

**Alaska Indoor Gardening Curriculum**

**Aquaponic Fish Care**

**Author/Source:** Cody Beus/Southeast Island School District

**Suggested Grade Levels:** 4th grade and up

**Time:** 45 minutes - 1 hour, Daily care of fish

**Teaching Goal:**

Introduce students to fish biology and maintenance of fish health.

**Learning Objectives:**

Explore fish needs through investigation of water quality and interaction with environment.

**Core Topics:**

* Introduction to Aquaponics
* Introduction to Fisheries (biology and care)
* Water Quality and Monitoring
* Plant Dynamics (circulation and nutrient uptake)
* pH, Acidity, and Alkalinity Testing
* Recording Scientific Data in Tables
* Standardized Science Measurements
* Small Scale construction of an Aquaponic System
* Drawing Conclusions from Experimentation (hands-on, observation, and note-taking)

**Alaska State Science Standards:** 4-LS1-1, 4-PS3-4, 5-PS3-1, 5-LS1-1, 5-LS2-1, MS-LS2-1, MS-LS2-2, MS-LS2-4, MS-ESS3-3, MS-ETS1-4, HS-LS1-2, HS-LS2-3, HS-LS2-5, HS-LS2-6, HS-ESS3-4

**NGSS Standards:** 4-LS1-1, 5-PS3-1, 5-LS1-1, 5-LS2-1, 3-5-ETS1-1, MS-LS1-5, MS-LS2-2, MS-LS3-3, MS-ESS3-3, MS-ETS1-4, HS-LS1-3, HS-LS2-6, HS-LS2-7, HS-LS4-5, HS-ESS2-6, HS-ESS2-7, HS-ESS3-4, HS-ETS1-3

**Materials Needed:**

* Existing aquaponic setup (see Aquaponic System Set Up Lesson)
* Water Test Kit (Test Strips or Drop Test Kits)
* Fish toy or cut out fish shape
* Peat Moss or Local Moss
* Baking Soda
* Cups or containers for water
* Optional: a selection of liquids that would have very different pH levels. Consider bringing in milk, pickle juice, tap water, river water, water from a stagnant pool, swimming pool/hot tub water, etc. Get creative!

**Vocabulary:**

1. *Aquaponics:* Aquaponics is the raising of fish and plants in a recirculating ecosystem. The fish provide nutrients for the plants. Bacteria and plants help to clean the water for the fish.
2. *Hydroponics:* Is a method of growing plants in water without soil. The water must be enriched
3. *pH:* Stands for power of hydrogen, which is a measurement of the hydrogen ion concentration in the plants. Plants grow best in a slightly acidic pH range of 6 to 7.
4. *Algae:* Algae is an informal term for a large diverse group of photosynthetic organisms which are not necessarily closely related
5. *Ammonia:* A [compound](https://en.wikipedia.org/wiki/Chemical_compound) of [nitrogen](https://en.wikipedia.org/wiki/Nitrogen) and [hydrogen](https://en.wikipedia.org/wiki/Hydrogen) with the [formula](https://en.wikipedia.org/wiki/Chemical_formula) NH3. Commonly found as a component of fish waste
6. *Nitrite:* Nitrite is the intermediate nitrogen waste product in the biological filtration process. After fish release ammonia waste, bacteria convert it to nitrite before becoming nitrate.
7. *Oxygen:* Plants take in oxygen and give off carbon dioxide nutrients plants must obtain the following mineral nutrients for their growing medium they need nitrogen, phosphorus, potassium, calcium, sulfur, and magnesium

**Background for Teachers:**

This link explains efficacy and accuracy of different water test kits

[**https://etd.auburn.edu/bitstream/handle/10415/4974/Shamim Naigaga thesis.pdf?sequence=2**](https://etd.auburn.edu/bitstream/handle/10415/4974/Shamim%20Naigaga%20thesis.pdf?sequence=2)

**Raising pH:** A common method of raising the aquarium’s pH is by adding baking soda. 1 teaspoon of baking soda per 5 gallons is generally considered a safe amount for small incremental increases. It’s best to remove the fish from the tank prior to raising the pH. Then simply dissolve the required amount of baking soda in some conditioned water and add it to the aquarium. Once the pH is at the desired level you can re-introduce the fish just like you would when you first brought them home from the store. You should never make sudden and large pH changes, as this will have a severe effect on your fish. Start with 1 teaspoon per 5 gallons of water and slowly raise the pH incrementally. This will allow your fish to acclimate to the new tank conditions.

