AQUAPONICS

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

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.

Answer Keys (50 points)

Fill In (13 points)

1. food
2. waste
3. clean
4. ammonia
5. nitrites
6. nitrates
7. growth / life
8. balance
9. less / 90% less
10. seasons
11. fossil fuel / fuel / gas / diesel
12. smaller
13. fish waste / fish / waste / decomposing

Label (7 points)

1. Plants
2. Animals
3. Bacteria 1
4. Bacteria 2
5. Ammonia
6. Nitrite
7. Nitrate

Match I (12 points)

1. I
2. E
3. L
4. B
5. F
6. A
7. D
8. C
9. K
10. G
11. J
12. H

Match II (9 points)

13. H
14. F
15. J
16. A
17. E
18. G
19. D
20. I

Short Ans (3 + 6 pts)

Answers will vary

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

AQUAPONICS

ANIMATED

1. Aquaponics Animation

Aqua Greens

This brief aquaponics animation shows the basic relationship of fish, bacteria and plants – advanced.

https://www.youtube.com/watch?v=joy7YDL2xss

2. Understanding Aquaponics By Animation

Mohamed Ghonamy

This basic animation shows the relationship of fish, bacteria and plants in an aquaponics system.

https://www.youtube.com/watch?v=Gm0ojYMuHHg

3. AQUAPONICS Animated Introduction

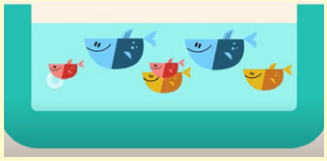
K Infographics

A brief and humorous animated introduction to aquaponics. (Part 2 not currently available, narrator has a rather strong accent.)

https://www.youtube.com/watch?v=5094hoUSM4w

4. Aquaponics Animation Video

Michael Lazo



This animated video gives a thorough review of aquaponics including the advantages of using this system. The pace is a bit fast and vocabulary a bit high but worth viewing.

https://www.youtube.com/watch?v=i0PHlnbGaul

ALBERTA CONTENT

5. Aquaponics Farm Produces Fish, Greens For Calgary Restaurants

CBC News

Deepwater Farms, a 10,000-square-foot aquaponics facility in southeast Calgary, uses aquaponics to supply fish and greens to the city's top restaurants. To read more: http://cbc.ca/1.4919579

Video: https://www.youtube.com/watch?v=cX6_7lwMgZI

6. Tilapia Hatchery and Aquaponics in Alberta

AquaDocs

This video was prepared as a student project (Dalhousie University, Nova Scotia) showcasing a southern Alberta aquaponics farm in detail. The level is a bit high, but provides good information about the fish.

https://www.youtube.com/watch?v=wTPBxg-2FIM

7. Blood Tribe Aquaponics Farming Project Could Hold Key To First Nations Food Security

Global News

Blood Tribe resident Dan McGinnis says the aquaponics farming project he's been working on with the help of Lethbridge College could offer sustainable, waste-free food production to rural Indigenous communities across Canada. (January 18, 2021)

https://globalnews.ca/video/7584527/blood-tribe-aquaponics-farming-project-could-hold-key-to-first-nations-food-security

ALBERTA CONTENT (Cont.)

1. New Aquaponics Courses Offered At Lethbridge College

Bridge City News

Lethbridge College's Aquaculture Centre is offering a series of courses for people who want to access sustainable food production using aquaponics. (March 24, 2021)

https://www.youtube.com/watch?v=8RQ834mEDiU

CANADA CONTENT

2. Aqua Grow Farms Canada's First Aquaponic Food Bank 1

nelsonandpade

This short promotional video shows the Mississauga Food Bank operating a Home Garden Clear Flow Aquaponic System to provide fresh food to people in need. No narration, just text. (See next video for more details.)

https://www.youtube.com/watch?v=L9cdHtkNpog

3. Ontario Food Bank Harvesting Fresh Fish And Greens Indoors

The Canadian Press

This news story highlights the Mississauga Food Bank is aiming to supply clients with healthier options by using aquaponics to produce fresh fish and lettuce. (Feb. 14, 2017)

https://www.youtube.com/watch?v=Phek1qpqoGo

4. Reciprocity: Dene Relationships with Fish

Yellowknives Dene First Nation, NT

This enrichment video explores the relationship between Dene people, fish and the lake, and the importance of harvesting and taking care of each other. Ethical harvesting and preparation of fish is demonstrated, and the importance of the land is discussed.

