Environmental Approach to Chemistry & Biology

Presented by:

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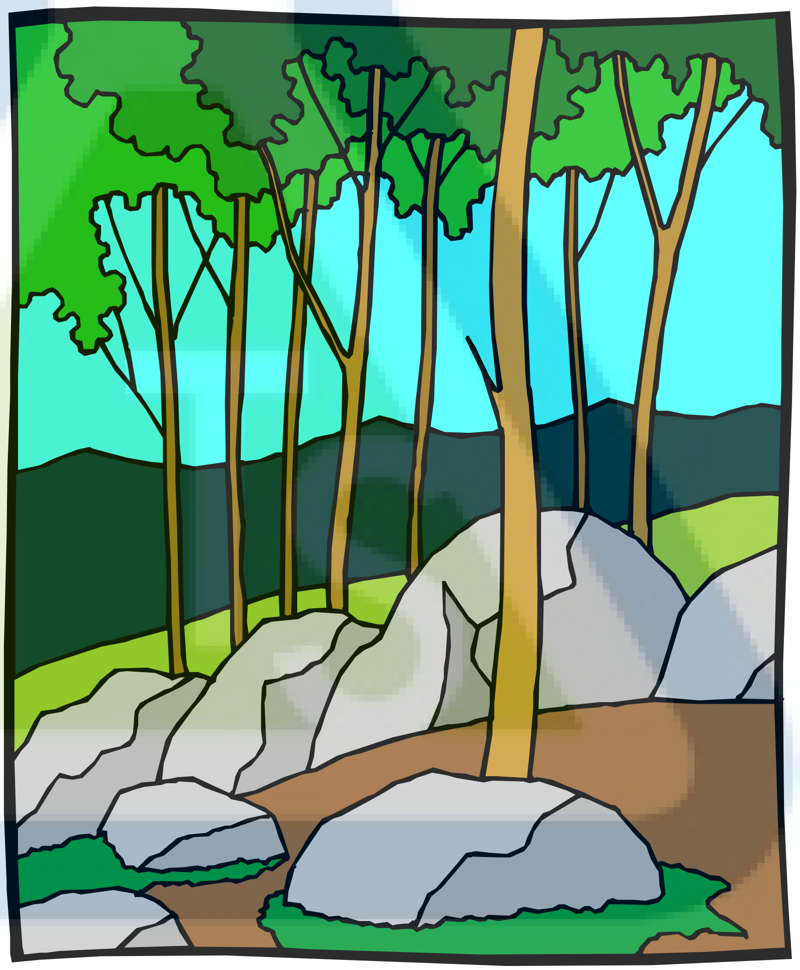
An Environmental Approach to Chemistry and Biology

Instructed by Eric Eichinger

It could be said that we live in a gigantic ecosphere. One in which our very existence is dependent on the interaction between animals, insects, humans, plants, bacteria, the atmosphere-everything in balance-everything interdependent. What happens when suddenly something in the environment becomes out of balance?



These lab experiments all deal with the chemical and biological aspects of the world surrounding the student. They are all constructed to give the student the ability to create a smaller ecosphere either in a terrarium or an aquarium. The overall objective is to achieve an understanding of the fragility of life and what happens when the balance, on which we are all so dependent, is upset.

Lab A: Effect of Light on Plants

Materials:

2 glass or clear plastic containers
10 bean seeds (soaked in water overnight)
Paper towels

Procedure:

1. Form paper towels into a cylinder and slip 5 beans between towel and container.*

2. Place one container in a dark area and one under a growth light.

3. Measure the height of the plants once every week.

Week #1 Height________________(dark)

Week #1 Height________________ (light)

Week #2 Height________________(dark)

Week #2 Height________________ (light)

Week #3 Height________________(dark)

