HYDROLOGY PROTOCOLS FOR GLOBE AND NON-GLOBE AQUATICS TESTS

UW-MADISON, SPACE SCIENCE ENGINEERING CENTER

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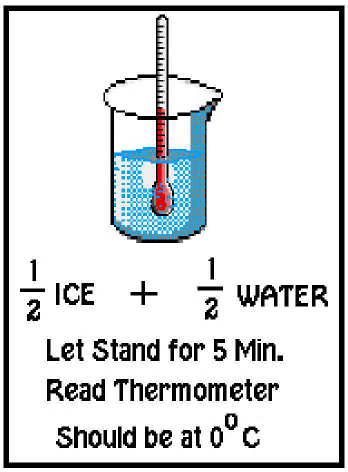
FIELD WATER CHEMISTRY PROTOCOLS

WATER TEMPERATURE PROTOCOL

Part 1: Calibration and Quality Control Before Going into the Field



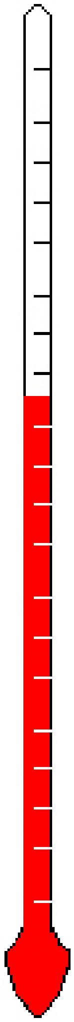
This calibration takes only a few minutes to complete. It should be done in lab before hand.

1. Fill a 600 mL beaker half full of water and add an equal half of crushed ice.
2. Place the thermometer into the ice water mixture for 5 to 10 minutes and stir.
3. With the thermometer bulb still in the mixture, read the temperature. It should be at 0° or 1° C. If it is not in this range, get a new thermometer.

Part 2: How to Measure Water Temperature

1. Tie one end of a piece of string securely to the end of the thermometer and the other end to a thick rubber band. Slip the rubber band around the wrist so that the thermometer is not lost if it is accidentally dropped in the water.
2. Hold the end of the thermometer (opposite of bulb) and shake it several times to remove any air in the enclosed liquid. Note the air temperature reading. (<u>Record on Data Sheet</u>)
3. Immerse the thermometer to a depth of 10 cm in the sample water for three to five minutes.
4. Raise the thermometer only as much as is necessary to read the temperature. Quickly note the temperature reading.

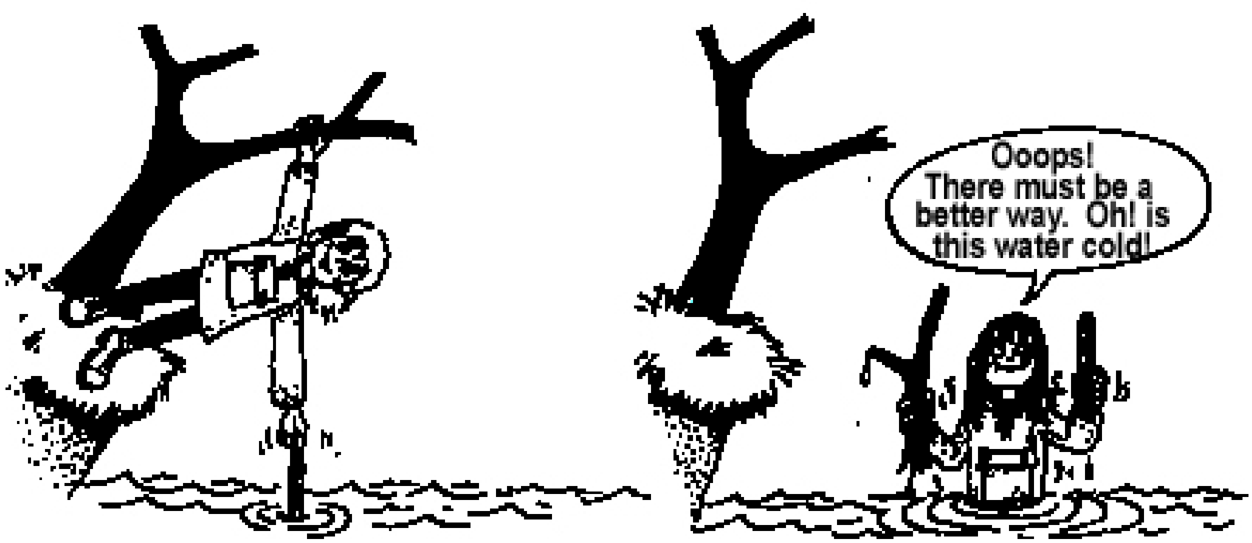
If the air temperature is significantly different from the water temperature or it is a windy day, the thermometer reading may change rapidly after it is removed from the water.



This is why you must take the reading always while the thermometer bulb is in the water.

5. Repeat step 3. Average the two readings.

6. Record this average temperature along with the date and time on the HYDROLOGY INVESTIGATION DATA WORKSHEET. (Record Temperature Data, Time of Day, and the Date)



FIELD WATER CHEMISTRY PROTOCOLS
WATER PH PROTOCOL

Part 1: Calibration Method if using a pH pen or meter Only.

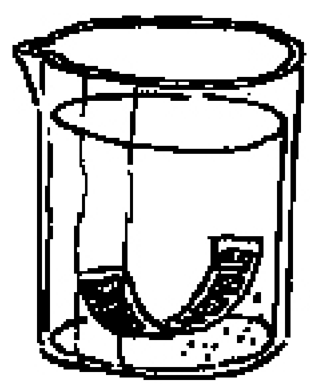
In order to measure the pH of your water sample using the pH meter you need to:

1. Prepare buffer solutions…found on **page 6**,
2. Calibrate the instruments,
3. Recheck your instrument by measuring the buffers in the field, and
4. Measure the pH of your sample in the field.

