Activity 1 Instruction Sheet: Turbidity

Time Limit: 15 minutes
Equipment: turbidity tube, measuring cup, waders or boots, life jacket

Turbidity is the cloudiness of water. Turbidity is caused by things suspended in the water, like small plants, animals, sand, mud, and pollutants. High turbidity levels can decrease how much oxygen fish can use from the water. Turbidity can also stop light from reaching plants beneath the surface. A **Secchi disk** is that black and white disk inside the **turbidity tube** that used to measure turbidity.

Activity

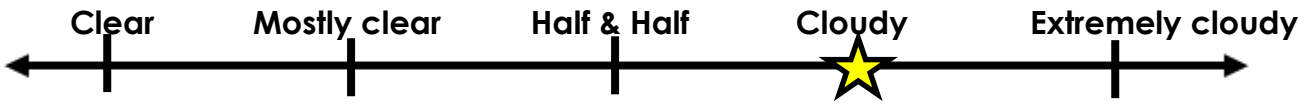
1. Put on waders, go into the river, and fill the measuring cup with water. Don't kick up too much mud, as this will affect your results.
2. Fill the turbidity tube to the top with water. Get another cup full of river water if needed.
3. Place the turbidity tube near the edge of the water with the bottom valve facing the water (this way, when you spill the water out, it doesn't get the whole site wet). As one student looks through the top of the turbidity tube, another slowly lets water out of the tube through the valve at the bottom.
4. The student looking through the top says "Stop" as soon as they can see the black and white circle (Secchi disk). The other student closes the water valve as soon as they hear "Stop."
5. Record the height of the remaining water in the tube as "Reading 1."
6. Empty the tube. Repeat steps 1-4 to obtain "Reading 2."
7. Take the average of your two readings to get your turbidity measurement.
8. Complete the "Field Observations" boxes on your data sheet.

Example

Time	Reading 1	Reading 2	Average
8:17 AM	30 cm	32 cm	31 cm

Field Observations

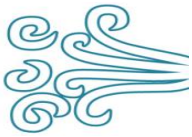
How turbid is the water? Mark your observation on the line.



Field Observations: Circle all that apply.

OBSERVATION	LIKELY CAUSE
Light brown water (muddy or cloudy)	Mud, silt or sand on the river bottom may result from runoff from construction sites or bank erosion
Green water: dark green or blue-green	Organic pollution is being released into the water, feeding algae and causing them to grow.
Multi-color film over water surface	Oil or gasoline spill
Foam floating on water surface	If white in color and over 3 inches high, indicates fertilizer/detergent pollution
Bubbles rising to surface	Anaerobic respiration: bacteria digest leaves etc. which creates gas bubbles.

Activity 2 Instruction Sheet: Weather and Wind



Time Limit: 15 minutes
Equipment: air thermometer, compass, flagging tape, anemometer, sand timer

Weather and wind tell us about the physical conditions around the river. Weather includes what the weather is today and what the weather was like during the past few days. Weather conditions can affect water quality. Heavy rains might flush pollution into the river. High winds can mix extra oxygen from the air into the water and increase dissolved oxygen levels (see Activity 7).

Activity

1. Weather

1. Hold the air thermometer upright and out of direct sunlight. Allow several minutes for the thermometer to give an accurate reading.
2. Record air temperature, cloud cover and precipitation.

Example

Time	Air Temperature ° F	Air Temperature ° C
8:00 AM	66	19

Cloud cover: (*check one*)

- ■ Clear (0-25%)
- ☐ Mostly cloudy (51-75%)
- ☐ Partly cloudy (26-50%)
- ☐ Overcast (76-100%)

Precipitation: (*check all that apply*)

