Watershed Watchdogs

Assessing Water Quality

Water Quality Testing Instructions

For some tests, you will need the Kit Code, which is located on the bottom right hand side of the box lid. Example: Kit 3354

Table of Contents

Parameters to be completed on site during the field study:

Parameters started on site and completed in the classroom:

DISSOLVED OXYGEN

WHY DOES DISSOLVED OXYGEN MATTER?

The dissolved oxygen (DO) test measures the amount of oxygen present in the water. All animals need oxygen to live. Aquatic organisms such as fish, macroinvertebrates, and aerobic bacteria all require oxygen for respiration. Oxygen dissolves readily into water from the atmosphere, especially in rivers and streams where there are riffles (rapids) until the water is saturated.

Oxygen is also produced by aquatic plants, algae, and phytoplankton as a by-product of photosynthesis.

The amount of oxygen required by aquatic species varies. Dissolved oxygen levels below 2 parts per million (ppm) or mg/L may not support fish. Dissolved oxygen levels below 3 ppm are stressful to most aquatic organisms. Levels of 5 to 6 ppm are usually required for growth and activity for most aquatic species.

Read all steps before beginning:

Part 1: Collect the Water Sample

Your goal in collecting the water sample is to make sure that there are no bubbles or air pockets in the sample bottle.

1) Find the glass water sample bottle with the black cap (may be in your DO box or in the big box).

2) Remove cap and rinse the bottle in the sample water (body of water being tested). Place the cap back on the rinsed, empty bottle.

3) Submerge the bottle (with cap attached) under the water (your hand will get wet). Remove the black cap while the bottle is under water, and tilt until it is completely filled.

4) While the bottle is still completely submerged, tap the sides of the bottle until all air bubbles are gone.

5) **Important**, while the bottle is still under water, put the cap back on.

6) When you take the bottle out of the water, invert it (turn it upside down) with the cap on to check again to make sure no air bubbles are trapped inside.

7) If there is any air, repeat the process until you can fill the bottle all the way, with no air. Take the bottle with the cap on back to your table.

DISSOLVED OXYGEN continued:

Part 2: Adding the Reagents (the chemicals to test for DO)

Read all of the Part 2 instructions before proceeding.

Any time you open the bottle during this part of the procedure, atmospheric oxygen is added and this should be minimized.

1) Find the bottles of manganous sulfate solution and alkaline potassium iodide azide in your DO box.

2) Remove the cap of the water sample bottle and immediately add 8 drops of manganous sulfate solution AND 8 drops of alkaline potassium iodide azide.

3) Cap the sample bottle and shake it several times to mix the contents. A precipitate (cloudy substance) will form.

4) Allow the precipitate to settle below the shoulder (rounded top) of the bottle (Figure 1).

5) While waiting, find the bottle of sulfuric acid in your DO box.

6) **When the precipitate has settled below the shoulder**, add 8 drops of the sulfuric acid to your sample bottle.

7) Cap and shake the bottle until the precipitate has dissolved. If the precipitate has not totally dissolved after two minutes of shaking, check with your instructor or teacher before going to the next step.

At this point the solution in your water sample bottle is "fixed," meaning that contact with air will not affect your results.

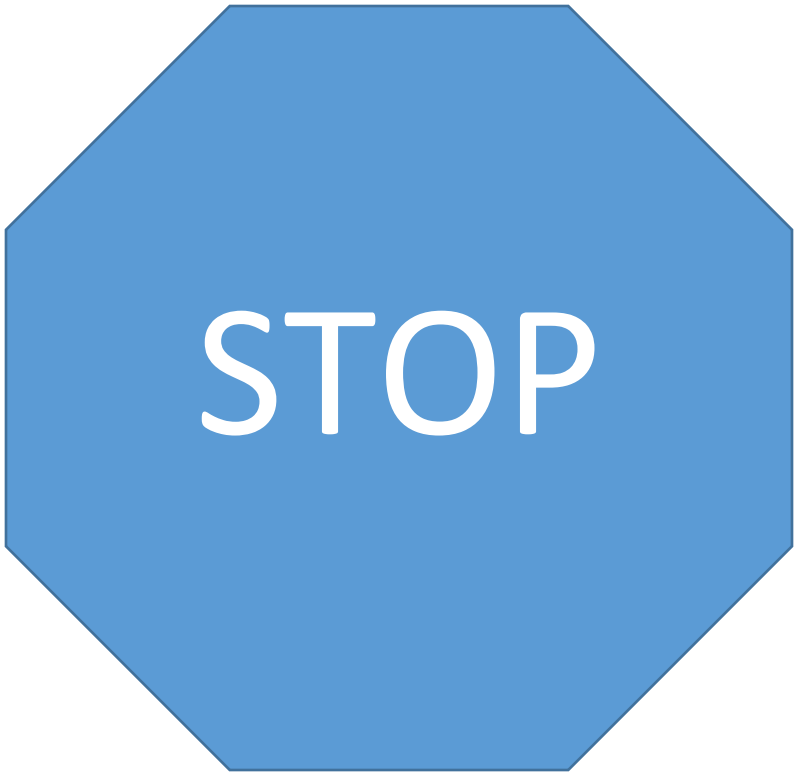
Figure 1

Part 3: Titration

1) Take the cap off of the Titration Tube (Figure 2). **Pour** 20 mL of the fixed sample from the sample bottle (Figure 3) into the titration tube. Cap the titration tube.

Figure 2: Titration Tube

Figure 3: Sample Bottle



Check with your instructor.

DISSOLVED OXYGEN continued:

Titration means adding solution **a drop at a time** to produce a measureable change. In Bridging the Watershed, we call this the "drop and swirl method". Using your titrator (Figure 4) you will add one drop of solution to the fixed sample in the capped titration tube and then give the tube a gentle swirl. Keep doing this until you get the result you are looking for. You must keep the extra solution (liquid) in the titrator when you are done; you will need it later!

