying lens to observe the organic and inorganic materials. Record observations in Table 1 on the following page. Place the materials back into the jar and return the jar to a position near a window.

Table 1: CHANGE IN MATERIAL OVER TIME

MATERIAL	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
ORGANIC	*Answers will vary.*				
1					
2					
3					
4					
5					
6					
INORGANIC	*Answers will vary.*				
1					
2					
3					
4					
5					
6					

Interpretations:

Compare and contrast the rate of decomposition for the organic and inorganic materials.

The organic material decomposes the most. In most cases the inorganic material hasn't changed or broken down at all. Inorganic materials change at slower rates, depending on their composition.

Review for you:

Q1. What breaks down organic materials over time?

Microbes feed on the organic materials, causing decay. Earthworms tunnel through the soil providing aeration needed by the decomposers. Emptying and refilling the jars each week also help provide aeration.

Q2. What is compost?

Compost is organic material that develops over time through the action of microbes. Mixtures of leaves, grass clippings and garbage can be used to make compost.

Q3. What are the advantages of composting?

Composting reduces the amount of material going to the landfill and provides rich, organic soil for growing plants for the home.

Think about this:

Q4. Landfills usually contain a combination of organic and inorganic materials. Explain what will happen to the landfill soil over time.

The layers of garbage and trash are sealed by dirt on a daily basis. Because the solid waste is crushed and compacted, there is very little air to aid decomposition. Oxygen from the air is essential to the decomposition of materials in a landfill. Therefore, much of the material in a landfill decomposes very slowly.

Q5. Do some research and answer the question, if everyone in Florida had a compost pile for their organic garbage, how much landfill space would be saved each year?

About 25%.

Q6. Using your textbook or a library reference, describe why inorganic materials take so long to decompose.

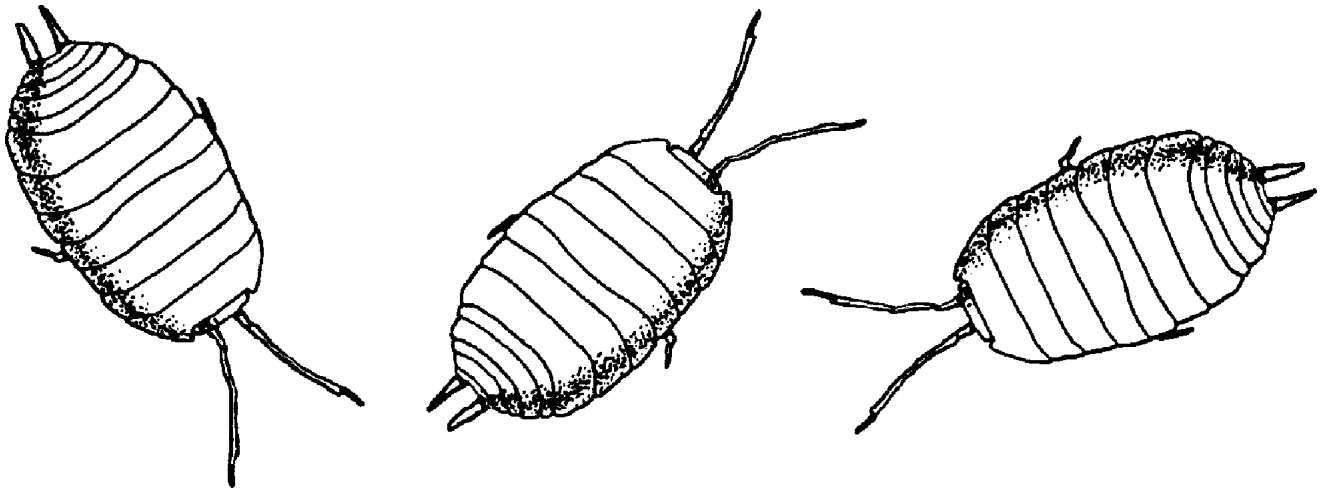
Plants and animals cannot reduce these new compounds. Perhaps over millions of years some organisms will evolve to a point where they could make use of these newly created materials, but not before terrible damage is done by some of these materials.

Q7. Why is it a bad idea to dump garbage into the ocean? Do you think materials that did not decompose in your compost pile will decompose in the sea? How might dumping garbage into the sea harm fishing in Florida?

Garbage contains many toxic materials. Also some items may be eaten causing the animal to die. Animals that eat these organisms may also eat the toxin which may kill them. A lesser, but still important reason, is that it is unsightly. Many products that may not decompose in a compost pile may decompose in the sea, where chemical compounds and organisms may act on the products. Dumping garbage in the Gulf may negatively affect every trophic level, therefore harming fisheries.

PILL BUG DENSITY

A population is a group of individuals of the same species inhabiting a given area. Populations vary in size. Some populations are so small that their size can be determined by directly counting the individuals. Other populations are too large to count so the number of individuals must be estimated. The quadrant method, used in the Trawl EcoVenture, for estimating populations works well if you are studying organisms that do not move or that move very slowly, such as snails in a seagrass meadow, sea urchins or sea stars or the isopods known as pill bugs.



The size of the quadrant will vary with the size of the organism to be counted. In this exercise, the population of an insect, the pill bug, will be estimated with a square decimeter (dm) quadrant. Often biologists are concerned with population density. To study this phenomenon, population is expressed as the number of individuals per square unit area.

Teacher Tip:
Many animals, such as earthworms, can be substituted for pill bugs. Modify your procedures as needed.

Objective:

To estimate the number of individual pill bugs in a population, and to relate the density of the population to other factors found in the environment.

Materials:

4 stakes
String
Meter stick
Wire quadrant (1 decimeter)

Procedure:

1. Measure a study site in the area selected by the teacher that is 25 square meters in size. Place a stake at each corner of the area. Loop string around one stake and continue to the next stake until the boundaries have been formed for the site.

2. Randomly toss the wire quadrant into the study site. Describe the technique used by your group to assure that the toss is random.

3. Count the number of pill bugs found within the quadrant. Record this data on the data table.

4. Repeat steps 2 and 3 nine times, and record the results on the data table.

5. Add and average the population found in each dm to obtain a total for the ten square decimeters (dm^2). Place this information in the data table.