- ■ None
- ☐ Rain
- ☐ Snow
- ☐ Rain and snow
- ☐ Other: _____

Temperature Conversions

° C = 0.556 x (° F - 32)
° F = (1.8 x ° C) + 32

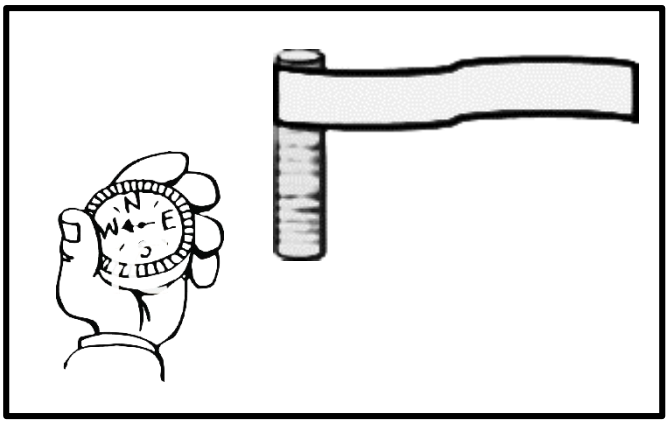
OVER →

Activity

2. Wind

1. Hold up the wooden stick with flagging tape. Use the compass to determine wind direction. Remember, winds are named for the direction the wind is coming *from*, so record the opposite direction of the flagging.

   The example below shows a **west wind**.

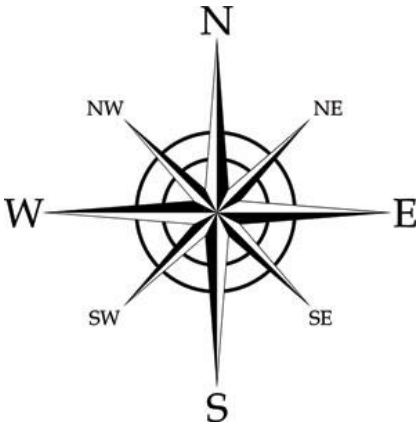


2. Place the cup anemometer in an open area. Assign one person as the "Counter" and one person as the "Timer".
3. When the "Timer "flips over the sand timer, the "Counter" counts how many times the colored cup passes them until time is up. Record this number.

Example

Wind direction: ***West***

Wind Speed: ***8*** rotations per minute



Describe the river water: (*check one*)

- ☐ Virtually flat
- ☐ Calm, slightly wavy
- ■ Rippled
- ☐ Choppy/High waves

Activity 3 Instruction Sheet:
The Environment at the Sample Site

Time Limit: 15 minutes
Equipment: measuring tape, meter stick, waders, life jacket, field guides (optional)

Each sample site is unique, ranging from old industrial sites to rural nature preserves. Some sites may show heavy human involvement, such as industries or houses near the river. Other sites will have many **ecosystems**, such as forests and marshes. An area with more **habitats** usually has a greater variety of living things (**biodiversity**). Every environment has features that can potentially help or harm water quality.

Activity

1. Explore and observe the area around your sample site, using the numbered list as a guide. Record data.
2. Put on waders, choose a location, and use the meter stick to measure the water depth. Do not go in water deeper than your knees.
3. Complete the "Field Observations" boxes. Use field guides to identify plants (optional).

Example

1. Using the list below, describe the land around your site. Estimate to the nearest 5%.

10 %	houses (urban/residential)	0 %	recreational (playgrounds, sports)
0 %	forest	40 %	roads or parking lots
50 %	beach	0 %	other: _____
0 %	marsh/swamp		
0 %	industrial/commercial	Total % = 100%	

2. Shoreline appearance (*check all that apply*):

- ☐ Beach area
- ■ Marsh
- ■ Covered with plants
- ■ Muddy
- ☐ Pier
- ☐ Debris
- ■ Pipe entering river
- ☐ Bulkheading (wooden timbers or metal plates that hold the shore in place)
- ☐ Riprap (large rocks piled up along the shore)
- ☐ Other: _____

3. What is the water depth at the sample site? 12 in. / 30.48 cm.

4. River *bottom* is mostly: (*check one*)

☐ Sandy	■ Muddy	☐ Unable to determine
☐ Rocky	☐ Weedy	

5. What percent of the river *bottom* is covered with plants? (*check one*)

☐ 0-25%	☐ 26-50%	■ Unable to determine
☐ 51-75%	☐ 76-100%	

6. What percent of the river *surface* is covered with plants? (*check one*)

☐ 0-25% ☐ 26-50% ■ 51-75% ☐ 76-100%

Activity 4 Instruction Sheet: Nitrate and Phosphate Levels

Time Limit: 15 minutes
Equipment: water chemistry kit, waders or boots, container for waste chemicals, sand times

NITRATES: Nitrogen is a common element in the air we breathe. It is also used by organisms to build protein. Nitrogen occurs in streams in several forms. The easiest form to measure is nitrates (NO4).