Part 3: Titration *continued*

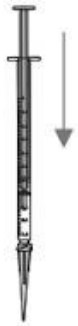


Figure 4: Titrator

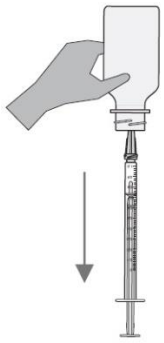


Figure 5: Filling the titrator

2) Find your titrator (Figure 4) and the bottle of sodium thiosulfate in your DO box.

3) Uncap the sodium thiosulfate and insert the titrator into the top.

4) Turn the bottle upside down. You may need a partner to hold the bottle.

5) Slowly pull the plunger on the titrator (Figure 5) until the ring on the plunger gets to 0.0. You will now have enough sodium thiosulfate in the titrator to react with 10 ppm of oxygen.

6) Check for bubbles. If you have any bubbles in the titrator, keep the titrator in the sodium thiosulfate bottle, and squirt the solution back into the bottle to release any bubbles.

7) Once you have the titrator full of sodium thiosulfate without any bubbles, turn the bottle upright and remove the titrator.

8) Titrate the fixed sample by inserting the titrator into the small hole in the cap of the titration tube.

DISSOLVED OXYGEN continued:

Part 3: Titration *continued*

9) Add **one drop** of sodium thiosulfate to the fixed sample in the capped tube and then give the tube a gentle swirl.

10) Keep doing this, **one drop at a time**, until the solution becomes **pale yellow**.

11) The best way to accurately determine the color change is to hold the sample bottle and the titration tube against a solid white background (you can use your direction manual for this purpose).

Important: Keep your leftover sodium thiosulfate solution in the titrator, as you will need it later.

12) Carefully remove the cap to the titration tube and add 8 drops of starch indicator solution. Cap the titration tube and gently swirl. The sample should turn blue.

13) Cap the titration tube and insert the tip of the titrator with the remaining sodium thiosulfate into the opening of the titration tube cap.

14) Continue to titrate the sodium thiosulfate (one drop, swirl, repeat) until the blue solution becomes colorless.

15) If you need to refill your titrator with sodium thiosulfate, do so in the same manner as described on the previous page.

16) The ppm of sodium thiosulfate remaining, in the titrator corresponds with the ppm or mg/L of dissolved oxygen in the water.

Record the amount of sodium thiosulfate remaining from the scale on the titrator in the appropriate space on your data sheet. You are not done yet!

17) Dump the used chemicals including any leftover sodium thiosulfate into the chemical waste bucket. Ask your instructor if you do not know where the chemical waste bucket is.

DISSOLVED OXYGEN continued:

Part 4: Determining Percent Saturation *continued*

1) To find the dissolved oxygen percent saturation, you must also determine the temperature (in Celsius) of the water where you collected your sample.

2) Find the thermometer in your kit. This will be in the main part of your box or a small side pocket.

3) At the site where you are performing the water quality tests submerge the thermometer about 4 inches below the surface. Do not let it touch the bottom of the stream, and hold it tightly.

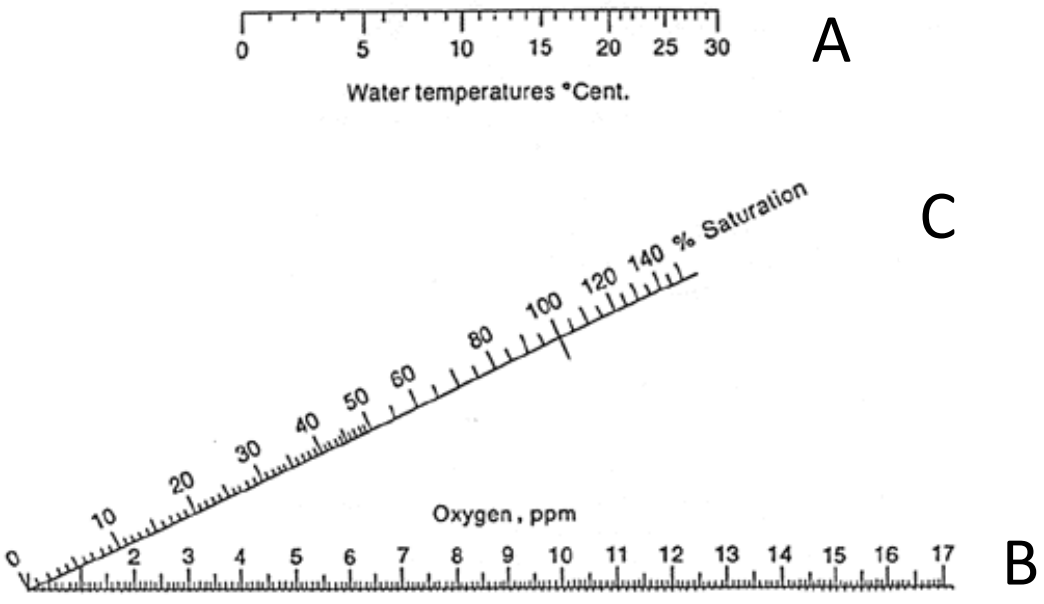
4) Hold it in place for about two minutes, until it remains constant, and read the temperature while the thermometer is still under water.

5) Record the temperature in the appropriate space on your data sheet in degrees Celsius. Determine the maximum percent dissolved oxygen by using the graph on the next page.

6) On the figure below, find the temperature on the top scale (A), then the amount of titrant (the ppm) used on the bottom scale (B).

7) Use a straight edge to line up the two results (your clipboard can work for this). Where the straight edge hits the % saturation scale (C), is your final result.

8) Record the oxygen saturation percentage on your data sheet.



DISSOLVED OXYGEN continued:

Use the guidelines below to determine whether the amount of dissolved oxygen is in the acceptable range, and circle yes or no on your data sheet.

WHAT DO THESE NUMBERS MEAN?

Is there enough dissolved oxygen to support aquatic life?

> 100%–80% saturation of dissolved oxygen	is	sufficient/acceptable
79–60% saturation of dissolved oxygen	is	stressful/unacceptable
< 60% saturation of dissolved oxygen	is	fatal/unacceptable

TURBIDITY

WHY DOES TURBIDITY MATTER?

