Testing Stormwater Chemistry

A *Watersafe* Science Project

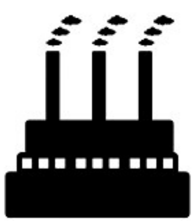
Background

After reading about common water pollutants below, you will use maps, water chemistry kits, and critical thinking to answer these questions:

> What types of nutrients and other pollutants can be measured in a watershed? Where do they come from? What harm do they cause to the tributaries of the Chesapeake Bay?

Nitrogen (N): Nitrogen is an essential nutrient for plants and animals, but an excess of nitrogen in our waterways harms aquatic ecosystems. Nitrogen (in the forms of **nitrites, or NO_2,** and **nitrates, NO_3**) enters water from runoff carrying farm animal manure, field fertilizers, and human wastes, as well as from vehicle exhaust in the air. Excess nitrites and nitrates water greatly increase the growth of algae. Masses of algae block sunlight from underwater plants, and when the algae masses die, their decomposition uses oxygen. Both these factors are part of a process known as *eutrophication,* which depletes oxygen in the water. Zones in water bodies with very low levels of oxygen are called *hypoxic*, or dead zones, because fish, oysters, and most other aquatic organisms cannot survive in these areas (USF, 2000).

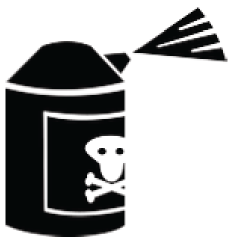
Phosphorus (P): Phosphorus, released from soils and weathered rocks, is another naturally occurring essential nutrient for plants and animals. Elevated levels of phosphorus in water bodies are caused by human activities and lead to increased algae growth and eutrophication. The largest source of phosphorus pollution is agricultural runoff from mineral fertilizers and animal waste. Other sources include industrial wastes, home fertilizers, and lawn clippings. (Watersafe, 2015)



Carbon Dioxide (CO2): Carbon dioxide is absorbed by surface waters. As the burning of fossil fuels has boosted carbon dioxide in our atmosphere, the levels of carbon dioxide in our oceans and estuaries, such as the Chesapeake Bay, also have increased. Part of the carbon dioxide reacts with the alkaline water, forming carbonic acid. The increased acidity of the water is detrimental to aquatic species, especially to animals with calcium carbonate shells, such as oysters and coral, because it triggers buffering reactions that use the carbonate minerals needed for shell building. (NOAA, 2015)

pH: pH is a measure of a water's acid/base content (H+ and OH- ions), measured on pH units on a scale of 0 to 14. The pH level of a water body is influenced by the concentration of acids in rain and the types of soils in the bedrock. Most fish require waters with a pH of 6.2 to 8.2 to reproduce and survive. Increased levels of pH from anthropogenic sources include acid mine drainage from mines, known as *acid mine drainage*, and emissions from coal-burning plants, causing what is commonly called *acid rain*.

Bacteria: Bacteria in our waters can lead to diseases in humans and aquatic life. Fecal coliform bacteria from pets, farm animals, and human waste enter rivers via stormwater runoff and combined storm-sewer system could be present. Another recent concern is the increase in incidences of life-threatening bacteria vibrio infections in humans and seafood, likely caused by warmer waters.



Pesticides & Herbicides: Pesticides are chemicals used to eliminate weeds, insects and other harmful elements in crops and home gardens. Their pervasive use, however, has produced its own harm to native plants and insects. It is not uncommon to find pesticide contamination even in our drinking water. (Watersafe, 2015)

Salinity: Salinity is the total of all salts dissolved in water, usually expressed as parts per thousand (ppt). In an estuary, such as the Chesapeake Bay, the flow of fresh water from streams and rivers mixes with salty ocean water, producing a range of salinity from 1 to 35 ppt. Water salt content affects the distribution of animal and plant species according to the amount of salinity they can tolerate. Brackish waters, such as the tidal portions of the Potomac River, range from 10 ppt to 1 ppt salinity. Freshwater streams should have 0 ppt salinity, but their salinity (or chloride levels) can be elevated by pollutants, such as road salt (sodium chloride) and industrial waste. The accumulation and persistence of chloride in fresh water poses a risk to the plants, animals, and humans who depend upon it.

Testing Nutrients and Pollutants in your School's Watershed

After reading about pollution sources, observe a land use map of the area surrounding your school, what types of contaminants do you expect to find in your school's watershed? (For Maryland areas, see this site for land-use maps: http://planning.maryland.gov/OurWork/landuse.shtml

Observations in your School's Watershed

You can observe a stream near your school, a stormwater pond, or stormwater that has collected after a storm. Observe and record information about the areas you are testing. Include variables that might affect your results. Include the following.

