# Flint River GREEN: Dissolved Oxygen

## MATERIALS

- LaMotte Dissolved Oxygen Kit
- 2nd Bottle and Foil for BOD
- Safety Goggles (1/person)
- Nitrile Gloves (2/person)
- Overflow Container
- Paper Towel
- Temperature Reading
- Waders or Boots

## VOCABULARY

- Biodiversity
- Dissolved Oxygen (DO)
- Organic Matter
- Precipitate
- Invert
- Titration Tube
- Titrator
- Percent Saturation

## WATER QUALITY STANDARDS

**DRINKING WATER:**

- No drinking water standards

**SURFACE WATER:**

- Coldwater Streams: $\geq$ 7mg/L
- Warmwater Streams: $\geq$5 mg/L
- Ideal percent saturation: 80%-120%

## WHAT DOES THIS TEST MEASURE?

Aquatic animals need oxygen to live just like land animals do. In order for oxygen to be made available for most aquatic organisms, it must be dissolved in water. Higher **dissolved oxygen** is usually better. We typically find the greatest **biodiversity** in waters with high levels of dissolved oxygen. This test measures the amount of oxygen in water and is paired with a temperature reading to determine the **percent saturation** (the amount of dissolved oxygen in the water sample compared to the maximum possible amount that could be present at the same temperature).

## LOOK FOR THESE CAUSES

**EVIDENCE FOR DECREASES IN DO?**

- Is the water warmer than normal?
- Is the stream stagnant or slow moving?
- Do you see excess **organic matter** and decomposition occurring?
- Is there a lot of groundwater input?

**EVDENCE FOR INCREASES IN DO?**

- Do you see aquatic plants or algae growing in the water (photosynthesis)?
- Are there high winds or do you see water moving through ripples or waterfalls (this mixes and dissolves oxygen from the air)?

## CONNECTING CONCEPTS

- Cold water can hold more dissolved oxygen than warm water. As water temperature rises, gases like oxygen are driven out of the water (much like how a warm soda pop goes flat).
- Water clarity or turbidity affects the amount of sunlight that is available to aquatic plants.
- Excess organic matter could be caused by direct outside sources (such as sewage, lawn clippings, and erosion) or by excess nutrients entering the water which stimulate plant growth.

## WEB LINKS

- USGS Water Science School: https://water.usgs.gov/edu/dissolvedoxygen.html
- List of Michigan's Coldwater Streams: http://www.michigandnr.com/law/law_book/orders/Fisheries%20Orders.html#FO210
- Activity (50 min): Teaching Great Lakes Science—Sizing up the Lake Erie Dead Zone: http://www.miseagrant.umich.edu/lessons/lessons/by-broad-concept/physical-science/dead-zones/activity-sizing-up-the-lake-erie-dead-zone/
- Case Study: Tracking Oxygen in Lake Erie's Central Basin—https://ohioseagrant.osu.edu/news/2017/0n38h/tracking-oxygen-lake-erie

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## PROCEDURE: PARTS 1 & 2 of 3

**Part 1 of 3 (at stream):**

1. Inventory your test kit supplies—check to be sure everyone is wearing gloves and goggles first!
2. Enter the stream wearing gloves and waders or boots. Aim to stand as close to the middle of the main stream flow as possible and away from vegetation. Try not to kick up excess sediment from the bottom of the stream while you are working. <u>SAFETY NOTE: Do not stand in water above your ankles if wearing boots or above your knees if you are wearing waders. DO NOT enter flooded streams.</u>
3. Rinse the glass sample bottle with stream water, then empty the bottle and cap it. 
4. While the cap is on the bottle, submerge the bottle completely ($\geq$ 4”), then remove the cap and allow the bottle to fill with water. 
5. While the bottle is still under water, tip the bottle sideways, tapping it until all of the air bubbles escape. 
6. Cap the bottle while it is still under the surface of the water. 
7. Remove the bottle and tip it upside down to be sure there are no air bubbles left inside. If there are air bubbles, repeat steps 3-7.

**Part 2 of 3 (at stream):**

1. Make sure everyone is wearing safety goggles and gloves.
2. Work over a container and make sure no air is added to the sample while adding chemicals.
3. Remove the cap from the bottle and add <u>8 drops</u> of Manganous Sulfate Solution AND <u>8 drops</u> of Alkaline Potassium Iodide Azide.
4. Cap the bottle and **invert** several times. A **precipitate** will form.
5. After the precipitate settles below the shoulder of the bottle, remove the cap and add <u>8 drops</u> of Sulfuric Acid, 1:1. <u>SAFETY NOTE: This chemical may burn if it gets on your skin, even through your clothes. Make sure you wash any skin contact with this chemical immediately with soap and water.</u>
6. Cap the bottle and wipe off any chemical overflow.
7. Mix by gently inverting several times. DO NOT shake the bottle. Your sample should turn orange.
8. Continue inverting until the precipitate has dissolved (5-10 minutes). While waiting for your precipitate to dissolve, collect the Biochemical Oxygen Demand (BOD) sample. If a different group is assigned to the BOD test, use this time to read and understand part 3 of these instructions.
9. The sample is now fixed and Part 3 of the test may be completed at school if short on time.