PHOSPHATE: Phosphorus is a nutrient that acts as a fertilizer for aquatic plants. Phosphorus occurs in natural waters in the form of phosphates (PO4).

Nitrogen and phosphorus are often added to fertilizer to help crops grow. High measurements of these elements may be caused by fertilizer runoff, manure runoff, leaky septic systems, sewage treatment plants, car exhausts, or industrial waste. The use of phosphorus detergents also contributes to high phosphate levels.

Nitrates and phosphates are necessary for organisms in small qualities. However, high amounts can cause rapid plant growth that can become a nuisance.

An increase in plant growth in the water, such as an algal bloom, can cause water temperature to increase and dissolved oxygen to decrease. When these plants die, bacteria causing the plants to decompose use large amounts of dissolved oxygen. Low amounts of dissolved oxygen and higher temperatures can be stressful and deadly to fish and other aquatic organisms. This process is called **eutrophication**.

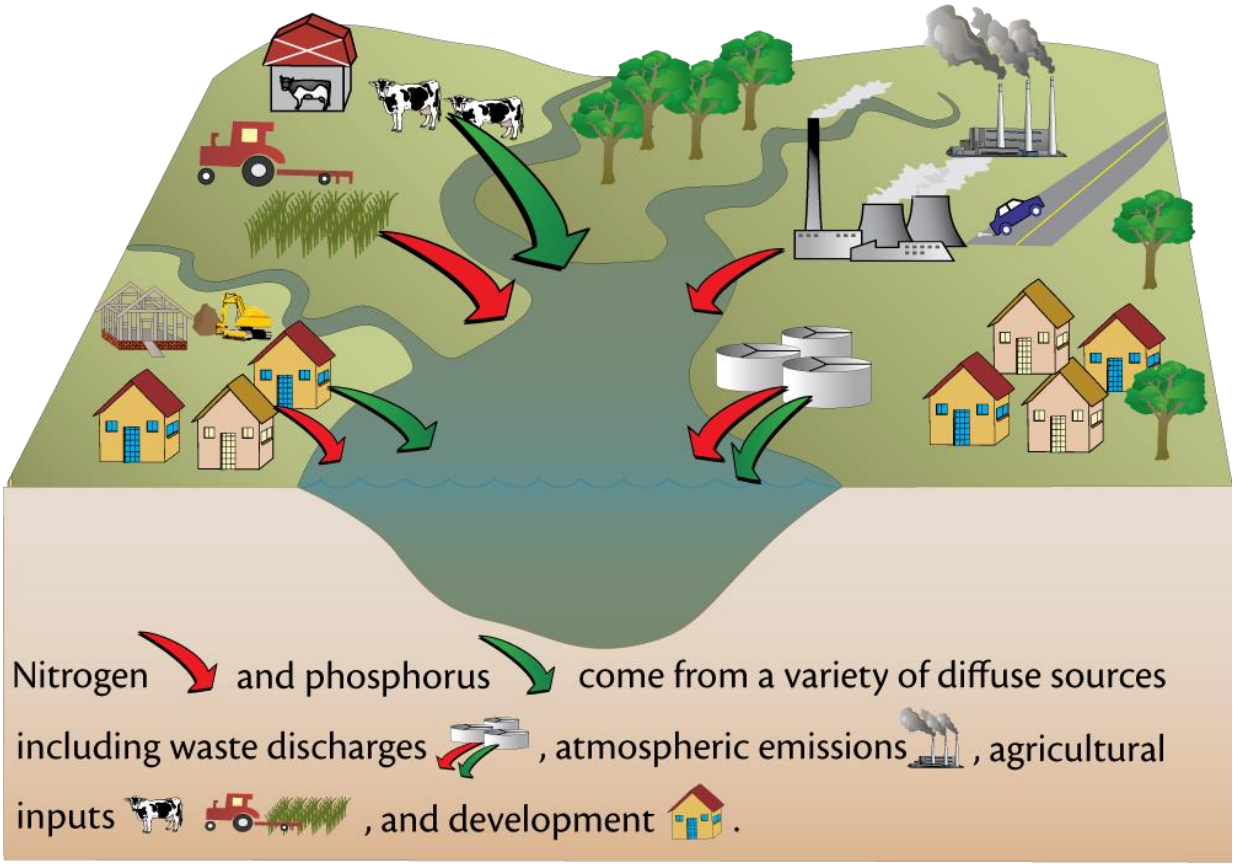


Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Lane, H., J.L. Woerner, W.C. Dennison, C. Neill, C. Wilson, M. Elliott, M. Shively, J. Graine, and R. Jeavons. 2007. Defending our National Treasure: Department of Defense Chesapeake Bay Restoration Partnership 1998-2004. Integration and Application Network, University of Maryland Center for Environmental Science, Cambridge: MD.