Part 2: How To Measure pH Method 1: pH Indicator Paper
Beginning Level

1. Rinse a 50 mL or 100mL plastic beaker at least twice with sample water.

2. Fill the beaker about halfway with water to be tested.



3. Dip one strip of indicator paper into the sample water for at least a minute. Make sure all segments of the paper are immersed in the sample water.

4. Remove the paper from the water and compare the resultant color segments with the chart on the back of the pH indicator paper box. Try to find a sequence where all segments on the sample paper match all segments on the box.

5. If reading is unclear, it may be because the paper needs more time to fully react. Repeat three more times until satisfied that the reading is accurate.

6. Read the corresponding pH and <u>record this value on your Hydrology Investigation Data Worksheet.</u>

Part 3: How To Measure pH   Method 2: pH Pen or pH Meter
Intermediate and Advanced Levels

Calibration Procedure – Calibration should be performed before each set of measurements. This procedure can be performed in the classroom before you go out in the field.

Step 1: Preparing your pH calibration buffers (4, 7, and 10):

1. Write the buffer pH and date on two pieces of masking tape. Place one on a clean, dry 100 mL plastic beaker and the other on a 50 mL bottle.

2. Using a graduated cylinder, measure 50 mL of buffer and pour the buffer solution into the labeled bottle. Cap the bottle tightly.

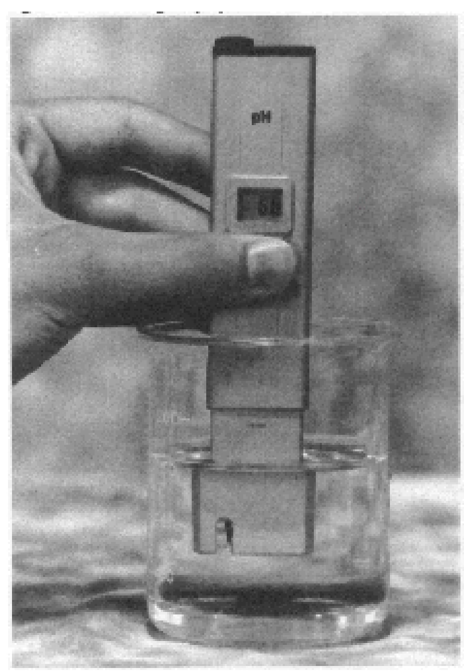
3. Continue preparing the other buffers, repeating steps 1-2 for each.

Step 2: Calibrate the pH meter:

1. Rinse the electrode (glass probe) and area around it twice with distilled water using a squeeze bottle and blot dry with a soft tissue after each rinse. Rinse into a discard beaker or sink, not into the pH buffer solution and <u>do not touch the electrode (glass probe) with your fingers.</u>

2. Turn the meter on (by pressing the ON/OFF button). Push the CAL button to indicate that you will be calibrating the instrument.

3. Immerse the electrode in the pH 7.0 buffer solution, making sure that the electrode is entirely immersed. Do not immerse the instrument further than is necessary.



4. Gently stir the buffer solution with the electrode and wait for the display value to stabilize. Once the reading has stabilized, press the HOLD/CON button to accept the value and complete the calibration. If the electrode is still immersed in the buffer, the display will read the same value as the pH of the buffer.

5. Remove the pH tester from the buffer solution, rinse the electrode with distilled water, and blot dry with soft tissue.

6. Repeat steps 2 through 5 using the pH 4 buffer and then using the pH 10 buffer.

7. Set the tester aside on a paper towel; turn the meter off by pushing the ON/OFF button.

8. Pour the buffer solution into their labeled bottles and cap them tightly.

Step 3: Recheck your pH pen or meter in the Field

1. Take the pH buffer solutions into the field with you. Treat them as samples. Test the pH of the buffer solutions and record the field pH buffer values on the data sheets. If the values of the buffer solution are more than – 0.2 pH units from the true value, go through the instrument calibration procedure again.

2. After you have tested the pen or meter with the buffer solutions, you are ready to measure the pH of the actual water sample.

Step 4: pH Measurement Procedure

1. Rinse the electrode and the surrounding area with distilled water using the squeeze bottle. Blot the area dry with a soft tissue.

2. Fill a clean, dry 100 mL beaker to the 50 mL line with the water to be tested

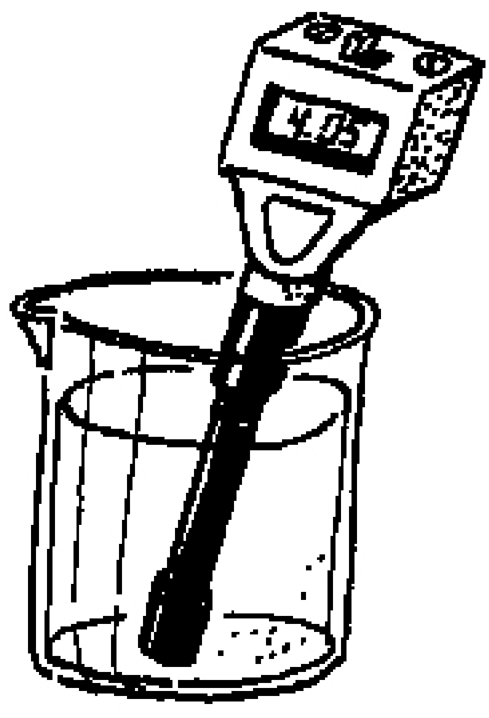
3. Immerse the electrode in the water. Be sure that the entire electrode is immersed, but avoid immersing it any further than necessary.

