

Day 1 Duration:
30-40 Minutes

First 10-15 Days:
15 Minutes/Day

Day 15 Duration:
20-30 Minutes

Remaining 40 Days:
20 Minutes/Week

Day 54 Duration:
30-40 Minutes

Soil vs. Aquaponics Lettuce

Grade 1-8

Objective

Students will grow lettuce seedlings in a traditional soil medium, and in an aquaponics system. Students will follow the scientific method to organize the project, track results, and compare plant growth.

Overall Materials

- Scientific method chart
- Lettuce seeds
- Grow Tray & Humidity Dome
- 25 peat moss pellets (e.g. Jiffy Peat Pellets)
- 25 rockwool cubes
- Spray bottle
- Growth tracking chart
- 25 StudyPonics net pots
- StudyPonics system
- 25 2" pots
- Potting soil

Day 1 Introduction

"Today we are going to begin an experiment to compare how plants grow in an aquaponics system vs traditional soil. We all know that plants can grow successfully in soil, but most of us have never seen plants growing in an aquaponics system! We will be following the scientific method, to ensure that our experiment has good results. The scientific method has six components:"

Discuss the Scientific Method;

1. **Purpose:** why are we doing this experiment? What do we want to learn?
2. **Hypothesis:** what do we think will happen? What is our educated guess?
3. **Material:** make a list of all materials needed for the experiment
4. **Procedure:** how exactly will we conduct this experiment? What steps do we need to perform?
5. **Results:** what is happening? Track what we see in our growth tracking chart!
6. **Conclusion:** what did our experiment show us? What does it mean?

Day 1 Materials

- Scientific method chart
- Lettuce seeds
- Grow Tray & Humidity Dome
- 25 peat moss pellets (e.g. Jiffy Peat Pellets)
- 25 rockwool cubes
- Spray bottle

Day 1 Activity (30-40 Minutes)

1. Brainstorm answers to #1-4 as a class. Ensure students understand each step of the method.
2. Hand out the worksheet to students and have them complete #1-4.
3. Moisten the rockwool cubes in the grow tray. The rockwool cubes should be full of water, with only a few drops in the grow tray.
Note: Dry Rockwool may cause irritation to the skin. It is recommended that a teacher handle the Rockwool until it is moistened.
4. Have students moisten the peat moss pellets as per their instructions. Place into grow tray.
5. Plant lettuce seeds in both the peat moss pellets and the rockwool.
6. Cover grow tray with humidity dome.
7. Place near window or other source of warmth.
8. Write labels to indicate who (which group) each plant belongs to, as well as the date started.

Daily for First 10-15 Days Materials

- Growth tracking chart

Daily for First 10-15 Days Activity (15 Minutes)

1. Observe seedlings. Note when they first start to sprout, when first leaves appear, and when second leaves appear.
2. Ensure plant media remains moist.

Approx. Day 15 Materials

- 25 StudyPonics net pots
- StudyPonics system
- 25 2" pots
- Potting soil

Approx. Day 15 Activity (20-30 Minutes)

1. Transfer Rockwool cubes into StudyPonics net pots
2. Transfer StudyPonics net pots into StudyPonics system
3. Transfer peat moss pellets into 2" pots.
4. Fill pots with potting soil. Water.

Weekly for Remaining 40 Days Materials

- Growth tracking chart
- Ruler

Weekly for Remaining 40 Days Activity (20 Minutes)

Choose a consistent day of the week to perform this activity.

1. Count and record the number of leaves on the lettuce
2. Measure and record the overall width and height of the lettuce.
3. Measure and record any other data points the students are interested in tracking.

Day 54 Materials

- Scientific method chart

- Growth tracking chart
- Ruler

Day 54 Activity (30-40 Minutes)

1. Take final measurements.
2. Harvest lettuce

To Harvest from Soil:

- a. Break head of lettuce at the base
- b. Dispose of soil

To Harvest from StudyPonics

- a. Remove net pot and lettuce from system.
 - b. Break head of lettuce at the base
 - c. Hold roots and twist pot to easily release the Rockwool from the net pot.
 - d. Dispose of roots and Rockwool. Reuse net pot.
3. If you are going to eat the lettuce, ensure you wash it first! Note any taste or texture differences
 4. Write conclusions

Discussion

“What conclusion did you reach after our experiment? If aquaponics is an efficient, sustainable way to produce food, where are some places that would be great for aquaponics farms?”