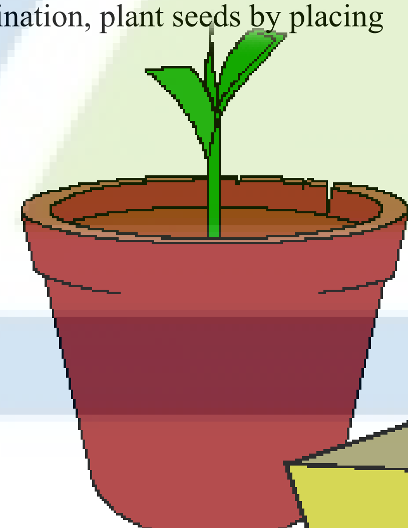
Week #3 Height________________ (light)

Questions:

A. What will happen to the plant grown in the dark?

B. Why do the two plants look different?

* To observe germination, plant seeds by placing a soaked paper towel against the inside of a clear plastic or glass cup. Place the seeds between the container and the moist paper towel.



Lab B: Effect of Nutrients on Plants

Materials:

3 glass or clear plastic containers
15 been seeds (soaked in water overnight)
Paper towels
Plant fertilizer
Tape
Spoon
Sharpie pen (permanent ink, felt tipped)

Procedure:

1. Add soil to three pots or use clear container with wet paper towel (described in lab A).

2. Select one pot and add a spoonful of fertilizer. Label this pot "High Food."

3. Select another pot and add a small amount (one pinch) of fertilizer. Label this pot "Regular Food."

4. Select a third pot and label it "No Food."

5. Plant 5 beans in each pot.

6. Record plant height every week, add water to moisten towel every few days.

Week #1 Height________________(high food)
Week #1 Height________________(regular food)
Week #1 Height (no food)

Week #2 Height________________(high food)
Week #2 Height ________________(regular food)
Week #2 Height________________(no food)

Week #3 Height________________(high food)
Week #3 Height ________________(regular food)
Week #3 Height________________(no food)

Questions:

A. Which plant will grow most?
B. Which will grow least?

Lab C: Mold Culture

Materials:

4 pieces of bread
4 sandwich size ziplock bags
Refrigerator
Sharpie pen
Water

Procedure:

1. Allow bread to be exposed to air for two hours (to collect microorganisms)
2. Place one piece of bread in each bag.
3. Pour about 20 ml of water on two of the bread slices. Label these bags "wet warm" and "wet cold."
4. Label the other two bags "dry warm" and "dry cold."
5. Close each bag.
6. Place bags marked "cold" into the refrigerator.
7. Place bags marked "warm" in a dark place.
8. Examine slices of bread after one day and after one week.

Questions;

A. On which pieces of bread will microorganisms grow best?

On which the poorest?

B. What things do microorganism need to grow?

Lab D: Yeast Are Hungry

Materials:

1 active yeast cake
Cornstarch (1 spoonful)
Iodine solution
Warm water
500 ml beaker
50 ml beaker

Procedure:

1. Mix cornstarch, yeast, and warm water in the 500 ml beaker.
2. Transfer three teaspoonfuls of yeast culture from the 500 ml beaker to the 50 ml beaker.
3. Add three drops of iodine. Remember-color indicates food is present.
4. Record color of mixture below.
5. Discard culture from 50 ml beaker.

Repeat steps 2 through 5 every 2 to 4 hours.

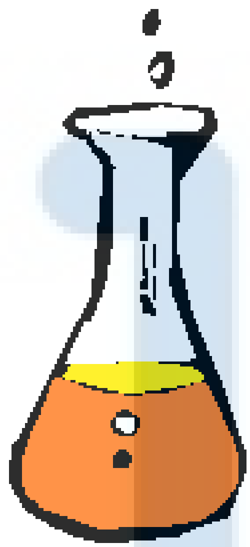
#Hours	Color	#Hours	Color

Questions:

A. Will the yeast eat the starch?

Will they eat all of it?

B. Why did we use the iodine?



Lab E: Where Do Microorganisms Live?

Materials:
2 petri dishes with media
parafilm wax seal
4 cotton swabs

Procedure:

1. Divide into quadrants by drawing a "+" on the bottom of the dish.
2. Leave one dish closed. This will be the control dish.
3. Swab four areas where microorganisms might live.
4. Open the other dish and rub one swab per quadrant onto the medium.
5. Label the quadrants (in the "+" area) according to where the swab was sampled.
6. Seal both dishes with parafilm wax.
7. Set containers in dark place and observe once per week.
8. Draw and describe what you see in each dish.