4. Stir once and then let the display value stabilize.

5. Once the display value is stable, read the pH value and record it in the Hydrology Investigation Data Worksheet.

6. Repeat Steps 1 through 5 for another sample as a quality control check. The two pH values should agree to within 0.2 which is the accuracy of this technique.

7. Rinse the probe with distilled water, blot it dry with a soft tissue, replace the cap on the probe, and turn the instrument off.



FIELD WATER CHEMISTRY PROTOCOLS

DISSOLVED OXYGEN PROTOCOL

Part 1: How to Run the Dissolved Oxygen Test

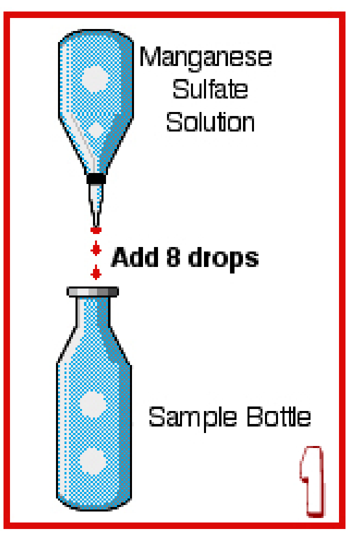
Because of the chemicals used in this test, you must have rubber gloves and protective goggles on at all times.

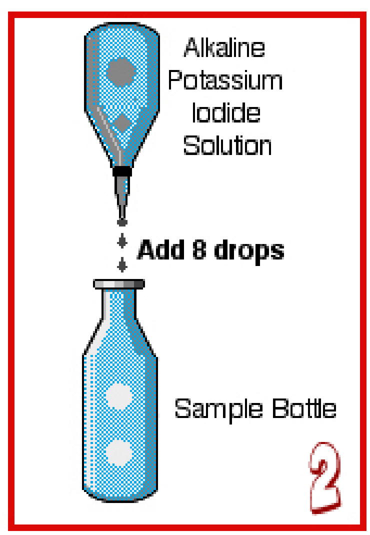
1. Rinse the **WATER SAMPLE BOTTLE** with water.

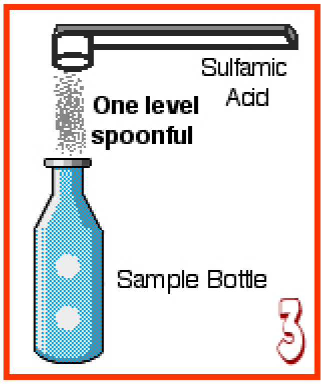
2. Fill the **WATER SAMPLE BOTTLE** to the top so that it is just about over flowing. Cap the bottle immediately.

3. Using the test kit and holding the chemical bottle vertical, **ADD 8 DROPS OF MANGANESE SULFATE SOLUTION**. Cap the bottle and shake gently.

4. Now **ADD 8 DROPS OF ALKALINE POTASSIUM IODIDE SOLUTION** to the bottle. Cap the bottle and shake gently.

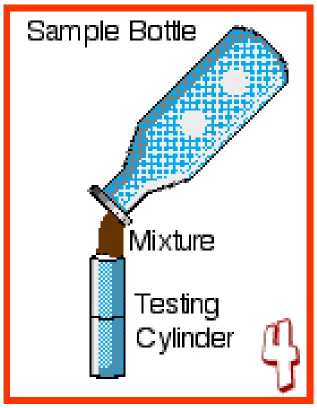






5. Let the water sample bottle stand until the globs of whitish-brown precipitate settle to the lower half of the bottle.

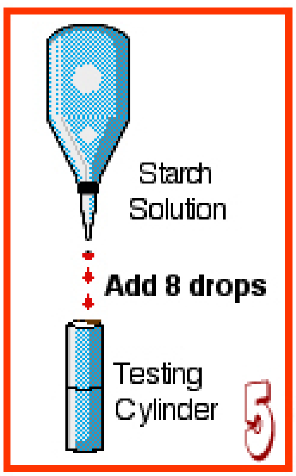
6. Using the 1-gram measuring spoon, **ADD ONE LEVEL MEASURE OF SULFAMIC ACID** to the bottle. Cap and shake gently until all of the sulfamic acid crystals are dissolved.



7. Take out the **SAMPLING CYLINDER** and pour the **SAMPLE BOTTLE MIXTURE** into the flask up to the marked level.

8. **ADD 8 DROPS OF STARCH SOLUTION** to the cylinder, swirl and mix together the entire solution.