## WHAT TO WATCH OUT FOR

- This is the most complex test to complete. A very common mistake is caused when a sample is not taken directly from the stream. Do no collect a bucket of water to take your sample from if it is avoidable. Extra splashing in the bucket or from pouring one bucket into another can introduce extra oxygen from the atmosphere and give you a false reading.
- Make sure you get all air bubbles out of the bottle while it is still submerged in the stream.
- Work over an overflow container. Have paper towel ready to clean up any spill over.

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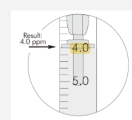
FLINT RIVER WATERSHED COALITION

## PROCEDURE: PART 3 of 3

**Part 3 of 3 (at stream or back at school):**

1. Gloves and Goggles! Fill the **titration tube** to the 20mL line with the fixed  sample from Part 2.
2. After shaking the bottle, add 8 drops of Starch Indicator Solution and cap the titration tube. Your sample should turn blue. *NOTE: This step usually comes later in the instructions that come with the LaMotte kit. Instead, it is easier and accepted to add the Starch Indicator Solution here.*
3. Depress the plunger of the **Titrator** completely. 
4. Insert the tip of the Titrator into the hole in the plug on the top of the Sodium Thiosulfate 0.025N titrating solution. 
5. Invert the bottle once the Titrator has been inserted and slowly withdraw the plunger until the widest ring on the plunger lines up with the zero (0) line on the scale. *NOTE: If small air bubbles appear in the Titrator, get rid of them by partially filling the Titrator and then pumping the titration solution back into the container. Repeat until the air bubbles disappear*.
6. Turn the bottle upright and remove the Titrator. SAFETY NOTE: The Titrator is very sensitive. Be sure everyone in your group is wearing goggles and keep the Titrator pointed away from others during this test.
7. Insert the tip of the Titrator into the opening of the titration tube cap.
8. Slowly depress the plunger to dispense the titrating solution, stopping at each whole number and swirling the titration tube until the color begins to fade. *TIP: View reaction over a white paper.*
9. When the color begins to fade, add smaller amounts of the titrating solution as you continue (stop at each subdivision on the Titrator scale to swirl). You want to pinpoint the exact reading on the scale that the solution turns colorless.
10. If you dispense all of the titrating solution before your sample turns colorless, fill the Titrator again and continue the titration. If this occurs you will need to add 10 to your final reading.
11. Once your sample is colorless, read where the widest ring meets the scale on the Titrator to the nearest subdivision (each subdivision is 0.2). If you feel you added too much titrating solution, you can re-do the test with the rest of your fixed sample form Part 2.




12. Final Reading: ______ (+ 10 if you re-filled the Titrator) = _________ **Parts Per Million (ppm)**
13. Record your result, clean up, and dispose of your chemicals in a hazardous waste container.
14. Use your final reading in ppm along with the temperature ($^{o}$C) on the Percent Saturation chart to calculate percent saturation of dissolved oxygen for your sample site: _________ **% Saturation**
15. Use your % Saturation to find your Q-Value on the Temperature Change Chart. **Q-Value: _______**
16. Check the Q-Value by adding the temp. data at http://www.flintrivergreen.org/add-info/add-data/

