



FACT SHEET: Hydroponics in Fort Chipewyan

(Basic)



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What is Hydroponics?

- Hydroponics is growing food without soil.
- We just have to give the plants the same conditions that soil would provide:
 - Water
 - Nutrients, including oxygen
 - Support
 - Good growing environment (temperature)

Why Grow Things Hydroponically?

Advantages

- Plants get what they need more easily so they grow faster.
- Plants need much smaller root systems so more energy goes into leaf and stem growth.
- With smaller roots, you can grow more plants in the same area. You can even stack them up.
- You can grow plants all year round – in cold climates or deserts.
- Hydroponics uses much less water than traditional gardening. (Water is captured and reused.)
- Automated systems make the work easier.

Many Kinds of Hydroponic Systems

Wick Watering

Plants are supplied with water and nutrients by soaking them up (capillary action) using some kind of spong-like material. No energy or moving parts are needed.

Ebb and Flood Systems

This uses a pump on a timer to flood the plant roots over and over again with water and nutrients.

Nutrient Film Technique NTF

A pump sends water and nutrients to the top of a slanted shelf where the plant roots hang. The roots are continuously watered in a thin “film” of nutrients as it runs “downhill”. This is the system used in Fort Chipewyan.

Deep Water Culture DWC -

Well-rooted plants are placed in a net pot on a floating plate in the liquid tank, like a raft.

Drip Irrigation

Using thin tubes, the water and nutrients are dripped onto a sponge-like material around the plants.

Aeroponics

The roots of cuttings or plants hang in the air and are covered in a mist of water and nutrients.

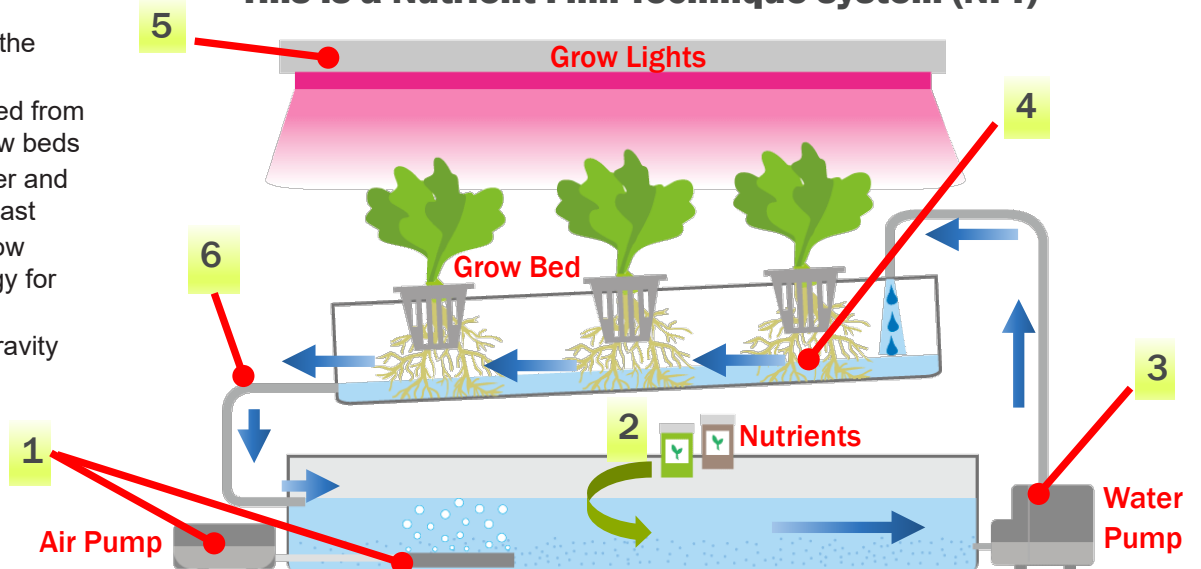
Aquaponics

This combines aquaculture (fish farming) and hydroponics. The waste produced by the fish supplies nutrients in water for the plants. At the same time the plants purify the water.

How do hydroponic systems work?

1. Oxygen is added to the water with an air pump
2. Nutrients are added to the reservoir tank
3. Nutrient water is pumped from the reservoir to the grow beds
4. Plant roots absorb water and nutrients as they flow past
5. High efficiency LED grow lights provide the energy for growth
6. Water flows down by gravity back to the reservoir

This is a Nutrient Film Technique system (NFT)



This is the type of system used in the Fort Chipewyan Grower Unit

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What Can be Grown?