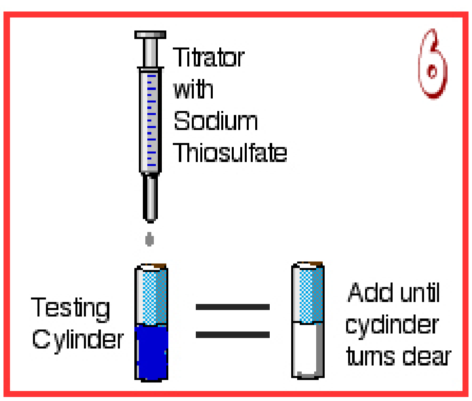
9. Fill the **TITRATION PIPETTE** (Titrator) with **SODIUM THIOSULFATE SOLUTION.**



10. Hold the **TITRATOR** above the central mouth of the **SAMPLING** cylinder.

11. Add **SODIUM THIOSULFATE** to the cylinder, a drop at a time and mix gently.

12. Keep adding the **SODIUM THIOSULFATE** until the mixture turns perfectly clear.



13. Once the solution becomes clear, read and record the amount of **SODIUM THIOSULFATE** that you used on your Hydrology Data Sheet.

14. The amount of **SODIUM THIOSULFATE** used is equal to the amount of dissolved oxygen in the water. Record your reading in **PARTS PER MILLION** (ppm).

Part 2: Calibration and Quality Control of Dissolved Oxygen Kits

Calibration should be performed every six months to verify your technique and the integrity of your chemicals.

1. Rinse a 250 mL bottle twice with distilled water. Measure 100 mL of distilled water with a graduated cylinder.

2. Pour this water into the 250 mL bottle. Put the lid on tightly and shake it vigorously for 5 minutes.

3. Uncap the bottle and take the temperature of the water. Be sure the tip of the thermometer does not touch the bottom or sides of the bottle. Wait 1 minute before reading the temperature.

4. Record the temperature on the Hydrology Investigation Data Worksheet.

5. Follow directions to measure dissolved oxygen.

On the data sheet, record the value as mg/L D.O. (Dissolved Oxygen) for the distilled water standard. The mg/L D.O. found using the shaken standard must be within 0.4 mg/L of the expected value for a shaken (thus saturated with oxygen) distilled water sample. To find the expected value for a saturated D.O. distilled water sample:

1. Look up your temperature in **Table 1** on the next page, and obtain the corresponding "**solubility in mg/L**".

2. Look at the corresponding solubility of oxygen (mg/L) and record it on the Calibration Data Worksheet.

3. Look at the **Calibration Value** in **Table 2** corresponding to your elevation in meters and record it on the Calibration Data Worksheet.

4. Multiply the solubility of oxygen found in **Step 2** by the calibration found in **Step 3**.

EXAMPLE

From Table 1:
A standard temperature of 22ºC has a corresponding DO solubility of 8.7 mg/L.

From Table 2:
An elevation of 1,544 meters has a corresponding saturation calibration value of 0.83.

You multiply (8.74 mg/L) x (0.83) = 7.25

5. This value (7.25 in the example) is your expected value for a shaken distilled water standard.

6. Compare this value to the value for D.O. that you found when you tested your shaken distilled water standard. If the value is not within 0.4 mg/L (LaMotte kit), try the measurement again on the distilled water. If it is still off, but by less than 1 mg/L, <u>record the D.O. value on the Hydrology Investigation Data Worksheet</u>.

Table 1 Solubility of Oxygen in Water Exposed to Air at 750 mm Hg Pressure

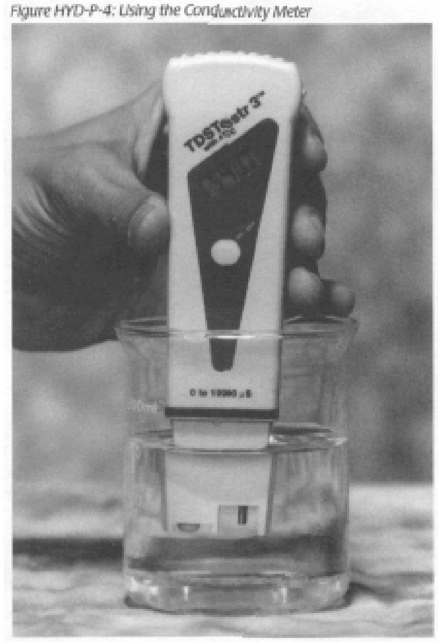
Temp °C	Solubility mg/L	Temp °C	Solubility mg/L	Temp °C	Solubility mg/L
0	14.6	16	9.9	32	7.3
1	14.2	17	9.7	33	7.2
2	13.8	18	9.5	34	7.1
3	13.5	19	9.3	35	7.0
4	13.1	20	9.1	36	6.8
5	12.8	21	8.9	37	6.7
6	12.5	22	8.7	38	6.6
7	12.1	23	8.6	39	6.5
8	11.9	24	8.4	40	6.4
9	11.6	25	8.3	41	6.3
10	11.3	26	8.1	42	6.2
11	11.0	27	8.0	43	6.1
12	10.8	28	7.8	44	6.0
13	10.5	29	7.7	45	5.9
14	10.3	30	7.6	46	5.8
15	10.1	31	7.4	47	5.7

FIELD WATER CHEMISTRY PROTOCOLS
CONDUCTIVITY PROTOCOL

Conductivity of water sample is a measure of its ability to carry an electric current. The more impurities (total dissolved solids) in water, the greater its electrical conductivity. By measuring the conductivity of a water sample, the amount of total dissolved solids in the sample can be determined.