OVER →

Activity

1. Nitrate Levels

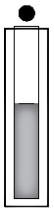
PROCEDURE

1. Fill the test tube (0106) to the 5 mL line.

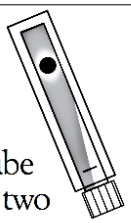
2. Add one Nitrate #1 TesTab (2799A).

3. Cap the tube & mix until the tablet has disintegrated.

4. Add one *Nitrate #2 CTA TesTab (NN-3703A). Immediately slide the test tube into the Protective Sleeve (0106-FP).



5. Cap the tube & mix for two minutes to disintegrate the tablet.



LaMotte Testabs Water Investigation Kit

6. Wait 5 minutes. Remove the tube from the Protective Sleeve.

Start the phosphate test while you wait

7. Compare the color of sample to the Nitrate color chart (5891-CC). Record the result as ppm Nitrate.

Dispose of solution in waste container.

Example

Time	Nitrate Level (ppm)
8:00 AM	20

Activity

2. Phosphate Levels

PROCEDURE

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1. Fill the test tube (0106) to the 5 mL line.

2. Add one Phosphorus TesTab (5422A).

3. Cap the tube & mix until the tablet has disintegrated.

4. Wait 5 minutes.

5. Compare the color of the sample to the Phosphate color chart (5892-CC). Record result as ppm Phosphate.

Example

Time	Phosphate (ppm)
8:00 AM	2

Don't Forget!
Dispose of solution in waste container.

Activity 5 Instruction Sheet: Water Temperature

Time Limit: 15 minutes
Equipment: water thermometer, meter stick, waders, life jacket

Water temperature can determine which animals survive in the river. It affects their feeding habits and other bodily functions. Water temperature also determines how much oxygen the water has in it. Oxygen that is mixed into water is called "dissolved oxygen." Warm water holds less oxygen than cold water, which means there's less oxygen for fish and other animals to breathe.

One factor that can change water temperature in a river is **thermal pollution**. Thermal pollution occurs when heated water flows into a waterway. Industries and power plants may draw in cold river water to cool machines, and then return warmer water to the river. Buildings and sidewalks can trap heat and warm up rainwater, which then runs off into the river.

Activity

1. Put on waders. Do not go in water deeper than your knees.
2. Choose a location and measure the water depth with the meter stick. Record water depth.
3. Submerge the water thermometer for 2 to 4 minutes at that location. Record the water temperature as "Reading 1."
4. Repeat steps 2-3 to obtain "Reading 2."
5. Average the two readings.
6. Complete the Field Observations box.

Example

	Time	Depth	Temperature
Reading 1	8:00am	20 in 50.8 cm	65 ◦ F 18.3 ◦ C
Reading 2	8:02am	20 in 50.8 cm	66 ◦ F 18.8 ◦ C
		Average Temperature	65.5 ◦ F 18.6 ◦ C

Field Observations

Check off all of the potential sources of thermal pollution at your site:

- ■ Industry/power plant
- ■ Road
- ■ Parking lot/sidewalk
- ☐ Pipe entering water
- ☐ Buildings
- ☐ Other: _____

Unit Conversions

◦ C = 0.556 x (◦ F - 32)
◦ F = (1.8 x ◦ C) + 32
Centimeters = inches x 2.54

Activity 6 Instruction Sheet: Bioassessment

Time Limit: 15 minutes
Equipment: waders, life jackets, scoop nets, viewers, Cool Whip containers, shallow tubs, macroinvertebrate ID sheets, field guides (optional), seine net (optional)

Macroinvertebrates ("macro" = big, "invertebrates" = animals without backbones) are animals visible to the naked eye, such as insects, worms, and spiders. Some macroinvertebrates spend their entire life in the water. Others, such as dragonflies and damselflies, begin life in the water and take to the air as adults. Just like frogs, macroinvertebrates go through **metamorphosis**, where their bodies change from egg, to juvenile, to adult. They also have special **adaptations** that help them survive in the water, such as oar-shaped legs, snorkel-like breathing tubes, and hairs that trap air like a scuba tank.