6. Determine the number of dm^2 found in the study site. Then calculate the total population of pill bugs. You may do this by multiplying the total number of dm^2 by the average number of pill bugs in each dm^2. This will give you the total population of pill bugs on your site. Record this total in the data table.

7. Prepare a class chart that lists the total population of pill bugs found in each area. Graph these data using a bar graph. Put the site number on the X-axis and the total population on the Y-axis.

DATA TABLE

Sample	Number of pill bugs counted

Total number of pill bugs counted _____

Average for each dm^2 _____

Total population of pill bugs in the study area _____

Interpretation:

Account for the differences in pill bug population in the areas sampled. Did you observe any physical or biological factors, such as type of litter, in the environment that might account for these differences?

Habitat variation is usually the reason for differences in distribution of living things.

Review for you:

Q1. Describe the technique used by your group to assure the toss was random (Step 2 of your procedure).

1. Blindfold the tosser. 2. Divide the area into numbered plats.

3. Put pieces of paper with numbers in a box. 4. Draw out (without looking) three pieces of paper, and count the pill bugs in the plats with the corresponding number.

Q2. What are some of the factors that might cause the population density to change from week to week?

Changes in amounts of food, moisture, or shelter available.

Think about this:

Q3. What are some of the factors that might cause the population density to change from year to year?

Same as for question 2, but also such things as climatic changes and increases in organisms that would feed on the population.

Q4. If seeds were planted in varying densities, what would affect the growth of these populations? Compare the factors that influence survival of plants with those of animals.

Crowding is the major factor consideration here. Factors modifying population growth are similar for plants and animals. Shelter could arguably be a more important consideration for plants than animals.

Q5. Based upon what you have learned in this lab what factors might affect the population of Tarpon in Florida waters?

The amount of fishing and/or overharvesting.

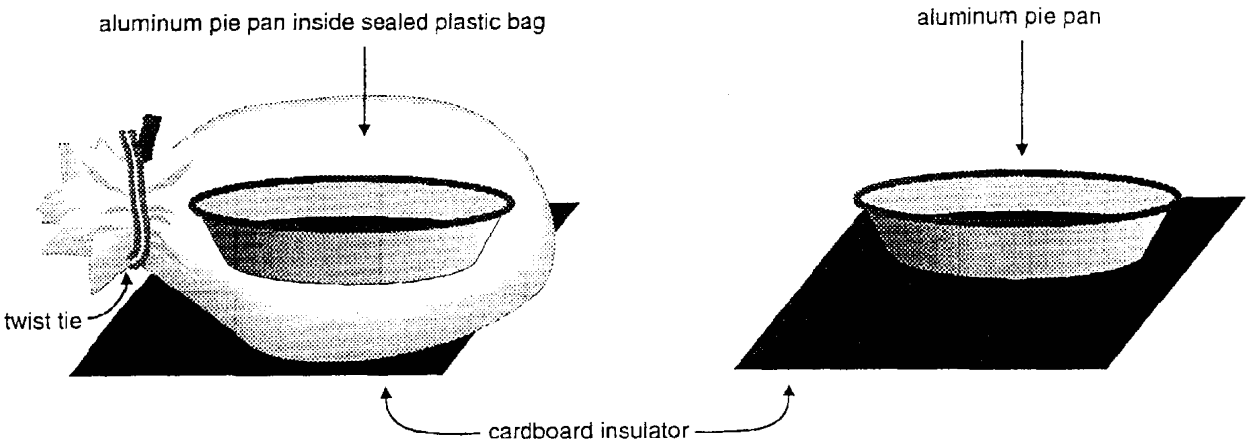
Levels of pollution.

Lack of shelter for juvenile Tarpon.

Decrease in their food source.

SOLAR COLLECTOR

Have you ever felt the heat inside a car after it had been parked in the bright summer sunshine? Have you ever gone swimming at the beach in March and returned to the same beach in August to find that the water felt warmer? How quickly would the bay heat up if it were covered with a large glass dome? In this exercise, you will explore the warming effects of sunlight. You will examine how the sun affects water temperatures in both open and closed containers. After completing this laboratory, you will have a better understanding of the sun's heating effects.



In nature, the greenhouse effect occurs as shortwave radiation (light) passes through the atmosphere, striking the surface of Earth. A heated substance, such as Earth's surface, emits longwave radiation (heat). Most longwave radiation cannot escape through the atmosphere back into space. Specific gases, carbon dioxide, and water vapor in Earth's atmosphere absorb this longwave radiation creating a greenhouse effect. Scientists predict a rise in global temperature if humans continue to increase the amount of greenhouse gases in the atmosphere.

On a smaller scale, this effect is especially apparent in a greenhouse or a car parked in the sun. Glass or plastic can act like the carbon dioxide in the atmosphere, permitting shortwave solar radiation to pass through, but not allowing longwave radiation to escape.

Objective:

To determine whether a covered pan or uncovered pan produces warmer water when exposed to sunlight.

Materials:

Paper cup (5 oz. size)
Aluminum pie pan (8 inch size)
Cardboard
Plastic bag
Twist ties
Thermometer
Water

Procedure:

1. Get into groups of four. Your team selects two students in your group to cover their pans, and two students to leave their pans uncovered.

2. Place the pans and thermometers on insulators (a piece of cardboard) on level ground in the sunlight. If you and your partner are to cover your pans you should put them in a plastic bag before setting them on the insulators. DO NOT SEAL THE BAG YET.

3. Fill one paper cup with water and pour it into the pan. Make sure that each pan has the same amount of water. Take the temperature of the water by immersing the thermometer and leaving it there. After 30 seconds, read and record the starting temperature in Chart 1. Feel the temperature of the water with your fingers. If you are using plastic bag covers you should seal your bags with twist ties.

4. Wait about 15 to 20 minutes.

5. Return to the water pans to take a final temperature reading. Record this data in Chart 1. Feel the temperature of the water with your fingers again and compare this to how the water felt initially.

6. Pour the water on a plant or on the lawn.

7. Repeat the experiment. However, this time place both containers in a shady spot and compare temperatures of the containers after 20 minutes. Record your data in Chart 2.

Chart 1

	Start Temp °C	Final Temp °C
Covered Pan	*Answers will vary.*	
Uncovered Pan		

Chart 2

	Start Temp °C	Final Temp °C
Covered Pan	*Answers will vary.*	
Uncovered Pan		

Interpretation:

Compare and contrast the observations you made about the water in the two pie pans.

