**UBMS Summer Biology Water Lab**

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**Introduction**

The purpose of this experiment was to determine the water qualities of each water sample collected. The soil qualities were also determined by collecting soil from different areas, but yet close to each other. Freshwater is found in streams, lakes, rivers, etc. so we went to 3 different sites to collect water. The locations were Hiram, Ky. Lynch, Ky. and in the river at Harlan County High School located in Harlan, Ky. A couple of people in UBMS brought tap water from where they live. One brought water from Harlan Co. and the other from Bell Co. The soil samples were all located near the river at Harlan County High School. The tests that were included in water testing were coliform bacteria (CB), dissolved oxygen (DO), % saturation, biochemical oxygen demand (BOD), nitrate, ph, phosphate, temperature, and turbidity. Tests conducted during soil testing include nitrogen, ph, phosphorus, and potassium. You see, companies purify water and then bottle it, but how do we know if it’s really purified?

**Materials**

**Water Testing**:

Of course, water was used (3 sites, tap, and bottled water). Without the water, no procedure would’ve taken place. Three sampling containers were used to put the water samples in. The LaMotte testing kit was used which included test tubes, TesTabs (DO, CB, Phosphate, BOD, Nitrate, and ph), secchi disk icon sticker, water monitoring book, thermometer, and a color chart guide. Other items or tools that were used in this experiment were droppers (pipettes), foil, gloves, bleach, and of course a timer (or clock).

**Soil Testing**:

Soil was used in order to have this test. TesTabs were also used in this experiment as well, which were Potassium, ph, Nitrate, and Flock-Ex. A trowel was used to scoop up all 3 different types of soil, along with a paper bag to but the soil in. Paper was used because the soil had to be laid out somewhere in order to pick out rock, plant roots, etc. Other materials include a test bag, distilled water, plastic cup, spoon, freezer bag, color chart poster, and a timer (or clock).

**Experimental Procedure**

**Water Testing**

**River-site Testing**:

When you collect water samples from the river, you must first remove cap of the sampling container and rinse the bottle 2-3 times with the stream water, wearing gloves of course. Then, hold the container near the bottom and plunge it below the water surface, opening downward. Turn the container away from you and turn it into the current and allow the river water to flow into the container for at least 30 seconds. Cap the container when it gets full and carefully, but immediately, remove it from the river.

Do this procedure for ALL testing sites.

**Coliform Bacteria**:

To begin this test, you must pour the water sample into a test tube until it’s filled to the 10 ml line. Place a coliform bacteria (CO) TesTab into the test tube after filling it with water. Then let the test tube set at room temperature for 48 hours, out of direct sunlight. Once this is completed, compare the color of the water to the picture on the Color Chart Guide in the Coliform Bacteria column. Record your results once you have completed the test.

Do this procedure for ALL water samples.

Coliform Test Disposal:

To properly dispose of the coliform bacteria test, add approximately 1 ml of bleach to each test tube one at a time. Let the test tubes stand upright for at least 4 hours. Once time is up, rinse out each test tube thoroughly more than once.

Do this with ALL water samples.

Fecal coliform bacteria are naturally present in the human digestive tract, but are rare or absent in unpolluted waters. CO should not be found in well water or other sources of drinking water. Their presence in water serves as a reliable indication of sewage or fecal contamination. Although coliform bacteria themselves are not pathogenic, they occur with intestinal pathogens that are dangerous to human health. This presence/ absence total coliform test detects all coliform bacteria strains and may indicate fecal contamination.

**Dissolved Oxygen (DO):**

To perform the DO test, you must first take the temperature of the water sample and record it. Then, fill a test tube with the water and place 2 dissolved oxygen (DO) TesTabs into the tube. Invert the tube until the tablets have completely disintegrated. DO NOT SHAKE IT. This will take at least 4 minutes. Maybe even more. Wait at least 5 minutes so the color can develop. Then compare the color to the Color Chart Guide in the Dissolved Oxygen (DO) column. Finally, record your results.

Dissolved Oxygen (DO) is important to the health of aquatic ecosystems. All aquatic animals need oxygen to survive. Natural waters with consistently high DO levels are most likely healthy and stable environments, and are capable of supporting a diversity of aquatic organisms. Natural and human- induced changes to the aquatic environment can affect the availability of DO.

Locate the temperature of the water sample on the % Saturation Chart in your Water Monitoring book. Locate the DO result of the water sample at the top of the chart. The % Saturation of the water sample is where the temperature row and the DO column intersect.