A **bioassessment** ("bio" = life, "assessment" = study) looks at the health of an **ecosystem**, like a river. It uses living things in the ecosystem, like macroinvertebrates, as clues to its health. Species that can live in polluted waters are "tolerant." Species that can't handle pollution are "intolerant." If you find pollution-intolerant animals, it means you have good water quality!

Activity

1. Put on the waders. Grab a small net and Cool Whip container. Scoop for macroinvertebrates along the river's edge, under rocks, along the river bottom, or on aquatic plants.
2. Use the bigger nets (if available) to scoop in deeper water. Do not go in water deeper than your knees.

   To use the seine net: stretch the net between two people. Make sure the sinkers are on the bottom and the foam rollers are on top. Walk upstream (against the current) and see if anything swims into the net.
3. Place macroinvertebrates in the pond viewers and shallow tubs. Identify and record each species.
4. Complete the Pollution Tolerance Index and the Field Observations boxes.
5. You may keep macroinvertebrates in the tubs for other students to see. Release all animals back to the river at the end of the event.

Example

Macroinvertebrate Species List

Species	# Estimated
1. Stonefly nymph	4
2. Mayfly nymph	13
3. Dragonfly nymph	2
4. Crayfish	1
5. Aquatic Worms	hundreds
6. Water Strider	~50
7. Mosquito larva	hundreds
8. Water Scorpion	1

Field Observations

List any other species you saw (birds, fish, frogs, etc.)

Mallard Ducks
Canada Geese
Minnow
Golden Shiner fish
Green Frog

OVER →

Activity

Pollution Tolerance Index

1. Place a check next to each macroinvertebrate species you caught. For example, whether you found one mayfly or 50 mayflies, place one check next to the mayfly line in Group 1.
2. Complete the chart for all of the marcoinvertebrate groups.
3. Calculate each group's score using the formulas provided.
4. Add all of the group scores together for your Total Score.
5. Compare your Total Score with the Water Quality Assessment scores. Record the quality rating for your sample site.

Example

Group 1 Macroinvertebrates: Very Intolerant	**Group 2 Macroinvertebrates: Intolerant**	**Group 3 Macroinvertebrates: Tolerant**	**Group 4 Macroinvertebrates: Very Tolerant**
x Stonefly x Mayfly ____ Caddisfly ____ Dobsonfly	x Dragonfly ____ Damselfly ____ Scud	x Water Strider ____ Water Mite x Crayfish	____ Pouch Snail x Aquatic Worm ____ Water Boatman
# of checks 2 x 4 Group Score = 8	# of checks 1 x 3 Group Score = 3	# of checks 2 x 2 Group Score = 4	# of checks 1 x 1 Group Score = 1

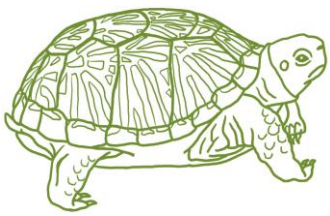
Total Score = 16

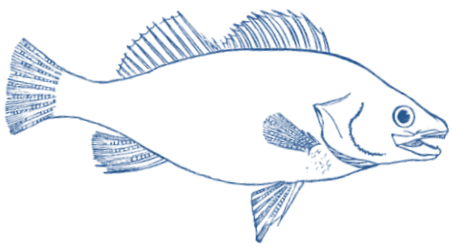
Water Quality Assessment (*circle one*):
23 or more = Potentially Excellent Water Quality
17-22 = Potentially Good Water Quality
11-16 = Potentially Fair Water Quality
10 or less = Potentially Poor Water Quality

Intolerant = animal can't live in polluted water.

Tolerant = animal can live in polluted water.