When the two pans were in the sun, the covered pan had the highest temperature gain (collected the most heat energy.) When the pans were in the shade, they both gained some energy, but there was not a big difference between the covered and uncovered pans.

Review for you:

Q1. What kind of radiation passes through the earth's atmosphere, glass, and other translucent materials?

Shortwave radiation (light) from the sun.

Q2. Describe the kind of radiation which is radiated from the earth.

Longwave radiation (heat or infrared). On the average, the quantity of absorbed solar energy is balanced by an equal longwave emissin to space.

Q3. Besides the temperature difference, what other observations can you make when comparing the results of placing the two pie pans in the sunlight?

Answers will vary.

Q4. In your own words, describe how the greenhouse effect works.

The water vapor and carbon dioxide in the atmosphere absorb part of the longwave radiation and radiates it back toward earth, creating a greenhouse effect for the earth.

Q5. How might air currents over the open pie pan affect the temperature of the pan's water?

The air currents might evaporate water from the pan, cooling the water.

Think about this:

Q6. Carbon dioxide in the atmosphere acts like glass, in that shortwave solar radiation from the sun passes through it. However, longwave radiation emitted from the earth's surface cannot pass through it. What might happen to the earth's temperature if there were a significant increase in the amount of carbon dioxide in the atmosphere?

Shortwave radiation from the Sun comes to Earth and is radiated as longwave radiation from the earth's surface. Part of the longwave radiation is trapped as heat beneath the atmosphere. An increase in CO_2 will cause more heat to be trapped, therefore the temperature of the earth's surface will increase.

Q7. What would happen if there were a significant decrease in the amount of carbon dioxide in the atmosphere?

The greenhouse effect would be lessened; hence the temperature of the Earth would decrease.

Q8. Green plants remove carbon dioxide from the atmosphere. What might happen if there were a significant decrease in the number of green plants on earth?

There would be more carbon dioxide; which will cause an increase in the temperature of the Earth's surface (i.e., the greenhouse effects will be enhanced).

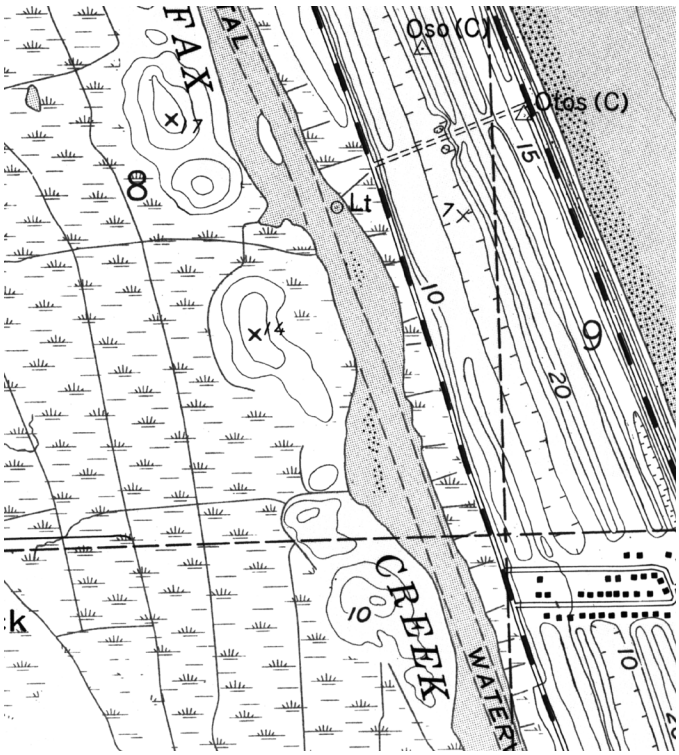
Q9. Two large, one thousand gallon aquariums are filled with various Florida freshwater fish species. Suppose that the water in the aquariums is heated with bright lamps positioned above the aquariums. One aquarium has a light-colored, sandy bottom, while the other has a dark brown, gravel bottom. Which tank would likely have the highest water temperature? Why?

The dark brown will have the higher water temperature because the darker color bottom will absorb more heat than the lighter color. Light colors reflect heat and light more than dark colors.

TOPOGRAPHIC and BATHYMETRIC MAPS

Imagine hiking someplace you have never been before. You might want to know if there are hills to climb or valleys to cross. Or, imagine going fishing in unfamiliar waters. It might be helpful to know the sea floor features where your favorite fish might be found.

To find the locations of hills and valleys and sea floor terrains, you could use a special kind of map called topographic —or topo—maps and bathymetric maps. Topographic maps show land elevations and bathymetric maps show water depths.. You might ask, how can a flat map show the height of ground or underwater features? Topographic maps and bathymetric maps do this with contour lines. These lines connect points of equal elevation. The contour interval is the difference in elevation between two adjacent lines.



In this investigation you will learn how a geologist can interpret the landforms of an area by reading topographic maps.

Objective:

To construct a contour map by connecting points of equal elevation or depth.

Materials:

Map with point elevations (page 112)
Pencil

Procedures:

1. Use a pencil to connect all the points of equal elevation (depth) on the map. Start with the -1.5 meter elevation in the bay and connect all -1.5 meter points. Then draw a contour line for -1.0 meters and connect the points. Likewise draw a contour line for -.5 meters. Next, draw .5 meters, then 1.0 meters, and continue in this manner until you have completed the map.

2. Hint: A stream or river flows over contours of lower and lower elevations the farther it travels toward the mouth of the stream. Valley walls rise up from the stream on both sides of it. Therefore the contours on both sides of the stream will get higher and higher as you go away from the mouth of the river.

3. Imagine that you are walking from point A to point B on the map. Every 100 meters, record your elevation in Table 1.

Table 1

Position 'A'	Elevation (in meters)
100 meters	*-0.5*
200 meters	*Between 0.5 and 0.0*
300 meters	*0.0 or sea level*
400 meters	*+ 0.5*
500 meters	*Between +0.5 and +1.0*
600 meters	*" "*
700 meters	*+1.0*
800 meters	*Between +1.0 and +1.5*
900 meters	*" "*
1000 meters Position 'B'	*+1.5*

Interpretation:

Describe your journey in terms of the changes in elevations from point A to point B.