Turbidity is a measure of how cloudy water is. Turbid water contains suspended solids such as soil particles (clay, silt, fine sand), plankton, algae, and microorganisms. These materials are typically in the size range of 0.004 mm (clay) to 1.0 mm (sand), large enough to block some of the light rays, reducing the amount of light that can pass through the water. The higher the turbidity, the less light passes through to the plants living under water.

Drinking water should have a turbidity less than 0.5 Jackson turbidity units (JTU). Typical groundwater is considered acceptable with a turbidity of anything less than 1.0 JTU.

In a stream, turbidity greater than 40 JTU can damage gills and interfere with the ability of fish to find food. 8–-10 JTU may cause harmful effects to animal life by interfering with respiration and can affect submerged plants by blocking sunlight. Around 5–7 JTU allows for plankton to flourish, supporting a healthy, well-functioning ecosystem. Below 4 JTU is safe for drinking water.

In this test, you are trying to see how much material is clouding the water. The reagent is actually just dirt particles that you are adding to the “clean” water until it is as “dirty” or “cloudy” as the sample (river) water.

Read all steps before beginning:

1) The equipment for the turbidity test, the turbidity tubes (two large tubes with a base) and the standard turbidity reagent, may be in a box within the chemistry kit, or may be found separately in the kit.

Turbidity Tubes

Standard Turbidity Reagent

TURBIDITY continued:

2) Fill the turbidity tube labeled: "Sample" to the 50 mL line with sample water (from the body of water we are testing today). Collect the water away from the shore and below the surface of the water in an area that has not been disturbed and made muddy by walking in the water. Look straight down into the tube.

3) If you cannot see the black dot on the bottom of the tube, pour out half the water so that the tube is filled to just the 25mL line.

4) Fill the turbidity tube labeled "standard" with the same amount of distilled or tap water, which you will get from your instructor.

5) Place both tubes on the table next to each other and look straight down through the water into the tube to the black dot at the bottom. Make sure no one is touching the table.

If the dot is equally clear in both tubes, turbidity is zero. Remember, you are matching the cloudiness of the water, not the color.

6) If the dot is fuzzy or less clear in the sample tube than it is in the standard tube, there is some turbidity in the water.

You must keep track of how many times you add reagent. Remember, you are matching the cloudiness of the water, not the color.

7) To measure the turbidity, take out the bottle of standard turbidity reagent (you may find this in the turbidity box or in the main part of your water chemistry kit), and vigorously shake the closed bottle. Check your cap. If it has a pipette attached to the lid, proceed. If it does not, see your instructor.

8) Fill the pipette to the 0.5 mL line with the standard turbidity reagent and add this to the "standard" (clean water) tube. Gently swirl the tube or stir, using the stirring rod, to mix the reagent with the water and put it back on the table.

9) Look down into each tube at the black dot. If the dot in the "standard" tube and the "sample" tube look the same, stop and use the instructions and chart on the next page to determine the sample water's turbidity in JTUs, and write this on your data sheet.

TURBIDITY continued:

10) If the sample is still "dirtier" or "more cloudy," add another 0.5mL of standard turbidity reagent to the "standard" (clean water) tube until it matches the cloudiness of the "sample" (dirty water) tube. Each time you add 0.5mL of reagent, stop and swirl or stir the tube and then compare the dots of the two tubes.

10) When you have matched the cloudiness in both tubes, use the amount of turbidity reagent added and the chart to convert the final result. Record the result in JTU on your data sheet.

11) Using the information below the chart, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

Turbidity Test Results

Number of Measured Additions	Reagent Added mL	50 mL Graduation JTU	25 mL Gradation JTU
1	0.5	5	10
2	1.0	10	20
3	1.5	15	30
4	2.0	20	40
5	2.5	25	50
6	3.0	30	60
7	3.5	35	70
8	4.0	40	80
9	4.5	45	90
10	5.0	50	100
15	7.5	75	150
20	10.0	100	200

WHAT DO THESE NUMBERS MEAN?

0–7 JTU	is	a good, clean, healthy ecosystem/acceptable
8–10 JTU	is	slightly polluted/acceptable
> 10 JTU	is	polluted/unacceptable

PHOSPHATES

WHY DO PHOSPHATES MATTER?

Phosphorus is essential for life. When phosphorus combines with four oxygen atoms, it forms a phosphate ion. Phosphate that is not combined in any molecules in plants or animals, making it available for reaction, is called orthophosphate. Algae and larger aquatic plants rapidly take up this ion because they need it for many metabolic reactions and for growth.

In most natural bodies of water, orthophosphate is present in very low concentrations. When compared to phosphorus, nitrogen is more important to plants. However, there is usually plenty of nitrogen available. Therefore, the less-available phosphorus acts as the growth-limiting factor for producers because plants compete for it, and plant growth and reproduction will be limited by the amount available.

The most common reasons for excess phosphates are due to human impact. Some of these reasons are: fertilizers for lawns or crops, detergents with phosphate water softeners, industrial wastes, human and animal waste.

When excess amounts of orthophosphates are available, algae reproduce rapidly in population explosions called algal blooms. These algal blooms are problematic because when algae die, bacteria consume it and depletes the oxygen in the water.

*****Check your kit number. If you have code 3121-01, use the instructions on the next page. If you have code 3121-02 turn to page 28, and for code 3119-01, turn to page 30.**

PHOSPHATES Kit 3121-01

Read all steps before beginning:

1) Fill a test tube to the 10mL line with sample water (in the stream, river, pool, or body of water we are testing today).

2) Use the 1.0 mL pipet to add 1.0 mL of phosphate acid reagent. Cap and shake to mix.

3) Use the 0.1 g spoon to add one level measure of phosphate reducing reagent to the same test tube. Cap and mix until dissolved.

4) Set timer for 5 minutes and wait. While you are waiting, fill out the remaining parts of your data-sheet like location, weather, or sketch your site. Other team members can complete the change in temperature test at this time.

5) Fill two test tubes to the 10 mL line with sample water.

Do not add any chemicals to these test tubes.

