An Aquatic Study in the Classroom

In this project, you will make your own aquatic system in a jar and then bring it to school to study its physical, chemical and biological characteristics. Follow the instructions below to make your aquatic system.

<u>Making an Aquatic System to Study</u>

1) Locate a one-gallon wide mouth jar.
2) Put 1-2 cm of mud at the bottom of your jug. This layer will be called the ooze layer. This layer is very important in your ecosystem. Be sure to get the mud from the bottom of the pond.
3) Select water for your jug from the pond. If you should happen to collect some aquatic plants and insects living in your water source, so much the better.
4) Bring your jug, water, ooze, and critters to school. Place the jug near a light source. Draw a line at the water level in your jug.
5) On a label put the name of your ecosystem, the date you collected the water, the location where the pond water and mud were collected, and your name.

You will identify the organisms in your jug. You will count the organisms in your jug by sub-sampling. You will record the data collected in this exercise. You will need a low-power microscope, 10-ml pipettes, a small glass dish, and an algae color code card. Each observation session will be about 30 minutes.

Ecosystems are dynamic. This means that they are always in a state of change. These changes are directional and can be predicted. Sometimes these changes are very slow and other times they go like mad. In order to determine the quantitative and qualitative changes that take place you will have to develop great skill in observing.

<u>Biotic and Abiotic Factors in the Jug Ecosystem</u>

Procedure

1) Now that you are an ecologist, you will start sampling the abiotic and biotic parts of your ecosystem. This must be done at regular intervals. A suggestion would be to conduct your counts three times per week. The changes in your jug may be very slow or they might change rapidly. The way to note these changes is to make regular counts.
2) Every week check the water level in your jug. Make sure it is up to the waterline. Record the numbers of ml of water that you added to bring it up to the water line. Use water that has set out over night so that the chlorine is gone or keep some extra water from the pond in another jar.
3) <u>Macroscopic Organism Counts</u> - Macroscopic organisms in your ecosystem will seldom reach high numbers. The easiest method is to just count them all. Be careful because not all of the macroscopic organisms are the same. Look at the organism carefully. Now look at the data sheet and you will find the section called macroscopic animals. In one of the columns write the name of the animal and below it write in the number of that type of organism found in your jug.
4) <u>Microscopic Organism Counts</u> - Counting the little organisms is much more difficult than the big ones. First let's learn how to collect them. You will use some glass tubes called pipettes.

There is a trick to using a pipette. Put the tube in the water. When you reach the level you want, put you finger over the end. When you let your finger go, the water will come out of the bottom of the pipette. Your pipette is just like a straw with numbers on it.

5) Collect a 10-ml sample from your jug. Pipette the water and organisms in a watch glass. Put
   the watch glass under a scope and identify the organisms. Count each group of organisms separately. Write the name of the microscopic organism at the top of a column. Under it write the date in the left column and the number of organisms in its proper column.
6) You may see several different kinds of green plants in your jug. These are called algae. Algae are difficult to count because they are so small. We will use the color of the water as a quantitative value for the number of algae cells present in the water. Take a small test tube and fill it with water from the jug. Now take the color code algae card and hold it up beside your tube. Now compare the color of your tube with the card. When you find the color on the card that is closest to your tube water color, check the number of the card color and record this in the proper column of your data sheet.
7) You may have a little plant called duckweed in your jug. It is very common in this pond. Count the number of duck weed plants present and record it.

Common Pond Crustaceans

Water Fleas - Cladocere - These are tiny and covered by a transparent shell. Their internal structures show up very clearly under magnification.
Copepods - Cyclops - These appear as little white specks darting through the water. They move in a jerky manner. Magnification shows them to be pear shaped.
Seed Shrimp - Astracod - These are very small with two shells. They are bi-valved. They move by sticking their slender legs and antennae from between the shells and kicking rapidly.
Fairy Shrimp - Sea Monkeys - These are about 1/2 inch long. They look like they are swimming on their backs. They are very graceful and interesting to watch.

The above four crustaceans are common very early in the spring. They inhabit shallow ponds that dry up during summer. These organisms provide food for the salamander larvae that hatch in early spring.

Snails - Rotifers - These shelled animals are found crawling on vegetation. The part that extends out of the shell is called the “foot”. The snail moves on a slime track of mucous when it crawls. It has a pair of tentacles that extend from its head.
Tubifex - This worm will put its head into the mud and wave its posterior in the water to breathe. It is often found in large numbers in polluted waters.
Water Mites - These are usually no more than 5 mm long. Their bodies appear to be one piece. They commonly appear as brightly colored spots swimming in the water. They somewhat resemble spiders.
Water Boatman - This swims right side up. It carries down a glistening blanket of air, which makes it so light it must anchor itself by one claw hooked to a plant. They are plant eaters.
Diving Beetle - This looks like a common land beetle that swims in water. It breathes air through its tail when it comes to the surface of the water. They eat dead organic materials.

Dragonfly Nymph - These larvae are fierce creatures. They have a very heavy head with biting pincers. The abdomen has feathery gills. They are about an inch long.
Mosquitoes - These are segmented with many hairs. These larvae in still water often hang from the underside of the water surface, with their air tube sticking up through the surface. They swim by snapping their bodies. They feed on tiny plants and animals.

Physical Changes in the Jug

You will measure and record on your data sheet the daily temperature within your jug and the amount of evaporation of water in your jug. Then you will calculate the amount of heat lost from your jug through evaporation. You will need a thermometer calibrated in centigrade degrees and a graduated cylinder.
The abiotic factors play an important role in any ecosystem. The abiotic factors are divided into the physical and chemical properties. Temperature is an important physical parameter. All plants and animals have temperature limits. Evaporation is also an important physical parameter. This activity should take just a few minutes a day.