Elevation goes up as you travel from point A to point B. Beginning at point A, the elevation is somewhere between -.10 and -0.5 meters. As you travel towards point B the elevation is about at -0.5 m after walking 100 m, and is at sea level (0 m) after walking about 330 m, to .5 after walking 550 m, to 1.0 m after walking about 810 m, reaching an elevation somewhere between 1.0 and 1.5 m upon reaching point B.

Think about this:

Q1. What is a topographic map and a bathymetric map? A contour interval?

A topographic map is a map that shows land elevations, and a bathymetric map shows depth (sea floor elevations). Topographic and bathymetric maps show elevations by using contour lines, which connect points of equal elevation or depth. A contour interval is the difference in elevation between two contour lines.

Q2. What is the purpose of topographic and bathymetric maps?

Topographic and bathymetric maps can be used to find the locations of hills, valleys, and sea floor terrains and to determine elevations and depths at specific points on the map. Topographic maps are used for many purposes, i.e. construction, recreation. Bathymetric maps are used for navigation, as well as research on underwater features.

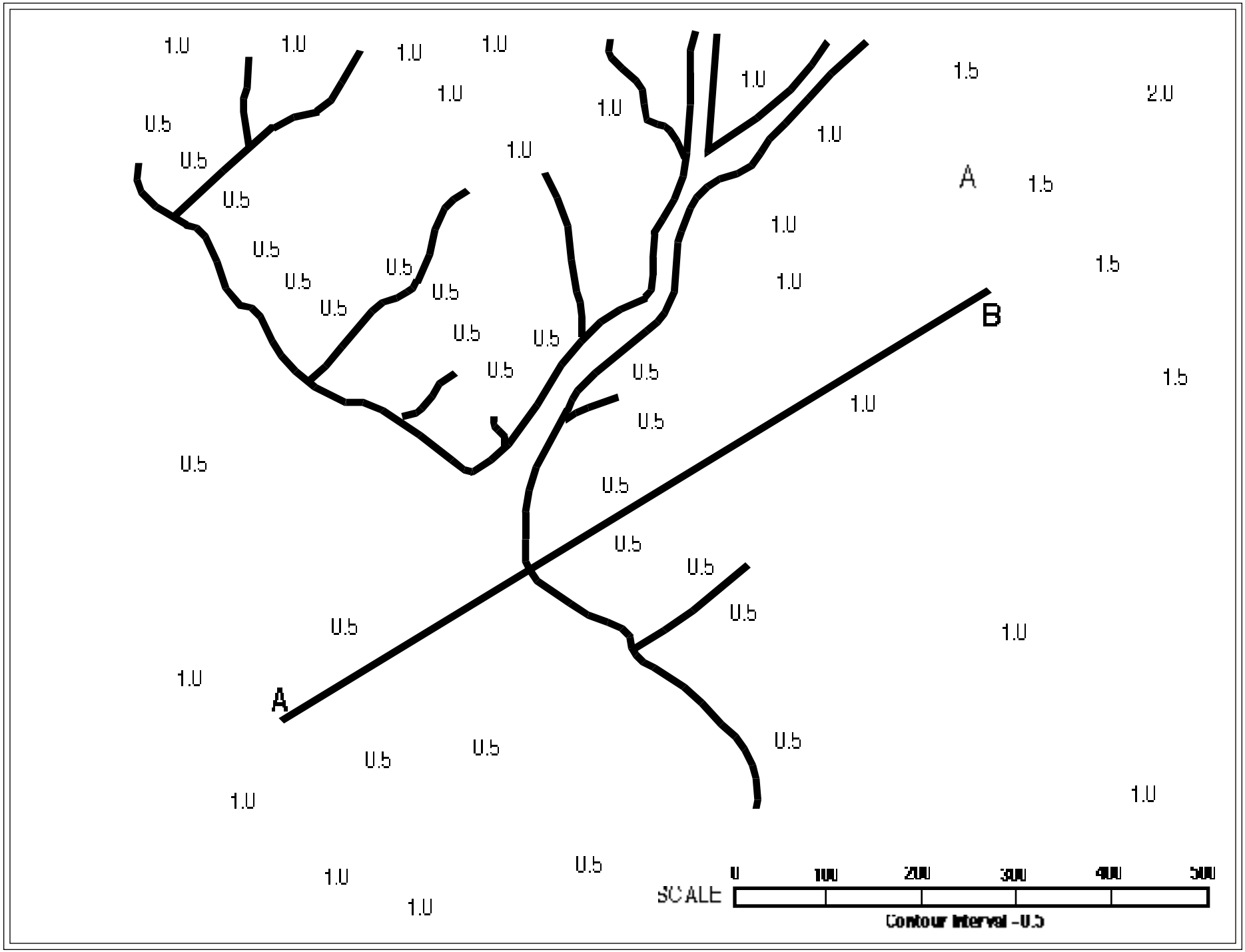
Review for you:

Q3. What does the 0 elevation contour interval represent, and where can it be found on the map?

The 0 elevation contour line represents sea level and can be found on the map where the land and water meet. Contour lines on a topographic map are usually labeled in relation to how they differ from sea level, which is set at 0 elevation.

Q4. Would it be possible for some salt water fish species to live some of their lives above sea level? Explain your answer. (Fish living in aquariums do not count.)

Yes. There are salt water lakes that have salt water organisms, including fish, in them. These lakes are found at various elevations higher than sea level.


1.0
1.5
2.0
0.5
A
B
SCALE
0
100
200
300
400
500
Contour Interval -0.5

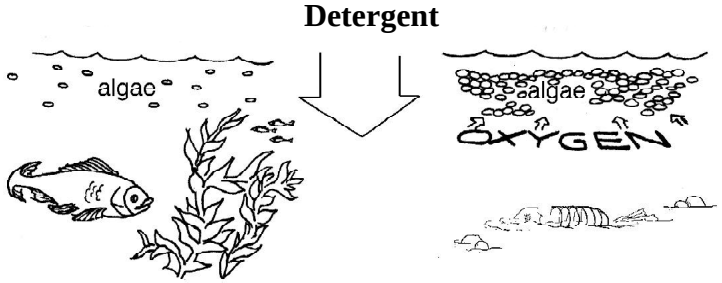
THE UNDESIRABLES

Soaps are the chief cleaning agents for home and industry. Detergents were developed because they have better cleaning properties than soap. Detergents also act faster and are longer lasting than soap. But detergents can have a bad effect on surface water. The properties of detergents last a long time. As a result, detergents collect in rivers, streams, and lakes. Waters that are contaminated with detergents have a negative effect on water plants and fish.