https://www.nccie.ca/videos/reciprocity-dene-relationships-with-fish/

AROUND THE WORLD

5. Aquaponics: Farming with Fish

Sacramento State University

At Sacramento State University's Sustainable Technology Outdoor Research Center (STORC), students and faculty work side-by-side to create an aquaponics farm. Presents good reasons for studying aquaponics.

https://www.youtube.com/watch?v=Fq0oRV9K-No

6. Introduction To Aquaponics (Concepts and Methods)

Purdue University/NOAA

An informational video about Aquaponics, the practice of combining fish farming and hydroponics. The video serves as an introduction to the recommended practices and guidelines for starting a successful Aquaponics operation. US content and a bit more advanced.

https://www.youtube.com/watch?v=u7oDLIsGev8

7. Introduction To Home Aquaponics

University of Hawaii

Introduces aquaponics as an agricultural technology that is rapidly gaining worldwide popularity, both for commercial production and small-scale, backyard systems.

Located in Hawaii, includes step by step how to build a backyard aquaponics unit.

https://www.youtube.com/watch?v=0-MJRB18T_o

8. What Are The Best Fish For Aquaponics?

desima

Good enrichment video about the types of fish that work best in aquaponics systems - advanced.

https://www.youtube.com/watch?v=ZTzpGREDlfU

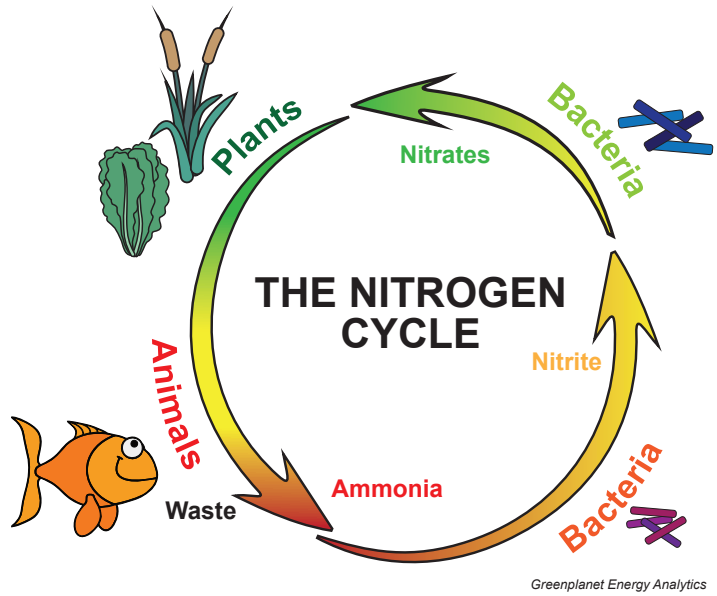
AQUAPONICS

What is Aquaponics?

Aquaponics is a system for growing food:

- Fish are raised in tanks of water where plants are also grown.
- The waste from the fish provides nutrients for the plants.
- The plants keep the water clean for the fish.

aquaculture (fish farming)	**+**	**hydroponics** (growing plants using water, not soil).



Greenplanet Energy Analytics

How Does It Work?

Aquaponics works because of the nitrogen cycle.

- In nature, when plants and animals produce waste or decompose (die and break down), ammonia is produced (NH_3).
- This ammonia is turned into nitrites and then into nitrates by two kinds of special bacteria.
- Plants need nitrates for growth and animals need plants to live.
- Then the cycle starts over again as plants and animals produce waste or decompose (die and break down). Everything is kept in balance.

Aquaponics uses the Nitrogen Cycle and keeps things in balance the same way nature does:

- The fish produce ammonia when they are fed and make wastes.
- Helpful bacteria turn this ammonia into nitrates which are used by the plants for growth.
- The plants clean the water that the fish need.

Why use Aquaponics?

Aquaponics Saves Water

- Aquaponics uses 90% less water than traditional farming.
- In traditional farming, only some of the water goes into the soil. A lot runs off or evaporates from the ground.
- In Aquaponics, most of the water is saved and reused.

Droughts are happening more often. Aquaponics may help since it grows food with less water.

Grow Food Year-Round, Anywhere

- An aquaponics system can be built anywhere you have a power source.
- They are indoors so location, weather and seasons are not a problem.