Adapted from Project WET, 2011





Activity 7 Instruction Sheet: Chemical Analysis

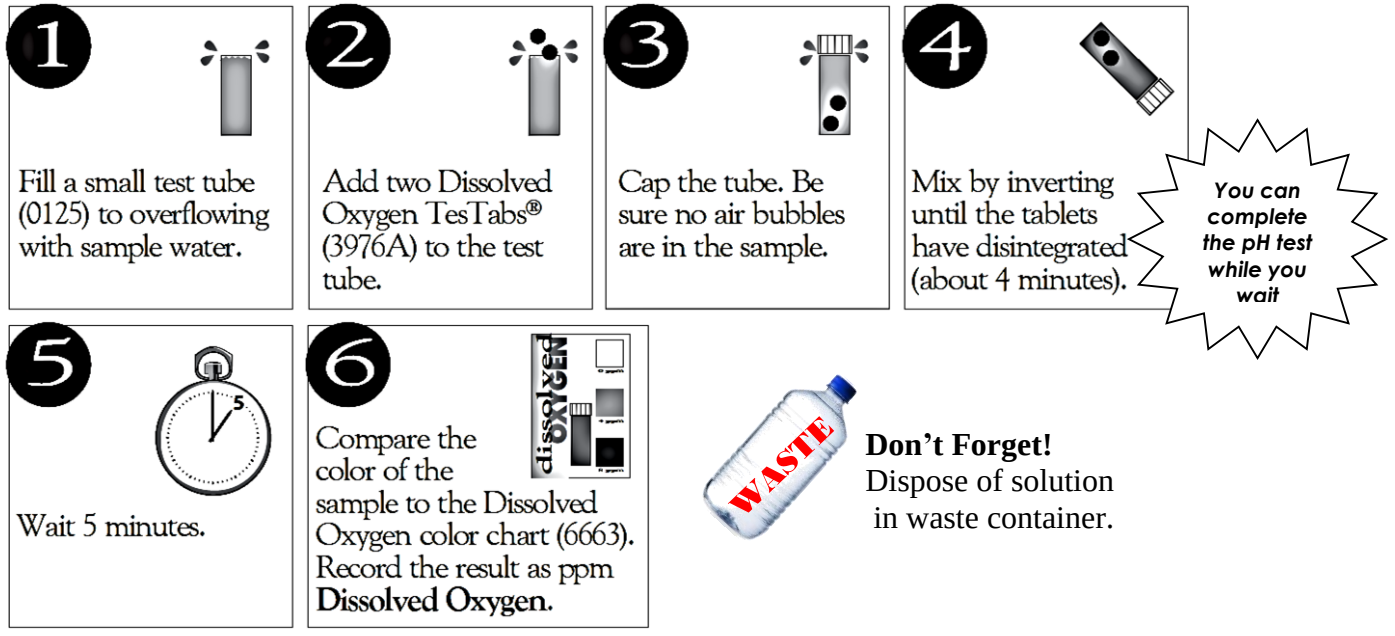
Time Limit: 15 minutes
Equipment: water chemistry kit, waders or boots, water thermometer, container for waste chemicals, ruler (optional)

1. **DISSOLVED OXYGEN**: Oxygen that is mixed into water is called "dissolved oxygen" (DO). It is a measure of how much oxygen is in the water for fish and other organisms to use. It is measured in parts per million (ppm). One ppm is like one cent in $10,000.

   DO increases when wind mixes up the water or when river plants make oxygen during **photosynthesis**. DO decreases when it is used by river animals to breathe, when photosynthesis stops during the night, or when the water is polluted. **A healthy stream DO range is 5 – 11 ppm.**

Activity

PROCEDURE *LaMotte Testabs Water Investigation Kit*



Example

Time	Water Temperature	DO (ppm)	% Saturation *(extra activity)*
8:00 AM	70° F / 21° C	8	90%