- Many kinds of plants can be grown hydroponically.
- Different systems are better for different kinds of plants.
 - Nutrient Film Technique Systems, for example, are mostly used for growing leafy greens and herbs.
- Plants that do well in a hydroponic garden can include artichokes, beans, lettuce, spinach, tomatoes, cabbage, celery, beets, asparagus, broccoli, cauliflower, brussel sprouts, green beans, peppers, English cucumbers, marrows, peas, strawberries, blueberries and herbs
- Vegetables that grow beneath the soil, such as onions, leeks, carrots, parsnips, potatoes, yams and radishes will also grow hydroponically, but require special equipment.
- Some crops to avoid are corn, zucchini, summer squash, and vining plants. They can be grown in a hydroponic garden, but they take up too much space and are just not practical.

Grow Lights

Getting the Light Right

- Plants need light to survive
- They use light in photosynthesis to create the energy needed for growth and survival.
- In nature this light comes from the sun.
- Regular indoor lights don't have the correct type of light "spectrum" that plants need.
- Special LED grow lights are usually used to provide the best wavelength of light so they are the most efficient.



commons.wikimedia.org

Advantages of LED Grow Lights

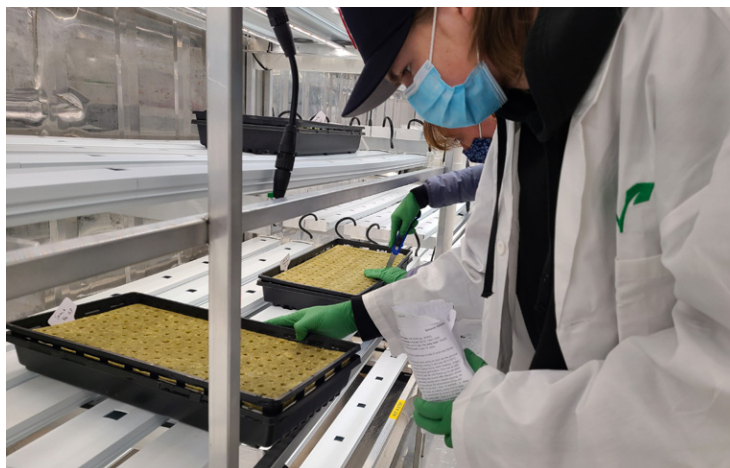
- LED's use less electricity. Grow lights use the most efficient wavelength so less power is needed.
- They also burn with less heat so they can be placed closer to plants for maximum benefit.
- LED's last longer.
- LED's can be set up to provide different color light as needed.
- Light timers can be used: lights on for up to 16h per day.

Plant Nutrients

It is important to ensure the plants receive all of the nutrients they need for healthy growth. These are often available in pre-mixed powders that can be added to the water.

There are two basic kinds of nutrients - Macro and Micro:

- **Macro Nutrients** – those needed in large amounts
 - From the Environment: Carbon, Hydrogen, Oxygen
 - From Fertilizer - the three main nutrients are:
 - Nitrogen - for vegetative leafy growth
 - Phosphorous - for root & flower formation
 - Potassium - for fruit development
(They also need Calcium, Sulfur, Magnesium)
- **Micro Nutrients** – those needed in small amounts
 - From Fertilizer - Iron, Boron, Chlorine, Copper, Manganese, Molybdenum, Nickel, Zinc



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Close Monitoring is the Key

Things that may need to be watched and adjusted in many of the more complex hydroponic systems include:

- The amount of plant nutrients in the water.
- The acidity of the water (pH). This is important for plants to absorb nutrients.
- Dissolved oxygen in the water for healthy roots
- Temperature – plants need a certain air and water temperature for best growth
- Carbon dioxide in the air – needed for plant growth

Some systems, like Fort Chip's, use a computer to help monitor these and in some cases, automatically adjust them.