Questions:

A. Will the microorganisms grow in these dishes?

B. Are there different kinds of microorganisms in the soil?

Lab F: Watch 'Em Grow

Materials:
Large 1 gallon ziplock bag
Paper towel
10 seeds (at least two different types)
Water

Procedure:

1. Fold the paper towel and place inside bag (towel edges should nearly touch bag edges).
2. Wet the towel with appx 30 ml of water and close bag.
3. Add the seeds to the bag by placing on one side of wet towel.
4. Tack the bag to the wall with seed side visible
5. Observe bag regularly.

Questions:

A. How long will it take the seeds to grow?

B. Which seeds grow the fastest?

Which grew the tallest?

C. What effect did seed size have?

Lab G: How Much Water Can I Hold?

Materials:
4 styrofoam cups (4-6 oz)
Soil
Sand
Gravel
100 ml graduated cylinder
Nail
Vermiculite

Procedure:

1. Fill the four cups with (1) soil, (2) sand, (3) gravel, and (4) vermiculite.
2. Select a cup and add 100 ml of water (there should be enough matrix in the cup to be just covered by the water)
3. Poke a hole in the bottom of a cup and quickly cover with your finger.
4. Hold the styrofoam cup over the graduated cylinder and move your finger.
5. Measure the amount of water that come out of the cup.
6. Repeat steps 2-5 for the remaining cups

Questions:

A. Which medium held the most water?

Which lost the most water?

B. In which medium do you think plants would grow best? Why?

C. Which media would you mix to improve plant growth?

Lab H: Fun With Sow Bugs

Materials:
4 to 6 sowbugs
Dish
cover for dish
Tape
6 meter sticks

Procedure:

1. Place bugs in dish.
2. Cover one half of the dish. What do the bugs do?
3. Replace the cover on the other half of the dish. Now what do the bugs do?
4. Select a bug to race against other bugs.

5. Place bugs between meter sticks and begin race.

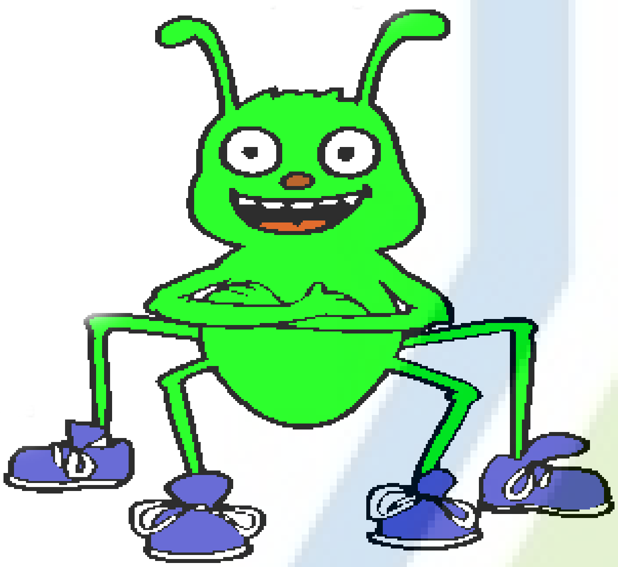
Questions:

A. Why did you choose the bug you did for the race?

B. Why did the winning bug win?

C. Why do the bugs run?

What are looking for?



Lab I: Celery Conduction

Materials:
1 celery stem
1 500 ml beaker
red dye (food coloring)
water

Procedure:
1. Cut celery into 5-10 pieces (option to let celery dry for about an hour)

2. Add 100 milliliters of water to the 500 ml beaker and add 10 drops of red dye.

3. Let the celery stand for about 30 minutes in the water.

4. Examine the inside of the celery by cutting it horizontally and vertically.

5. Draw the patterns in the celery.

HORIZONTAL PATTERN

VERTICAL PATTERN

Questions:

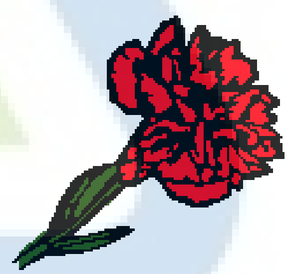
A. After one day, what will the inside of the celery look like?