6) Insert the sealed vial of distilled water into the square hole on the left side of Octet-Comparator.

7) Insert the two test tubes with untreated sample into the slots in the axial reader on either side of the treated sample (Figure 1).

Figure 1: Octet-Comparator with sealed vial of distilled water and two untreated sample test tubes, placed correctly.

PHOSPHATES Kit 3121-01 continued:

8) Insert the test tube with the treated sample into the slot in the Axial Reader directly behind the sealed vial of distilled water (Figure 2).

9) Line up the top edge of the axial reader with the top edge of the Octet-Comparator.

Figure 2: The treated sample has a lid on it, and is placed correctly.

10) Remove any test tube lids and hold the comparator so that natural light shines down through the test tubes.

11) Compare color in the center test tube to colors in the top left corner of Octet-Comparator (Figure 3).

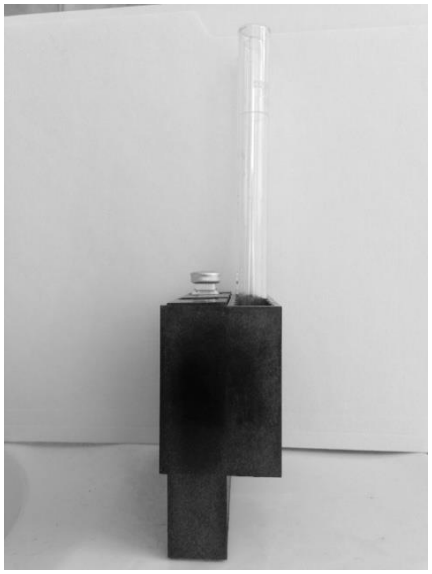


Figure 3: Top edges of Axial Reader and Octet-Comparator are aligned.

12) If the color is darker than the color labeled as “0” or zero, compare the color to the color labeled as “0.2”. If the color is darker than the color labeled as “0.2”, slide the Axial Reader down so that the bottom of the Axial Reader is even with the Comparator.

13) Repeat until you find a color match and record your results on your data sheet. Using the information on the next page, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

PHOSPHATES 3121-01 continued:

WHAT DO THESE NUMBERS MEAN?

0–0.306 mg/L of orthophosphates	is acceptable
> 0.306 mg/L of orthophosphates	causes eutrophication/unacceptable

PHOSPHATES Kit 3121-02

Read all steps before beginning:

1) Fill a test tube to 10mL line with sample water (from the stream, river, pool, or body of water we are testing today).

2) Place this test tube in the rear hole of the Octa-Slide Viewer (Figure 1).

Do not add any chemicals to this test tube.

3) Fill the other test tube to the 10 mL line with sample water.

4) Use the 1.0 mL pipet to add 1.0 mL of phosphate acid reagent. Cap and shake to mix.

5) Use the 0.1 g spoon to add one level measure of phosphate reducing reagent. Cap and mix until dissolved. Place test tube in front hole (Figure 2).

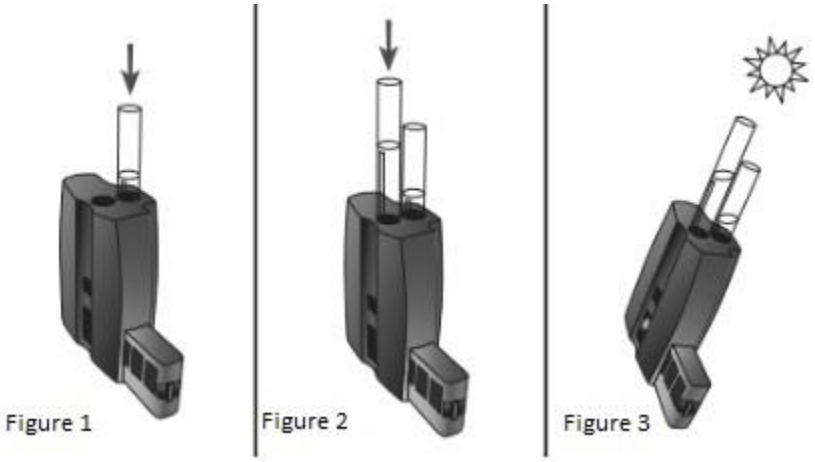
6) Set a timer for 5 minutes and wait.

7) Fill out the remaining parts of your data sheet on location, weather, or sketch your site. Other team members can complete the change in temperature test at this time.

8) Remove any test tube lids and angle the Octa-Slider viewer so that light is shining through the test tubes (Figure 3).

9) Match the sample color to the color standard by moving the Octa-Slide bar back and forth. When you find a matching color, record this number on your data sheet. This is your phosphate level.

10) Using the information on the next page, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.



PHOSPHATES Kit 3121-02 Continued:

WHAT DO THESE NUMBERS MEAN?

0–0.306 mg/L of orthophosphates	is acceptable
>0.306 mg/L of orthophosphates	causes eutrophication/unacceptable

PHOSPHATES Kit 3119-01

STEPS:

1) Take out the Octa-Slide viewer and insert the Octa-Slide bar, making sure that the right side with the phosphate scale is in the viewer (Figure 1).

2) Fill a test tube to 10 mL line with sample water (in the stream, river, pool, or body of water we are testing today).

3) Place it in the rear hole of the viewer (Figure 2).

Do not add any chemicals to this test tube.

4) Fill the other test tube to the 10 mL line with sample water (in the stream, river, pool, or body of water we are testing today).

5) Use the 1.0 mL pipet to add 1.0 mL of phosphate acid reagent to the test tube. Cap and shake to mix.

6) Use the 0.1 g spoon to add one level measure of phosphate reducing reagent. Cap and mix until dissolved.

Place test tube in front hole of the Octa-Slide viewer (Figure 3).

7) Set timer for 5 minutes and wait.