Regular Maintenance is Important

Here are some of the tasks that may be involved if you had a job working in a hydroponics facility:

GROWING

- Starting seeds
- Moving young seedling plants into the growbeds
- Harvesting + packaging + delivery / proper storage

MAINTAINING

- Fill the water reservoir + change out the old water every few weeks
- Ensure correct water flow and remove blockages in the plumbing
- Looking for insect pests or other plant illness

CLEANING

- Wear proper clothing
- Wash hands
- Inspect and clean pumps, filters, airstones, drip lines
- Clean plumbing fixtures, growbeds (remove algae, unwanted bacteria)
- Sanitize and clean the areas



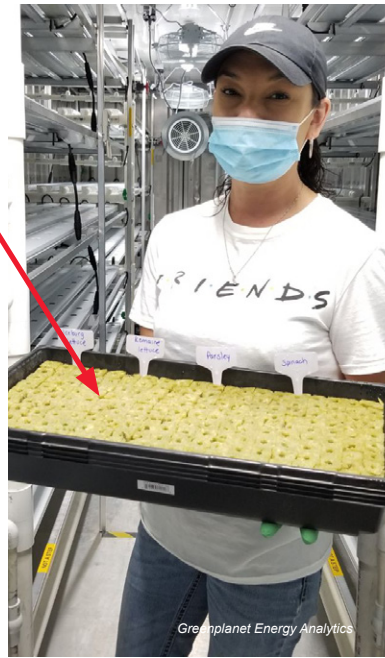
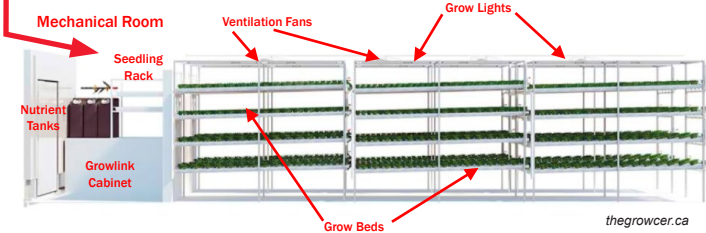
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Hydroponics in Fort Chipewyan

In Fort Chipewyan, the ACFN wanted to have more locally grown food so not as much food would have to be shipped in from outside the community.

Plants are grown all year-round:

- Seeds are planted in small cubes of “rock wool” (cushion made of stone-based fiber) and set on the seedling rack to sprout. They get bathed in water and nutrients.
- When the plants are large enough, they are moved into the large grow beds. Water and nutrients are pumped up from tanks to the grow beds. The water then flows “downhill”, over the plant roots.
- When the plants are ready, they are harvested and sent to the market.



For More Information

5 Ways to Start Hydroponic Gardening - The Spruce

<https://www.thespruce.com/beginners-guide-to-hydroponics-1939215>

How Hydroponics Works - How Stuff Works

<https://home.howstuffworks.com/lawn-garden/professional-landscaping/hydroponics.htm>

Various hydroponics systems - Hydroponic Urban Gardening

<https://www.hydroponic-urban-gardening.com/hydroponics-guide/various-hydroponics-systems/>

Video - Hydroponics: The Science of Growing Plants without Soil - Labroots

<https://www.labroots.com/trending/videos/10250/hydroponics-science-growing-plants-without-soil>

Video - The Science Behind Vertical Farming - Labroots

<https://www.labroots.com/trending/chemistry-and-physics/12038/science-vertical-farming>



See a video about Growcer

<https://www.youtube.com/watch?v=i4tl8PfBemo>



CBC, March 28, 2020.

Astronauts can now grow their own lettuce on the International Space Station, and scientists say it's as healthy as the kind grown here on Earth.

Astronauts usually have dried, pre-packaged foods on their menu, but those have been shown to lose nutrients over time. Since NASA is planning long space flights to Mars and the lunar south pole, scientists at the Kennedy Space Center have been trying to figure out how to feed the astronauts on their long journey.

This lettuce is the first food grown, harvested, and eaten in space. Just as nutritious, and delicious as Earth lettuce!

The first crop of red leaf lettuce was grown on the International Space Station between 2014 and 2016.

The growing system, known as “Veggie”, involves vacuum-sealed seeds, pre-planted in a pillow filled with ceramic soil (clay hardened by heat, then crushed) and fertilizer. When the astronauts were ready to start growing the lettuce, they put the pillow on a special root mat on top of a plate, bungee-cord it all down, and inject water inside. The root mat has wicks which are designed to deliver the water carefully to the plant without gravity.

The team started with red leaf lettuce because it's a tasty crop that's easy to grow. Since then, astronauts have grown different leafy greens and even flowers.