B. How did the patterns form?

C. What other foods would work instead of celery?

LAB J: Flower Stem Conduction

Materials:
1 white flower
1 test tube
Food coloring
Water
Knife or scissors
Test tube rack



Procedure:

1. Cut 3 to 4 inches below the flower and remove leaves (if any).

2. Transfer flower to a test tube with ½ inch of water (stem should touch water).

3. Add 10 drops of food coloring.

4. Set flower aside.

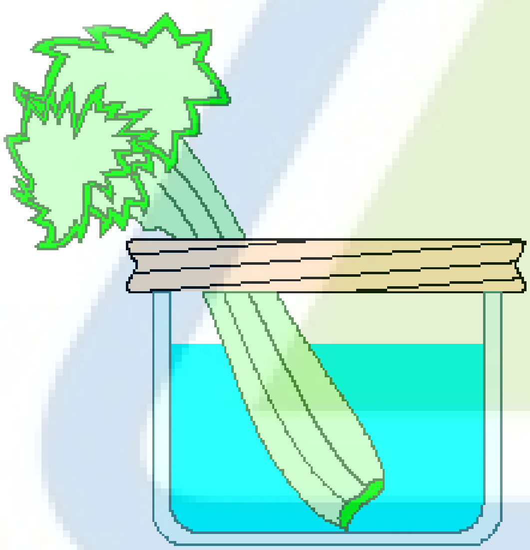
5. Examine flower every hour and record color.

Time	Color	Time	Color
1.______________		4.______________	
2. ______________		5. ______________	
3. ______________		6. ______________	

Questions:

A. What will happen to the flower?

B. How did the color get to the petals?



Lab K: Making a Terrarium

Materials:
2 liter soda bottle (clean)
Soil
Bugs
Water
Marking pen
Scissors
Seeds
Tape (clear)

Procedure:

1. Prepare soda bottle for terrarium by removing the label. Cut off the top of the bottle.

2. Add your choice of soil, plants, seeds, and bugs. Remember what you have learned when you select the type and quantity of each thing you put in your terrarium.

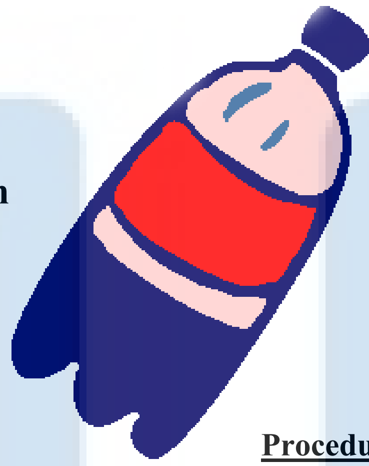
3. Remember to add water before sealing the terrarium.

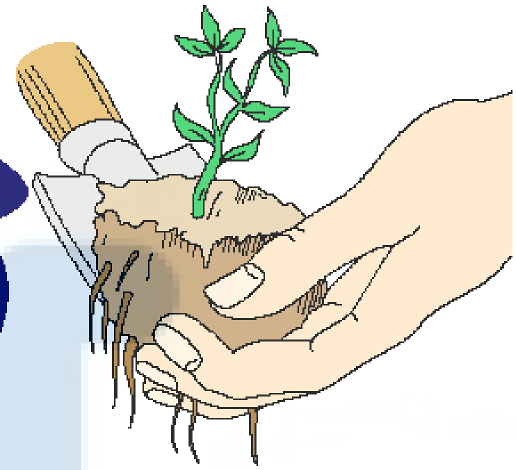
4. Observe the terrarium for two months.

Questions:
A. Which organisms did well?
Why?