Chemical wastes from detergents, industrial wastes, and agricultural processes are primary pollution agents. The effects of these chemicals may be quite harmful, particularly to organisms living in surface water such as rivers and bays. The negative effects result from two characteristics of the chemical:

1. Some chemicals are not easily decomposed and accumulate over time. Chemists and others who study the environment call nonbiodegradable materials "hard." Since hard chemicals do not break down, they build up in lakes and rivers. Growing plants and animals take in these compounds, along with the nutrients they need. These chemicals may then be passed on to larger animals that feed on them.

2. Other chemicals which can be decomposed by organisms are said to be biodegradable. Some of the chemicals from detergent wastes are a source of food for small plants called algae. Phosphate compounds are good examples. The presence of phosphates in streams or lakes produce rapid algae growth thus increasing their biochemical oxygen demand.



In the following activity, you will study the effect of detergents on germination and growth of seedlings.

What do you suppose will happen to the seeds that a farmer sows if the water used to germinate them contains detergent? Will the detergent affect the number of seedlings that germinate? Will it affect the seedling growth?

Objective:

To discover the effect that detergents have on the germination of seeds.

Materials:

3 ziplock sandwich bags
Paper towels
Radish seeds
Wax marking pencil
1% detergent solution*
5% detergent solution*
Liquid detergent
Tap water

* Make 1% detergent solution by adding 1 ml of liquid detergent to 99 ml of water.
* Make 5% detergent solution by adding 5 ml of liquid detergent to 95 ml of water.

Procedure:

1. With a wax pencil, label the three sealable bags: 5%, 1% and " C.". C is the control.

2. Using an ordinary pencil, put your initials on each piece of paper towel.

3. Moisten one piece of paper towel with tap water and place in the sandwich bag marked with a C.

4. Soak the second piece of paper towel in a 5% solution of detergent and place in the bag marked 5%.

5. Soak the last piece of paper towel in a 1% detergent solution and place it in the bag marked 1%.

6. Place 10 radish seeds in each of the three sandwich bags. Seal the bags and place them in indirect sunlight.

7. Begin your observations during the next class period. Look at the bags with radish seeds. Do not open the bags. Record the percent germinated on the Data Table 1. A seed is germinated if you can see any part of the root poking out.

$$\% \text{ germinated} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds}}$$

DATA TABLE 1

Day you observed List -day -month -year	Number of hours after putting seeds in bag	Percent Germinated Control	Percent Germinated 1% detergent solution	Percent Germinated 5% detergent solution
Responses will vary.				

Interpretation:

Was the germination of the seeds influenced by the detergent? If so, in what way?

Yes, up to a point the radishes grow better with an increase in fertilization. Some soaps have phosphates and other chemicals that stimulate growth. Very likely the radishes grown in the 5% solutions did not do as well as those in the 1% detergent.

Review for you:

Q1. Which detergent concentration had greater effect on the germination of the seeds?

Answers will vary

Q2. How many of the seeds in the 5% detergent solution germinated? How many germinated in the 1% solution? How many germinated in the control?

Answers will vary, but the 5% solutions usually will kill plants. The 1% might actually increase growth as some components of detergents may function as fertilizers to stimulate growth. The number germinated in the control set up will vary.

Q3. Describe how the control seedlings differ from the seedlings in the two detergent concentrations?

Answers will vary.

Q4. What harm might come from the building up of "hard" chemicals in water supplies?

The buildup of hard chemicals might kill or stunt the growth of plants, as some of the hardness is due to salts which can kill plants if they occur in concentrations higher than the plant can tolerate.

Q5. What do you think would happen to a farmer's crop if the water used on them contained detergent?

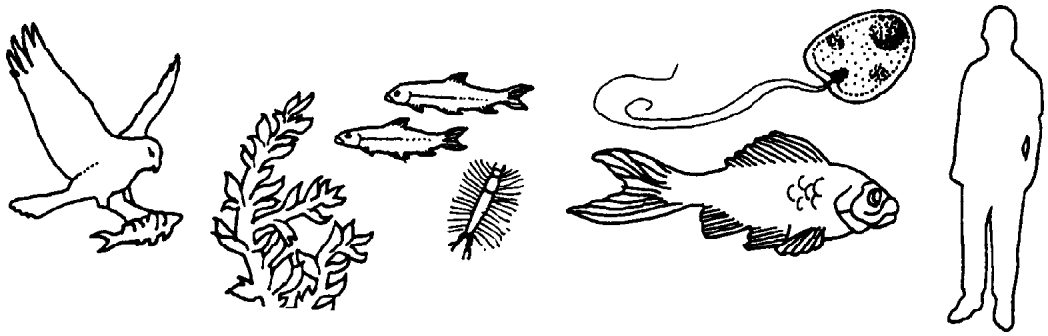
Depending upon the concentration, the plants could be damaged. However, as seen from this activity, small concentrations of detergent may actually enhance growth.

Think about this:

Q6. How would excess nutrients in a bay affect the fish population?

Excess nutrients would cause an algal bloom which would greatly reduce the dissolved oxygen of the water as it decomposes. Algal blooms also prevent sunlight from reaching SAV or seagrasses, negatively impacting excess nutrients in a bay. Fish would die due to a lack of oxygen (seagrasses provide a habitat with abundant food sources and shelter for many juvenile fish.) Also, the algal bloom may produce substances that could prove toxic to fish if they feed on the algae.

Q7. Use the organisms shown below and make a sketch that illustrates how nonbiodegradable chemical wastes may be passed from one living thing to another. *Answers will vary.*



Q8. As chair of the city planners, you have to vote for or against allowing an industry to locate in your town. Think about the advantages and disadvantages to your city. What additional information would help you decide how to vote? What will you vote? Why?

Answers will vary but should include concern over environmental damage.

Q9. Chemical pollutants that make their way into the water system are often found within fish. Why is this a problem for the Bald Eagles and Osprey? Why is this a problem for people?