DO % Saturation is an important measurement of water quality. Cold water can hold more DO than warm water. High levels of bacteria from sewage pollution or large amounts of rotting plants can cause the % saturation to decrease. This can cause large fluctuations in dissolved oxygen levels throughout the day, which can affect the ability of plants and animals to thrive.

**Biochemical Oxygen Demand (BOD):**

In order for you to find out the BOD of the samples, you must first fill a test tube with water and wrap the tube with foil. Store it in a dark place at room temperature for at least 5 days. Once the 5 days are up, unwrap the tube and add two dissolved oxygen (DO) TesTabs to the test tube. Next, Cap the tube and invert it until the tablets have disintegrated. Once they’re disintegrated, let the tube set for 5 minutes. Then compare the color of the water to the Color Chart Guide in the Dissolved Oxygen (DO) column. Record your results.

Biochemical Oxygen Demand (BOD) is a measure of the quantity of dissolved oxygen used by bacteria as they break down organic wastes. In slow moving and polluted rivers, much of the available dissolved oxygen is consumed by bacteria, robbing other aquatic organisms of the DO needed to live.

**Nitrate:**

To begin the Nitrate test, first you must fill the test tube to the 5 ml line with your water sample. Then add one Nitrate TesTab. Cap the test tube and invert it for at least 2 minutes or until it completely disintegrates. DO NOT SHAKE IT. Wait 5 minutes for a red color to develop. Compare the color to the Nitrate column located on the Color Chart Guide. Then record your results.

Nitrate is a nutrient needed by all aquatic plants and animals to build protein. The decomposition of dead plants and animals and the excretions of living animals release nitrate into the aquatic system. Excess nutrients like nitrate increase plant growth and decay, promote bacterial decomposition, and therefore, decrease the amount of oxygen available in the water.

Sewage is the main source of excess nitrate added to natural waters, while fertilizers and agricultural runoff also contribute to high levels of nitrate.

Drinking water containing high nitrate levels can affect the ability of our blood to carry oxygen. This is especially true for infants who drink formula made with water containing high levels of nitrate. You should always have a professional lab test your drinking water for the presence of nitrate.

**pH:**

To take the ph of a water sample, start off by filling a test tube with the water sample to the 10 ml line. Add one ph TesTab. Then cap it and then invert it until it has disintegrated. DO NOT SHAKE IT. Compare the color of your water sample to the ph column on the Color Chart Guide. Record your results.

Ph is a measurement of the acidic or basic quality of water. The ph scale ranges from a value of 0 (very acidic) to 14 (very basic), with 7 being neutral. The ph of natural water is usually between 6.5 and 8.2. Most aquatic organisms are adapted to a specific ph level and may die if the ph of the water changes even slightly.

Ph can be affected by industrial waste, agricultural runoff, or drainage from improperly run mining operations.

**Phosphate:**

Fill a test tube with the sample water to the 10 ml line. Add one Phosphorus TesTab. Cap the tube and invert it until the tablet has completely disintegrated. Then let it set for about 5 minutes for a blue color to develop, then compare the color to the Phosphorus column on the Color Chart Guide. Record your results.

Phosphate is a nutrient needed for plant and animal growth and is also a fundamental element in metabolic reactions. High levels of this nutrient can lead to overgrowth of plants, increased bacterial activity, and decreased dissolved oxygen levels.

Phosphate comes from several sources including human and animal waste, industrial pollution, and agricultural runoff.

**Temperature:**

For this procedure, make sure you’re wearing gloves! For each water sample, place the thermometer (from the LaMotte water kit) four inches below the water surface for one minute. Then, remove the thermometer from the water, read the temperature and record it as degrees Celsius.

Temperature is very important to water quality. Temperature affects the amount of DO in the water, the rate of photosynthesis by aquatic plants, and the sensitivity of organisms to toxic wastes, parasites and disease. Thermal pollution, the discharge of heated water from industrial operations, for example, can cause temperature changes that threaten the balance of aquatic systems.

**Turbidity:**

To determine the turbidity of a water sample, you must start off by removing the back of the secchi disk icon sticker. Place the sticker on the inside bottom of the sampling container. Press down on it so it’ll stick and won’t come off. Next, make sure the sample water is filled to the turbidity line located on the outside kit label on the sampling jar. Then, hold the Color Chart Guide on the top edge of the jar. Find the turbidity column on your Color Chart Guide. Looking down into the jar, compare the appearance of the secchi disk icon in the jar to the chart. Record your result as Turbidity in JTU.

