AQUAPONICS

FISH FACTS
Teacher Guide

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 (25 points)

Fill in the Blank (10 pt)

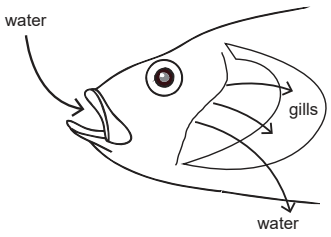
1. waste
2. balance
3. float/place
4. protein
5. 3 minutes

Matching (7 pt)

1. c
2. a
3. g
4. f
5. b
6. e
7. d

Short Answer (5 pt)

1. See diagram of gills on page 4



Short Answer (3 pt)

2. Answers will vary (could involve something about training the fish using a reward like food.)

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.

Aquaponics – What, How, Why - Basic introduction to aquaponics with a brief explanation of the Nitrogen Cycle, the advantages of aquaponics, and a breakdown of the parts of an aquaponics system. Includes Alberta curriculum ties, diagrams and question sheet.

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.

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

AQUAPONICS

FISH FACTS

In an aquaponics system, fish not only produce the natural fertilizers needed by the plants, they provide balance to this living system. This is also an opportunity to learn close-up about these wonderful animals.

Types of Fish

Many types of fish can be used in aquaponics:

- tilapia
- carp - including goldfish and koi
- catfish
- large mouth bass
- trout

An easy and inexpensive fish to start with is goldfish. Goldfish produce a lot of waste so they are a good choice for aquaponics.

Koi is another good choice but are more expensive to buy. An advantage of koi, however, is that you can sell them as decorative fish when they have matured.

If you would like to use tilapia, you will need to purchase a license to raise them. They are considered an *invasive species*. However, they are a fairly easy to raise and they are good to eat.

Trout is a more difficult fish to raise and is not recommended for beginners.

How Many Fish

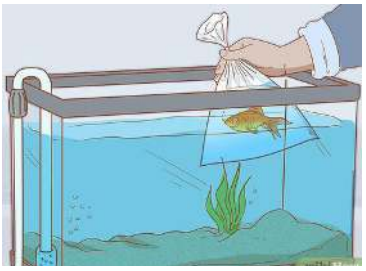
For your school aquaponics unit, you should start with 215 grams of young “feeder goldfish” (6 cm length, approximate 8 g weight each). **This is around 26 young fish.** If you prefer to buy large, mature goldfish, you will need 645 g of fish. Mature fish are 11 to 15 cm long. You can weigh the fish to determine how many you will need. (See page 3.)

If you are buying young fish, keep in mind that they will grow! This means that you eventually have to remove fish from your tank to maintain a balance. (Do not release fish into the wild.) **After 8-12 months, you should aim to have around 5 - 8 mature goldfish.**

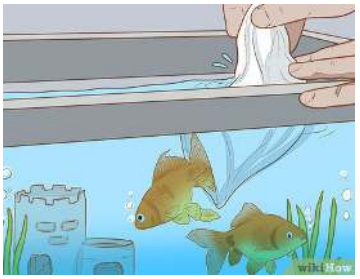
Introducing New Fish

Fish do not like rapid changes in temperature or pH so you need to do things slowly.

- The fish you buy will be given to you in a plastic bag.
- Float the bag of fish on top of the surface of the fish tank for 30min so it can slowly change the temperature.



- Slowly add small amounts of system water into the bag with the fish so it adjusts to the pH of the system water.
- After 30 minutes, open the bag and slowly pour the fish and the water into the main tank.



How to Weigh a Fish

You should periodically weigh your fish as they grow so you know how much to feed them and keep the system in balance.

- Place a clean cup or bag of system water on a scale and weigh it.
- Add a fish to this and weigh again.
- Subtract the first weight from this second weight to find out how much your fish weighs.
- Multiply this number by the total number of fish you have at that size to get an approximate total weight of fish in your system.

Fish Food

What Kind

There are many different types of fish food you can buy.

The industry standard in aquaponics is to use fish food with 32% protein. As protein content goes up in fish food, so does the amount of ammonia (and ultimately nitrogen) produced by fish. Nitrogen is one of the three main nutrients that plants need.

