How pure is our Water?

(Based on Vernier Environmental Science - 4.1)

From Vernier

In the early 1970s, the National Sanitation Foundation, in cooperation with over 100 water quality experts, devised a standard index for measuring water quality. This index, known as the Water Quality Index, or WQI, consists of nine tests to determine water quality. These nine tests are: temperature, pH, turbidity, total solids, dissolved oxygen, biochemical oxygen demand, phosphates, nitrate, and fecal coliform. A table (or graph) for each of the nine tests indicates the water quality value (or Q-value) corresponding to the data obtained. Once the Q-value for a test has been determined, it is multiplied by a weighting factor. Each of the tests is weighted based on its relative importance to overall water quality.

Initiative #1 - Where have all the fishes gone?

Four southern states - Louisiana, Mississippi, Alabama and Florida have claimed that the sea-water on their beaches has been has been ruined by oil leaks - they are asking us - the NDSMSTWPTF - the Notre Dame Special Middle School Teacher Water-Purity Task Force - to test the purity of their samples of water. Although the standard of WQI was established by the Federal government in 1977, they believe that our revision to these standards (see reference25) to incorporate more realistic and more easily measured parameters would be particularly appropriate in these unique circumstances. Samples to be tested have been carefully packaged, and shipped to Notre Dame. They are hoping for an immediate response, so that the fishermen and fisherwomen of their states can be recompensed for the loss of their life's work to the fullest extent possible.

Samples from 4 Southern Gulf states - Can the shrimp and the sea-turtles survive in this water?

Initiative #2 - Where have all the froggies gone?

The gradual disappearance in the past few years of Indiana's Giant Jumping Frogs remains a mystery. The State government is blaming the increased numbers of red-tailed deer, which seem to believe that "a frog a day keeps the hunter away". However, the Indiana Giant-Jumping Frog Society - the IGJFS - believes it is the lack of control of industrial emission into the 4 main rivers of Indiana that is the root of the problem. The IGJFS has recently heard about the expertise and efficiency of the NDSMSTWPTF - the Notre Dame Special Middle School Teacher water-purity task force - in their rapid and effective analysis of oily gulf water. They hope that our analysis will justify their appeal to the State to clean up Indiana's rivers.

Samples from 4 Indiana rivers - Can the Indiana Giant-Jumping frogs survive in this water?

Problem: We lost the labels on all these samples - what can we do?

How can we rescue our agency's good name by completing the evaluations of all these samples?

We need to report back to these agencies our estimation of the WQI of their samples **BEFORE THE END OF TODAY**!!

Unfortunately, all our trained science analysts have left for two weeks to watch the World Cup in South Africa.
Here is a possible solution which involves training new water-purity analysts...

Plan of Lesson -

Engaging the students
The above story: also, reading the "research section" below;
discussion of water quality - what factors could be important?
Can we define what we mean by water quality? (Checking out/completing the WQI table)

[*Materials...*]
1. *set up the testing stations*
   pH *Dissolved oxygen* *Conductivity* *Turbidity*
   Ion concentration (4) *Spectral absorption (2).*

2. *The 8 water samples - 1 from each "State" and "River" (divided into 2 samples each)*

Preliminary Investigation
Calibrating the Water Quality probes
- Each group will learn how to calibrate one of 5 different Vernier sensors
  pH *Dissolved oxygen* *Conductivity* *Turbidity* *Spectral absorption (2)*
- That group will explain to the other groups how to do the calibration of their sensor

Helpful Note: An instruction manual is available for each sensor;
2 sensors of each type are set up on separate tables; each group can calibrate one sensor, and then use the second sensor to illustrate the calibration technique.

- FOUR groups will each calibrate one of the additional 4 *ion concentration sensors*.

Investigation:(helping NDSMSTWPTF)
Students work in their groups to test one sample at each of the testing stations

Preliminary Analysis:
Each group develops a report/table describing the water quality (the WQI) of their sample [whiteboard report]
Students compare and discuss their results:

Follow-up investigation:
The groups return to analyze further samples to complete all measurements necessary for the final report

Conclusion:
Analysis and discussion of all the results in terms of a single WQI number for each sample.
Final report of the whole class (the rescue of NDSMSTWPTF's good name)

Research section

- what do we mean by water quality... follow-ups: chemistry, social studies, clean up...

...

