Citizen Science Fact Sheet W-2

Color, Odor, Temperature and pH

Water can be best understood as a complex mixture of biological, chemical and physical interactions. Nutrients exist in pools of readily available mineral components and slowly available bound forms attached to particle surfaces. Some are tied up within organic matter and in living organisms. The temperature and biological activity of the water affects the amount in each pool and whether it is moving from one pool to another, through decomposition for example.

The four tests described in this fact sheet are not definitive tests – by themselves they will not reveal whether water quality is good or bad. They are starting points. Color and odor are descriptive, and the human eye and nose can be more sensitive than their mechanical counterparts. Temperature and pH can have negative effects on water quality if they are extreme, either too high or too low. But they are important factors in the interpretation of other tests because they affect the toxicity of some nutrients such as ammonia.

Color

Purpose

Water color is due to a combination of silt, clay and organic matter in the water, along with algae, other plant life, and microorganisms. A coffee-colored, translucent brown might indicate tannins in the water from organic debris high in tannins, such as oak leaves. A lighter, more opaque brown is probably due to silt and clay loading. A greenish color is from algae in the water. Note that clear water rates the highest in our scoring system (see below), but clear water does not guarantee clean or high-quality water. For instance, the water in surface mining strip pits can be affected by acid and be clear but not suitable for aquatic life.

Tools

A clear sample container (glass or plastic) works best for observing the color of the water. A medium-sized container is best, so you are looking through a water column about 2 to 3 inches thick, held up to a light, window or sunlight. The clear Plexiglas tube used for the turbidity measurement (described in Turbidity, W3) also will work.

Procedure

Write down color and other observations about appearance on the data sheet. It is helpful to be able to compare it to other water you have sampled on the same day and to samples collected from this site on other dates. Note the silt level. Look for anything unusual on or in the water, such as the rainbow effect on the surface created by oil or solvents. If you bring the sample back to your house or school laboratory, be sure to shake the sample before recording your observation. If not, it will appear more or less clear, and it will be more difficult to designate a color.

Interpretation

Rate your water quality according to the scale below. Note that we are using the same rating system as the one used in the *River Friendly Farms* notebook (K-State Research and Extension publication S-138). A rating of 4 is the best, 3 is good, 2 is less than good and 1 means something needs improvement. Record the color and rating on the data sheet.

Color Rating			
4 – Best	3 – Good	2 – Fair	1 – Poor
Water is basically clear, no distinguishing color.	Slight tint of green, tan, or brown to the water.	There is a murky look to the water, in addition to a dark, distinct color.	Visible oil or other non-natural substance affects water color.

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Odor

Purpose

Like color, odor is not a quantitative measurement. Most samples will not have a distinguishable odor. However, some may have a detectable smell that can reveal pollution sources that may be present.

Tools

The water for this test should be in a clean jar or vial with a lid. You will need at least a cup of water to detect an odor, so collect more than just a small test tube's worth. Several people might want to smell the same sets of samples and compare notes because everyone smells things a little differently. The primary tool you'll need here is your nose. The human nose is quite sensitive at detecting many different odors at parts per million (ppm) or parts per billion (ppb) concentrations. With practice you can learn to identify and describe odors.

Note the smells in the air at the water sampling site. After you have collected samples and are back home or in a place where there is no detectable odor note the smell of each sample as you open the container. Natural smells may be described as fishy, soil-like, or musky. Non-natural smells might be chlorine, sulfide (rotten eggs), sewage, manure, or chemicals.

Procedure

Swirl the water gently in the container and sniff. If you detect a strong smell, do not put your nose close to the container opening. Instead, use your hand to move air across the open container towards your nose. If you are dealing with a sample that may have high *E. coli*, be careful to not splash it on your face.

Interpretation

Record the odor of each sample on the data sheet. Also note an absence of smell. The sample may smell fishy or like algae, or it may smell like manure if livestock or wildlife have been in the stream or pond recently. Record numeric data on the data sheet using the chart below. Later on, note if the odor relates to the other data you have recorded.

Odor Rating

4 – Best	3 – Good	2 – Fair	1 – Poor
No detectable odor.	Some odor, but basically natural smell of soil, fish, or leaves.	Strong odor, not completely natural or pleasant.	Strong, unpleasant odor; might be manure, sewage, or chemical smell.

Temperature

Purpose

This physical characteristic can be measured and used to interpret other measurements to help you understand more about your stream. KDHE regulations state, "Discharge from artificial origin shall not elevate the temperature of the water above 32°C (90°F) and not raise the temperature more than 3°C above natural conditions." This situation would rarely apply to a farm but is more of a concern for discharge from industries such as power plants or wastewater treatment plants.