B. Which organisms died?
Why?

C. Was your terrarium an ecosystem?





Lab L: Making an Aquarium

Materials:

2 liter soda bottle (clean)
Eloda Algae
Pond snail
Water
Soil

Procedure:

1. Prepare the soda bottle for the aquarium by removing the label.

2. Add your choice of soil and some algae.

3. Fill the bottle with water and add two snails.

4. Seal the bottle and observe your aquarium for two months.

Questions:

A. Does the number of snails change?

B. Does the amount of algae change?

C. Is your aquarium an ecosystem?

Lab M: Do Leaves Give Off Water?

Materials:

Small geranium plant
1 extra pot with soil
2 7-inch sticks
Aluminum foil
2 large plastic bags
2 twist ties

Procedure:

1. Place the sticks in the soil. Make sure the stick top is above the geranium.

2. Place bags over the sticks. Make sure the bag completely covers the geranium.

3. Use twist ties to close the bag around the base of the geranium.

4. Place the plant outside for four hours.

5. Examine the bags for water droplets.

Questions:

A. Do leaves give off water?

B. From where does this water come?

C. How does the water get in and out of the

Lab N: What Do Microorganisms Like To Eat?

Materials:
200 ml yeast solution
Sugar syrup
flour
2 small bottles
2 balloons

Procedure:

1. Place about 100 ml of yeast solution into each bottle.
2. Add a few drops of syrup to one bottle.
3. Add some flour to the other bottle.
4. Place a balloon over each bottle.
5. Observe what happens to the balloons.

Questions:

A. Will the microorganisms eat sugar or flour?

Which do they like most?

B. Are these microorganisms more like animals or plants?

C. What fills the balloons up?

LAB O: Predator/Prey Interactions

Materials:
80 to 100 multicolored plastic paper clips
Grassy field, weedy field, blacktop
Stopwatch or watch with second hand

Procedure:

1. Count the number of each color paper clip. If possible, start with the same number of each color.
2. Select one of the three locations (grassy field, weedy field, or blacktop)
3. The person selected as the timer scatters the paper clips on the ground in a small area.
4. When the timer says “go,” the rest of the group acts as predators and try to “capture” as many paper clips as they can in 1 or 2 minutes (1 minute is recommended for the blacktop, 2 minutes for fields).
5. When the timer says “stop,” the group’s captured prey (clips) are combined, sorted, and counted by color. During this counting period, group members can search for the clips that “escaped.”
6. Record the number of each color clip. Subtract this number from the original number to determine how many of each color escaped. Record this number as well.
7. Repeat steps 3 through 6 for the other two locations.

Questions:

A. Which color prey was best at escaping on each surface?

B. Which things helped the predators find the prey?

Which things helped the prey to escape?

C. Are the colors of prey animals in nature the ones that are more likely to escape or to be captured?

Lab P: What is an Acid? What is a Base?

Materials:
5 to 10 samples of household liquids (such as lemon juice, milk, bleach, soda, cleaner, water)
pH paper (range at least 3 to 10)
pH meter (optional)
5 to 10 beakers (200-500 ml)

Procedure:

1. Pour a small amount of each household liquid into a beaker.

2. Test the pH of each liquid with the pH paper.

3. If possible, compare this result to that obtained by using a pH meter.

Liquid#1 pH
________________________(paper)
________________________(meter)

Liquid#2 pH
________________________(paper)
________________________(meter)

Liquid#3 pH
________________________(paper)
________________________(meter)

Liquid#4 pH
________________________(paper)
________________________(meter))

Liquid#5 pH
________________________(paper)
________________________(meter)

Liquid#6 pH
________________________(paper)
________________________(meter)

Liquid#7 pH
________________________(paper)
________________________(meter)

Questions:

A. Which liquids were acidic?

Which were basic?

B. Why are some acids and bases poisonous, while others we drink?

Lab Q: Introduction to Acid-Base Chemistry

Materials:
Beaker with mystery solution (2 to 10 drops of either 0.1N HCl or 0.1N NaOH)
2 eyedroppers
10 ml of both 0.1N NaOH and 0.1N HCl
Phenolphathalein indicator (3 drops)
Safety equipment (gloves, face masks, etc.)