The resulting values for all tests are used to gauge the health of the water source (excellent, good, medium or average, fair, or poor).
In this experiment, you will be performing ***five core WQI tests: dissolved oxygen, pH, total turbidity, etc...***

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A modified version of NSF WQI Worksheet for these tests will allow you to determine the general quality of the water source being sampled.
In the Preliminary Activity, you will gain experience using a Dissolved Oxygen Probe while measuring the concentration of dissolved oxygen (DO) in a water sample provided by your teacher and then using that DO to determine the percent saturation of DO. You will also gain experience using other probe, a Conductivity Probe, a Turbidity Sensor, several ion concentration sensors, two spectrometers, and a pH Sensor.
After completing the Preliminary Activity, you will first use reference sources to find out more about water quality issues before you choose and investigate a researchable question dealing with water quality. Some topics to consider in your reference search are:

Old Factor	**Percent**	**New Factor**	**Percent**
Dissolved oxygen	17	Dissolved oxygen	10
Fecal coliform	16	pH	10
pH	11	Conductivity	10
Biochemical oxygen demand	11	Turbidity	10
Temperature change	10	Nitrates	10
Total phosphate	10	Ammonia	10
Nitrates	10	Chlorides	10
Turbidity	8	Calcium (heavy metals)	10
Total solids	7	Absorption	10
		Other tests	10

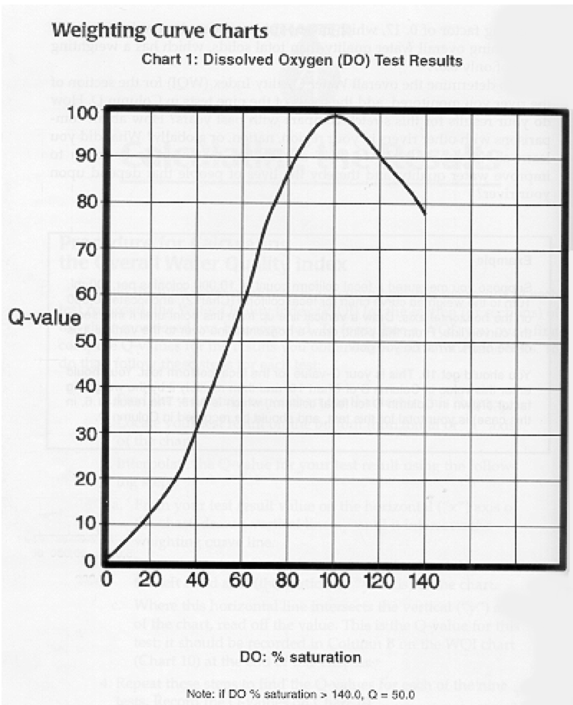
The Oregon Water Quality Index (OWQI) is a single number that expresses water quality by integrating measurements of eight water quality variables (temperature, dissolved oxygen, biochemical oxygen demand, pH, ammonia+ nitrate nitrogen, total phosphorus, total solids, and fecal coliform). Its purpose is to provide a simple and concise method for expressing the ambient water quality of Oregon's streams. The index allows users to easily interpret data. The OWQI improves comprehension of general water quality issues, communicates water quality status, and illustrates the need for and effectiveness of protective practices

The Components of the Water Quality Index (WQI) From
http://www.water-research.net/watrqualindex/index.htm

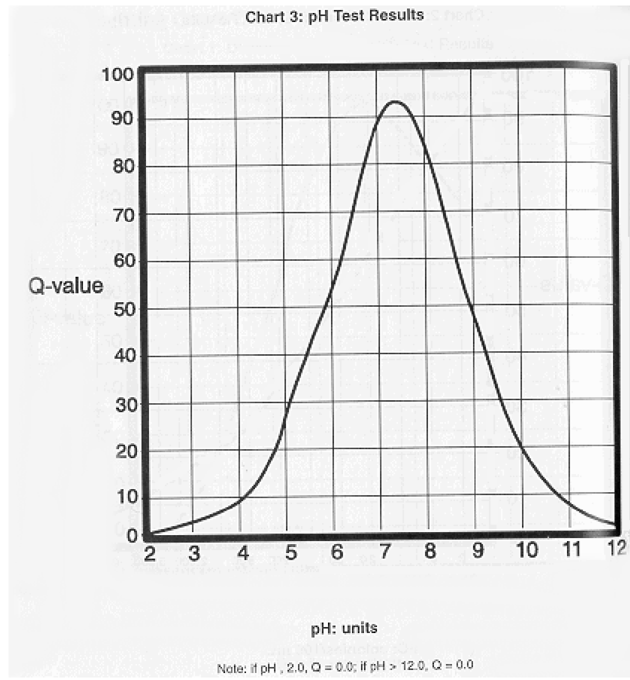
The ***Water Quality Index*** is a 100 point scale that summarizes results from a total of nine different measurements when complete:

The data of each component is transformed into a 0 to 100 scale, called the **Q-value** -
- usually by comparing the results with a graph:
Here are some examples of Q-values -

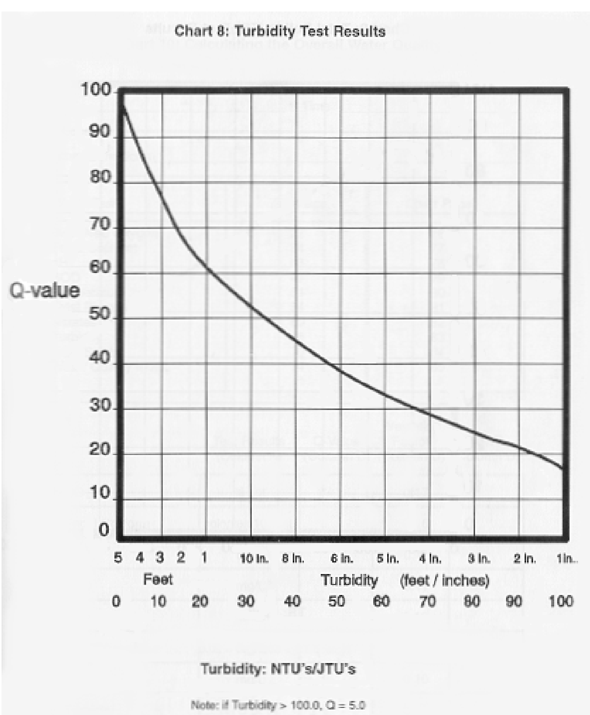
1. **Dissolved Oxygen** (100 saturation ≈ 10mg/L)



2. **PH value**



3. **Turbidity**



4. **Nitrate Ions**

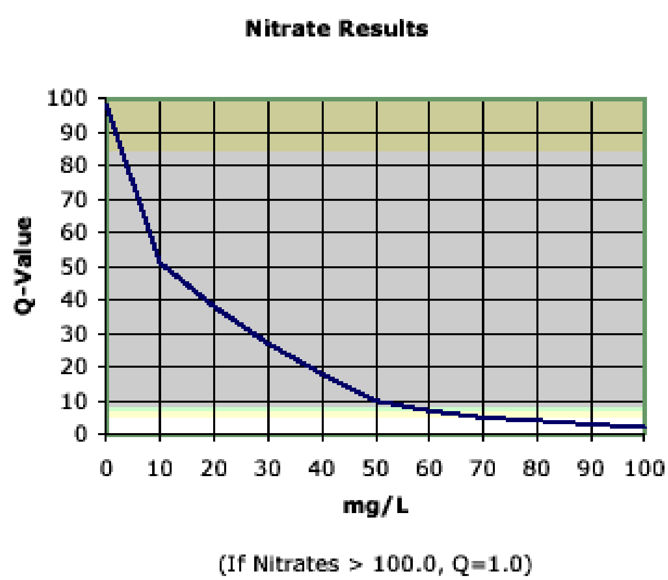


Figure 5 Water quality Index(WQI) for a Colorado river

Figure 6 Oil on the Gulf of Mexico

Appendix about some of the probes follows:

Ion Selective Electrodes

Ammonium Ion-Selective Electrode	(Order Code NH4-BTA or NH4-DIN)
Calcium Ion-Selective Electrode	(Order Code CA-BTA or CA-DIN)
Chloride Ion-Selective Electrode	(Order Code CL-BTA or CL-DIN)
Nitrate Ion-Selective Electrode	(Order Code NO3-BTA or NO3-DIN)

The Vernier Ion-Selective Electrodes can be used to measure the concentration of a specific ion in aqueous samples. The species available include Nitrate (NO_3^-), Chloride (Cl^-), Calcium (Ca^{2+}), and Ammonium (NH_4^+). These electrodes can be used to perform a wide variety of tests or planned experiments, including the following:

