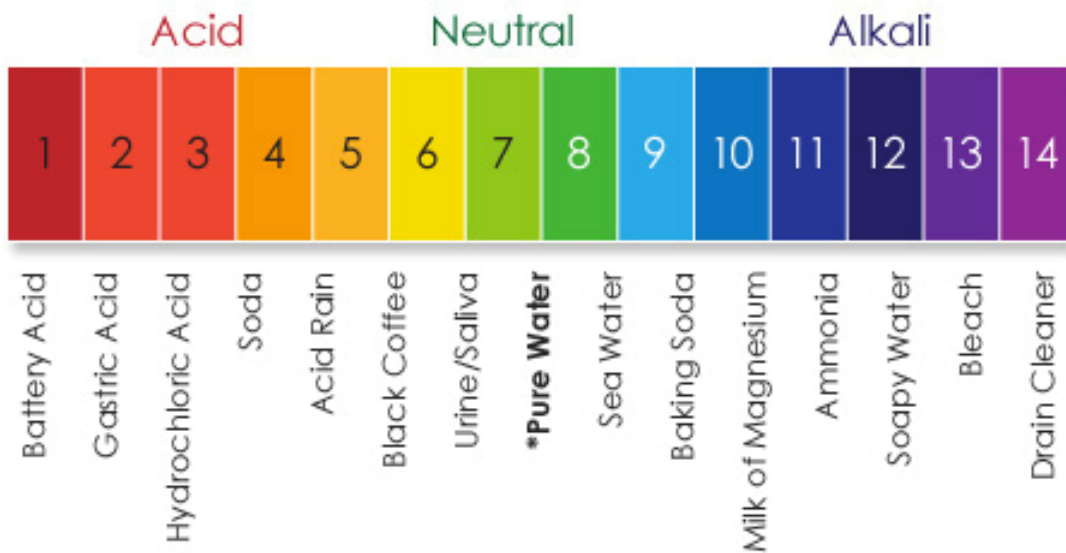


Water Quality Testing Lesson Plan

These directions can be used by students to help test the water quality of the aquaponics system. These instructions are a simplified version of the instruction manual for the water quality testing kits and the pH meter that were given to SAHS in March, 2015- which can always be referred to should the students have any questions.

To prepare to test the pH, ammonia, nitrite, and nitrate levels of the system, it is important to understand how the system works and the different stages in the system where ammonia (NH₃), nitrite, and nitrate will be present. As well as pH and water quality importance to living systems in general.

pH is a measure of how acidic or basic a substance is. It technically measures the activity of hydrogen ions in a substance or solution. The following is a chart with demonstrates the pH scale and examples of different substances expected pH.



Students may use both the pH meter as well as the water quality testing kit to measure pH.

pH meter

To use the pH meter, students should obtain a solution they hope to test, in this example water from the aquaponics system, in a cup. They should then take the pH meter and ensure that it is clean by placing it in a neutral water solution. They should then calibrate the pH meter by placing it in the pH 7 solution, provided to the students. It is important to make sure the meter is clean before placing meter in pH 7 solution. Once the pH meter is calibrated to pH 7 by pushing the calibration button. They should then place the pH meter in water. They can then calibrate the pH meter to pH 4 using the pH4 solution supplied to

the school. It is important to clean the meter before ever putting it into the pH 4 & 7 solutions as they are used to ensure the accuracy of the measurements.

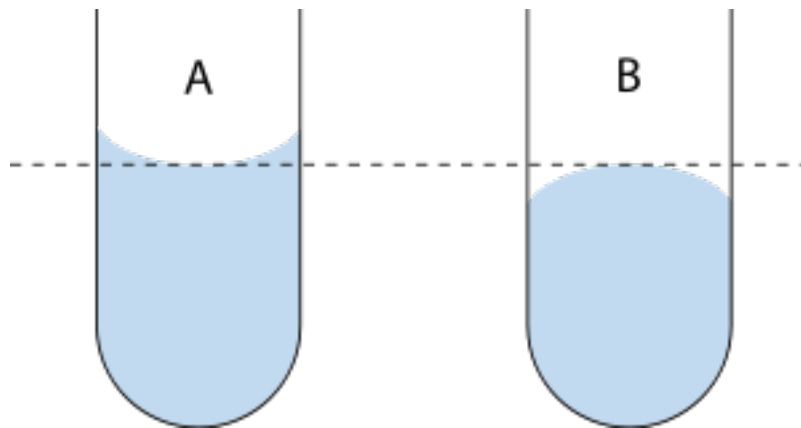
Once calibrated, students can place pH meter into solution they hope to test. They should stir meter and then let sit until pH meter reading comes to a pause. Students should then record the given pH. They can also measure the temperature of their given solution using the meter, the temperature will appear in the bottom corner of the pH reading screen.