See the plants that were grown on the space station. Use a smart phone to have a look at this video or type in this address:

Space Station Live: Everything's Coming up Veggie
<https://www.youtube.com/watch?v=9JDAZBoLJUc>





QUESTION SHEET: Hydroponics in Fort Chipewyan

(Basic)

Fill in the Blanks (18 points)

- _____ is growing food without soil.
- Hydroponics uses much _____ water than traditional gardening.
- In order to grow without soil, plants are given water, _____ and _____ as well as a good growing environment.
- Using hydroponics means plants need much smaller _____ so more energy goes into leaf and stem growth.
- The advantage of hydroponics in cold climates is that you can _____.
- The Fort Chipewyan hydroponics unit uses a _____ system. The best plants to grow in this system are _____.
- Plants use light in _____ to create the energy needed for growth and survival.
- Regular indoor lights don't have the correct type of _____ that plants need.
- Macro Nutrients are those needed _____.
- Nutrients that plants get from the environment include (3) _____, _____, _____.
- The main or primary nutrients from fertilizer include (3) _____, _____, _____.
- In Fort Chipewyan hydroponics farm, seeds are planted in cubes of _____.



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Short Answer (10 points total)

1. Briefly describe what each of these Macro nutrients in fertilizers does for the plants. (2 points each)

Nitrogen -

Phosphorous -

Potassium -

2. Name TWO things that needs to be watched and adjusted in a hydroponics farm. (2 points each)

Matching (7 points)

- | | |
|---|----------------------------|
| ___ 1. Live fish are raised in a tank and the "fertilized" water they produce is used to grow plants. | a. Wick Watering |
| ___ 2. Uses material that soaks up nutrient water so no energy or moving parts are needed | b. Aeroponics |
| ___ 3. Plants are on a tilted shelf and a pump bathes the roots continuously with a light layer of nutrients. | c. Ebb and Flood Systems |
| ___ 4. A large tub of nutrients in water has plants in net pots floating on the surface. | d. Aquaponics |
| ___ 5. Plant roots are covered with nutrients and water over and over using a pump on a timer. | e. Drip Irrigation |
| ___ 6. Nutrients and water are supplied a drop at a time around the plants. | f. Deep Water Culture |
| ___ 7. Plants hang in the air and are covered with a mist of nutrients in water. | g. Nutrient Film Technique |

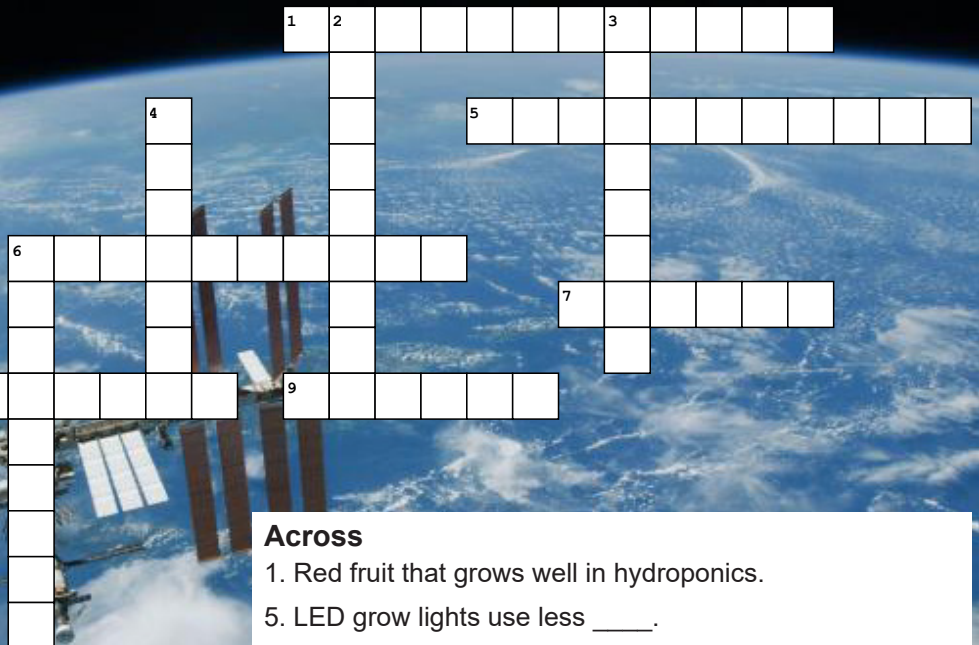


Eating "home-grown" lettuce aboard the International Space Station
NASA

Down

2. Nutrient Film ___ is the system used in Fort Chipewyan.
3. Fort Chip hydroponic seeds are planted in cubes of ___.
4. Space lettuce is pre-planted in a pillow filled with ___ soil.
6. ___ systems make the work easier.