- Empty warehouses/factories in urban centres
- Building an aquaponics facility on contaminated land (because you can't farm the ground)
- Places with water restrictions (aquaponics uses less water than traditional farming)
- Cold climates that want year-round fresh food

What was the differences between both growing methods?

- How did they get watered or nutrients?
- Did one use more water than the other?
- Did one use more energy?
- Did one grow faster?
- Is one tastier?

Optional

- Graph results
- Research some real-life aquaponics farms (e.g. Ripple Farms, AquaGrow Farms)

Table 1: Ontario Curriculum Links

Grade	Subject Area	Ontario Curriculum Links
1	Science and Technology	<p>Needs and Characteristics of Living Things</p> <p>Specific Expectation:</p> <p>1.1 identify personal action that they themselves can take to help maintain a healthy environment for living things, including humans</p> <p>2.1 follow established safety procedures and humane practices during science and technology investigations</p> <p>2.2 investigate and compare the basic needs of humans and other living things, including the need for air, water, food, warmth, and space, using a variety of methods and resources</p> <p>2.3 investigate and compare the physical characteristics of a variety of plants and animals, including humans</p> <p>2.4 Investigate the physical characteristics of plants and explain how they help the plant meet its basic needs, using a variety of methods and resources</p> <p>2.6 Use appropriate science and technology vocabulary, including investigation, explore, needs, space, and food, in oral and written communication.</p> <p>2.7 use a variety of forms to communicate with different audiences and for a variety of purposes</p> <p>3.2 identify the physical characteristics of a variety of plants and animals</p> <p>3.7 describe how the things plants and animals use to meet their needs are changed by their use and are returned to the environment in different forms</p>
2	Science and Technology	<p>Air and Water in the Environment</p> <p>Specific Expectation:</p> <p>2.1. follow established safety procedures during science and technology investigations</p> <p>2.3. investigate, through experimentation, the characteristics of water and its uses</p> <p>2.7 use a variety of forms to communicate with different audiences and for a variety of purposes</p> <p>3.3 describe ways in which living things, including humans, depend on air and water</p> <p>3.4 identify sources of water in the natural and built environment</p>

3	Science and Technology	<p>Growth and Changes in Plants</p> <p>Specific Expectation:</p> <p>1.1 assess ways in which plants are important to humans and other living things, taking different points of view into consideration and suggest ways in which humans can protect plants</p> <p>1.2 assess the impact of different human activities on plants, and list personal actions they can engage in to minimize harmful effects and enhance good effects</p> <p>2.1 follow established safety procedures during science and technology investigations</p> <p>2.2 observe and compare the parts of a variety of plants</p> <p>2.3 germinate seeds and record similarities and differences as seedlings develop</p> <p>2.4 investigate ways in which a variety of plants adapt and/or react to their environment, including changes in their environment, using a variety of methods</p> <p>2.5 use scientific inquiry/experimentation skills, and knowledge acquired from previous investigations, to investigate a variety of ways in which plants meet their basic needs</p> <p>2.6 Sample guiding questions: How do plants meet their need for air, water, light, warmth, and space? What are different ways in which we can help plants meet their needs?</p> <p>2.7 use appropriate science and technology vocabulary, including stem, leaf, root, pistil, stamen, flower, adaptation, and germination, in oral and written communication</p> <p>2.8 use a variety of forms to communicate with different audiences and for a variety of purposes</p> <p>3.1 describe the basic needs of plants, including air, water, light, warmth, and space</p> <p>3.2 identify the major parts of plants, including root, stem, flower, stamen, pistil, leaf, seed, and fruit, and describe how each contributes to the plant's survival within the plant's environment</p> <p>3.3 describe the changes that different plants undergo in their life cycles</p> <p>3.4 describe how most plants get energy to live directly from the and how plants help other living things to get energy from the sun</p> <p>3.6 describe ways in which plants and animals depend on each other</p> <p>3.7 describe the different ways in which plants are grown for food, and explain the advantages and disadvantages of locally grown and organically produced food, including environmental benefits</p> <p>3.8 identify examples of environmental conditions that may threaten plant and animal survival</p>
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		<p>Soils in the Environment</p> <p>Specific Expectation:</p> <p>2.1 follow established safety procedures during science and technology investigations (e.g., wash hands after working with soil samples)</p> <p>2.3 use scientific inquiry/experimentation skills, and knowledge and skills acquired from previous investigations, to determine which type(s) of soil (e.g., sandy soil, clay soil, loam) will sustain life</p> <p>3.2 identify additives that might be in soil but that cannot always be seen (e.g., pesticides, fertilizers, salt)</p> <p>3.3 describe the interdependence between the living and non-living things that make up soil (e.g., earthworms ingest the soil and absorb the nutrients, then their castings return the nutrients to the soil; the roots of plants use the soil as an anchor to keep the plants from blowing away)</p> <p>3.4 describe ways in which the components of various soils enable the soil to provide shelter/homes and/or nutrients for different kinds of living things (e.g., microscopic bacteria and micro-organisms feed on decaying matter in the soil; roots of plants absorb minerals from the soil)</p>
4	Science and Technology	<p>Habitats and Communities</p> <p>Specific Expectation:</p> <p>1.1 analyse the positive and negative impacts of human interactions with natural habitats and communities, taking different perspectives into account, and evaluate ways of minimizing the negative impacts</p> <p>1.2 Identify reasons for depletion or extinction of plants or animal species</p> <p>2.2 build food chains consisting of different plants and animals, including humans</p> <p>3.1 Demonstrate an understanding of habitats as areas that provide plants and animals with the necessities of life.</p> <p>3.3 Identify factors that affect the ability of plants and animals to survive in a specific habitat</p> <p>3.4 demonstrate an understanding of a community as a group of interacting species sharing a common habitat</p> <p>3.9 demonstrate an understanding of why all habitats have limits to the number of plants and animals they can support</p>
5	Science and Technology	<p>Properties of and Changes in Matter</p> <p>Specific Expectation:</p> <p>1.1 evaluate the environmental impacts of processes that change one product into another product through physical or chemical changes</p> <p>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</p>