- Water Hardness (Calcium ISE): Calcium is very useful as an indicator of hardness of water in freshwater samples. Even though water hardness is also due to other ions (Mg^{2+} and Fe^{3+}), because Ca^{2+} is normally the predominate hardness ion, hardness as Ca^{2+} is a reliable indicator of water hardness.
- Nitrate Monitoring (Nitrate ISE): Students can use this ISE to qualitatively determine the concentration of the nitrate ion, NO_3^-, in freshwater samples. This ion may appear in samples due to waste or fertilizer runoff. Increased levels of nitrate may also be present in waste from plants or in water samples with animal decay.
- Salinity and Chloride Monitoring in Seawater (Chloride ISE): Use this ISE to determine the concentration of chloride ion, Cl^-, or salinity levels in saltwater samples. The wide range of this electrode allows you to measure salinity (as sodium chloride), chloride concentration, seawater, or brackish water samples.
- Monitoring Streams for Ammonium (Ammonium ISE): Ammonium (NH_4^+) is often present as a result of water runoff from fertilized fields. This ISE gives you an easy way to check for this environmentally important ion.

Inventory of Items Included with the ISE

- One Ion-Selective Electrode (Nitrate, Calcium, Chloride, or Ammonium).
- One bottle of High Standard solution with MSDS sheet (1000 mg/L for Ca^{2+} and Cl^-, or 100 mg/L for NO_3^- and NH_4^+).
- One bottle of Low Standard solution with MSDS sheet (10 mg/L for Ca^{2+} and Cl^-, or 1 mg/L for NO_3^- and NH_4^+).
- One ISE Soaking Bottle (empty bottle with insertion cap).

Collecting Data with the ISE

Here is the general procedure to follow when using the ISE:

1. The Ion-Selective Electrode (ISE) must be soaked in the High Standard solution (included with the ISE) for approximately 30 minutes. **Important:** Make sure the ISE is not resting on the bottom of the container, and that the small white reference contacts are immersed. Make sure no air bubbles are trapped below the ISE.
2. If the ISE needs to be transported to the field during the soaking process, use the Short-Term ISE Soaking Bottle. Remove the cap from the bottle and fill it 3/4-full with High Standard. Slide the bottle's cap onto the ISE, insert it into the bottle, and tighten. **Important:** Do not leave the ISE soaking for more than 24 hours. Long-term storage should be in the Long-Term ISE Storage Bottle.
3. Connect the ISE to the interface.
4. Start the data-collection software[1].
5. The software will identify the ISE. See below for calibration instructions.

Calibrating the ISE with a Computer

1. Choose Calibrate from the Experiment menu and then click Calibrate Now.
2. High Standard Calibration Point: The ISE should still be soaking in the High Standard. Enter the concentration value of the High Standard (e.g., 100 for 100 mg/L or 1000 for 1000 mg/L) in the edit box.
3. When the displayed voltage reading for Reading 1 stabilizes (~1 minute), click Keep.
4. Low Standard Calibration Point: Remove the ISE from the High Standard, rinse well with distilled water from a wash bottle, and gently blot dry with a paper towel or lab wipe. Place the electrode into the Low Standard (included with your ISE). Important: Make sure the ISE is not resting on the bottom of the container, and that the small white reference contacts are immersed. Make sure no air bubbles are trapped below the ISE.
5. Enter the concentration value of the Low Standard (e.g., 1 for 1 mg/L or 10 for 10 mg/L). After 60 seconds, click Keep and then Done.
6. After calibrating, rinse off the end of the ISE, and blot it dry with a paper towel or lab wipe.
7. Insert the tip of the ISE into the sample to be tested. Important: Make sure the ISE is not resting on the bottom of the container, and that the small white reference contacts are immersed. Make sure no air bubbles are trapped below the ISE. **Note:** Do not completely submerge the sensor. The handle is not waterproof.
8. Hold the ISE still for 60 seconds and record the displayed reading.

Dissolved Oxygen Probe

(Order Code DO-BTA or DO-DIN)

The Dissolved Oxygen Probe can be used to measure the concentration of dissolved oxygen in water samples tested in the field or in the laboratory. You can use this sensor to perform a wide variety of tests or experiments to determine changes in dissolved oxygen levels, one of the primary indicators of the quality of an aquatic environment:

- Monitor dissolved oxygen in an aquarium containing different combinations of plant and animal species.
- Measure changes in dissolved oxygen concentration resulting from photosynthesis and respiration in aquatic plants.
- Use this sensor for an accurate on-site test of dissolved oxygen concentration in a stream or lake survey, in order to evaluate the capability of the water to support different types of plant and animal life.
- Measure Biological Oxygen Demand (B.O.D.) in water samples containing organic matter that consumes oxygen as it decays.
- Determine the relationship between dissolved oxygen concentration and temperature of a water sample.