Procedure

1) Each day, at about the same time, take a thermometer and measure the temperature in your jug. Record this temperature on your data sheet. Do this at the same time that you measure the temperature of the room. Record this on your data sheet as well.
2) Each day observe the water level in your jug. When the water level drops below the black line you drew at the original water level in the jug, add water from your replacement jug. Using a pipette or a graduated cylinder, measure the number of ml of replacement water required to bring the level back to the black line. Record this water volume on your data sheet.
3) How much energy is required to evaporate the water from the jug? Scientists have calculated that it requires 540 calories of heat to evaporate l ml of water at room temperature. We can determine the amount of heat that is lost from the water in your jug by multiplying the ml of water evaporated times 540.

(_______ ml of water x 540 = calories of heat lost from the jug)

Chemical Properties of the Jug

At weekly intervals, you will record on your data sheet the amount of oxygen present , the alkalinity, and the pH of the water in your jug. You will need chemical test kits to conduct these tests. This activity will take about 30 minutes a week.
An ecologist can tell you many things about an ecosystem by running a series of chemical tests on water. The physical properties of the water will tell the ecologists organisms that might be present. Chemical properties will also influence the type of organisms that may be present and may also indicate the number of organisms present. Since these chemicals provide the needed nutrients for the ecosystem, you can see how a lack of these nutrients could limit the number of organisms present.
We are all aware of how important oxygen is for the growth of plants and animals. In a terrestrial environment, the oxygen makes up 21% of the air around us but in water the amount

of oxygen is only a fraction of that percentage. Therefore we will measure the amount of oxygen in the water in parts per million (ppm) by weight. Directions for doing this test will follow later.
When you test for alkalinity in the water you are testing for the amount of calcium bicarbonate present in the water. The reason that this chemical is so important in an aquatic ecosystem is that it provides the CO2 that is needed by the plants. Directions for this test will follow later.
You will also determine the pH of the water. A pH test can also be used as an indicator as to the quality of the environment. Directions for this test will follow later.

Guide for Water Chemistry - Oxygen Determination

1) Fill the bottle marked DO (dissolved oxygen) with water from your jug.
2) Be certain that there are no air bubbles present in the bottle.
3) Remove the stopper and put in pill #1 and pill #2.
4) Insert the stopper to keep air from getting in.
5) Shake the bottle and mix the chemicals and water. It should turn a brownish color. Let the small pieces that are floating around in the bottle settle.
6) Pound pill #3 into a powder and pour it into the bottle.
7) Put the stopper in and shake up to mix. The small pieces will dissolve and the water will be a yellow color if oxygen is present.
8) Fill the plastic measuring tube with the prepared sample from the DO bottle and pour into the mixing bottle.
9) Holding the dropper straight up, add drops of POA solution to the mixing bottle.
10) Count the drops of POA solution until the sample changes from yellow to colorless. The ppm dissolved oxygen is equal to the number of drops used.

Dissolved oxygen results:
0 to 2 ppm dissolved oxygen - means that you have a highly polluted aquatic environment or a winter kill situation.
3 to 4 ppm dissolved oxygen - carp, bullheads, and some warm water fish, such as sunfish and crappies can live in this water.
5 to 15 ppm dissolved oxygen - This is trout water. It also means that there is very little pollution in the water.

Guide for Water Chemistry - Alkalinity Determination

1) Fill the plastic measuring tube full of water from your jug and pour into the mixing bottle.
2) Add the contents of one Brom Cresol Green-Methyl Red Indicator Powder Pill to the mixing bottle. Now the solution should be a green color.
3) Add the Alkalinity Sulfuric Acid drop by drop. Swirl the mixing bottle as you add the drops. Count the drops as you mix them.
4) Continue to do this until the color changes from green to pink.
5) The total alkalinity equals the number of drops of Alkalinity Sulfuric Acid times l7.

Alkalinity results:

0 to 99-ppm alkalinity - low alkalinity and usually fish populations will be low. This range of alkalinity is usually found in the high mountain lakes in granite formations. These lakes appear to be blue when viewed at a distance.
100 to 180 ppm alkalinity - These are usually productive lakes found in the area of limestone formations. Instead of appearing blue these will have a green tint.
181 to 300 ppm alkalinity - These waters are found in eastern Montana for example in lakes with no streams or in farm ponds. These are highly alkaline waters and are very productive.

Guide for Water Chemistry - pH Determination

1) Fill the two-glass pH sample measuring tubes.
2) Fill the pH measuring tubes to the mark near the top of the tube with water from your sample.
3) Add 6 drops of pH indicator to one of the tubes and swirl to mix.
4) Put the tube with the indicator solution in the opening nearest the middle of the pH measuring device.
5) Put the other tube of water without the pH indicator in the outside opening to the pH measure.
6) Hold the pH measure up towards a light or the sky so the light comes through the two holes in the side of the pH measurer.
7) Turn the color disc until the color of the wheel matches the color of the water you are measuring.
8) Read the pH from the scale on the disc.

pH results:
6.0 to 6.8 pH - This is low pH and indicates that either the water is polluted with some type of waste or the water contains only small amounts of dissolved minerals.
6.9 to 7.5 - These ranges are common in many Montana waters. Once again it indicates that the mineral content of the water is low.
7.6 to 8.5 - This is a high pH and indicates that the stream has an abundant supply of dissolved minerals, including calcium bicarbonate.