Duration: 20-30 Minutes

Aquaponics Survival Game

Grade 4-7

Objective

Students will learn about the symbiotic relationship of the three organisms in the aquaponics cycle; **fish**, **bacteria**, and **plants**. Students will also understand that farmers can help maintain the balance of the system.

Materials

- Poster of Aquaponics Cycle
- StudyPonics system of diagram of an aquaponics system
- 2 Farmer lanyards
- 7 Fish lanyards
- 7 Plant lanyards
- 7 Bacteria lanyards
- Laminated Ammonia and Fish Food[1] cards
- Laminated Nitrate and Plant Harvest[2] cards
- Laminated Clean Water cards
- Laminated Symbiotic cards

Advanced Preparation: Print Survival Game Cards double sided onto cardstock or other heavy stock paper. Print enough cards of each style to work with the group size. Cut along outline to create cards.

Introduction

"Has anyone ever visited a farm that grows both vegetables and fish?! Well that is exactly what happens with aquaponics! Aquaponics is a system of growing, where plants and fish are being raised together in a tank system."

Show StudyPonics system, or photo, point out key elements as you discuss them

"Both plants and fish need light. Can you see where the light is coming from? Right, electric grow lights attached above. This means that aquaponics farms can be inside instead of outside! So, we can grow fish and vegetable all year round, no matter what the weather is.

You can see that in our aquaponics tank, the fish and the plants share the same water, as it travels through the system. The water that the fish live in is the same water that the plants absorb! Do you see any other living things in our aquaponics tank? There are tiny organisms called bacteria living in the water also. How do you think the plants, fish, and bacteria help each other?"

Take some ideas. Some prompts can include; *What do plants need to live? What do fish produce when they've eaten?*

"Let's have a look at the Aquaponics Cycle"

---

[1] The Fish Food and Ammonia card is one card; the Fish accepts the Fish Food card and flips it over into an Ammonia card
[2] The Nitrate and Plant Harvest card is one card; the Plant accepts the Nitrate card and flips it over into a Plant Harvest card

Show poster of aquaponics cycle. Explain the cycle;

"When fish eat, they produce both liquid and solid waste, which has ammonia in it. When fish breath, they also produce ammonia, like how humans exhale CO_2. The bacteria in the water, on the rocks, roots, walls, and in the filters convert that ammonia into nitrates, often known as fertilizer. The plants absorb those nitrates and the other nutrients from the fish waste and use them as food. The plants roots keep the water clean, and the fish live in the clean water. Every organism in the aquaponics tank is necessary for survival!

This is all interesting, but why do we care? How does aquaponics help the environment?"

Take some ideas. Some prompts can include; W*hat would happen if the plants didn't use the waste from the water, would we have to dump it? What if the fish didn't provide the nutrients, where would we get them from?*

Some of the reasons that aquaponics is sustainable:

- Uses 85% less water that regular outdoor farms
- Does not use any chemical fertilizers, only fish waste
- Uses less land (can be stacked vertically, and plants can grow very densely), and can go anywhere (not dependent on the seasons or good soil so can be used in old warehouses and other non-farmable land)
- Fish and vegetables are locally produced meaning less transportation pollution
- No pollution of our local watershed by fish poop or fertilize, as it is all contained

"Let's play a game to see how the organisms in our tank work together, to grow food sustainably."

Activity

Hang the Aquaponics Cycle poster where visible, so students may refer to it throughout the activity.

1. Hand out one lanyard to each student, ensuring that the general percentage of each Fish, Bacteria, and Plant stays the same. If possible, have an adult also be the Farmer.

   "This is a cooperative game, meaning that we all work together to make sure that we win the game. We win by keeping our aquaponics tank healthy, by keeping enough of each organism in the tank. We stay healthy by trading cards to get what we need."

2. Distribute the cards as follows:
   - Fish start with one (1) Ammonia and one (1) Symbiotic
   - Plants start with one (1) Clean Water and one (1) Symbiotic
   - Bacteria start with one (1) Nitrate and one (1) Symbiotic
   - Farmer starts with all the Fish Food and one (1) Symbiotic

   "*What does **symbiotic** mean? **Symbiotic** is a relationship between organisms that helps both. It means we all need to give and take from each other to survive."*

3. Instruct everyone to take a moment to read the back of their lanyard, as it explains how to trade the cards.
4. Using two students, demonstrate how a trade is made

   All Trade Instructions:

   Fish

Find a **Bacteria**[3]. Give the Bacteria **one (1) Ammonia** card and take **one (1) Symbiotic** card. If the Bacteria has no Symbiotic card, the trade cannot happen.

Find a **Plant**. Give the Plant **one (1) Symbiotic** card and take **one (1) Clean Water** card. If the Plant has no Clean Water card, the trade cannot happen.

Find a **Farmer**. Give the Farmer **one (1) Clean Water** card and take **one (1) Fish Food** card.

Bacteria

Find a **Fish**. Give the Fish **one (1) Symbiotic** card and take **one (1) Ammonia** card. If the Fish has no Ammonia card, the trade cannot happen.

Find a **Plant**. Give the Plant **one (1) Nitrate** card and take **one (1) Symbiotic** card. If the Plant has no Symbiotic card, the trade cannot happen.

Find a **Farmer**. Give the Farmer **one (1) Ammonia** card and **take one (1) Nitrate** card.