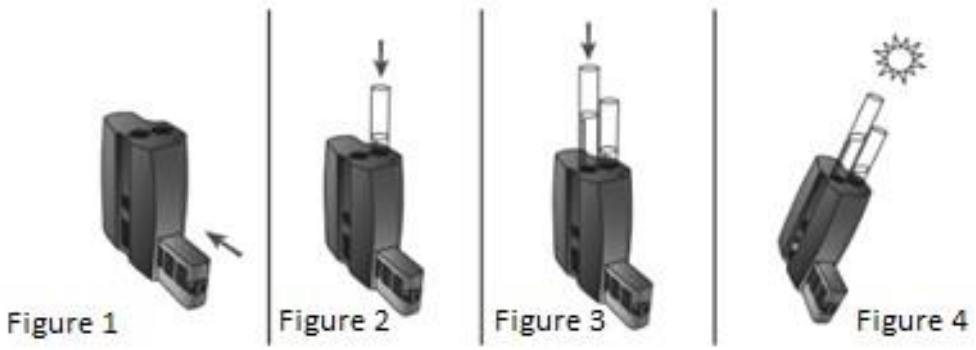
8) Fill out the remaining parts of your data sheet like location, weather, or sketching your site. Other team members can complete the change in temperature test at this time.

8) Remove any test tube lids and angle the Octa-Slide Viewer so that light is shining through the test tubes (Figure 4).

9) Match the sample color to the color standard by moving the Octa-Slide bar back and forth.

10) When you find a matching color, record this number on your data sheet. This is your phosphate level.

11) Using the information on the next page, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.



PHOSPHATES Kit 3119-01 continued:

WHAT DO THESE NUMBERS MEAN?

0–0.306 mg/L orthophosphates	is acceptable
> 0.306 mg/L orthophosphates	causes eutrophication/unacceptable

NITRATES

WHY DO NITRATES MATTER?

Both plants and animals need nitrogen to build proteins and nucleic acids. Animals get nitrogen from the foods they eat. Plants get nitrogen from the soil and what is dissolved in the water. A certain amount of nitrates gets into water by natural processes such as the decomposition of organic matter.

Human sources of nitrates are fertilizers, leaky septic tanks, and manure from livestock. Sewage treatment plants release nitrogen into waterways. The burning of fossil fuels (e.g., from homes and vehicles) also releases nitrogen into the atmosphere in the gases released after combustion.

Too much nitrogen in water bodies can overstimulate plant growth (especially algae). An over-abundance of algae can cause excess turbidity in water, keeping light from reaching rooted aquatic plants. When algae die, bacteria and decomposers use oxygen to break down the algae, leading to reductions in dissolved oxygen in water.

Natural levels of nitrate are usually less than 4.4 mg/L or ppm.

The drinking water standard for nitrate is 44 mg/L or ppm. Concentrations of nitrate greater than that in drinking water can result in restriction of oxygen transport in the bloodstream in humans.

*****Check your kit number. If you have code 3354, use the instructions on the next page. If you have code 3354-01 turn to page 21, or 3119-01, turn to page 22.**

NITRATES Kit Number 3354

Read all steps before beginning:

1) Fill the test tube to the 5 mL line with the sample water (from the stream, river, pool, or body of water we are testing today).

2) Add one nitrate #1 CTA tablet to the test tube by pressing the tablet through the bubble pack.

3) Cap and mix until the tablet dissolves.

4) Add one nitrate #2 CTA tablet to the test tube, by pressing the tablet through the bubble pack. Cap and mix until the tablet dissolves.

5) Set a timer and wait 5 minutes.

6) Fill out the remaining parts of your data sheet like location, weather, or sketching your site. Other team members can complete total dissolved solids test at this time.

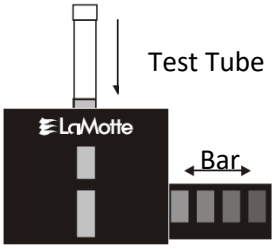


Figure 1: Octa-Slide Viewer with test tube

7) Insert the nitrate-nitrogen Octa-Slide bar into the Octa-Slide viewer and the test tube into the Octa-Slide viewer (Figure 1).

8) Raise viewer in front of a sheet of paper (you can use this manual for that). Match the sample color to a color standard by moving the bar back and forth.

9) When you find a matching color, multiply the corresponding number by 4.4 and record this on your data sheet.

This is your nitrate level.

10) Using the information below, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

WHAT DO THESE NUMBERS MEAN?

0–4.4 mg/L	is unpolluted, healthy amount of nitrogen, acceptable
>4.4 mg/L	is polluted, with the potential for eutrophication, unacceptable

NITRATES Kit Number 3354-01

Read all steps before beginning:

1) Fill the test tube to the 5 mL line with the sample water (from the stream, river, pool, or body of water we are testing today).

2) Add one nitrate #1 CTA tablet to the test tube by pressing the tablet through the bubble pack. Cap and mix until the tablet dissolves.

3) Add one nitrate #2 CTA tablet to the test tube, by pressing the tablet through the bubble pack.

4) Cap and immediately slide test tube into the silver protective sleeve. Mix for 2 minutes to dissolve the tablet. Leave the test tube inside the protective sleeve.

5) Set a timer and wait 5 minutes.

6) While you are waiting, fill out the remaining parts of your data sheet like location, weather, or sketching your site. Other team members can complete total dissolved solids test at this time.

7) Remove the tube from the protective sleeve. Insert the nitrate-nitrogen Octa-Slide bar into the Octa-Slide viewer and the test tube into the Octa-Slide viewer (Figure 1).

8) Raise the Octa-Slide viewer in front of a blank sheet of paper. Match the water sample color to a color on the Octa-Slide Bar, 0–15 ppm, by moving the test tube up and down.

Figure 1 Octa-Slide viewer with Octa-Slide Bar and test tube inserted

9) When you find a matching color, multiply the corresponding number by 4.4 and record this on your data sheet. This is your nitrate level.

10) Using the information below, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

WHAT DO THESE NUMBERS MEAN?

0–4.4 mg/L	is unpolluted, healthy amount of nitrogen
> 4.4 mg/L	is polluted, with the potential for eutrophication/unacceptable

NITRATES Kit Number 3119-01:

Read all steps before beginning:

1) Take out the Octa-Slide viewer and insert the Octa-Slide bar, making sure that the left side with the nitrogen scale is in the viewer (Figure 1).