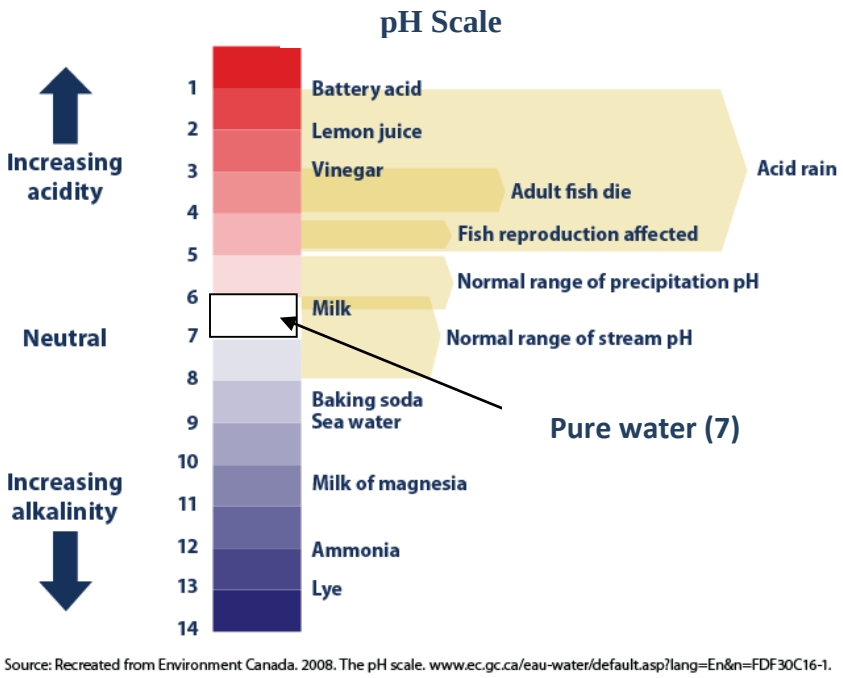
EXTRA ACTIVITY - Determining percent saturation: Percent saturation is a measure of how much dissolved oxygen is in the water and available for aquatic life to use. Waterways with a saturation value of **90% or greater** are considered healthy.

1. Measure the water temperature with the water thermometer. Record in the table.
2. On the graph in your packet, pair up your DO (ppm) result with the water temperature (° C) with a ruler. Draw a straight line between the two values. The percent saturation is the value where your drawn line intercepts the angled saturation scale.

OVER →

2. **pH**: The pH scale measures how **acidic** or **basic** (alkaline) a solution is on a scale of 0 to 14. You may have tested pH before with litmus paper. Pure water is neutral, and has pH of 7.0. **Anything with a pH less than 7.0 is acidic**, and turns litmus paper red. Something that's acidic is an orange. **Anything with a pH greater than 7.0 is basic**, and turns litmus paper blue. Something that's basic is soap.

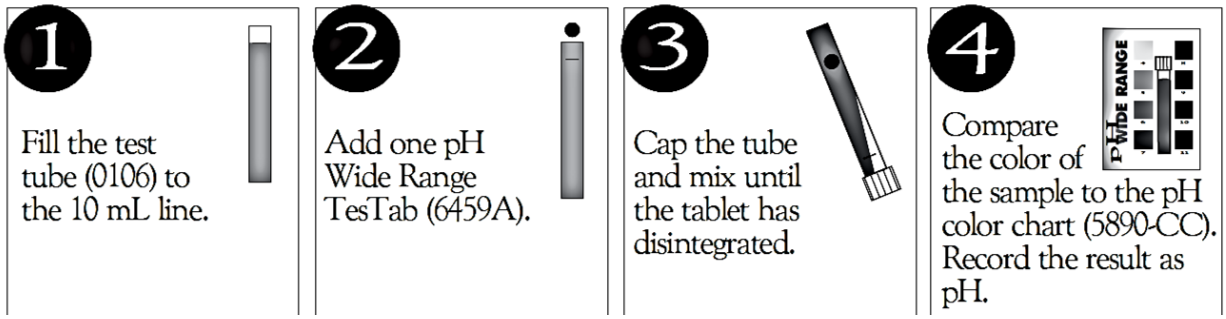
   Most river animals are very sensitive to pH changes, and may die if the pH falls outside of the healthy range. **A healthy stream pH range is 6.5 – 8.2.**



Source: Recreated from Environment Canada. 2008. The pH scale. www.ec.gc.ca/eau-water/default.asp?lang=En&n=FDF30C16-1.

Activity

PROCEDURE *LaMotte Testabs Water Investigation Kit*



While one students mixes the tube, other students can test pH using the testing strips:

1. Fill a test tube with river water to the 10 mL line.
2. Dip one pH strip in the sample water for 10 seconds. Hold the strip as still as possible.
3. Remove strip.
4. Immediately match the strip to the corresponding pH color chart. Record the result in the table.
5. Dispose of sample water and test strip in the waste container.
6. Complete the Field Observations box.

Example

Test Type	Time	pH
Tablet	8:00 AM	7.5
pH Strip	8:00 AM	8