

AQUAPONICS



A BALANCING ACT Teacher Guide

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Curriculum Connections

Science 14

Unit C: Investigating Matter and Energy in the Environment

- Describe the relationship between photosynthesis and cellular respiration in terms of biological energy storage
- Identify life functions common to living systems



Answer Keys (20 points)

Fill In The Blank (11pt)

1. balance
2. ammonia
3. nitrate
4. leaf / stem
5. nitrate
6. cycling
7. water testing
8. balancing
9. nitrates
10. right away

Short Answer (9 pt)

- (In any order)
1. Feed less to the fish
 2. Remove some fish
 3. Do a partial water change

Unit D: Investigating Matter and Energy in the Environment

- Assess the impact of modern agricultural technology on the natural pathways of recycling matter
- Explain how various factors influence the size of populations
- Describe the relationship between land use practices and altering ecosystems

Science 20

Unit D: Changes in Living Systems

General Outcome 3: Students will analyze and describe the adaptation of organisms to their environments, factors limiting natural populations, and evolutionary change in an ecological context.

Science 30

Unit D: Energy and the Environment

General Outcome 1: Students will explain the need for balancing the growth in global energy demands with maintaining a viable biosphere.

Useful Resources

Please see the other Aquaponics resources available at <https://www.3ne.ca/learning-resources/>

Exploring Employment - Two articles discussing aquaponics as a possible home business and training opportunities.

Activity 1: How to Test the Water - includes step-by-step on how to run chemical tests for Nitrates, Nitrites, pH and Ammonia. Also includes Excel Aquaponic Log Sheets for recording results. These can be used as printouts or in electronic form.

Coming Soon - Activity 2: What Water Tests Tell You - Taking the information collected from Activity 1 and learning the basics of how to interpret the data to make decisions about the care of the aquaponics unit. Includes questions and graph sheets.

Check for updated video resources on Greenplanet's YouTube Channel: <https://www.youtube.com/channel/UCbcT9RNR0o5bao4m9VBJQBA>



A BALANCING ACT

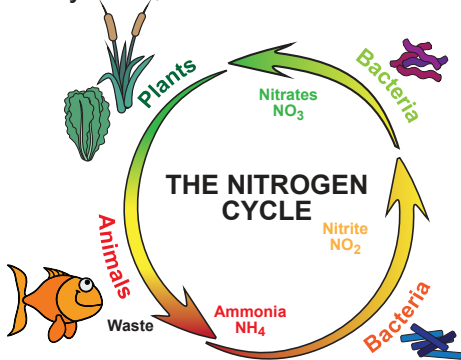
An aquaponics system is like a mini piece of nature - it has to be in balance to be healthy.

Bacteria – The Major Player

Bacteria are the critical link between fish and plants in an aquaponics system.



- ◆ Fish waste produces toxic ammonia (NH_4) and these special bacteria called nitrifying bacteria, convert it into nitrate (NO_3).
- ◆ Nitrate is used by the plants for nutrition.
- ◆ If you do not have these bacteria living in your aquaponics system, it will not work!



Plants use the nitrogen from nitrate for leaf and stem growth. In an aquaponics system, the plants will remove nitrate from the water and keep the water healthy for fish. This is what makes an aquaponics system work!



Cycling – How It Begins

Cycling an aquaponics system is the start-up process of growing a strong community of nitrifying bacteria (also known as the “biofilter”).

- ◆ This must be done before adding fish or plants to your system.
- ◆ Cycling can take up to 4-6 weeks.
- ◆ The cycling process is started by adding pure ammonia hydroxide. This provides “food” for the nitrifying bacteria and allows the community of bacteria to grow.
- ◆ Special conditions are needed to cycle a system and it needs to be watched carefully.

Once the system is cycled, fish and seedlings can be added.

Aquaponics might seem trendy and high-tech, but it’s actually ancient.

More than 1000 years ago, Maya and Aztec farmers in Mexico planted on *chinampas*, man-made islands in freshwater lakes and marshes.

They used the nutrients made by crayfish, fish, and worms to grow many different crops.



Keep a Close Eye

To keep the aquaponics system healthy, you must watch it closely. Do regular water testing of temperature, pH, ammonia, nitrite, and nitrate. A healthy system should have:

- ◆ Temperature: 20 - 22°C
- ◆ pH: 6.5 - 7.0
- ◆ Ammonia: 0 ppm
- ◆ Nitrite: 0 ppm
- ◆ Nitrate: 80 - 150 ppm.

Just as per cent (%) means "out of a hundred", so parts per million or ppm means "out of a million". This describes the concentration or strength of something in water. 1 ppm can also be written as 1 milligram per liter of water (mg/l).

Keep a daily log of the levels of each and watch how they change.

Be sure to follow all of the maintenance instructions as well.