Procedure:

1. Using the first eyedropper, add 3 drops of the indicator into the mystery solution.

2. Based on the color, determine if the mystery solution is an acid or a base (acid=clear and base=pink).

3. Select either the acid or the base to neutralize the mystery solution.

4. Fill the second eyedropper with the chemical selected in step 3.

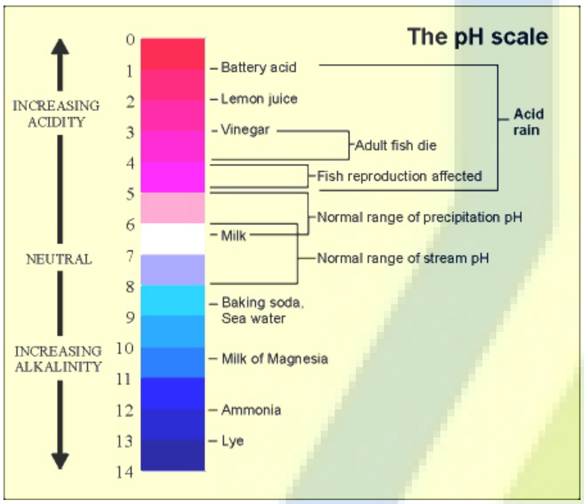
5. Add drops to the mystery solution one at a time until the color changes. Record the number of drops.

Questions:

A. Was the mystery solution acidic or basic?

B. How many drops of acid or base were in the mystery solution? (Remember, one drop of mystery chemical is equal to one drop added in step 5.)

C. Why do we use indicators?



Lab R: Learning To Use Microscopes

Materials:
One microscope with light source
Pond water with sediment (such as water from the Santa Ana River bed)
Glass slides with coverslips
Eyedropper

Procedure:

1. Using the eyedropper, take one drop of the pond water and place it on a clean glass slide.

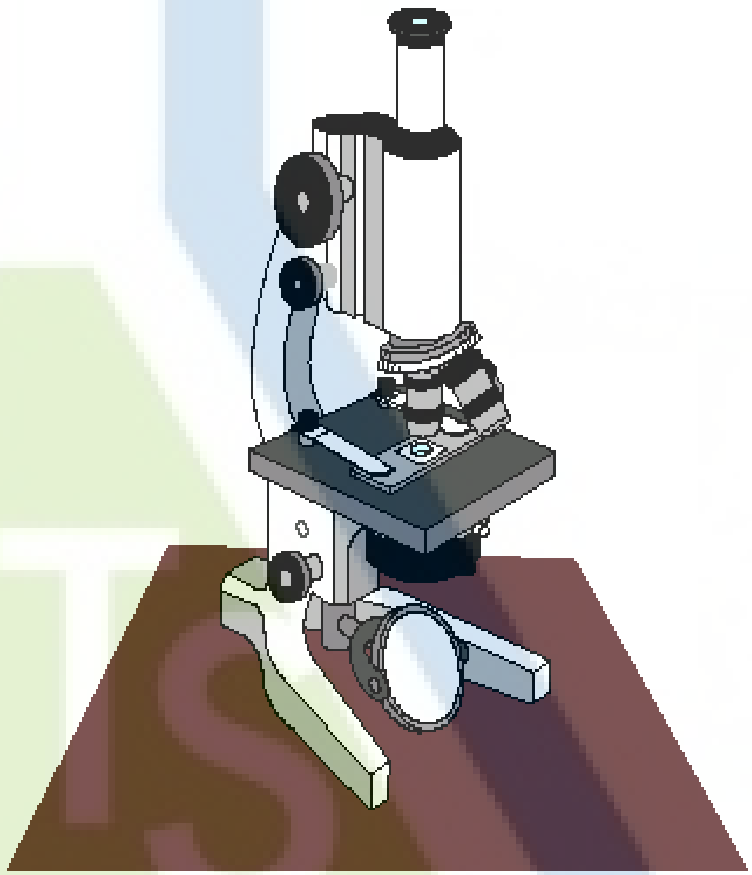
2. Gently place a coverslip over the drop.