Water Quality Testing Kit

In order to test for the water quality of pH, ammonia, nitrite, and nitrate the water quality testing kits can be used.

To prepare students should fill testing kit test tubes up to 5mL with desired solution they are testing (in this case water from the aquaponics system).

To fill the test tubes fill the water so that the bottom of the meniscus (which will be concave up or down depending on the substance) falls on the 5mL line as seen in the diagram below.



Once this is done students should use the following table for directions on how to perform the tests for the pH, ammonia, nitrite, and nitrate.

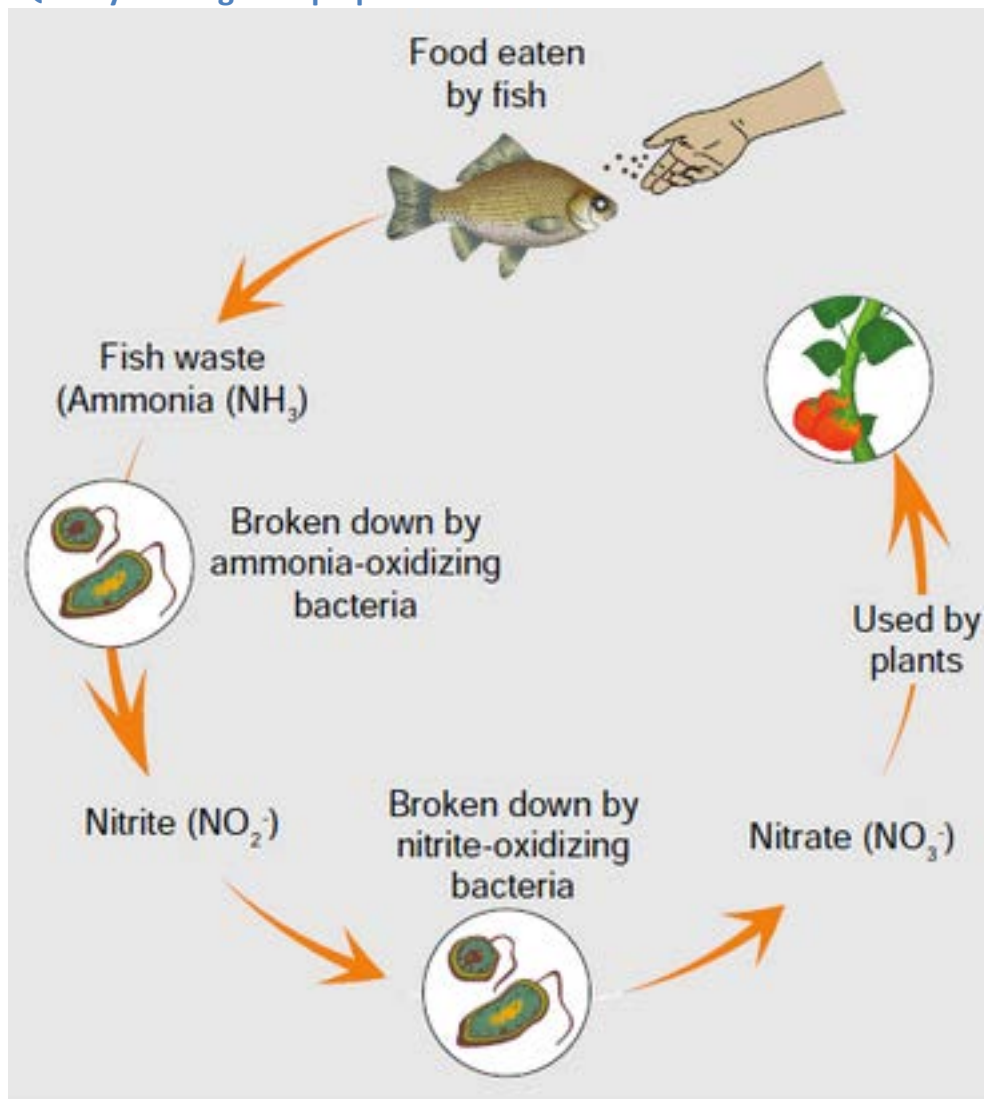
pH	Ammonia, NH ₃	Nitrite, NO ₂ ⁻	Nitrate, NO ₃ ⁻
Using pH Bottle: Add 3 drops of solution to test tube.	Using NH ₃ Bottle #1: Add 8 drops of solution to test tube.	Using , NO ₂ ⁻ , bottle: Add 5 drops of solution to test tube.	Using NO ₃ ⁻ Bottle #1: Add 10 drops of solution to tube.
Cap tube.	Cap tube.	Cap tube.	Cap tube.
Invert tube several times.	Shake tube for 5 seconds.	Shake for 5 seconds.	Invert tube several times.