If you are using pellets and not flakes, make sure you buy the correct size of pellet food for your fish. Smaller fish cannot eat larger pellets and larger fish use a lot of energy digesting pellets that are too small. As your fish grow, you will need to increase the size of fish food you buy. If you use flakes, this is not a problem.

A recommended brand of fish food for goldfish is 'Hikari' or 'Omega-one'.

How Much Food

For your school aquaponics unit, you will need 6.45g of fish food per day, divided over 2 feedings.

Younger fish will eat up to 4-5% of their total body weight in fish food per day. Mature fish eat as little as 1% of their total body weight in fish food per day. You can use this as a guideline when trying to determine how much to feed your fish.

Another general rule you can use is to feed your fish as much as they will eat in 3 minutes. Remove any left-over food with a siphon or net.

You can also buy an automatic fish feeder or slow release food if you are away for a few days. (You can give them extra food before you leave on Friday and then feed them Monday morning. Fish in the wild do not have a constant food supply. But if you can, keep them fed regularly.)

A Healthy Home

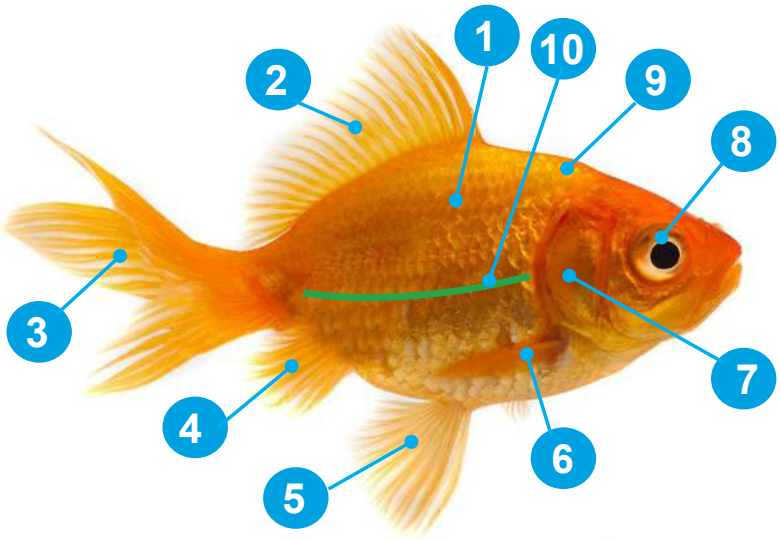
To keep your fish healthy, it is very important to watch the water quality. Be sure to do regular water testing.

- Ammonia is toxic so it must be less than 0.25ppm.
- Nitrite is also toxic so it can't be over 0.50ppm.
- Nitrates are relatively harmless to fish, but should not be over 150ppm for any length of time.
- Fish prefer a pH of 6.5 – 8. They can't handle large pH changes so adjust it slowly (no more than 0.2 per day).
- Keep the water temperature at about 20°C. Fish do not like rapid changes so adjust it very slowly.
- Fish need a lot of oxygen. Make sure the airpump and airstones are working well. If you notice your fish 'gasping' at the top of your fish tank they probably need more oxygen. Try to avoid this as it means the fish are already in danger.

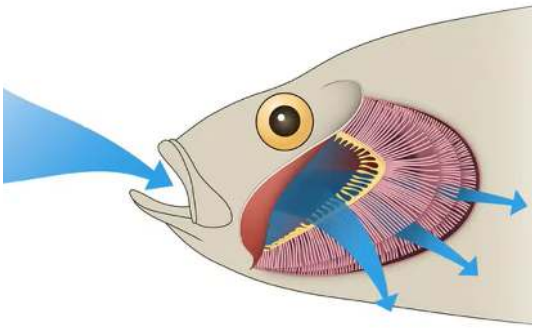
Just as per cent (%) means "out of a hundred", so parts per million or ppm means "out of a million". This describes the concentration or strength of something in water. 1 ppm can also be written as 1 milligram per litre of water (mg/L).

Goldfish Anatomy

Aquaponics gives you a chance to learn about fish close up.