Inventory of Items Included with the Dissolved Oxygen Probe

Check to be sure that each of these items is included in your Dissolved Oxygen Probe box:

- Dissolved Oxygen Probe (dissolved oxygen electrode with membrane cap)
- One replacement membrane cap
- Sodium Sulfite Calibration Standard (2.0 M Na_2SO_3) and MSDS sheet
- D.O. Electrode Filling Solution, MSDS sheet, and filling pipet
- Calibration bottle (empty, lid with hole)
- D.O. Polishing Strips (1 pkg)
- Dissolved Oxygen Probe booklet

Do I Need to Calibrate the Dissolved Oxygen Probe?

It is not always necessary to perform a new calibration when using the Dissolved Oxygen Probe in the classroom. If your experiment or application is looking only at a change in dissolved oxygen, then the software's stored calibration is all you need. If you are making discrete measurements, such as taking readings in a stream or lake, and you want to improve the accuracy of your measurements, then it is best to perform a new calibration.

Preparing the Dissolved Oxygen Probe for Use

Part A: Probe Preparation

1. Prepare the Dissolved Oxygen Probe for use.
   a. Remove the blue protective cap from the tip of the probe. This protective cap can be discarded once the probe is unpacked.
   b. Unscrew the membrane cap from the tip of the probe.

   c. Using a pipet, fill the membrane cap with 1 mL of DO Electrode Filling Solution.
   d. Carefully thread the membrane cap back onto the electrode.
   e. Place the probe into a beaker filled with about 100 mL of distilled water.

Part B: Probe Warm-up

2. Connect the Dissolved Oxygen Probe to the interface. [1]
3. It is necessary to warm up the Dissolved Oxygen Probe for 10 minutes before taking readings. To warm up the probe, leave it in the water and connected to the interface with the data collection program running for 10 minutes. The probe must stay connected at all times to keep it warmed up. If disconnected for a few minutes, it will be necessary to warm up the probe again. [2]

Part C: Probe Calibration

4. You are now ready to choose the calibration method for the Dissolved Oxygen Probe.
   - If you wish to use the stored calibration, proceed to Part D.
   - If you wish to perform a new calibration for the Dissolved Oxygen Probe, follow this procedure:

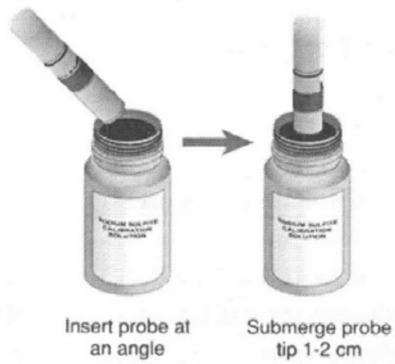
   a. Enter the calibration routine for your data collection program. [3]

   b. **First Calibration Point:** Remove the probe from the water and place the tip of the probe into the Sodium Sulfite Calibration Solution.

   c. When the displayed voltage reading stabilizes, enter **0** (the known dissolved oxygen value in mg/L).

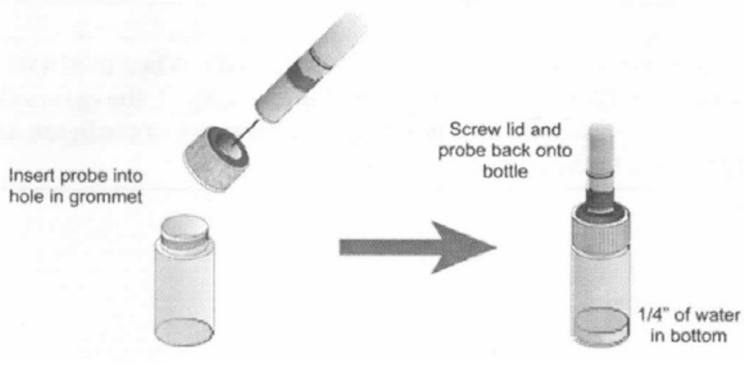
   d. **Second Calibration Point:** Rinse the probe with distilled water and gently blot dry.

   e. Unscrew the lid of the calibration bottle provided with the probe. Slide the lid and the grommet about ½ inch onto the probe body.



   f. Add water to the bottle to a depth of about ¼ inch and screw the bottle into the cap, as shown. **Important:** Do not touch the membrane or get it wet during this step. Keep the probe in this position for about a minute.

   g. When the displayed voltage reading stabilizes, enter the correct saturated dissolved oxygen value (in mg/L) from Table 1 found on pages 5–6 using the current barometric pressure and air temperature values. If you do not have the current air pressure, use Table 2 found on page 7 to estimate the air pressure at your altitude.