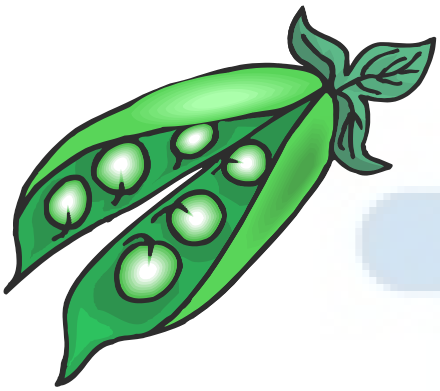
3. Place slide on micorscope stage and draw any microorganisms you see.

Questions:

A. Were the microorganisms plant-like or animal-like?

B. Could the microorganisms be seen without the microscope?





Lab S: Seed Dissection

Materials:
1 large bean seed
Microscope (optional)
Water

Procedure:

1. Soak one large bean seed for a 12-hour period (overnight).

2. Using fingernail pressure, lightly scrape off the seed coat.

3. Gently split the seed into two halves.

4. Identify the following seed parts: Embryo, Endosperm, and Cotyledons. (Use a microscope if available.)

Questions:

A. Why do we soak the seeds first?

B. How does the seed size affect the embryo?

LAB T Corn Flake Chemistry

Materials:
1 cup of Total cereal
1 cup of Frosted Flakes cereal
1 500 ml glass beaker
1 magnetic stir bar and stirring device
Water

Procedure:

1. Place the magnetic stir bar into the 500 ml beaker.

2. Add 1 cup of Total cereal to the glass beaker.

3. Cover the cereal mixture by adding water to the beaker.

4. Stir the cereal mixture for 30 minutes.

5. Discard the cereal mixture and examine the magnetic stir bar for the presence of iron.

6. Repeat steps 1 through 5 using the Frosted Flakes cereal.

Questions:

A. Where did the iron come from?

B. Which cereal contains the most iron?

Lab U: Wolves and Rabbits (Population Dynamics)

Materials:

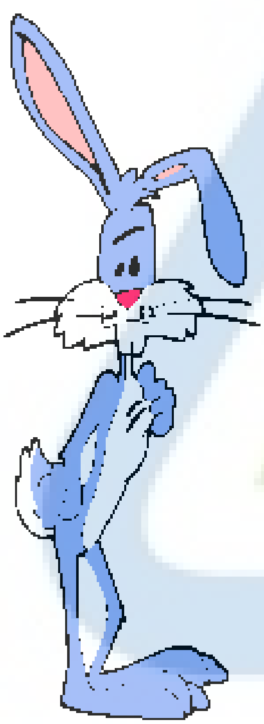
20 to 40 carrots
15 to 40 streamers (1 to 2 feet long)
Tape
Watch (with second hand) or timer
Large outdoor field
A group of at least 10 participants (students)

Procedure:

1. Split the group into two categories. Designate one wolf for each eight rabbits. (For example, 19 kids would be divided into one group of 17 rabbits and one group of 2 wolves.)

2. Let the wolves spread the carrots (at least one per rabbit) over a 500 to 1,000 square foot area of the field.

3. Tape one or two streamers to the shoulders of each rabbit.



4. Start the rabbits 50 to 100 feet away from the "carrot patch." Wolves must start in the carrot patch.

5. Say "Go." During the next 60 seconds, the wolves try to "catch" as many rabbits as possible by removing their taped streamers. At the same time, the rabbits try to get at least one carrot.

6. Say "Stop" after 60 seconds and adjust the wolf population according to the following formulas:

- Wolf with no streamers = dead wolf (becomes a rabbit for the next round)
- Wolf with 1 streamer =one wolf (stays a wolf for the next round)
- Wolf with 2 streamers = two wolves (original wolf and one new wolf)
- Wolf with 4 streamers = three wolves (original pus two new wolves)
- Wolf with 6 streamers = four wolves (original pus three new wolves), Etc.

7. Allow the wolves who have captured more than one rabbit to pick new wolves from the rabbit population.

8. Add up the new number of wolves. All other students become or remain rabbits.

9. Repeat steps 2 through 8 three more times or enough to develop a stable population.