Wait 3 minutes.	Un cap tube.	Wait 3 minutes.	Using NO ₃ - Bottle #2: Add 10 drops of solution to tube.
	Using NH ₃ Bottle #2: Add 8 drops of solution to tube.		Cap it & shake for 5 seconds.
	Cap tube & shake for 5 seconds.		Wait 3 minutes.
	Wait 3 minutes.		

Once all solutions are prepared, students should place the tubes next to the color they see visible on the water quality testing kit diagram, as shown in the picture below. They should record the pH, Ammonia, Nitrite, and Nitrate levels or given ranges. For example if Nitrate falls under the 160ppm color, they should record this as 80-160ppm.



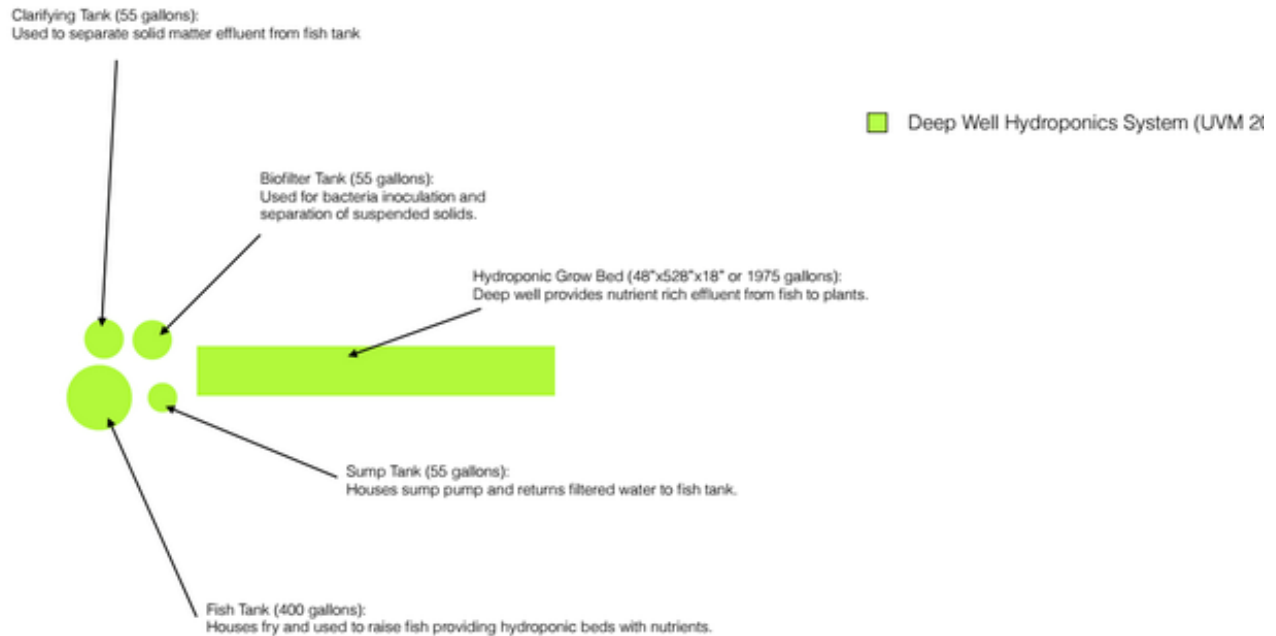
Water Quality Testing of Aquaponics



To prepare, students should obtain water quality samples from the aquaponics system in three locations.

- 1) The grow beds
- 2) The Fish Tank
- 3) The Sump Pump

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All three of these sections should have varying levels of NH_3 , NO_2^- , and NO_3^- . To better understand this, students can use the excel calculator water quality section comments.

- 1) The Grow Beds- High levels of NO_3^-
 - a. Why? Because NO_3^- is what plants need to grow.
- 2) The Fish Tank- Minimum levels of ammonia.
 - a. Why? The fish will be pooping so some ammonia will be present, although ammonia is toxic to fish so it shouldn't be high levels.
- 3) The Sump Pump – No form on nitrogen or ammonia present (low levels)
 - a. Why? Because ammonia and nitrogen are toxic to the fish.

In one example of a successful aquaponics system in the Virgin Islands, the following levels of ammonia, nitrite, and nitrate have been determined to be successful, the acceptable ranges for each of these categories can be seen in parentheses next to these. These ranges should be used by students to monitor their aquaponics system.

pH: ~ 7.4 (6.8-8.5)

Temperature: 23 Degrees C (17-34 Degrees Celsius)

Ammonia: 2.2 ppm (1-3ppm)

Nitrite, NO₂ -: 0.7 ppm (1ppm max)

Nitrate NO₃ -: 42.2 ppm (400ppm max)