For your purposes, it is useful to look at your farm maps and the monitoring sites along your stream. Look at the temperature pattern along the stream, noting if it is going up, down, or staying about the same. Warm field runoff could raise the temperature, as would areas where sunlight falls directly on the water – in riparian areas without trees, for example. Where trees shade the water's surface or where springs or seeps enter the stream, you may note a temperature decline. You will notice differences in stream temperature related to the seasons and time of day as you take readings throughout the year. Temperature, in addition to pH, affects the toxicity of ammonia to fish. The warmer the water, the more toxic the ammonia.

If you are monitoring ponds or lakes, you might notice some interesting seasonal differences and observe the temperature stratification that occurs during the winter and summer and the mixing or turning of the water body that takes place in the spring and fall. During the summer, warmer water is in the upper layers. Wind may cause mixing throughout the year, but major mixing, or overturn, occurs in the fall. As the upper layers cool due to colder air temperatures, they begin to sink once they are colder than the lower layers. The water may appear to be exceptionally cloudy or muddy for a few days and may have stronger odors.

In the winter, stratification will occur again, this time with the colder water near the top. In spring after the ice melts and the water warms, the mixing, or overturn, may be observed again. These overturns may also bring up sediment, change the oxygen content of the water, and affect the nutrient and other factors measured. If possible, note on your data sheets not only the water temperature in the pond or lake, but whether you are sampling before, during, or after one of the spring or fall overturn periods.

Tools

Use a thermometer that has been designed for rugged use such as stream or pond monitoring. This will be a non-mercury thermometer and ideally will be encased in a hard plastic or other material to reduce the chance of breakage. There also will be a place to tie a string or cord to the top, so it can be placed in the water without fear of losing it to the current.

Procedure

To monitor temperature, secure the thermometer on a string or cord about 5 or 6 feet long. When you arrive at each sampling site, place the thermometer under water in a representative location. In a stream that means it is not too close to the edge or too far out. Place it at about the depth that you will be collecting water samples. Tie the string or cord to something on the bank to prevent it from washing downstream. Go ahead and collect the water sample while the thermometer adjusts to the water temperature. Before you leave the site, pull the thermometer from the water and read the temperature. Note that many water thermometers record temperature in Celsius (or centigrade) rather than Fahrenheit. Be sure to record the data on the sheet in the same scale that you are measuring. To evaluate the rating, you may need to sample temperature in several locations on the stream or pond site if ambient temperature is close to 90°F (32°C).

Interpretation

Record the actual water temperature on the data sheet. This number, along with pH, will be used to interpret the ammonia level reading. On the chart below, determine which rating best describes the water body you are monitoring. Record the temperature and rating on your data sheet.

For information on ordering the thermometer see page 5.

Temperature Rating			
4 – Best	3 – Good	2 – Fair	1 – Poor
Water temperature is below 90°F (32°C), and is even cooler in some locations due to shade from trees and/or grass. The varied habitat and temperature allows for more stream/pond species diversity.	Water temperature is below 90°F (32°C) throughout the water body (pond, lake, stream or river).	Water temperature is above 90°F (32°C) at some sampling locations, but this is due to lack of shade and ambient temperature, not industrial or farm runoff.	Effluent from farm runoff or on-farm industry raises the temperature of the water more than 3°C above ambient, and the water temperature is above 90°F (32°C) in several locations.

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pH

Purpose

The pH measures whether the water is more acid (lower pH) or basic (higher pH), compared to a reading of 7.0 as neutral. Often the pH reading, on its own, does not tell much about water quality. However, it can give valuable clues as to what else is going on in the water, and the pH will affect things like the solubility of various minerals in the water. KDHE guidelines state that the pH should be between 6.5 and 8.5. Water treatment plants, factories, and wastewater treatment plants need to pay close attention to the pH of their effluent. On a farm scale, your activities are unlikely to affect the pH directly, but nutrient loading can have an indirect effect. Nearby limestone rock roads can also contribute to a higher pH.

The minerals in the soil and streambed or lake bottom will determine the starting pH and the buffering capacity. Water moving across limestone or calcareous rocks or soil (typical of Kansas) will tend to have a higher pH than water in streams coming off of granite, igneous rock, or sand or gravel stream beds from these rocks.

The next factor affecting the pH of the water is biology and sunlight. On sunny days, rapidly growing algae and plants release oxygen and remove carbon dioxide from the water during photosynthesis. This can increase pH levels significantly. At night the opposite happens; plants respire, or give off carbon dioxide and take up oxygen from the water. This reduces pH because carbon dioxide combines with water to form carbonic acid.