Part D: Collecting Data

5. You are now ready to collect dissolved oxygen concentration data.
   a. Place the tip of the probe into the water being tested (submerge 4–6 cm). Do not completely submerge. The handle is not waterproof.
   b. Gently stir the probe in the water sample. Monitor the dissolved oxygen concentration in the live readouts. **Note:** It is important to keep stirring the probe in the water sample. There must always be water flowing past the probe tip when you are taking measurements. As the probe measures the concentration of dissolved oxygen, it removes oxygen from the water at the junction of the probe membrane. If the probe is left still in calm water, reported DO readings will appear to be dropping.

Specifications

Range:	0 to 15 mg/L (or ppm)
Accuracy:	±0.2 mg/L
Resolution	
13-bit resolution (SensorDAQ):	0.007 mg/L
12-bit resolution (LabQuest, LabPro, Go!Link, ULI II, SBI):	0.014 mg/L
10-bit resolution (CBL 2):	0.056 mg/L
Response Time:	95% of final reading in 30 seconds, 98% in 45 seconds
Temperature Compensation:	automatic from 5–35°C
Pressure Compensation:	manual, accounted for during calibration
Salinity Compensation:	manual, accounted for during calibration
Minimum sample flow:	20 cm/second
Stored Calibration Values	
Slope =	3.27
Intercept =	–0.327

pH Sensor
(Order Code PH-BTA or PH-DIN)

Our pH Sensor can be used for any lab or demonstration that can be done with a traditional pH meter. This sensor offers the additional advantages of automated data collection, graphing, and data analysis. Typical activities using our pH sensor include studies of household acids and bases, acid-base titrations, monitoring pH change during chemical reactions or in an aquarium as a result of photosynthesis, investigations of acid rain and buffering, and investigations of water quality in streams and lakes.

Vernier Software & Technology also publishes the following lab books that offer a wide variety of experiments using the pH Sensor:

- *Chemistry with Vernier*
- *Water Quality with Vernier*
- *Biology with Vernier*
- *Physical Science with Vernier*
- *Middle School Science with Vernier*
- *Science with Handhelds*
- *Advanced Chemistry with Vernier*
- *Investigating Chemistry through Inquiry*
- *Investigating Environmental Science through Inquiry*
- *Forensics with Vernier*

Collecting Data with the pH Sensor

This sensor can be used with the following interfaces to collect data:

- Vernier LabQuest® as a standalone device or with a computer
- Vernier LabPro® with a computer, TI graphing calculator, or Palm® handheld
- Vernier Go!®Link
- Vernier EasyLink®
- Vernier SensorDAQ®
- CBL 2™

Here is the general procedure to follow when using the pH Sensor:

1. Connect the pH Sensor to the interface.
2. Start the data-collection software[1].
3. The software will identify the pH Sensor and load a default data-collection setup. You are now ready to collect data.

[1] If you are using Logger *Pro* 2 with either a ULI or SBI, the sensor will not auto-ID. Open an experiment file for the pH Sensor in the Probes & Sensors folder.

How the pH Sensor Works

The pH Amplifier inside the handle is a circuit which allows a standard combination pH electrode (such as the Vernier 7120B) to be monitored by a lab interface. The cable from the pH Amplifier ends in a BTA plug.

The pH Sensor will produce a voltage of 1.75 volts in a pH 7 buffer. The voltage will increase by about 0.25 volts for every pH number decrease. The voltage will decrease by about 0.25 volts/pH number as the pH increases.

The Vernier gel-filled pH Sensor is designed to make measurements in the pH range of 0 to 14. A polycarbonate body that extends below the glass sensing bulb of the electrode makes this probe ideal for the demands of a middle school, high school, or university level science class or for making measurements in the environment. The gel-filled reference half cell is sealed—it never needs to be refilled.