2) Fill a test tube to the 10mL line with sample water (from the stream, river, pool, or body of water we are testing today). Insert this test tube into the rear hole of the Octa-Slide viewer (Figure 2).

Do not add any chemicals to this test tube.

3) Fill the other test tube to the 2.5 mL line with sample water.

4) Fill the same test tube to the 5 mL line with mixed acid reagent. Cap and mix. Wait two minutes.

5) Use the 0.1 gram spoon to add one measure of nitrate reducing reagent to the same test tube. Cap and mix for one minute.

6) Place capped test tube in the front hole of the viewer (Figure 3).

7) Wait for 10 minutes.

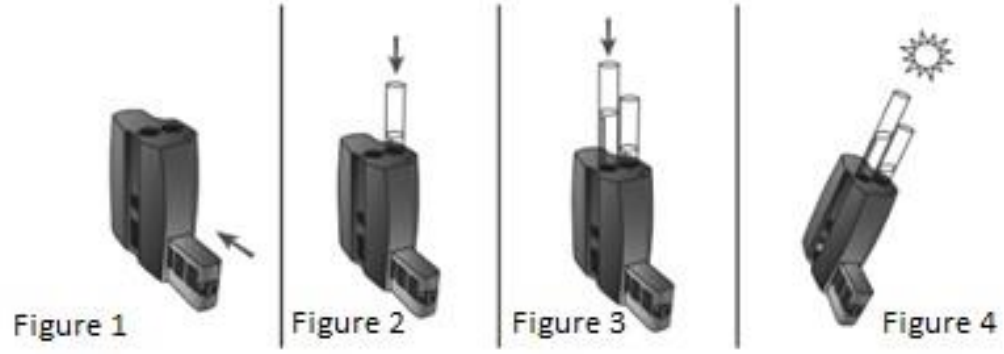
8) Fill out the remaining parts of your data sheet like location, weather, or sketch your site. Other team members can complete total dissolved solids test at this time.

9) Remove the cap from the front test tube.

10) Angle the Octa-Slide Viewer so that light is shining through the test tubes (Figure 4). Match the sample color to the color standard on the Octa-Slide by moving the bar back and forth.

11) When you find a matching color, multiply the corresponding number by 4.4 and record this on your data sheet. This is your Nitrate Level.

12) Using the information on the next page, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.



NITRATES 3119-01 continued:

WHAT DO THESE NUMBERS MEAN?

0-4.4 mg/L	is unpolluted, healthy amount of nitrogen, acceptable
>4.4 mg/L	is polluted, with the potential for eutrophication, unacceptable

CHANGE IN TEMPERATURE

WHY DOES TEMPERATURE MATTER?

Temperature affects many of the chemical qualities of water itself, how much dissolved oxygen can be held in the water, and many biological and physical processes within the aquatic ecosystem.

Humans cause water temperature changes by removing stream bank vegetation and tree canopy that shade the water, impounding water (meaning we confine it, like with a dam), and discharging heated water from power plants and factories (thermal pollution). A significant source of heated (and contaminated) water is runoff from impervious surfaces, like roads and parking lots that flow into storm drains and then into rivers.

A very important measure is the change in temperature from one place in a river to another place, downstream, in the same river on the same day. The segment between the two places where you take the temperature is called a "reach."

Read all steps before beginning:

For this parameter, the water sample is tested in place. This means the thermometer is placed in the actual sample water (from the stream, pool, or body of water we are testing today), not a test tube.

1) Find the thermometer in your kit. **This will be in the main part of your box or a small side pocket**.

2) At the site where you are performing the water quality tests submerge the thermometer about 4 inches below the surface. Do not let it touch the bottom of the stream, and hold it tightly.

3) Hold it in place for about two minutes, until it remains constant, and read the temperature while the thermometer is still under water.

4) Record the temperature on your data sheet in degrees Celsius.

5) Immediately go 10 meters upstream from your original test site and repeat this procedure. If you are unsure where to test, ask your instructor.

CHANGE IN TEMPERATURE continued:

6) Try and find a location that has similar habitat to where you took the first test – i.e. similar water depth and water speed. Record the temperature on your data sheet in degrees Celsius.

7) Determine the temperature change for that "reach" using the following equation:

Temperature downstream [°C] - temperature upstream [°C] = temperature change

8) Using the information below, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

WHAT DO THESE NUMBERS MEAN?

A change of 0–5 degrees Celsius	is acceptable
A change > 5 degrees Celsius	is an indicator of thermal pollution/unacceptable

TOTAL DISSOLVED SOLIDS

WHY DO TOTAL DISSOLVED SOLIDS MATTER?

Each body of water contains a unique mixture of dissolved materials. Total dissolved solids (TDS) is the amount of material dissolved in the water. Sources of TDS include runoff from urban areas, salt carried in runoff from the streets, fertilizers from lawns, and many other materials.

Rainwater has very little dissolved in it, so it has a low TDS level of less than 10 ppm. Rivers typically contain between 100 and 2,000 ppm of dissolved material. Municipal water systems try to achieve <500 ppm TDS for drinking water. Higher TDS levels give water a mineral taste and can cause the water to have a laxative effect.

Read all steps before beginning:

For this parameter, the water sample is tested in place. This means the meter is placed in the actual sample water (from the stream, river, pool, or body of water we are testing today), not a test tube.

1) Find the TDS meter (in the main part of your kit, in a clear box). Remove the cap from the TDS meter.

2) Press the ON/OFF button once to turn the meter on. When you are sure the meter is on, dip the meter's electrode (the uncapped end only) into the water sample.

3) Keep the electrode in the sample for 10 seconds. Press the HOLD button once to keep the number on the display. Remove the meter from the water and record the ppm reading on your data sheet.

4) Press the ON/OFF button once to turn the meter off. The display reading will be blank.

5) Rinse the electrode with distilled or tap water provided by your instructor.

6) Recap the meter.