If you are tracking pH carefully, note on your data sheets the weather and time of day you collected the water sample. If possible, collect water at about the same time of day (with respect to sunrise and sunset) when doing repeated measurements. If you are interested in observing this photosynthesis effect, sample the same pool of water or an indoor aquarium with plants at several times during the day and at night and record the pH. Fish can also affect the pH of water. They take in oxygen, and give off carbon dioxide, which lowers the pH.

If the pH of your water is extremely low, look for other sources of acid. In some regions of the country, acid rain can have an effect on the pH of runoff into streams. This has not been a major problem in Kansas. Decaying plant matter and acidic runoff from mines can also lower pH. A high pH value increases the toxicity of ammonia to fish. For example, the same amount of ammonia is five to 10 times more toxic to fish when the pH is 8.5 as compared to when the pH is 6.5. If pH is abnormally high, check for runoff from recently limed fields, driveways or roadways with limestone rock or screenings.

Tools

We have found that commercially available pH test strips are a cost effective and convenient alternative to consumer-grade electronic pH meters. Several types are available through pool and pet stores as well as through scientific and educational suppliers. We recommend the Hach, or similar, brand strips. These test strips have a wide range (pH 4 to 9), in increments of whole pH units. Some pH tests are more sensitive, and may cover a narrower range and have readings at the half as well as whole pH units. In our field-testing, we found that these test strips correlate better with KSU water test lab readings than either of our electronic handheld meters. While some applications may benefit from the greater precision possible with electronic meters or lab tests, test strips are useful for qualitative assessment and will alert you to large changes in pH.

pH Rating			
4 – Best	3 – Good	2 – Fair	1 – Poor
The water pH is between 6.5 and 8.5.			The water pH is lower than 6.5 or higher than 8.5.

Procedure

Take out the number of strips that you'll need for your water samples and replace the cap. Store the pH test strips at room temperature. The expiration data is stamped on the bottom of the bottle.

1. Dip a test strip into water and remove immediately.
2. Hold the strip level for 15 seconds. Do not shake excess water from the test strip.
3. Compare the pH test pad to the color chart on the bottle. Estimate results if the color on the test pad falls between two color blocks, for example, a pH of 6.5 would be recorded if the color falls roughly half way between the 6 and the 7 color blocks when reading.

Note: With the pH test, it is extremely important to do the test when the samples are as fresh as possible. Either run the test in the field while you are still at the sampling site, or as soon as you return to your laboratory, classroom, or kitchen. Storing the sample at room temperature, or even in the refrigerator can change the pH.

Interpretation

Record the pH reading of your water sample on the data sheet. Use the table o page 4 to rate the pH level of your water and record the appropriate number on the data sheet. Generally, pH is either ok (rating = 4) or not ok (rating = 1). Also use the result in the interpretation of the ammonia test.

Where to order supplies

LaMotte Company
P.O. Box 329
802 Washington Ave.
Cherstertown, MD 21620
www.lamotte.com
1-800-344-3100
Order #1066 – armored non-mercury thermometer. Cost is about $20, multiuse.

Hach Company
P.O. Box 389
Loveland, CO 80539
www.hach.com
1-800-227-4224
Order #27456 for 50 pH test strips. Cost is about $0.30 per test.

Water Monitoring Data Sheet

How to Score

Using either the boxes in the fact sheets or the *Interpretation Guide* (W-12), determine if the test results were in the best, good, fair or poor category and circle the number that corresponds to the correct rating on the data sheet. For example: best = 4, good = 3, fair = 2, and poor = 1.

Duplicate the data sheet (opposite) as needed. Use the space below for a farm or sampling map. These data sheets are also found in W-11 but are included here for your convenience.

Farm Map

Water Monitoring Data Sheet

Date: ______________________________ Location/farm: ______________________________

Samples collected by: ______________________ Recent precipitation date: ______________________

Baseline ______________________________ Runoff ______________________________

Other (describe) ____

Measurement	Units	Site 1 (or control)	Site 2	Site 3	Site 4	Site 5	Site 6
Site Description (pond, stream, etc. and name)							
Water level at site (high, medium or low?)							
Turbidity	cm						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Temperature	°C						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Color	description						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Odor	description						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
pH	units						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Nitrate	ppm NO_3-N						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Nitrite	ppm NO_2-N						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Ammonia	ppm NH_4-N						
Chronic level (from Table 4-1)							
Acute level (from Table 4-2)							
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Phosphorus	ppm PO_4						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
E. Coli	cfu/1 ml						
(blue)	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Total coliform	cfu/1 ml						
(pink)	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1
Triazine	yes/no 3 ppb						
	score	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1	4 3 2 1

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