This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest, LabPro, Go! Link, SensorDAQ, EasyLink, or CBL 2, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

Preparing for Use

To prepare the electrode to make pH measurements, follow this procedure:

- Remove the storage bottle from the electrode by first unscrewing the lid, then removing the bottle and lid. Thoroughly rinse the lower section of the probe, especially the region of the bulb, using distilled or deionized water.
- When the probe is not being stored in the storage bottle, it can be stored for short periods of time (up to 24 hours) in pH-4 or pH-7 buffer solution. It should never be stored in distilled water.
- Connect the pH Sensor to your lab interface, load or perform a calibration (as described in the next section), and you are ready to make pH measurements. **Note:** Do not completely submerge the sensor. The handle is not waterproof.

When you are finished making measurements, rinse the tip of the electrode with distilled water. Slide the cap onto the electrode body, then screw the cap onto the storage bottle. Note: When the level of storage solution left in the bottle gets low, you can replenish it with small amounts of tap water the first few times you use the probe (but not indefinitely!). A better solution is to prepare a quantity of pH-4 buffer/KCl storage solution (see the section on Maintenance and Storage) and use it to replace lost solution.

Do I Need to Calibrate the pH Sensor?

We feel that you should not have to perform a new calibration when using the pH Sensor for most experiments in the classroom. We have set the sensor to match our stored calibration before shipping it. You can simply use the appropriate calibration file that is stored in your data-collection program from Vernier in any of these ways:

pH Buffer Solutions

In order to do a calibration of the pH Sensor, or to confirm that a saved pH calibration is accurate, you need to have a supply of pH buffer solutions that cover the range of pH values you will be measuring. We recommend buffer solutions of pH 4, 7, and 10.

- Vernier sells a pH buffer kit (order code PHB). The kit has 10 tablets: two tablets each of buffer pH 4, 7, and 10. Each tablet is added to 100 mL of distilled or deionized water to prepare respective pH buffer solutions.
- Flinn Scientific (www.flinnsci.com, Tel: 800-452-1261) sells a wide variety of buffer tablets and prepared buffer solutions.
- You can prepare your own buffer solutions using the following recipes:

• pH 4.00	• Add 2.0 mL of 0.1 M HCl to 1000 mL of 0.1 M potassium hydrogen phthalate.
• pH 7.00	• Add 582 mL of 0.1 M NaOH to 1000 mL of 0.1 M potassium dihydrogen phosphate.
• pH 10.00	• Add 214 mL of 0.1 M NaOH to 1000 mL of 0.05 M sodium bicarbonate.

How the pH Sensor Works

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The pH Sensor will produce a voltage of 1.75 volts in a pH 7 buffer. The voltage will increase by about 0.25 volts for every pH number decrease. The voltage will decrease by about 0.25 volts/pH number as the pH increases.

The Vernier gel-filled pH Sensor is designed to make measurements in the pH range of 0 to 14. A polycarbonate body that extends below the glass sensing bulb of the electrode makes this probe ideal for the demands of a middle school, high school, or university level science class or for making measurements in the environment. The gel-filled reference half cell is sealed—it never needs to be refilled.

> This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest, LabPro, Go! Link, SensorDAQ, EasyLink, or CBL 2, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

Preparing for Use

To prepare the electrode to make pH measurements, follow this procedure:

- Remove the storage bottle from the electrode by first unscrewing the lid, then removing the bottle and lid. Thoroughly rinse the lower section of the probe, especially the region of the bulb, using distilled or deionized water.
- When the probe is not being stored in the storage bottle, it can be stored for short periods of time (up to 24 hours) in pH-4 or pH-7 buffer solution. It should never be stored in distilled water.
- Connect the pH Sensor to your lab interface, load or perform a calibration (as described in the next section), and you are ready to make pH measurements. **Note:** Do not completely submerge the sensor. The handle is not waterproof.

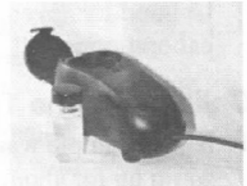
When you are finished making measurements, rinse the tip of the electrode with distilled water. Slide the cap onto the electrode body, then screw the cap onto the storage bottle. Note: When the level of storage solution left in the bottle gets low, you can replenish it with small amounts of tap water the first few times you use the probe (but not indefinitely!). A better solution is to prepare a quantity of pH-4 buffer/KCl storage solution (see the section on Maintenance and Storage) and use it to replace lost solution.