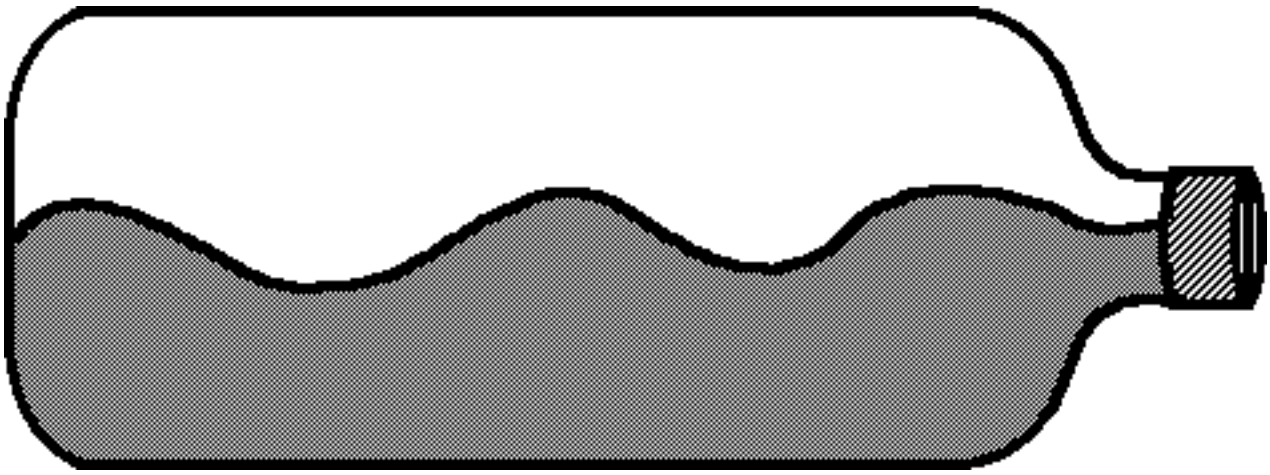
When an animal eats a plant, it absorbs chemicals and other substances. These animals must eat a lot of plants to stay alive, so they continue to eat and store chemicals in their bodies at concentrations greater than in the plants they eat. When these animals are in turn eaten, the next predator stores these concentrated chemicals, in turn increasing the concentration. The top carnivores then are more affected by chemicals than those organisms low on the food chain.This is known as bioaccumulation.

WAVE IN A BOTTLE

Have you ever been able to see a wave travel in slow motion? It's important to look at waves because they are a basic energy transfer. Have you ever thrown a rock into a pool of water? You probably noticed that small circular ripples moved out from the spot where the rock struck the water. The energy which your muscles exerted to throw the rock is transferred to the water as a series of circular waves. Thus, the waves transferred some of the energy from the rock, which got its energy from your muscle, which got energy from the foods you eat.

On the ocean and large lakes, waves result from the force of the winds. Again, this is an energy transfer from air currents to the water. If you have ever played in the surf, you have felt the energy in waves. Enough in fact, to knock you off your feet if you aren't careful!

You can see water waves, but other kinds of waves are invisible. You cannot see television and radio waves. Ultraviolet waves, which can damage your skin, are another form of invisible waves. These waves come from the energy of the sun. Can you think of other kinds of waves? Are they visible or invisible?



In this laboratory you will construct a device which can be used to model water wave action. With the model, you will study how waves reflect off the wall of containers and interfere with each other. Wave reflection and interference are important concepts in understanding wave motion.

Objective:

To construct a model of a wave and demonstrate the wave action using a model.

Materials:

2-liter colorless soda bottle with base
Liter of water
Blue food coloring
Liter of colorless vegetable oil or baby oil
Rubber cement or other waterproof glue
Funnel
Knife or sissors

Procedure:

1. Pop off colored band from bottom of soda bottle if present (soaking in very hot water aids in removal).

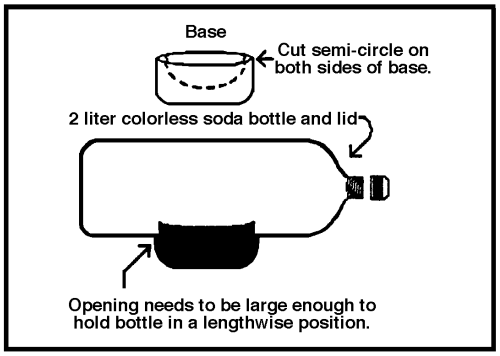
2. Using funnel, fill soda bottle with approximately one liter of water.

3. Add a few drops of blue food coloring. Stir or swirl to mix. Continue adding food coloring to water to create a dark blue color.

4. Using funnel, add approximately one liter of oil to the soda bottle.

5. Put glue around threads at the opening. Tightly screw on lid. Set aside for several minutes to allow the glue to dry.

6. A base can be made from the colored bottom of the bottle by cutting a semicircle on two sides. (See figure below.)



7. Hold the bottle at the neck and base and tilt to see the wave action.

Interpretation:

Describe wave action in the bottle after you have tilted the bottle. Explain the behavior of the waves before and after they strike the side of the bottle and before and after the waves strike each other.

Answers will vary

Review for you:

Q1. What are waves?

In the case of water, a wave is an undulation (up and down motion) of water above and below its natural level. A wave is a form of energy that moves across the water.

Q2. What causes waves?

Waves result when energy is transferred to the water from an outside source. Waves are naturally caused by winds which blow across a body of water. Waves can also be caused by sudden changes in elevation between two sea floor areas such as the underwater land slides known as tectonic fault block movement. Tsunamis, giant waves, are caused by underwater earthquakes or tectonic activity.

Think about this:

Q3. Why is oil used to make the wave in a bottle?

To reduce the sloshing. You could have the students fill bottles with only oil, water, or alcohol in each and compare with the oil/water set up. Oil is less dense than water and will float above the water, allowing you to see the wave form and break.

Q4. How would the wave differ if you added alcohol to the water instead of oil?

Larger more steep waves would result with alcohol than with oil, because alcohol is even less dense than oil.

Q5. How could you modify the bottle and its contents to demonstrate wave action at the shore?

