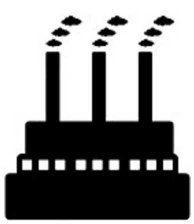
Background

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?
- What kinds of contaminants affect your local stream?

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 in 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).

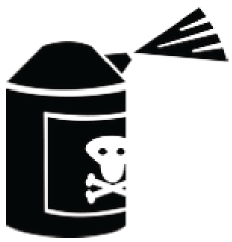
Phosphorus (P): Phosphorus, released from soils and weathered rocks, is another naturally occurring essential nutrient for plants and animals. Elevated levels of phosphorus in water bodies are caused by human activities and lead to increased algae growth and eutrophication. The largest source of phosphorus 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.

Nutrients and Pollutants in Your School's Watershed

After reading about pollution sources, observe a land use map of the area within your school's watershed (or 2 square miles around your campus, if you do not know the subwatershed). What types of contaminants might be found in your school's watershed? (For Maryland areas, see this site for land-use maps: http://planning.maryland.gov/OurWork/landuse.shtml)

Observations of Collection Sites

You will collect stormwater runoff from a stormwater pond or from various spots on your campus. Observe and record information about the areas you are testing below. Include variables that might affect your results, such as vegetation or traffic in the nearby area. Include the following.

- The type of water source and its location
- The clarity and color of water
- Land cover in the area contributing to the runoff
- Presence of living organisms in the water
- Weather in the preceding 12 hours (note if it is raining while collecting)

The Water Chemistry Kits

The tests are best performed by at least two people, so that someone can read the directions and operate the timer, while the other performs the steps. As always during labs, it is best to read the directions before doing the experiment and to wear the necessary protective gear. Disposable gloves are recommended for these tests.

Nitrate and Nitrite

1. Carefully open Nitrate/Nitrite Test packet, and take out test strip.
2. Immerse the reagent pads* into the water sample for 2 seconds, and then remove. (Ccount 1000, 2000, or use a timer.)
3. After 1 minute, match the colors to chart below. (The colors will be stable for 1 minute.)
4. Record the results of your Total Nitrate/Nitrite in the top chart. The reagent pad for nitrate/nitrite is at the *end of the test strip*.
5. The reagent pad indicating the presence of nitrites is *nearest to the strip handle*. Record the results in the bottom chart.

Total Nitrate/Nitrite

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.							

The unit of measurement is parts per million (ppm), which is equivalent to mg/liter.

Nitrites

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.								

*Reagent: a substance or compound used to test for the presence of another substance by causing a chemical reaction with it.

Bacteria

1) Take out the Bacteria Test vial and set upright on a flat surface.
2) Carefully twist off cap and fill vial to the 5 ml line with the water sample. DO NOT OVERFILL, and DO NOT SPILL the bacterial growth powder in the vial. Using a dropper helps.
3) Replace the cap and twist on tightly. Shake the vial vigorously for 20 seconds.
4) Place the capped vial upright in an area 70-90 °F where it cannot be disturbed for 48 hrs.
5) Mark your sample if there are multiple test vials.
6) After 48 hours, without opening the vial, observe the color of the liquid:
    a. Purple Color: Negative Result
    b. Yellow Color: Positive Result - meaning a high likelihood of potentially harmful bacteria.
7) Record the results in the table below.

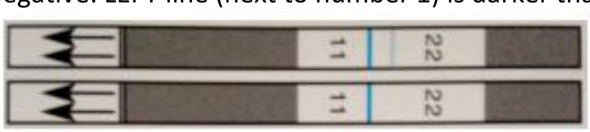
Water Sample	Positive	Negative
A.		
B.		
C.		
D.		

Pesticides and Lead

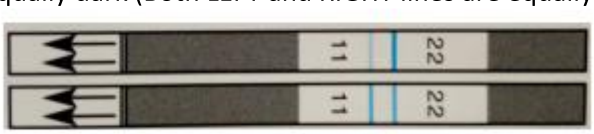
The Lead/Pesticide Test detects dissolved lead at levels below the EPA Action level (15 ppb) and two common herbicides used in the United States at or below the EPA Maximum Contaminant Level –atrazine (3 ppb) and simazine (4 ppb). A positive result does not distinguish which substance is present; rather, it indicates that the sample contains lead and/or pesticides at a toxic level.

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 the dropper, put exactly TWO full droppers 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. Squeeze to expel sample in the vial.
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)



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.

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

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

pH/Hardness/Chlorine

1) Carefully open pH / Hardness / Chlorine Test packet and take out test strip.
2) Immerse strip 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 charts below and record your results.

The pH reagent pad is at the end of the test strip. Match it to the color chart below.

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

The hardness reagent pad is in the middle of the strip. Match it to the color chart below. Record results in ppm.

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

The chlorine reagent pad is nearest the strip handle. Match it to the color chart below. Record results in ppm.

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

Water Test Desired Values

The Environmental Protection Agency (EPA) has established the following maximum contaminant levels for drinking water under the National Primary Drinking Water Regulations.
More information can be found at the EPA's Table of Regulated Drinking Water Contaminants.
https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants

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

How do your results compare to the above EPA standards?

How could stormwater runoff affect our drinking water sources? What other reasons would the following contaminants in stormwater be a problem?