7) Use the guidelines on the next page to determine whether the total dissolved solids measurement is in the acceptable range, and circle yes or no on your data sheet.

TOTAL DISSOLVED SOLIDS continued:

WHAT DO THESE NUMBERS MEAN?

< 500 ppm TDS is acceptable

>500 ppm TDS is polluted/unacceptable

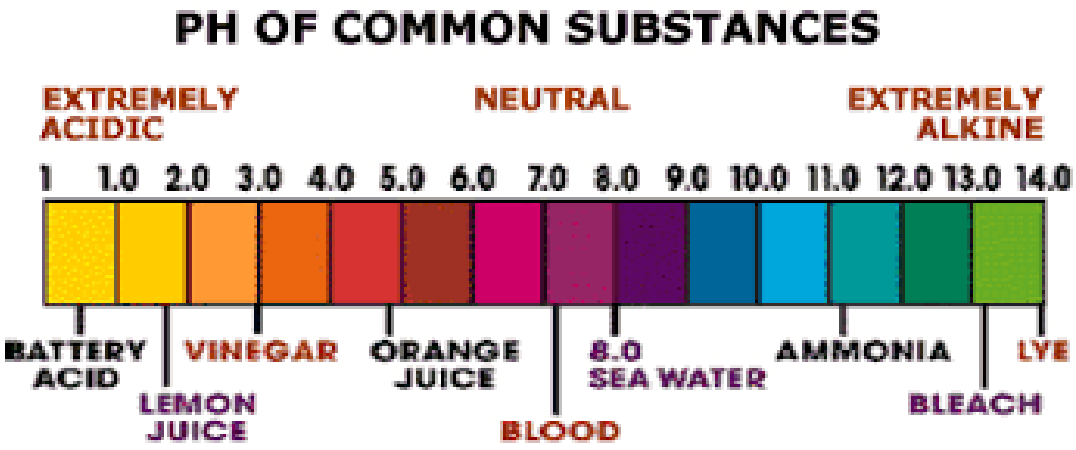
pH

WHY DOES pH MATTER?

The pH test is one of the most common variables used in water quality testing. pH ranges from 0–14, with 7.0 considered neutral. Solutions with a pH below 7.0 are considered acids, and those with a pH above 7.0 are considered bases.

Most rainwater has a pH of about 5.6, slightly acidic. What we call pH is really a ratio of the hydrogen ions (H^+) to hydroxide ions (OH^-) in the sample.

The chart below shows the pH of common substances, and the chart at the end of this section shows the optimal pH range for some aquatic organisms.



*****Check your kit number. If you have code 5858, use the instructions on the next page. If you have code 5858-01, turn to page 34.**

pH Kit 5858:

Read all steps before beginning:

1) Fill the test tube to the 5 mL line with the sample water (from the stream, river, pool, or body of water we are testing today).

2) Add 10 drops of wide range indicator. Cap and mix.

3) Insert the test tube into the Octet-Comparator (Figure 1), and raise the comparator in front of a sheet of paper. Match the sample color to a color standard.

4) Record the pH on your data sheet**.** Using the chart below, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

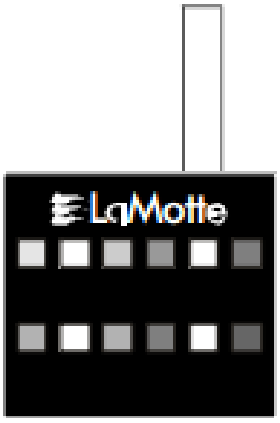
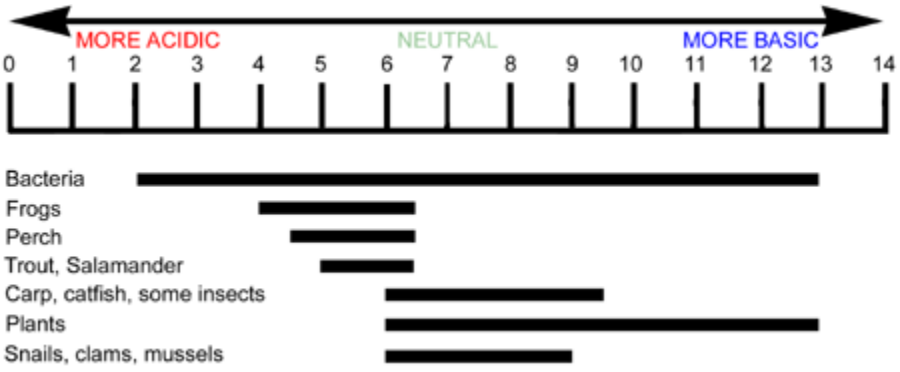


Figure 1: Test tube in comparator

WHAT DO THESE NUMBERS MEAN?



pH of 0–4	is fatal to fish and humans/unacceptable
pH of 4–6.5	is stressful/unacceptable
pH of 6.5–8.2	is acceptable
pH of 8.2–11.5	is stressful/unacceptable
pH of 11.5–14	is fatal to fish and humans/unacceptable

pH Kit 5858-01

Read all steps before beginning:

1) Fill a test tube to the 10 mL line with the sample water (in the stream, river, pool, or body of water we are testing today).

2) Add 10 drops of wide range indicator. Cap and mix.

3) Take out the Octa-Slide viewer and slide one Octa-Slide bar into the viewer (Figure 1).

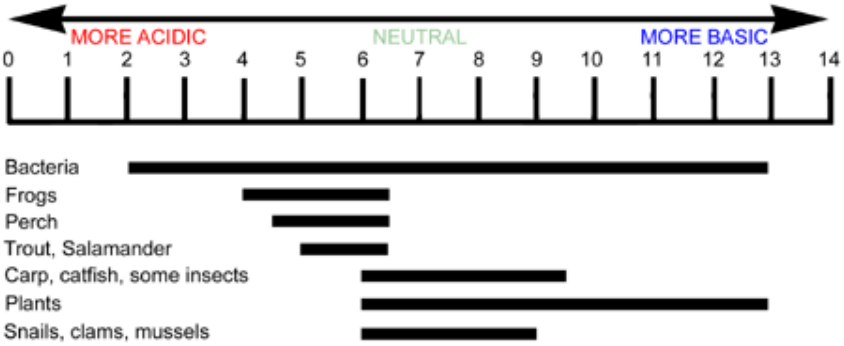
4) Insert the test tube into the viewer, and raise the viewer in front of a sheet of paper. Match the sample color to a color standard on the Octa-Slide bar.