Part 1: How to Measure Conductivity

Figure HYD-P-4: Using the Conductivity Meter



1. Remove cap from the meter and press the ON/OFF button to turn the tester on.

2. Rinse the electrode with distilled water and blot it dry.

3. Fill a clean, dry, 100 mL beaker with water to be tested.

4. Immerse the electrode in the water sample.

5. Gently stir the sample for a few seconds, then allow the display value to stabilize.

6. Read the display value and **multiply it by 0.67**. Record this value on the Hydrology Investigation Data Worksheet.

Part 2: Calibration of Conductivity Meter

The conductivity meter should be calibrated before each set of measurements. Before use and every six months the temperature compensation should be checked.

1. The standard solution should be tightly capped and kept refrigerated. The label on the bottle in which the solution is stored should include the date on which the solution was made or purchased.

2. Remove the cap from the meter.

3. Line up two clean and dry 100 mL beakers and fill each beaker with just enough standard solution to immerse the electrode.

4. Press the ON/OFF button to turn the tester ON.

5. Rinse the electrode (at the bottom tip of the pen) with distilled water from a squeeze bottle. Do not rinse above the brown line. Blot it dry with a soft tissue.

6. Immerse the electrode in the first beaker of standard solution for a second or two. Take the meter out of the first beaker and dip it into the second standard solution beaker, without rinsing the electrode.

7. Gently stir for a few seconds, then allow the display value to stabilize.

8. If the display does not read the standard value, you must adjust the instrument to read this number. Using a small screwdriver, adjust the calibration screw on the pen until the display reads the standard value.

9. Discard the standard solution that was used in the two beakers.

10. Rinse the electrode with distilled water and blot it dry. Rinse the beakers thoroughly.

11. Press the ON/OFF button to turn the meter OFF. Cap the meter.

FIELD WATER CHEMISTRY PROTOCOLS

ALKALINITY PROTOCOL

Part 1: How to Measure Alkalinity

If your alkalinity kit has both a low range protocol and a high range protocol, use the **low range protocol** unless your water sample has an alkalinity greater than about 125 mg/L as $CaCO_3$. This will enable you to make more precise measurements.

Precautions before Testing for Alkalinity:

1. Always wear goggles and rubber gloves.

2. Wash all lab ware between tests. Contamination may alter test results. Clean with a nonabrasive detergent or solvent such as **isopropyl rubbing alcohol**. Use a soft cloth for wiping or drying. Do not use paper towels or tissue on plastic tubes as this may scratch them. Rinse with clean water (preferably de-ionized water).

3. When titrating, count each drop of titrant. Hold the dropper vertically. Swirl the mixing bottle after each drop is added.

4. The result can be expressed in grains per gallon (gpg) by dividing the mg/L result by 17.1.

5. To open **PerrnaChem03 Powder Pillows**:

   A. Tap the bottom of the pillow on a hard surface.
   B. Tear open the pillow along the dashed line.
   C. Open the pillow and form a spout by squeezing the side edges.
   D. Pour the contents into the sample.

It is strongly recommended that for optimum test results, reagent accuracy be checked with each new lot of reagents. Use the standard solution included in this kit or listed in the OPTIONAL REAGENTS AND EQUIPMENT section. Follow the instructions included with each standard solution.

Running the High Range Test (20 – 400 mg/L):

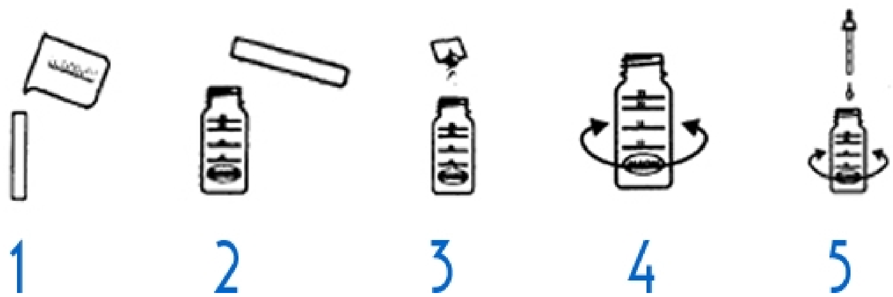
1. Fill plastic tube full (to the top) with sample water.

2. Pour the contents of the tube into the square mixing bottle.

3. Add the contents of one **Phenolphthalein Indicator Powder Pillow** to the mixing bottle.

4. Swirl to mix. If the water remains colorless, the phenolphthalein alkalinity is zero. **In this case, proceed to Step 7.**

5. If the sample turns pink, add **Sulfuric Acid Standard Solution** one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample turns colorless.

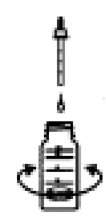


6. Multiply by 20 the number of drops of titrant used. This is the mg/L of phenolphthalein alkalinity as calcium carbonate ($CaCO_3$).

mg/L $CaCo_3$ phenolphthalein alkalinity	=	number of drops x 20

7. Add contents of one **Bromcresol Green-Methyl Red Indicator Powder Pillow** to the mixing bottle. Swirl to mix.

8. Add **Sulfuric Acid Standard Solution** one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample turns **PINK.**



9. Multiply by 20 the total number of drops of titrant used in both steps 5 and 8. This is the total mg/L of methyl orange alkalinity as calcium carbonate ($CaCO_3$).