Do I Need to Calibrate the pH Sensor?

We feel that you should not have to perform a new calibration when using the pH Sensor for most experiments in the classroom. We have set the sensor to match our stored calibration before shipping it. You can simply use the appropriate calibration file that is stored in your data-collection program from Vernier in any of these ways:

Turbidity Sensor

(Order Code TRB-BTA)



Turbidity is a measure of water's lack of clarity and is an important indicator of water quality. Water with high turbidity is cloudy, while water with low turbidity is clear. The cloudiness is produced by light reflecting off particles in the water; therefore, the more particles in the water, the higher the turbidity. High turbidity can be detrimental to water quality as more sunlight is absorbed, causing an increase in water temperature. According to the USGS, the turbidity of surface water is usually between 0 and 50 NTU. Turbidity is often higher than this, however, especially after heavy rain when water levels are high.

Inventory of Items Included with the Turbidity Sensor

Check to be sure that each of these items is included in your Turbidity Sensor package:

- Turbidity Sensor
- Turbidity Accessories Kit (includes one empty cuvette and one cuvette containing 100 NTU StablCal® Formazin Standard)
- Material Safety Data Sheet for StablCal Formazin Standard

Collecting Data with the Turbidity Sensor

This sensor can be used with the following interfaces to collect data:

- Vernier LabQuest® as a standalone device or with a computer
- Vernier LabQuest® Mini with a computer
- Vernier LabPro® with a computer, TI graphing calculator, or Palm® handheld
- Vernier Go!®Link
- Vernier EasyLink®
- Vernier SensorDAQ®
- CBL 2™

Here is the general procedure to follow when using the Turbidity Sensor:

1. Connect the Turbidity Sensor to the interface.
2. Start the data-collection software[1].
3. The software will identify the Turbidity Sensor. Proceed to Step 4 to calibrate the Turbidity Sensor
4. There are two options for calibration.
   - A new calibration can be performed each time the Turbidity Sensor is used as described below.
   - A new calibration can be performed as described below and the slope and intercept of the calibration written down. When the sensor is used, the slope and intercept values can be entered manually rather than performing a new

calibration. If the same cuvettes are always used, these calibration values should be good for several months. Periodic checks should be made to insure the calibration is still valid.

Calibrating the Turbidity Sensor

1. If your sample water is very clear, you might want to let the Turbidity Sensor warm up for about five minutes to assure a stable voltage.
2. Enter the calibration routine for your data-collection program.
3. **First Calibration Point:** Obtain the cuvette containing the Turbidity Standard (100 NTU) and gently invert it four times to mix in any particles that may have settled to the bottom. **Important:** Do not shake the standard. Shaking will introduce tiny air bubbles that will affect turbidity readings.
4. Wipe the outside of the cuvette with a soft, lint-free cloth or tissue.
5. Holding the standard by the lid, place it in the Turbidity Sensor. Align the mark on the cuvette with the mark on the Turbidity Sensor. **Important:** These marks must be aligned whenever a reading is taken.
6. Close the lid.
7. Enter **100** as the value in NTU.
8. Remove the standard.
9. **Second Calibration point:** Prepare a *blank* by rinsing the empty cuvette with distilled water, then filling it to the top of the line with distilled water. **Important:** The bottom of the meniscus should be at the top of the line for every measurement throughout this test. This volume level is critical to obtain correct turbidity values.
10. Screw the lid on the cuvette. Wipe the outside with a soft, lint-free cloth or tissue.
11. Holding the cuvette by the lid, place it into the slot of the Turbidity Sensor. Make sure that the marks are aligned. Close the lid.
12. Enter **0** as the value in NTU. You are now ready to collect turbidity data.

Collecting Data

1. Gently invert the sample water to mix in any particles that may have settled to the bottom. **Important:** Do not shake the sample. Shaking will introduce tiny air bubbles that will affect turbidity.
2. Empty the distilled water from the cuvette and rinse it with sample water. Fill the cuvette to the top of the line with sample water.
3. Screw the lid on the cuvette. Wipe the outside with a soft, lint-free cloth or tissue.
4. Hold the cuvette by the lid and place it into the Turbidity Sensor. Make sure the marks are aligned. Close the lid.
5. Monitor the turbidity value. **Note:** Particles in the water will settle over time and show a slow downward drift in turbidity readings; therefore, take your readings soon after placing the cuvette in the sensor.