1. Body: streamlined and not too long as goldfish forage on the bottom for food rather than chase prey.
2. Dorsal fin: on the back, used for stability
3. Caudal or Tail fin: for forward motion and direction
4. Anal fin: on the underside just before the caudal fin, helps to keep the goldfish upright
5. Ventral fins: on the lower belly, used for stability and sudden stops
6. Pectoral fins: behind the gills, used for low speed movement



7. Gill plate: one on each side of the head, protect the gills:
   - Gills are branching organs that have many small blood vessels called capillaries.
   - As the fish opens its mouth, water runs over the gills, and blood in the capillaries picks up oxygen that's dissolved in the water.
   - Then the blood moves through the fish's body to deliver the oxygen, just like lungs in humans.
8. Eyes: move very little and provide short distance vision only (Goldfish rely on other senses to find food and warn of danger.)
9. Lateral line: a series of sensory pits running from behind the gill plates along the side of the body to the tail. It detects vibrations, water pressure and temperature changes. (See photo below.)
10. Scales: protect the fish like very flexible armor

A goldfish's lateral line can be seen as small dots going across the scales in this photo.

Goldfish Trivia

- They can reach up to 59 cm in size, and 3 kg in weight.
- Goldfish can live for up to 30 years.
- It was once thought that goldfish have short memories, but scientists have proven that this is not true. In experiments, a goldfish was trained to swim through a maze.

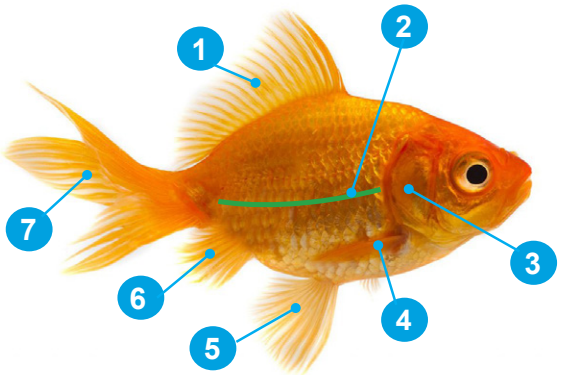
Goldfish were domesticated in China nearly 2,000 years ago for use as ornamental fish in ponds and tanks. They were seen as a symbol of luck and fortune, and they could only be owned by members of the Imperial Song Dynasty.

Name: _____ Date: _____

CHECKPOINT: Aquaponics - FISH FACTS (25 points)

Fill In The Blank (10 points)

1. Goldfish produce a lot of _____ so they are a good choice for aquaponics.
2. If you are buying young fish, you eventually have to remove some from your tank to maintain a _____.
3. When you get new fish _____ the bag of fish on top of the surface of the fish tank so it can slowly change the temperature.
4. The industry standard in aquaponics is to use fish food with 32% _____.
5. A general rule you can use for how much to feed your fish is to give them as much as they will eat in _____.



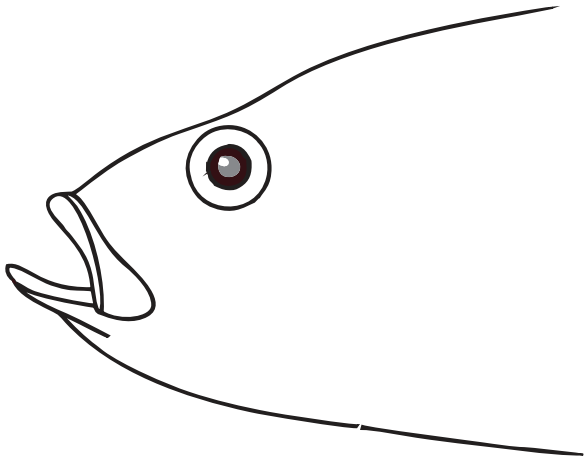
Matching (7 points)

Use the diagram above and place the correct letter into the blanks for each part.

1. _____	a. Lateral line
2. _____	b. Ventral fin
3. _____	c. Dorsal fin
4. _____	d. Caudal fin
5. _____	e. Anal fin
6. _____	f. Pectoral fin
7. _____	g. Gill plate

Short Answer (5 points)

1. Draw a simple diagram to show how fish breath. Label any parts or arrows you draw.



Short Answer (3 points)

1. Describe a simple experiment you could do to prove that goldfish have long memories.

_____

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