(Step 5 + Step 8) x 20 = ________ mg/L alkalinity

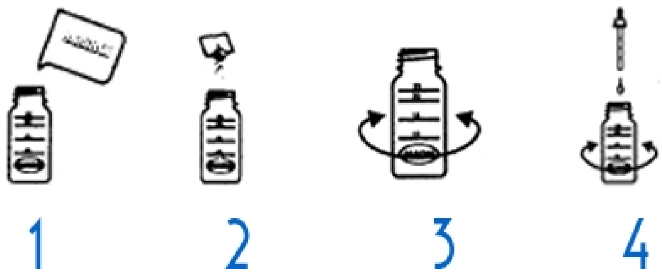
Running the Low Range Test (5 –100 mg/L):

1. Fill the mixing bottle to the 23 mL mark with the sample water.

2. Add the contents of one **Phenolphthalein Indicator Powder Pillow**.

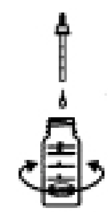
3. Swirl to mix. If the sample remains colorless, the phenolphthalein alkalinity is zero. **In this case, proceed to Step 6.**

4. If the sample turns pink, add **Sulfuric Acid Standard Solution** one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample turns colorless.



5. Multiply by 5 the number of drops of titrant used. This is the mg/L of phenolphthalein alkalinity as calcium carbonate.

6. Add the contents of one **Bromcresol Green Methyl Red Indicator Powder Pillow** to the mixing bottle. Swirl to mix.



7. Add **Sulfuric Acid Standard Solution** one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample turns PINK.

8. Multiply by 5 the total number of drops of titrant used in both **Steps 4 and 7**. This is the total mg/L of methyl orange alkalinity as calcium carbonate ($CaCO_3$).

(Step 4 + Step 7) x 5 = $\boxed{\quad\quad\quad}$ $CaCO_3$ alkalinity

9. Record the total alkalinity in mg/L as $CaCO_3$ on the Hydrology Investigation Data Worksheet.

Part 2: Calibration and Quality Control Preparing the Baking Soda Standard

1. Using your balance, weigh out 1.9 g baking soda and add it to your 500 mL graduated cylinder. Make sure to transfer all of the baking soda to the cylinder.

2. Fill the 500 mL graduated cylinder to the 500 mL mark with distilled water.

3. Pour this solution into the 500 mL beaker, and stir it with a stirring rod to make sure all of the baking soda has dissolved.

4. Pour 15 mL from the beaker into the 100 mL graduated cylinder.

5. Rinse the 500 mL graduated cylinder with distilled water first. Pour the 15 mL of your baking soda solution into the 500 mL graduated cylinder.

6. Fill the 500 mL graduated cylinder to the 500 mL mark with distilled water.

7. The solution in your 500 mL graduated cylinder is your standard. The true alkalinity of this baking soda standard is 68 mg/L as $CaCO_3$. The true value for distilled water is usually below 14 mg/L.

8. Record the alkalinity value in mg/L as $CaCO_3$ on the Hydrology Investigation Data Worksheet.

FIELD WATER CHEMISTRY PROTOCOLS
NITRATE/NITRITE PROTOCOL

Measuring nitrate levels in water is an important step in the determination of water quality. Nitrogen exists in water in numerous forms, two of which are nitrate (NO_3) and nitrite (NO_2). Of these forms, nitrate is usually the most important. Nitrate is an essential nutrient for growth of algae and other aquatic plants, and can be present at high levels due to inputs from a variety of sources. Nitrate is very difficult to measure directly, so it is reduced to nitrite and the resulting nitrite concentration is measured.

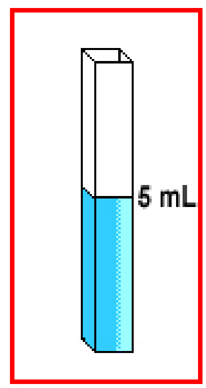
Part 1: How to Measure Nitrate Nitrogen

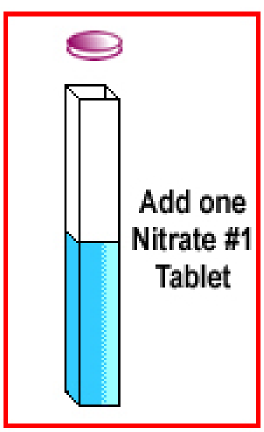
1. Rinse the sample tubes in the kit at least 3 times with sample water before starting the measurement.

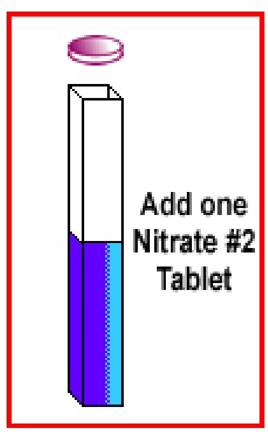
2. Fill the sample tube (squarish) to the 5 mL line with sample water.

3. Add one **Nitrate 1** tablet to the sample tube, cap and mix until tablet disintegrates.

4. Add one **Nitrate 2** tablet to the sample tube, cap and mix until the tablet disintegrates.





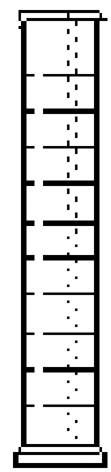


5. Place the sample tube carefully in your test kit and let it stand for 10 minutes.

6. Insert the Nitrate sample tube into the **NITRATE-NITROGEN COMPARATOR**. Move the comparator slide back and forth until you have matched the color of your tube to the color of the comparator. Have at least 3 students in the group read the color comparator. Record the nitrate concentration for each student group on the Hydrology Investigation Data Worksheet. (Note: Hold the comparator up to a light source such as a window, the sky, or a lamp. Do not hold it up to the sun.)