Helps the Environment, Cost & Quality

- Aquaponics can reduce the costs and the amount of fossil fuel used for shipping food long distances.
- Growing local means produce is fresh!

Less Space Needed

- Aquaponics gives plants ideal growing conditions. You can grow plants closer together than plants grown in soil.
- Growbeds can also be stacked on top of one another. This is known as “vertical farming”. More plants can be grown in a smaller space.

This is “vertical farming”. Plants grown with aquaponics or hydroponics can be grown this way.

Aquaponics Makes Healthy Food

- Food grown with aquaponics is guaranteed to be organic.
- You can’t spray pesticides on the plants as this will kill the fish.
- You can’t use antibiotics on the fish as this will kill the bacteria needed to break down the ammonia.
- In aquaponics, the plants get their nutrients from the fish waste, so there is less need to add chemicals.
- This rich environment prevents the growth of dangerous bacteria.

Fish And Plants Together Solve Problems

- Fish farms have buildups of waste.
- Hydroponics uses human made plant food and has to have the water changed regularly (due to the buildup of nitrates).
- Both of these problems are solved using aquaponics.

Bonus – grow your meat and veg in one shot!

What Parts Are Needed for Aquaponics?

Fish Tank

This is where the fish live. Fish tanks can be different sizes depending on the number of plants you want to grow. You can figure out how many fish you need to supply nutrients for the plants.

Mechanical Filter

This is where most of the fish waste ends up. Small systems may have just a screen or net. Industrial systems will have something more complex.

BioFilter

The biofilter is where the bacteria convert the ammonia into useful nitrates for the plants. In smaller systems this is done by the growbed.

Growbed

This is where the plants are grown.

- There are many different types of growbeds - some made with PVC pipes, floating rafts on water or trays of gravel.
- Expanded clay pellets are often used in aquaponics and hydroponics. (See page 4)
- The top of the growbed is kept dry to prevent algae growth. The bottom is for root growth.
- The majority of the helpful bacteria live in the growbed in the tiny pores of the clay pellets.
- The best plants to grow here are leafy greens.

Water Pump

This electric device pushes the water from the fish tank up to the growbed.

Expanded clay pellets (Hydroton) are made by heating the clay to over 1000°C!

As the balls heat up, they fill with bubbles and form into small marble-sized balls. They are ideal for growing plants in water.

Bell Siphon

This device allows the water in the grow bed to fill up and empty back into the fish tank, over and over again.

- It works without electricity.
- The water fills the grow bed and delivers the nutrients from the fish waste to the roots of the plants and the helpful bacteria.
- When the water is drained, oxygen is pulled into the bed which is needed by the plants and helpful bacteria.

Aquaponics unit in the lobby of Keyano College in Fort Chipewyan

Another type of growbed uses large tubs of water with thick foam rafts that floats on top. The foam rafts have holes where the seedlings are put to grow. The roots hang down into the water where they get the food and oxygen they need.

Air Pump

This pushes air down a hose into the water.

- Air stones at the end of this hose help make bubbles so that oxygen is added to the water.
- This extra oxygen is needed for plants, fish and the helpful bacteria.

Lights

LED grow lights are needed so indoor plants can get enough energy to grow.