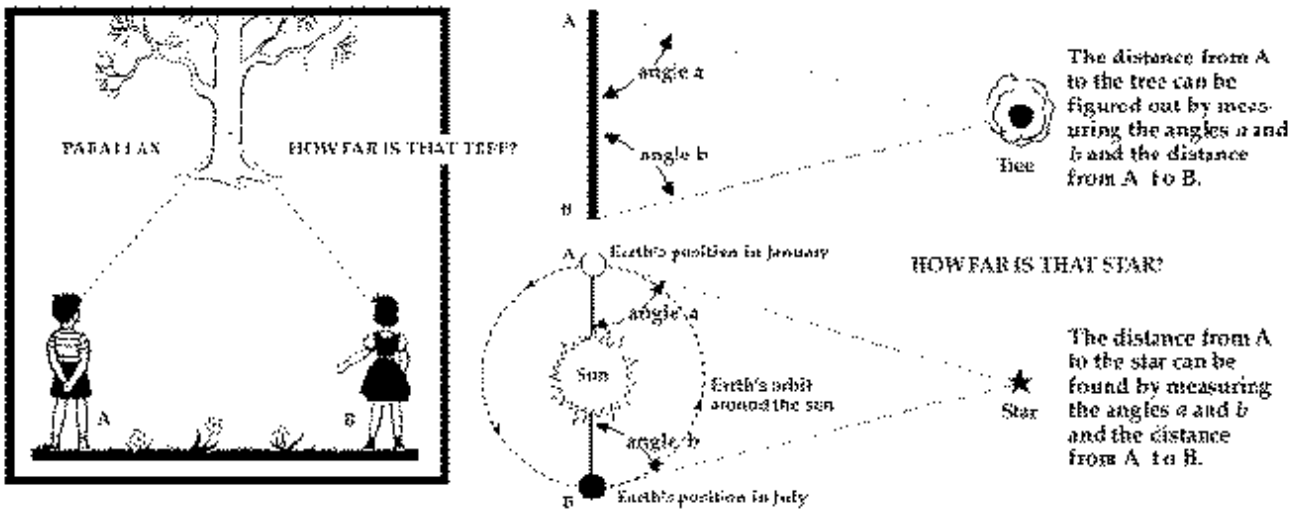
Add sand or silt to demonstrate the action of waves on shoreline or beach materials.

Q6. Explain why waves are larger in a storm. Why is it unsafe to go boating in strong winds?

The energy of the wind of the storm is transferred to the sea. The stronger the storm the higher the waves. The waves may break on the boat, swamping it, or causing it to capsize.

WHERE IS YOUR TEXTBOOK?

In this exercise, you will use parallax to map the position of a textbook on a laboratory table. Parallax is the apparent change in direction of an object caused by a change in the viewer's position. To experience this effect, hold up one finger. Look at it first with one eye and then the other. Notice how the finger seems to change position in relation to more distant objects when seen with one eye and then the other.



Parallax is used in astronomy for finding the distance to stars. But stars are so far away that a base line across the entire orbit of the earth — 300,000,000 kilometers — is big enough to use the parallax method to determine the distance to some of the nearest stars.

Parallax, also known as triangulation, is used in surveying to determine the distance of an object. A base line of known length is laid off, the far-off object is viewed from each end of this base line, and the two angles with the baseline are noted. Knowing the length of the baseline and the number of degrees in the angles at each end, you can determine the height of the triangle. You are now using techniques from an area of math called trigonometry. The height of the triangle is the shortest distance to the object from the baseline.

This method of mapping is used to track animals such as manatees as they move from place to place. In the case of manatees the researchers "see" with their ears. They listen from two places and point to the animal to determine where it is.

Objective:

To accurately use a compass and protractor to determine the location of a textbook on a table top.

Materials:

Magnetic compass
Meter stick
2 protractors
String
Student textbook
Transparent tape

Procedure:

1. Use the compass to align the student work table so that the long edge of the table is pointing toward the magnetic north pole.

2. Place the textbook on the table so that the book rests entirely on the table. (No part of the book should extend over the edge of the table.)

3. Facing north, select a point on the west edge of the table, near the south end. Label it with an "A" placed on a piece of transparent tape and attach it at the point. Measure the distance from point A to the north end of the table. Record this distance.

4. Select a second point "B" near the south end of the table on the same (west) edge, and label it as you did with point "A". Measure the distance from point B to the south end of the table. Record this distance.

5. Orient one protractor at point A by having the 0° angle pointing to magnetic north. Note that the 90° angle will be pointing east and the 180° angle will be pointing south when viewing the table from south to north. Then tape the edge of the protractor to the edge of the table with the transparent tape.

6. Run a string from point A to a corner of the textbook. Read the obtuse angle that the string makes with the edge of the table and record in the data table. An obtuse angle is an angle greater than 90° but less than 180°.

7. Orient the second protractor at point "B" as you did with point "A" in step 5.

8. Run a string from point "B" to the same corner of the textbook selected in step 6. Read the acute angle the string makes with the edge of the table and record in the data table. An acute angle is greater than 0° but less than 90°.

9. Repeat steps 6-8 with the other three corners of the textbook.

10. Give your data table and the textbook from the tabletop to another group of students and have them attempt to position your textbook on their table in the exact place where it was when you took the measurements.

Distance from North Corner
Point A_____

Distance from South Corner
Point B_____

Textbook Corner Number	Point A (Degrees)	Point B (Degrees)
1	*Answers will vary.*	
2		
3		
4		

Interpretation:

Was there a difference in where you measured the textbook and where the other students placed it after they followed your readings? Explain why.

Differences will probably result due to such things as measurement errors, rounding off measurements, etc., if students are not careful.

Review for you:

Q1. Describe how parallax is used to determine the location of an object.

A baseline of known length is laid off, the object is viewed from each end of the baseline, and the two angles with the baseline are noted. Knowing the length of the baseline and measuring the angles at each end of the baseline, you can determine the distance of the object.

Q2. Why can the distance of only the nearby stars be measured using the parallax method?

The baseline that is used (a baseline across the earth's entire orbit) is large enough to determine distances to nearby stars, but not big enough to determine the distances to far away stars. You get little or no parallax (apparent change in direction) with distant stars.

Q3. When trying to determine the location of the textbook, what two factors must be considered to accurately describe the location of the book?

You must accurately measure and describe the distance between points A and B and the angle measurements from A and B to all 4 corners of the textbook.

Think about this:

Q4. If the table edge were aligned to magnetic North, the protractor were aligned so that the 0° angle is pointed to the North, and you moved three right angles in the clockwise direction, what would be the degree heading? What compass direction is this?