7. Take the average of the three readings. If the recorded values are all within 1 mg/L of the average, record the average on the Hydrology Investigation Data Worksheet. If they are not within 1 mg/L of the average have the students reread the color comparator, then record and average new values.

Part 2: Calibration and Quality Control Procedure



1. Dilute the 100 mg/L premade standard to make a 2 mg/L standard. Use this standard to test the accuracy of the nitrate kit. Measure out 10 mL of the 100 mg/L standard nitrate solution using the 100 mL graduated cylinder. Pour this into the 500 mL flask or beaker. Measure out 490 mL of distilled water in the 500 mL graduated cylinder and add to 500 mL bottle or jar. Label with masking tape (include date). Carefully swirl the solution to mix the standard.

2. Follow the directions in the Protocol section to measure the standard. Where it says "**sample water**" this is where you use the standard that you made.

3. After testing, record the value of the standard on the Hydrology Investigation Data Worksheet.

FIELD WATER CHEMISTRY PROTOCOLS

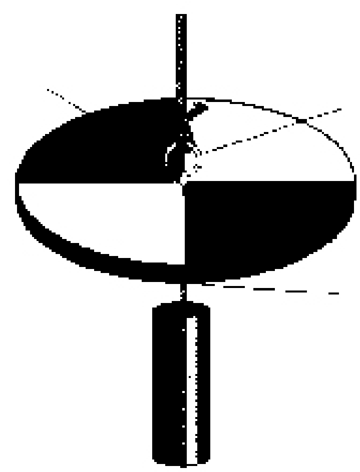
WATER TRANSPARENCY PROTOCOL

How to Measure Transparency

Make sure that Secchi disk and turbidity tube measurements are **made in the shade with the sun to your back** to make an accurate and reproducible reading. If there is no shade available, use an umbrella or a large piece of cardboard to shade the particular area where the measurement is being made. For the turbidity tube the shadow of the observer should be adequate.

Different individuals may see the Secchi disk or the bottom of the turbidity tube disappear at different water depths. For this reason, whenever possible the transparency observation **should be made by three different persons** and each of their observations submitted to the GLOBE Student Data Server.

Part 1: Measuring Transparency with a Secchi Disk (Lakes, Deep Shoreline)



1. Lower the disk slowly into the water until it just disappears. If possible, grab the rope at the surface of the water and mark this point on the rope (e.g. use a clothes pin). If it is not possible to mark the rope at the water surface, mark the rope a known distance above the water.

2. Then raise the Secchi disk until it just reappears into view. Grab the line at the surface of the water when the Secchi disk reappears and mark this point (or some known distance above the water). The rope should now be marked at two points. There should only be a few centimeters difference between these two points.

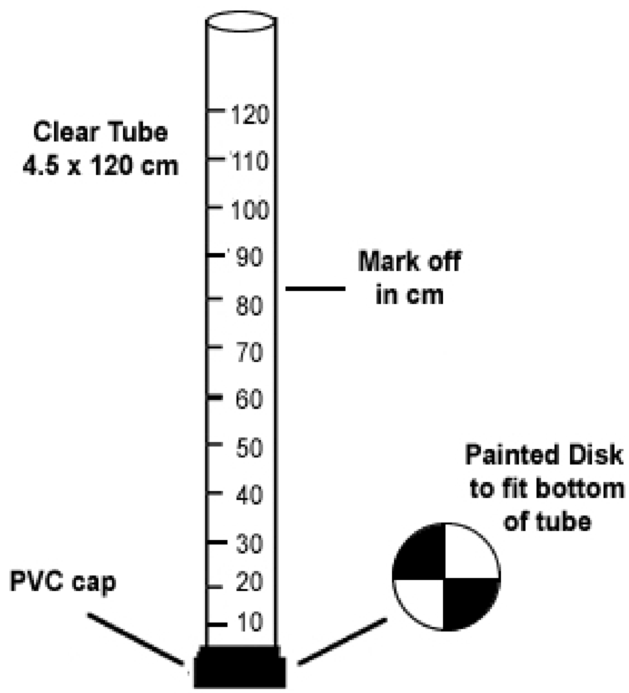
3. Record both depths on your Hydrology Investigation Data Worksheet to the nearest 1 cm. **If the two depths differ by more than 10 cm, repeat the measurement, recording the new depths on your Hydrology Investigation Data Worksheet**.

4. Using the **Cloud Cover Protocol**, determine the cloud cover. Determine the distances between where each observer marked the rope and the water surface. Record both on your Hydrology Investigation Data Worksheet. If the rope was marked at the water surface, enter 0.

5. Submit your depths along with the cloud cover and distance form the mark to the water surface to the GLOBE Student Data.

Part 2: Using a Turbidity Tube to Measure Transparency (Streams, Rivers)

1. Pour sample water into the tube until the image at the bottom of the tube is no longer visible when looking directly through the water column at the image. Rotate the tube while looking down at the image to see if the black and white areas of the decal are distinguishable.



2. Record this depth of water on your Hydrology Investigation Data Worksheet to the nearest 1 cm.

3. Submit your depth to the GLOBE Student Data Server. Enter data for each observer, not the average of the different observeations.

   Note: If you can still see the image on the ________________, simply record the depth as the depth of the tube.