**Lower pH:** Using peat moss is a common way to lower the aquarium’s pH. Simply put the peat moss into a mesh bag and add it to the filter. Peat moss will gradually lower the pH. With peat moss, it is likely however that your water will temporarily discolor. It should clear up over time and you can also use activated carbon to help it along. Often increased aeration will also help to lower the pH of the tank.

**Procedure:**

1. Ask students what fish live in. They will say “water.” Tell them they are right, but that fish need their water to have specific qualities or they won’t survive and thrive. Ask students what they think may go wrong with water quality that would harm fish. Generate ideas like; too much algae, too much food, too warm, too cool, etc. Explain that today we will teach the students how to monitor and adjust pH, which can affect the health of the fish and the whole system.
2. Show procedure for testing for water quality. This can be accomplished by following test kit instructions. Be sure to have students wear protective gear if handling drop test kits. Parameters test kits commonly look for are pH, ammonia, and nitrites. Different kits have been evaluated for accuracy and efficacy (see background for teachers). **Extension:** can include activity or discussion about why these different methods and tests can differ.
3. After showing the procedure, have students select a liquid to work with and pour it into a cup. Have them follow the procedure to test the pH of the liquid they selected. Emphasize following the procedure and using safety equipment. Or, they can all use tap water from the classroom.
4. Demonstrate how pH can be raised or lowered in the aquarium. Have students add peat moss or baking soda to the liquid they chose to work with. Have students hypothesize if the liquids pH will be raised or lowered by the materials. Retest liquid and discuss results. (See background for teachers for how to accomplish this in existing tank). Allow students time and materials to raise and lower the pH of the liquid they are working with.
5. Ask students to dump out their liquid and rinse their materials well. Explain to the students that you will be using tap water in your aquaponics systems. Explain that your fish and plants will thrive at a pH level between 6.5-7.0. In front of the students, demonstrate testing the tap water and ask them if the tap water needs the pH lowered or raised to make it suitable for the aquaponics system. Ask them what we should add to the water to make it suitable. Demonstrate to the students that we use very small amounts of chemicals and measure as we go.
6. Ask students to refill their containers with tap water. Allow them to try to adjust their tap water to make the pH appropriate for the aquaponics system. Monitor students for understanding, appropriate use of safety equipment, and ability to change the pH.
7. Monitor ammonia and nitrite levels to ensure fish health. Establish daily or weekly testing to see fluctuating levels.

Teacher Information: Ammonia poisoning is most likely to happen when first establishing fish. Nitrite poisoning leads to the oxygen not being retained in fish blood. Discussion and research can be done on the causes/biology of ammonia and nitrite poisoning. Changing out 30% of the water during high levels of either component will alleviate the negative effects.

**Extension:** Isolate plants into cups with water from fish tank, measure ammonia and nitrate levels over several days to demonstrate plant nutrient uptake. (Be aware that water loss through evaporation and transpiration can lead to water loss/increased nutrient concentration)

1. As a class develop criteria to ensure fish health. This can include monitoring the above mentioned parameters (pH, ammonia, and nitrite), oxygen, temperature, and algae growth.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | pH | Ammonia | Nitrite | Oxygen Flowing | Temperature |
| Monday |  |  |  |  |  |
| Tuesday |  |  |  |  |  |
| Wednesday |  |  |  |  |  |
| Thursday |  |  |  |  |  |
| Friday |  |  |  |  |  |

**Possible Assessment:**

1. Have students create fish health manuals to share with younger students explaining how to care for fish in an aquaponic system.
2. Evaluate their science journals
3. Evaluate anecdotal records to see if students participate appropriately and were able to adjust the pH of the water.

**References**

**Books:**

***Aquaponic Gardening: A Step-by-step Guide to Raising Vegetables and Fish Together***

by Sylvia Bernstein 2011 ISBN: 978-0-86571-701-5

***The Complete Idiot’s Guide to Aquaponic Gardening***

by Meg Stout 2013 ISBN: 978-1-61564-235-9

**Websites:**

*Aquaponics Association*: [www.aquaponicsassociation.org](http://www.aquaponicsassociation.org)

*Foothill Hydroponics:* <http://www.foothillhydroponics.com/>