- What type of water source and its location
- Clarity of water
- Land cover (vegetation, pavement, etc.) in surrounding the area
- Presence of living organisms
- Weather
- Human impacts

Total Nitrate/Nitrite

Record the results of your sample in ppm (parts per million units).
*End of the test strip

1. Carefully open Nitrate/Nitrite Test packet and packet and take out test strip.
2. Immerse the reagent pads into water sample for 2 seconds, and then remove. After 1 minute match colors to chart below.
3. Colors are stable for 1 minute.

Water Sample	Low Nitrite 0 ppm	0.5 ppm	2.0 ppm	5.0 ppm	10.0 ppm	20.0 ppm	High 50 ppm
A.							
B.							
C.							
D.							

Nitrites

Record the results of your sample in ppm (parts per million units).
*Nearest to test strip handle

Water Sample	Low Nitrite 0 ppm	0.15 ppm	0.3 ppm	2.0 ppm	5.0 ppm	10.0 ppm	20.0 ppm	High Nitrite 50 ppm
A.								
B.								
C.								
D.								

Bacteria

Record the results for each sample as negative or positive for bacteria detection.

1) Take out the Bacteria Test vial and set upright on a flat surface.
2) Collect water sample or turn on tap to a very slow stream.
3) Carefully twist off cap and fill vial to 1⁄2 inch below the top (to 5 ml line).
   DO NOT OVERFILL and DO NOT SPILL the bacterial growth powder in the vial.
4) Replace the cap and twist on tightly. Shake the vial vigorously for 20 seconds.
5) Place the capped vial upright in an area 70-90 °F where it cannot be disturbed for 48 hrs.
6) After 48 hours, observe the color of the liquid without opening the vial:
   a. Purple Color: Negative Result
   b. Yellow Color: Positive Result
      *It is highly likely that potentially harmful bacteria were detected

Water Sample	Positive	Negative
A.		
B.		
C.		
D.		

Pesticides and Lead

Record the results for each sample as negative or positive for pesticides detected.

The Lead/Pesticide Test detects dissolved lead at levels below the EPA Action level of 15 parts per billion (ppb) and two of the most common pesticides used in the US at or below the EPA Maximum Contaminant Level (atrazine – 3 ppb, and simazine – 4 ppb).

1) Open Lead/Pesticide packet and take out all contents. The packet contains a test vial, a dropper pipette, and two test strips.
2) Using dropper, place exactly TWO dropper-fuls of water sample into test vial. To pick up sample, tightly squeeze the bulb at the end of the dropper and place the open end into water sample. Release the bulb to pick up sample, then squeeze again to expel sample
3) Swirl gently for several seconds. Place on a flat surface.
4) Place both test strips into the test vial, with arrows pointing DOWN.
5) Wait 10 minutes. Do not disturb strips or vial during this time. Blue lines will appear on the strips.
6) Take the strips out of the vial and lay them on a flat surface with the arrows pointing to the LEFT. Read Results.

Negative: LEFT line (next to number 1) is darker than the RIGHT line (next to number 2).

Positive: RIGHT line (next to number 2) is darker than LEFT line (next to number 1), or lines are equally dark (Both LEFT and RIGHT lines are equally dark)

Water Sample	Positive	Negative
A.		
B.		
C.		
D.		

*Note: If no lines appear, or both lines are very light, the test did not run properly, and the results are not valid.

If a test strip shows a positive result, your water sample may contain lead or pesticides at a toxic level.

pH

Record the results of your sample in pH units based on the color chart (end of strip).

1) Carefully open pH / Hardness / Chlorine Test packet and take out test strip.
2) Immerse the reagent strips into water sample and remove immediately. Hold the strip level for 15 seconds.
3) Match pH, Total Hardness and Total Chlorine strips (in that order) to the color chart.

Water Sample	6.0	6.5	7.5	8.5	10
A.					
B.					
C.					
D.					

Hardness

Compare your results in the middle of the strip to the color chart.
Record the results of your sample in ppm (parts per million units).

Water Sample	0	50	120	250	425
A.					
B.					
C.					
D.					

Chlorine

Compare your results on the strip nearest the handle to the color chart .
Record the level of chlorine in your sample in ppm (parts per million units).

Water Sample	0	50	120	250
A.				
B.				
C.				
D.				

Water Test Desired Values

EPA maximum contaminant levels or guideline standards

Bacteria	None
Lead	Below 15 ppb
Pesticides (atrazine/simazine)	Below 3 ppb atrazine Below 4 ppb simazine
Total Nitrate/Nitrite	Below 10 ppm
Nitrite	Below 1 ppm
pH	6.5 to 8.5
Total Hardness	50 ppm or less
Total Chlorine	Below 4 ppm