CrossWord (10 Points)



Across

1. Red fruit that grows well in hydroponics.
5. LED grow lights use less ___.
6. Combines fish farming and hydroponics.
7. A micro nutrient.
8. Growing food without soil.
9. The growing system on the International Space Station.



TEACHER RESOURCE: Hydroponics in Fort Chipewyan

(Basic - Grades 4 - 9)

ANSWER KEY (50 points total)

Fill in the Blanks (18 points)

1. Hydroponics is growing food without soil.
2. Hydroponics uses much less water than traditional gardening.
3. In order to grow without soil, plants are given water, nutrients and support as well as a good growing environment.
4. Using hydroponics means plants need much smaller root system so more energy goes into leaf and stem growth.
5. The advantage of hydroponics in cold climates is that you can grow all year round.
6. The Fort Chipewyan hydroponics unit uses a nutrient film system. The best plants to grow in this system are leafy greens.
7. Plants use light in photosynthesis to create the energy needed for growth and survival.
8. Regular indoor lights don't have the correct type of light spectrum that plants need.
9. Macro Nutrients are those needed in large amounts

10. Nutrients that plants get from the environment include (3) Carbon, Hydrogen, Oxygen.
11. The main or primary nutrients from fertilizer include (3) Nitrogen, Phosphorous, Potassium.
12. In Fort Chipewyan hydroponics farm, seeds are planted in cubes of rock wool.

Short Answer (15 points total)

1. Briefly describe what each of the primary nutrients in fertilizers does for the plants. (3 points each)

- Nitrogen - for vegetative leafy growth
- Phosphorous - for root & flower formation
- Potassium - for fruit development

2. Name THREE things that may need to be watched and adjusted in a hydroponics farm. (2 points each) Choice of:

- Amount of plant nutrients in the water.
- Acidity of the water (pH).
- Dissolved oxygen
- Temperature
- Carbon dioxide

Matching (7 points)

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

CrossWord (10 Points)

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This fact sheet goes well with the Pop Bottle Hydroponics Activity (and Teacher Resource) available at:
<https://www.3ne.ca/learning-resources/>



- Sustainable Food Centre Project:
<https://www.3ne.ca/community-projects/sustainable-food-centre/>
- News about the Growcer Hydroponics Unit:
<https://www.3ne.ca/news/>
- Check out the Learning Resources:
<https://www.3ne.ca/learning-resources/>
- Share job opportunities with your students:
<https://www.3ne.ca/jobs-more/>

Alberta Curriculum Connections

	Subject	Unit	Detail
4	Science	Plant Growth and Changes	-Recognize that plant requirements for growth -Nurture a plant through one complete life cycle—from seed to seed -Describe the care and growth of a plant that students have nurtured
		Waste in Our World	-identify materials that can be reused or recycled -Identify alternative materials and processes that may decrease the amount of waste produced
5	Science	Topic E: Wetland Ecosystems	Experience with close observation of plant growth will aid in the general understanding of concepts in this unit. Understand interactions between living and nonliving things, both in and around water. Identify the roles of producers—green plants that make their own food, using sunlight.
6	Science	Topic E: Trees and Forests	Experience with close observation of plant growth will aid in the general understanding of concepts in this unit. Describe kinds of plants and animals found living on, under and among trees; and identify how trees affect and are affected by those living things. Describe the role of trees in nutrient cycles and in the production of oxygen.
7	Science	Unit A: Interactions and Ecosystems	- Illustrate how life-supporting environments meet the needs of living things for nutrients, energy sources, moisture, suitable habitat, and exchange of gases
		Unit B: Plants for Food and Fibre	-Investigate plant uses; and identify links among needs, technologies, products and impacts -Investigate life processes and structures of plants, and interpret related characteristics and needs of plants in a local environment -Analyze plant environments, and identify impacts of specific factors and controls - Describe methods used to increase yields, through modifying the environment
8	Science	Topic E: Freshwater and Saltwater Systems	- Recognize that fresh water and salt water contain varying amounts of dissolved materials, particulates and biological components; and interpret information on these component materials - Analyze human impacts on aquatic systems; and identify the roles of science and technology in addressing related questions, problems and issues
		Unit C: Environmental Chemistry	- Investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
9	Science	Unit C: Cycling of Matter in Living Systems	- Analyze plants as an example of a multicellular organism with specialized structures at the cellular, tissue and system levels
		Unit D: Energy Flow - Global	- Explain the response of humans to impacts on climate change