Turbidity is the measure of the relativity clarity of water. Turbid water is caused by suspended and colloidal matter such as clay, slit, organic and inorganic matter, and microscopic organisms. Turbidity should not be confused with color, since darkly colored water can still be clear and not turbid. Turbid water may be the result of soil erosion, urban runoff, algal blooms, and bottom sediment disturbances which can be caused by boat traffic and abundant bottom feeders.

Clean ALL test tubes with bleach once you’re done with your procedure!

**Soil Testing**

**Collecting Soil Samples:**

To collect soil samples, you must use a clean trowel to loosen the soil sample. Collect soil from a depth of 2 to 6 inches. Then collect several small samples from a single place and mix them together in a paper bag to get an average sample. Collect a total of 1 cup of soil.

**Soil Texture:**

In order to see what soil feels like, spread out the soil sample onto a piece of paper. Pick out any rocks, leaves, sticks, roots, etc. Crush any soil clumps until they’re not larger than 1/8 inch. Then wet your index finger with water. Rub a little bit of soil from your sample between your wet index finger and thumb. Record what you feel. Next, estimate where the soil sample would fall on the texture triangle and record the name for that “class” of soil on the Data Sheet and the Classroom Data Chart. Record ALL results

Soil contains small particles of weathered rocks and minerals. The size and mixture of these particles affects the movement of water and air in the soil. The 3 kinds of particles are called sand, slit, and clay. Sand particles are coarse, slit particles are smaller, and clay particles are very fine. Soil scientists measure the amount of each type of particle and classify soils using the texture triangle.

Sand helps water and air move through soil by creating space between the grains. Clay increases the amount of water and nutrients the soil can hold. Both clay and silt help to hold soil particles together.

**Nutrient Extraction:**

One important thing to do during this set of experiments is Nutrient Extraction. To begin this process, you must pour ½ cup of distilled water into a quart size freezer bag (ziplock bag). Then add 8 Flock-Ex TesTabs. Next, seal the bag and shake it until all the tablets have disintegrated. Open the bag then use a plastic spoon to add 5 teaspoons of soil. Close the bag and shake it for 1 minute. Then, hold the bag at an angle and let the soil particles settle for about a minute. Carefully open the bag then use the corner of the bag as a spout and pour the clear liquid into a paper cup. The soil extract is used for the Nitrogen, Phosphorus, and Potassium tests.

**Nitrogen:**

To see how much Nitrogen is in the sample of soil, start off by filling the test bag to line C with the soil nutrient extract. Add 1 Nitrate#1 TesTab. Roll the bag down 3 or 4 times. Fold the yellow tabs back around the bag. Hold the top of the bag and shake until tablet disintegrates. Open the bag. Add one Nitrate#2 TesTab. Roll the bag down and shake until tablet completely disintegrates (this usually takes about 2 minutes). Then, Wait 3 minutes for a pink color to develop. Then, once that is done, compare the color of the reaction to the Nitrogen column on the Color Chart Poster. Finally, record the result as Low, Medium, or High level of Nitrogen. Save the left-over soil nutrient extract solution, rinse out the test bag for re-use.

**Phosphorus:**

Start off by putting 7 teaspoons of distilled water in a plastic cup. Add 1 teaspoon of soil extract. Stir. Then, fill the test bag to line C with the diluted soil extract. Add Phosphorus TesTab. Roll the bag down 3 or 4 times. Fold yellow tabs back around the bag. Hold the top of the bag and shake until the tablet disintegrates. Wait 5 minutes for a blue color to develop. Compare the color of the reaction to the Phosphorus column on the Color Chart Poster. Next, record the result as Low, Medium, or High level of Phosphorus. Discard the left-over soil solution, rinse out paper cup, and the bag for future use.

**Potassium:**

To start this procedure, begin by filling the test bag to line C with the soil nutrient extract. Add 1 Potassium TesTab. Roll the bag down 3 or 4 times. Fold the yellow tabs back around the bag. Hold the top of the bag and shake until the tablet disintegrates. Next, compare the “cloudiness” of the reaction to Potassium column on the Color Chart Poster. Hold the bag over the black salamanders in the left hand column and see how fuzzy they look. Compare them to the gray salamanders in the right hand column. Record the result as Low, Medium, or High levels of Potassium. Save the left-over soil nutrient extract solution, rinse out test bag for re-use.