FIELD WATER CHEMISTRY PROTOCOLS

WATER HARDNESS PROTOCOL

Part 1: Directions for Testing Total Hardness

1. Fill the titration tube to the 12.9 mL line with the water sample to be tested.

2. Add 5 drops of **HARDNESS REAGENT 5**, cap and mix.

3. Add one **HARDNESS REAGENT 6 Tablet**, cap and gently shake to dissolve the tablet. A **RED** color will appear.

4. Fill the direct reading titrator with **HARDNESS REAGENT 7** in the manner described by your teacher. Insert the titrator in the center hole of the titration tube cap.

5. While gently shaking the tube, slowly press the plunger to titrate the sample until the **RED** color changes to clear **BLUE**. Read the test results where the plunger tip meets the titrator scale. The results are expressed as total hardness in ppm (parts per million) of $CaCO_3$ and $MgCO_3$.

6. If the plunger tip reaches the bottom line on the titrator scale (200 ppm) before the end point color change occurs, refill the titrator and continue the titration. When recording the test results, be sure to include the value of the original amount of reagent dispensed (200).

Part 2: Calcium Hardness Test

1. Fill the titration tube to the 12.9 line with the water sample to be tested.

2. Add six drops of **Sodium Hydroxide** solution to the test sample, cap and mix.

3. Add one **Calcium Indicator Tablet**, cap and gently shake to dissolve the tablet. A **RED** color will appear.

4. Now perform the titration as described in steps 4 through 7 of the total hardness test procedures, titrating until the **RED** color changes to **Violet**. Results are expressed as calcium hardness in ppm, $CaCO_3$.

Part 3: Magnesium Hardness Directions

1. Subtract the calcium hardness test results from the total hardness test result to obtain magnesium hardness in ppm, $MgCO_3$.

FIELD WATER CHEMISTRY PROTOCOLS
CHLORIDE PROTOCOL

Part 1: Directions for Testing Chloride Amounts

1. Fill titration tube to 15 mL line with sample water.

2. Add one drop of Phenolphthalein Indicator. **If solution remains colorless, proceed to Step 3**. If solution turns a pink color, add Sulfuric Acid, one drop at a time, mixing after each drop, until pink color disappears.

3. Add three drops of **CHLORIDE REAGENT 1**. Cap and swirl to mix. Solution will turn yellow.

4. Fill Direct Reading titrator with **CHLORIDE REAGENT 2**. Insert titrator in center hole of titration tube cap.

5. While gently swirling tube, slowly press plunger to add **Chloride Reagent 2**, one drop at a time, until yellow color changes to **orange-brown** color.

6. Read test results where plunger tip meets titrator scale. Record as ppm chloride. If you need to convert to grams per gallon, multiply ppm by **0.058**. Record your results.

High Chloride & Salinity Readings

For high chloride and salinity readings the sample must be diluted to bring it within a practicable range for titration. Dilutions of 1 to 20 or 1 to 100 are recommended. For example: 1 mL of sample water is diluted to a total of 20 mL of distilled water. This is a 1 to 20 dilution. Fill the titrator to the 15 mL line with diluted sample. Proceed with Steps 2 to 6 above. Multiply results by conversion factors below:

1 to 20 Dilution

ppm chloride	multiply titrator reading by 20
ppt chloride	multiply titrator reading by .02
% chloride	multiply titrator reading by .002

1 to 100 Dilution

ppm chloride	multiply titrator reading by 100
ppt chloride	multiply titrator reading by .1
% chloride	multiply titrator reading by .01

FIELD WATER CHEMISTRY PROTOCOLS
PHOSPHORUS PROTOCOL

Part 1: Directions for Testing Phosphate Amounts

As a precaution for this test, make sure you have rubber gloves on and goggles at all times.

1. Fill the test tube to the mark with the water sample.

2. Using the 1.0 mL pipette, add 1.0 mL of **PHOSPHORUS REAGENT** (large bottle) to the test sample **TUBE**; cap, and mix by inverting the tube several times.

3. Set the capped test tube aside. Wait for fifteen minutes, then use the spoon to place one level spoonful of **PHOSPHORUS REDUCING AGENT**. Cap and mix. Color will develop in 10 seconds.

4. Remove stopper from test tube, insert tube into the **Phosphate Comparator** and match the color of your test tube with the colors on the Comparator. Have three other students do the same. Average the three readings. Results are expressed as parts per million (ppm) of PO_4. If the test sample color is between two standard colors, the mid point between the two values should be read as your results.

5. Record your results. Discard the test liquids in the proper chemical disposal bottle.

FIELD WATER CHEMISTRY PROTOCOLS
CARBON DIOXIDE PROTOCOL

Part 1: Directions for Testing Carbon Dioxide Amounts

1. Fill a vial to the 20 mL mark with water.

2. Add 2 drops or 1 tablet of **Phenolphthalein Reagent**.

3. If the vial turns PINK, **go to Step 6**.

4. If the vial doesn't turn PINK, titrate with **Reagent "B"** until a PINK color appears for 30 seconds.

5. Record on your Hydrology Investigation Data Sheet the amount of titrant by reading the scale on the titrator. Remember this reading is in ppm (parts per million).

6. (From Step 3) If your vial turns PINK and stays PINK for 30 seconds, enter zero (0) as the parts per million amount of CO_2 on your Hydrology Data Sheet.