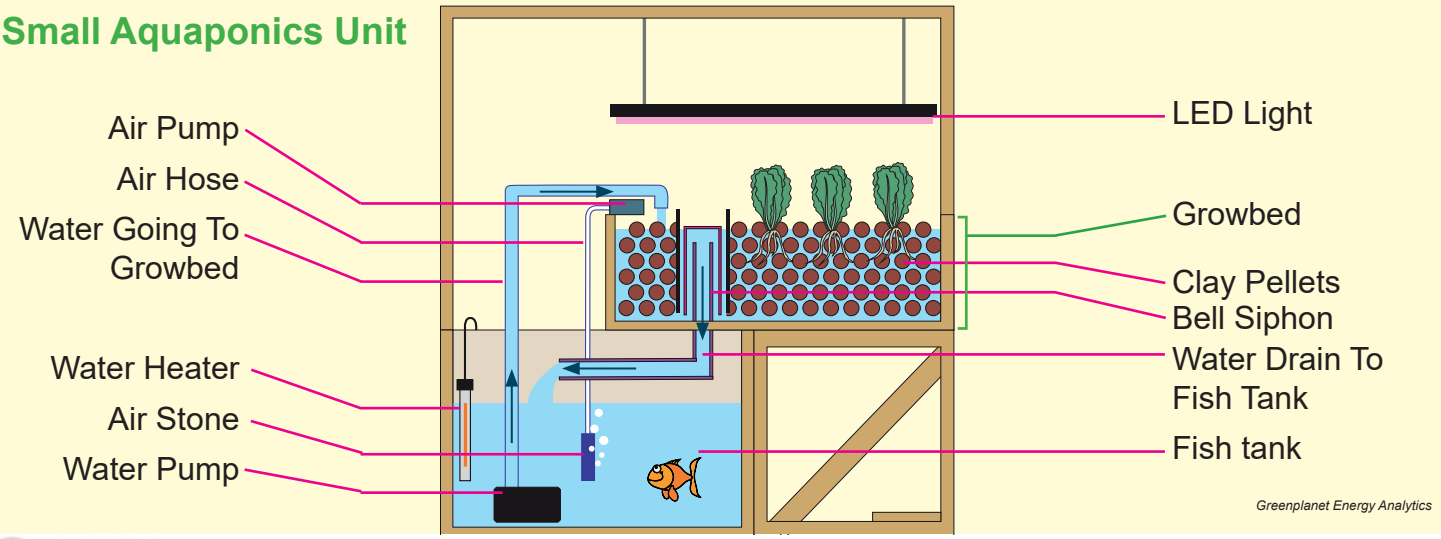
Water Heater/Thermometer

Bacteria and some fish need warmer water so a heater and thermometer are kept in the tank.

Test Kit

This measures the amount of ammonia and other chemicals in the water to make sure everything is kept in balance.

Small Aquaponics Unit



Name: _____ Date: _____

CHECKPOINT: The What, How, Why of Aquaponics (50 points)

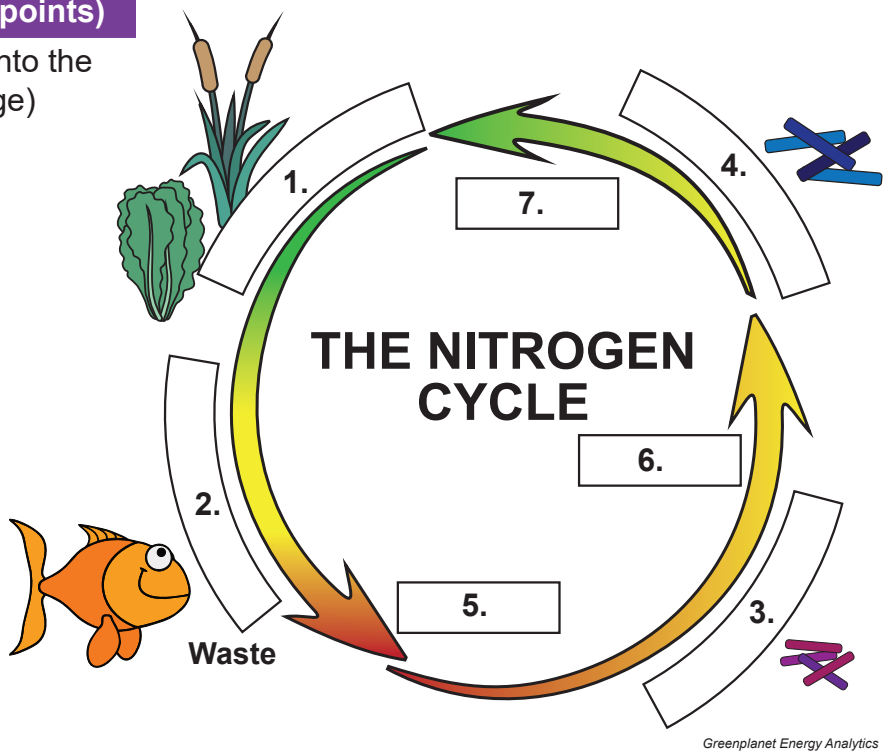
Fill In The Blank (13 points)

1. Aquaponics is a system for growing _____
2. _____ from the fish provides nutrients for the plants
3. Plants keep the water _____for the fish
4. In nature, when animals produce waste, _____ is produced
5. In nature, bacteria first turns ammonia into _____.
6. Different bacteria turn nitrites into _____.
7. Plants need nitrates for _____
8. Plants are eaten by animals which produces waste so everything is kept in _____.
9. Aquaponics uses _____ water than traditional farming
10. With aquaponics, location, weather and _____ are not a problem.
11. Aquaponics reduces use of _____ by reducing the need to ship food long distances.
12. More plants can be grown in a _____ space using aquaponics.
13. Instead of buying plant food, aquaponics gets the plant food from _____.