5) If the color doesn't match any of the colors on the bar, switch to the other bar and try again.

6) Record the pH on your data sheet. Using the chart below, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

Figure 1 Octa-Slide viewer with Octa-Slide Bar and test tube inserted

WHAT DO THESE NUMBERS MEAN?



pH of 0–4	is fatal to fish and humans/unacceptable
pH of 4–6.5	is stressful/unacceptable
pH of 6.5–8.2	is acceptable
pH of 8.2–11.5	is stressful/unacceptable
pH of 11.5–14	is fatal to fish and humans/unacceptable

FECAL COLIFORM

WHY DOES FECAL COLIFORM MATTER?

Fecal coliform bacteria (most commonly *Escherichia coli*, or just *E. coli*) are found naturally in the lower intestine of many vertebrates, including humans.

They are not found in water unless intestinal wastes (feces) have contaminated the water, so their presence in water is a reliable indicator of fecal contamination.

Fecal coliform bacteria do not usually cause disease, but many other types of organisms present in sewage do. It is much easier to test for *E. coli* than for all the other possible types of microbes. Therefore, *E. coli* can be used to warn us about the possible presence of those other pathogenic (disease-causing) organisms.

While drinking water has an acceptable level of 0 bacteria colonies per 100 mL, primary contact (swimming, bathing, anything where a high degree of bodily contact, immersion, and ingestion of water is likely) has a desirable range of less than 200 and an acceptable range of less than 1,000 colonies per 100 mL. Secondary contact (activities such as boating) has a desirable range of less than 1,000 and an acceptable range of less than 5,000 colonies per 100 mL.

Read all steps before beginning:

Part 1: Setting up the Petri Dish

1) Obtain the equipment for this parameter from your instructor.

2) Use a sterile pipette to add 3 mL of sample water (from the stream, river, pool, or body of water we are testing today) to the Coliscan medium bottle.

3) Tightly cap the Coliscan and water mixture and gently swirl.

Do not shake.

4) Shaking will cause foam to form, making your plate difficult to read.

5) Pour the Coliscan and water mix into a pre-treated Petri dish. You want the mixture to cover the bottom surface of the Petri dish.

6) Cover and set the Petri dish on a level surface until the liquid forms a gel, about 30 minutes.

7) Tape the Petri dish shut.

8) Take the Petri dish back to the classroom and place it in a warm place (29.5–35.0 C) and incubate for 24–48 hours.

Part 2: Reading and Calculating Results

1) After incubation, count bacteria colonies by looking at the Petri dish on a white sheet of paper, and then on a black sheet of paper for comparison.

Count only the **pink and purple colonies** that appear within 12–36 hours.

2) All other colonies are members of the coliform group, but only the purple colonies are fecal coliform. The *E. coli* are generally the fastest growing types of bacteria on this medium.

3) After 48 hours other types of bacteria may appear which should not be counted in your data.

4) To determine the coliform colonies per 100 mL of water, divide 100 mL by the 3 mL sample and then multiply that number by the number of coliform colonies on your Petri dish.

The equation is:

(100/3) x the number of coliform colonies = colonies/100 mL

5) Record the number of colonies/100 mL on your data sheet.

6) Using the information below, determine whether this reading is in the acceptable range, and circle yes or no on your data-sheet.

WHAT DO THESE NUMBERS MEAN?

< 200 colonies/100 mL	is acceptable
> 200 colonies/100 mL	is polluted/unacceptable

BIOCHEMICAL OXYGEN DEMAND

WHY DOES BIOCHEMICAL OXYGEN DEMAND MATTER?

Organisms that need oxygen to stay alive are called “aerobic.” When aerobic bacteria decompose aquatic organic matter, they use oxygen in the water.

Biochemical oxygen demand (BOD) is a measure of how much oxygen these bacteria use in the aerobic oxidation of organic matter. Bacteria use oxygen dissolved in water to decompose excess algae, animal manure, and pollutants such as inadequately treated sewage.

Read all steps before beginning:

Ask your teacher if your class is completing the BOD test today. If so, they will provide you with your own water sample bottle.

1) Your goal in collecting the water sample is to make sure that there are no bubbles or air pockets in the sample bottle.

2) Take the water sample bottle and remove the cap, rinse the bottle in the sample water (in the stream, river, pool, or body of water being tested). Place the cap back on the rinsed, empty bottle.

3) Submerge the bottle (with cap attached) under the water (your hand will get wet). Remove the black cap while the bottle is under water, and tilt until it is completely filled. While the bottle is completely submerged, tap the sides of the bottle until all air bubbles are gone.

4) **Important**: while the bottle is still under water, put the cap back on the bottle.

5) When you take the bottle out of the water, invert it (turn it upside down) with the cap on to check again to make sure no air bubbles are trapped inside. If there are any bubbles, repeat the process until you can fill the bottle all the way, with no bubbles.

6) Cover the bottle tightly with aluminum foil, label, and bring it back to school with you. Keep it wrapped in the aluminum foil, and store undisturbed in a dark place for five days.

BIOCHEMICAL OXYGEN DEMAND continued:

7) Using the 5-day old sample water, follow the test procedures for Dissolved Oxygen, and record the mg/L on your data sheet.

8) To determine BOD, subtract your result from the DO reading of the same-day sample:

DO of same-day sample (mg/L) – DO of sample after 5 day incubation (mg/L) = BOD

Using the information below, determine whether this reading is in the acceptable range, and circle yes or no on your data sheet.

WHAT DO THESE NUMBERS MEAN?

< 5 mg/L difference	is acceptable
6–29 mg/L difference	is considered moderately polluted/unacceptable
> 30 mg/L difference	is unsafe/unacceptable