Plant

Find a **Bacteria**. Give the Bacteria **one (1) Symbiotic** card and take **one (1) Nitrate** card. If the Bacteria has no Nitrate card, the trade cannot happen.

Find a **Fish**. Give the Fish **one (1) Clean Water** card and take **one (1) Symbiotic** card. If the Fish has no Symbiotic card, the trade cannot happen.

Find a **Farmer**. Give the Farmer **two (2) Plant Harvest** cards and take **two (2) Clean Water** card.

Farmer

You are the banker.

Find a **Fish**. Give them **one (1) Fish Food** card and take **one (1) Clean Water** card. If the Fish does not have a Clean Water card, the trade cannot happen.

> **Note:** When a Fish approaches you, you may also choose to harvest them. Once harvested, they must sit down until another Farmer adds them back.
>
> **Caution!** Harvesting too many fish may stop the symbiotic relationships from working!

Find a **Bacteria**. Give them **one (1) Nitrate** card and take **one (1) Ammonia** card. If the Bacteria does not have an Ammonia card, the trade cannot happen.

Find a **Plant**. Give them **two (2) Clean Water** cards and take **two (2) Plant Harvest** cards. If the Plant does not have two (2) Plant Harvest cards, the trade cannot happen.

> **Note:** When a plant approaches you, you may also choose to permanently harvest them. Once permanently harvested, they must sit down until another Farmer adds them back.
>
> **Caution!** Permanently harvesting too many plants may stop the symbiotic relationships from working!

At any time, you may trade any card with another Farmer.

5. Continue playing until the symbiotic relationship stops working or until time runs out.
6. Collect cards and lanyards.

[3] For the simplicity of instruction, the singular of bacteria (bacterium) is not used.

Discussion

If the symbiotic relationship stopped working, discuss why*; Were too many plants harvested? Were too many fish harvested? Why does harvesting too many plants or fish cause it to stop working?*

"When too many plants are harvested, the water cannot be cleaned for the fish. When too many fish are harvested, not enough ammonia is produced to turn into nitrate, and the plants run out of food."

Discuss why the symbiotic cards were used; "I*n nature, organisms need each other to survive, and that is true in our aquaponics tank as well. Every time you traded to get what you needed, you remembered that you are part of a cycle"*

Discuss which organism had the most control or power in the game; *The Farmers had a say in everything that happened; they fed the fish, the kept the tank at the right temperature for the bacteria to turn ammonia into nitrate, and they harvested the plants so that they could keep growing.*

In aquaponics, and in the environment, Farmers do have the power to keep organisms healthy and allow them to work together, or we can make decisions that hurt the environment. Aquaponics is a great way for Farmers to grow fish and vegetables, while protecting the environment

Optional If time:

- What would happen if our Farmer had removed all the fish or plants or bacteria?
- What would happen if we had too many plants?
- What would happen if we had too many fish?
- What would happen if we didn't have the Farmers? Where else could the fish get their food from in nature? (bugs, smaller fish, algae, plant roots)

Table 1: Ontario Curriculum Links

Grade	Subject Area	Ontario Curriculum Links
4	Science and Technology	**Habitats and Communities** Specific Expectation: 1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities (e.g., human dependence on natural materials), taking different perspectives into account (e.g., the perspectives of a housing developer, a family in need of housing, an ecologist), and evaluate ways of minimizing the negative impacts 1.2 Identify reasons for depletion or extinction of plant or animal species 2.2 build food chains consisting of different plants and animals, including humans 3.1 Demonstrate an understanding of habitats as areas that provide plants and animals with the necessities of life. 3.3 Identify factors that affect the ability of plants and animals to survive in a specific habitat 3.4 demonstrate an understanding of a community as a group of interacting species sharing a common habitat 3.9 demonstrate an understanding of why all habitats have limits to the number of plants and animals they can support
5	Science and Technology	**Properties of and Changes in Matter** Specific Expectation: 1.1 evaluate the environmental impacts of processes that change one product into another product through physical or chemical changes 1.2 assess the social and environmental impact of using processes that rely on chemical changes to produce consumer products, taking different perspectives into account
6	Science and Technology	**Biodiversity** Specific Expectation: 1.1 analyse a local issue related to biodiversity (e.g., the effects of human activities on urban biodiversity, flooding of traditional Aboriginal hunting and gathering areas as a result of dam construction), taking different points of view into consideration (e.g., the points of view of members of the local community, business owners, people concerned about the environment, mine owners, local First Nations, Métis, Inuit), propose action that can be taken to preserve biodiversity, and act on the proposal 3.2 demonstrate an understanding of biodiversity as the variety of life on earth, including variety within each species of plant and animal, among species of plants and animals in communities, and among communities and the physical landscapes that support them 3.5 describe interrelationships within species

7	Science and Technology	Biodiversity Specific Expectation: 1.2 analyse the costs and benefits of selected strategies for protecting the environment 3.1 demonstrate an understanding of an ecosystem (e.g., a log, a pond, a forest) as a system of interactions between living organisms and their environment 3.2 identify biotic and abiotic elements in an ecosystem, and describe the interactions between them 3.4 describe the transfer of energy in a food chain and explain the effects of the elimination of any part of the chain 3.5 describe how matter is cycled within the environment and explain how it promotes sustainability 3.7 explain why an ecosystem is limited in the number of living things (e.g., plants and animals, including humans) that it can support