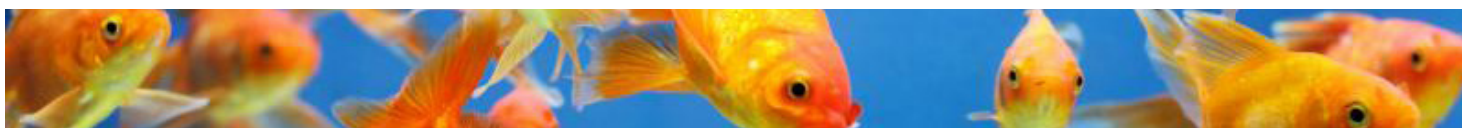
(Note: Fish food is designed for fish, not plants. You still need to add calcium, potassium, magnesium and iron to the aquaponics system.)

The Balancing Act

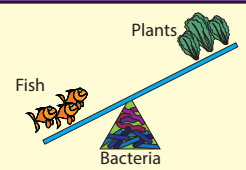
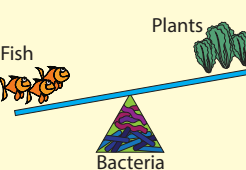
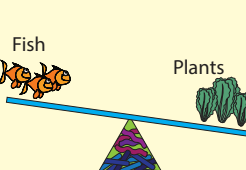
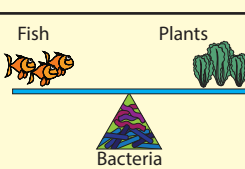
Aquaponics is a constant balancing act between the fish, bacteria and plants.

- ◆ If any of these get out of balance, the system will suffer.
- ◆ Use the amount of nitrates as a general guide to how well your system is doing. 80 - 150 ppm is good.
- ◆ Higher amounts of nitrate means the plants are getting most of the nutrients they need.
- ◆ Use the amount of ammonia and nitrite as warning signs. They should be 0 ppm.
- ◆ If either ammonia or nitrite levels increase, investigate and solve the problem right away.

Below is a chart showing what can happen if things get out of balance. Check out what can go wrong and what you can do to fix the problems.



Off Balance - What Can Go Wrong

Example	Symptom	Effect	Balance	How To Fix It
Too many fish	High levels of ammonia and nitrite (higher than 0ppm)	The fish will suffer and might die		<ul style="list-style-type: none"> • Feed less to the fish or • Remove some fish and/or • Do a partial water change
Too few plants	High levels of nitrate (over 150ppm)	Nitrates are mostly harmless to fish but very high amounts for a long time can make the fish ill		<ul style="list-style-type: none"> • Add more plants and/or • Feed less to the fish and/or • Do a partial water change (last resort)
Too many plants	Low levels of nitrates (less than 10ppm), plants are not healthy and grow slowly	There will not be enough nutrients in the system for the plants, and the plants will suffer		<ul style="list-style-type: none"> • Remove some plants and/or • Slowly increase the food for the fish (be sure to remove all uneaten food) and/or • Add more fish
Everything is balanced	Tests are all good	No stress		<ul style="list-style-type: none"> • Keep up the good work!

CHECKPOINT: Aquaponics - A Balancing Act (20 points)

Fill In The Blank (11 points)

1. An aquaponics system is like a mini piece of nature - it has to be in _____ to be healthy.
2. Fish waste produces toxic _____ (NH₄).
3. Special bacteria called nitrifying bacteria, convert the ammonia into _____ (NO₃).
4. Plants use the nitrogen from nitrate for _____ and _____ growth.
5. Plants remove _____ from the water and keep the water healthy for fish.
6. _____ an aquaponics system is the start-up process of growing a strong community of nitrifying bacteria.
7. To keep the aquaponics system healthy, you must watch it closely. Do regular _____.
8. Aquaponics is a constant _____ act between the fish, bacteria and plants.
9. Use the amount of _____ as a general guide to how well your system is doing.
10. If either ammonia or nitrite levels increase, investigate and solve the problem _____.

Short Answer (9 points)

1. Imagine you just finished testing the water of the aquaponics system and the colors for two of the test were as shown to the right. Name **three** things you could do to fix this.

FRESHWATER MASTER TEST KIT				
pH	HIGH RANGE pH	AMMONIA (NH ₃ /NH ₄ -)	NITRITE (NO ₂ -)	NITRATE (NO ₃ -)
6.0	7.4	0 ppm	0 ppm	0 ppm
6.4	7.8	0.25 ppm	0.25 ppm	5.0 ppm
6.8	8.0	0.50 ppm	0.50 ppm	10 ppm
6.8	8.2	1.0 ppm	1.0 ppm	20 ppm
7.0	8.4	2.0 ppm	2.0 ppm	40 ppm
7.2	8.8	4.0 ppm	5.0 ppm	80 ppm
7.6		8.0 ppm		160 ppm