Label (7 points)

Place the correct labels for the diagram into the blanks below. (See hints at bottom of page)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____



Greenplanet Energy Analytics

Nitrate	Bacteria 1	Ammonia
Nitrite	Bacteria 2	
Plants	Animals	

Matching I (12 points)

Place the correct letter from the diagram into the blanks below.

___ 1. Clay pellets

___ 2. Air stone

___ 3. Fish tank

___ 4. Air hose

___ 5. Water pump

___ 6. Air pump

___ 7. Water heater

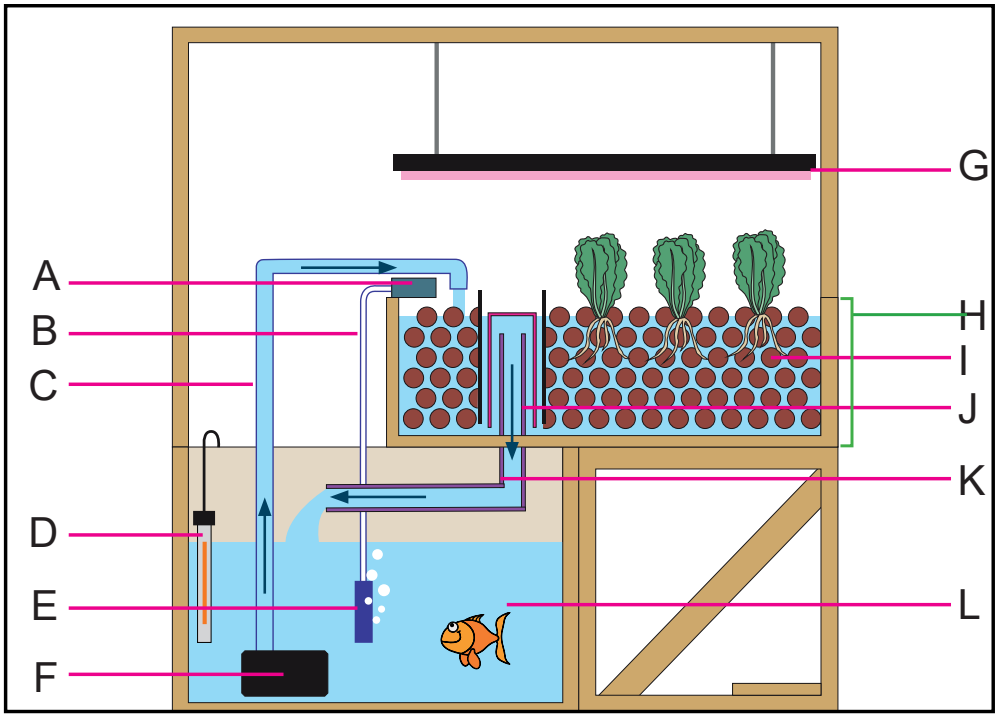
___ 8. Water pipe to growbed

___ 9. Water drain to fish tank

___ 10. LED light

___ 11. Bell siphon

___ 12. Growbed



Matching II (9 points)

Place the correct letter from the diagram above into these blanks.

___ 1. where the fish live

___ 2. the plants are grown here

___ 3. electric device that pushes water from the fish tank up to the growbed

___ 4. device allows the water in the grow bed to fill up and empty back into the fish tank, over and over again

___ 5. pushes air down a hose into the water.

___ 6. helps break air into bubbles to add oxygen to the water.

___ 7. provides light energy to the plants

___ 8. keeps the water warm for bacteria and fish

___ 9. these are made from clay and support the plants

Short Answer (3 points + 6 points)

1. What do you think the biggest advantage of using aquaponics is? Explain your answer.

_____

_____

_____

_____

_____

2. Do you think aquaponics could work in Fort Chipewyan? Give TWO reasons and explain your answers.

_____

_____

_____

_____

_____

_____

_____

_____

_____