The degree heading would be 270 degrees clockwise from North (or 90 degrees counterclockwise from North). The compass direction would be West.

Q5. If the table edge were aligned to magnetic North, the protractor were aligned so that the 0° angle is pointed to the North, and you moved two right angles in the clockwise direction, what would be the degree heading? What compass direction is this?

The degree heading would be 180 degrees, and the compass direction would be South.

Q6. Suppose that an angler on a boat sees a lighthouse in the distance and takes a compass reading from her position on the boat to the lighthouse. The compass needle points to 90 degrees. What direction is the lighthouse from the angler? _____ What direction is the angler from the lighthouse?_____ The boater decides to travel due North in search of a better fishing area. As she steers her boat North, will the lighthouse be on the left (port) or right (starboard) side of the boat? Explain your answer.

Right. If the boat is headed North it is pointed toward the 0° mark on the compass. A position at the 90° point would be due right as it is 1/4 of the way around a 360° circle.

WILDLIFE SYMBOLS

When you see a picture of a lion, what traits come to mind? Do you think of strength or nobility? According to The *Cousteau Almanac* by Jacques-Yves Cousteau and the staff of the Cousteau Society (Doubleday and Company, New York, 1980, 1981), "Lions appear on the United Nations coats of arms of more countries than any other animal—on those of India, Kenya, Malawi, Singapore, Burma, Burundi, Senegal, Sri Lanka, Swaziland, and several European nations." It is interesting that lions no longer exist in the wild in most of these countries! Why do you think these countries use the lion as a symbol for their nations?

The lion is a good example of how wildlife is valued as a symbol in many cultures. Wildlife may serve as a national symbol or as a logo for an organization or cause. It may represent a youth or civic group or be included in the symbols of a religious group.

Many other species are honored as symbols. Some examples include:

Bald eagle	Ospreys
Dolphins	Pelicans
Panthers	Sharks

This activity will acquaint you with the diversity of countries, organizations, and cultures that include wildlife in their symbols.

Objective:

To identify wildlife used in symbols and suggest reasons that wildlife are used as symbols.

Materials:

Access to library reference materials
Poster-making materials

Procedure:

1. Generate hypotheses about symbols. Where do they come from? What do they represent? Strength? Natural resources? Cultural heritage? How many are marine organisms?

2. Select five countries, research and comment about their national symbols. Sometimes the symbols will be stylized—that is, an artist will depict the symbol in a way that is not realistic. Sometimes the symbols will be literal and based on actual plants and animals. And sometimes, several symbols will be combined.

3. Make a poster displaying your findings.

Interpretation:

What did you learn about the plants and animals that appear as national symbols? Are they found in abundance in those countries or are they an endangered species?

Answers will vary.

Think about this:

Q1. Why are sharks used so frequently as symbols? What do they represent?

Sharks evolved about 400 million years ago, millions of years before dinosaurs. Their success is attributed to their superior design. Sharks are thought of as symbols of strength, cunning and swiftness. Most cultures admire these characteristics so sharks have been widely adopted as symbols by nations, sport teams and clubs.

More:

Repeat the procedures above. This time, however, examine school or community symbols instead of national symbols. Then examine trademarks, logos, and advertising symbols. Florida has many examples of plants and animals used as symbols. The manatee and panther tags are two well known examples.

Q2. What kinds of plants and animals appear as symbols for these organizations?

Answers will vary depending upon the states, provinces, and communities examined.

Some examples in Florida are the Miami Dolphins (Football) and the Tallahassee Tiger Sharks (Hockey).

Q3. What do these wildlife symbols represent?

Answers will vary.

Review for you:

Q4. Identify five plant or animal signs that are used as national, state or other symbols. Why might each species have been chosen to symbolize the country, state or organization?

Answers will vary.

Q5. How many of the animals used as school symbols are not found in that state or even in the country? What has happened to them?

Answers will vary but should include reference to some animals chosen as symbols becoming endangered or extinct for various reasons.

Q6. Take a look at professional and school sports teams. What are the five most common animal names used?

Answers will vary.

Q7. If your school uses an animal as a mascot, why was it chosen?

Answers will vary.

Q8. Make a mascot from each of the following fish, and make up an explanation for what each mascot symbolizes.

Answers will vary.

Blue Marlin

Snook

Tarpon

Appendix

Lab Activity: *Litterbugs*

Litterbug Card

Length (in ml)	
Colors(s)	
Wings (Yes or No)	
Number of legs	

Type of movement (Circle one)

Crawling Hopping Flying Running Slithering

Drawing of organism:

Litterbug Card

Length (in ml)	
Colors(s)	
Wings (Yes or No)	
Number of legs	

Type of movement (Circle one)

Crawling Hopping Flying Running Slithering

Drawing of organism:

Lab Activity: *Food Chain Games*

Rules for playing the Food Chain Game

1. Copy badges, one per student. You will need producer badges for 60 percent of the students, primary consumer for 25 percent and secondary consumer for 15 percent. Use the ones supplied in the Appendix or make up your own.

2. Copy about 20 extra producer badges and 15 extra primary consumer badges.

3. Decide on an outdoor area and mark the boundaries.

4. Mark an area called the "Decaying Area" for tagged students.

5. Place the badges from step 1 in a box. Have each student pick a badge. (No peeking or trading.)

6. Producers are released first into the play area, followed by primary consumers, then secondary consumers.

7. Primary consumers are to tag producers. When a producer is tagged, his/her badge is taken by the capturer, who sticks it to his/her badge. The dead producer must go to the decaying area.

8. Secondary consumers are to tag primary consumers who already have two producer badges stuck to their own badges. When this primary consumer is tagged, his/her badges are taken by his/her capturer, who sticks them to his/her badge. The dead primary consumer must go to the decaying area.

9. Tagged students (dead organisms) can get back into play (be reproduced) if two living organisms of their own kind come to the decaying area and touch them. The newly reproduced student gets one of the extra badges and returns to play.

10. Play continues for a set time or until a level of the food web is wiped out.

HINTS: If the primary consumers eat all the producers at once, they wipe themselves out due to lack of food. If the secondary consumers eat all the primary consumers at once, they wipe themselves out due to lack of food. This point can be related to the students before play or you can let them figure this out as they play. There are no winners or losers. Either all win by keeping the food chain alive or they all lose by killing off one part.