6	Science and Technology	<p>Biodiversity</p> <p>Specific Expectation:</p> <p>1.1 analyse a local issue related to biodiversity, taking different points of view into consideration, propose action that can be taken to preserve biodiversity, and act on the proposal</p> <p>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</p> <p>3.5 describe interrelationships within species</p>
7	Science and Technology	<p>Biodiversity</p> <p>Specific Expectation:</p> <p>1.2 analyse the costs and benefits of selected strategies for protecting the environment</p> <p>3.1 demonstrate an understanding of an ecosystem as a system of interactions between living organisms and their environment</p> <p>3.2 identify biotic and abiotic elements in an ecosystem, and describe the interactions between them</p> <p>3.4 describe the transfer of energy in a food chain and explain the effects of the elimination of any part of the chain</p> <p>3.5 describe how matter is cycled within the environment and explain how it promotes sustainability</p> <p>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</p>
8	Science and Technology	<p>Systems in Action</p> <p>Specific Expectation:</p> <p>1.1 assess the social, economic, and environmental impacts of automating systems</p> <p>1.2 assess the impact on individuals, society, and the environment of alternative ways of meeting needs that are currently met by existing systems, taking different points of view into consideration</p> <p>2.1 follow established safety procedures for working with apparatus, tools, materials, and electrical systems</p> <p>2.2 investigate the work done in a variety of everyday activities and record the findings quantitatively</p> <p>2.7 use a variety of forms to communicate with different audiences and for a variety of purposes</p> <p>3.2 identify the purpose, inputs, and outputs of various systems</p> <p>3.9 identify social factors that influence the evolution of a system</p>

Water Systems

Specific Expectation:

1.3 assess the impact on local and global water systems of a scientific discovery or technological innovation

2.1 follow established safety procedures for the use of apparatus and chemicals

2.3 test water samples for a variety of chemical characteristics

2.4 use scientific inquiry/research skills to investigate local water issues

2.7 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes

3.5 explain changes in atmospheric conditions caused by the presence of bodies of water

Scientific Method Chart

Team Name:

Purpose Why are we doing this experiment? What do you want to learn?	
Hypothesis What do you think will happen? What is your educated guess?	
Material Make a list of all materials needed for the experiment	
Procedure How will we conduct this experiment? What steps need to be performed?	
Results What results will you track? How will you track them?	
Conclusion What did the experiment show? What does it mean?	