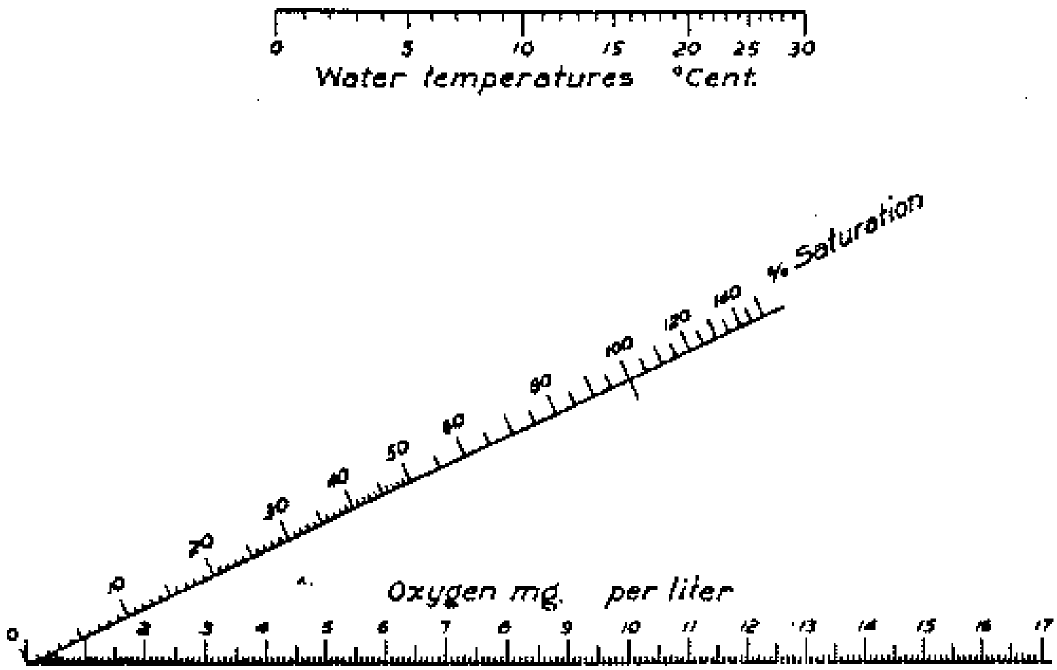
## WHAT TO WATCH OUT FOR

- Make sure to remove the air bubbles from the Titrator when adding the Sodium Thiosulfate.
- Make sure you used the stream temperature in Celsius when calculating percent saturation.
- Be sure to use % Saturation to determine the Q-value, NOT ppm oxygen.
- Make sure to add 10 to you final reading if you refilled the Titrator.
- Try to get the temperature reading from the stream as close to the time that you did Parts 1 & 2 as possible.

**% Saturation:**

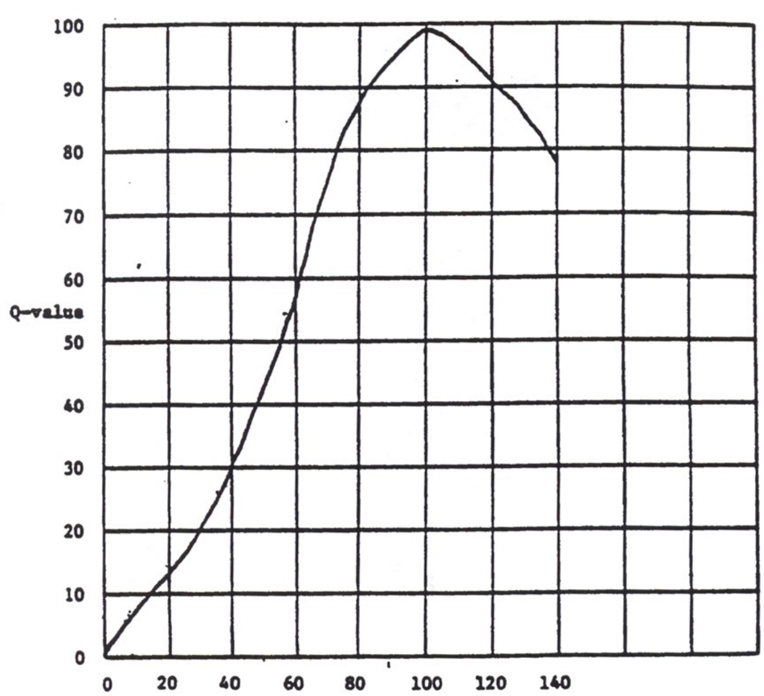
On the chart at the right, draw a straight line from the temperature at your site (°C) to your Dissolved Oxygen reading (mg/L). The percent saturation can be read where your line crosses the diagonal line.

There is also a fairly complicated equation you can use to determine percent saturation available at http://www.waterontheweb.org/under/waterquality/oxygen.html.




LaMotte 5860-01 Dissolved Oxygen Test Kit Percent Saturation Chart

**Dissolved Oxygen Q-Value Chart**




DO: % saturation

Note: if DO % saturation >140.0, Q=50.0


## Dissolved Oxygen Kit

*__Contents__*

a. Manganous Sulfate Solution - [4167-G]

b. Alkaline Potassium Iodide Azide - [7166-G]

c. Sulfuric Acid, 1:1 - [6141WT-G]

d. Sodium Thiosulfate, 0.025N - [4169-H]

e. Starch Indicator Solution - [4170WT-G]

f. Direct Reading Titrator - [0377]

g. Test Tube, 5-10-12.9-15.20.25mL, glass - [0608]

h. Water Sampling Bottle, 60mL, glass - [0688-DO]