**Ph:**

For the last test, fill the test bag to line C with distilled water. Use the plastic spoon to add about ½ teaspoon of soil. Next, add 1 Soil Ph TesTab. Roll the top of the bag down 3 or 4 times. Fold the yellow tabs back around the bag. Hold top of the bag and shake for 15 seconds. Then, let the bag sit for 2 minute so the soil can settle out. Then, compare the color of the liquid above the soil to the ph column on the Color Chart Poster. Record the ph of the sample. Pour the liquid down the drain with excess water. Dump the soil in the trash. Rinse out the test bag for future use.

**Results**

**Water Testing:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ppm- parts per million  JTU- Jackson Turbidity Units | Site 1 (Lynch,Ky.)  River water | Site 2 (Hiram, Ky.)  River water | Site 3 (Baxter, Ky.) (HCHS)  River water | Dasani  Bottled water | Cumberland Gap  Bottled water |
| Coliform Bacteria | Positive | Positive | Positive | Positive | Negative |
| Dissolved Oxygen | 4 ppm 46% saturation | 6ppm 70% saturation | 4ppm 46% saturation | 4 ppm 46% saturation | 4ppm 46% saturation |
| Biochemical Oxygen Demand | 1ppm | 2ppm | 4ppm | 4ppm | 4ppm |
| Nitrate | Less than 5ppm | Less than 5ppm | Less than 5ppm | Less than 5ppm | Less than 5ppm |
| Phosphate | Less than 1ppm | Less than 1ppm | Less than 1ppm | 4ppm | Less than 1ppm |
| pH | 8 | 8 | 8 | 8 | 7 |
| Temperature | 22C | 22C | 22C | 22C | 22C |
| Turbidity | 0 JTU | 5 JTU | 0 JTU | 0 JTU | 0 JTU |

**Soil Testing:**

|  |  |
| --- | --- |
| Texture | Feels grainy and gritty |
| Nitrogen | Low level of Nitrogen; no pink color |
| Phosphorus | Low level of Phosphorus; no blue color |
| pH | The ph color was green; ph of 7 |
| Potassium | Sample was cloudy; Medium level of Potassium |

**Discussion**

**Water Testing**

After the results were reviewed over, some of them were shocking while others were expected. The first test we conducted was Coliform Bacteria (CB). Cumberland Gap’s test proved to be negative, while on the other hand, everything else came out positive. Even the world’s widely used bottled water, Dasani. This was a shocking result because no one would have expected a big corporation, such as Dasani, to have coliform bacteria contamination. Site 1, 2, and 3 were all positive as well. Those results were expected to be positive since the samples collected came from the rivers. Site 1, Site 3, Dasani, and Cumberland Gap all had 4ppm and 46% saturation, while on the other hand, Site 2 tested 6ppm and 70% saturation. Site 3, Dasani, and Cumberland all had a BOD of 4ppm. Site 1 was 1ppm and Site 2 was 2ppm. I expected the BOD to be close to the DO. It is a possibility that the tube was shook instead of being inverted, or it might’ve been a false test result. In the next experiment, more time should be taken and everyone should be more patient. As expected, Nitrate remained the same in all water samples. All the phosphate tests resulted in the same levels except for Dasani. This was not expected. The temperature was the same for all water samples. This wasn’t expected either. The thermometer could’ve been left in the sample too long or been taken out to early. Next time, the experiment conductors can keep better time. All ph levels were 8 except for Cumberland Gap, which showed 7. All the potassium tests resulted in the same levels as well, except for Site 2.

**Soil Testing**

Even though more tests were conducted in the water testing, these results for the soil testing weren’t bad at all. First off, the texture of the soil was grainy and gritting when the experiment was conducted. As showed in the chart, there was a low level of both Nitrogen and Phosphorus. There may have been a tint to both test samples, but no color to show whether it had a medium or high level of Nitrogen and Phosphate. The directions did say shake, but maybe everyone shouldn’t have shaken the test bag too fast. Everyone may get better results next time the same experiment is conducted. The ph of the soil sample was 7. This is a good result because in the water test, Cumberland Gap also tested 7 in ph, which was one below of what all the other water samples were tested (which was 8). The soil had a medium level of potassium, which is good because the average level of potassium in soil is medium.

**Conclusion**

As of what all the test results showed, it’s clear that bottled water and tap water is basically the same when it comes to drinking them. It’s healthier than river water because of what the test results give. Now everyone knows that river water is contaminated and there is a possibility that the corporation Dasani might as well be contaminated too. The test results of soil testing showed that the soil sample was below average.

**References**

LaMotte; Low Cost Water Monitoring Kit