Three Nations ENERGY

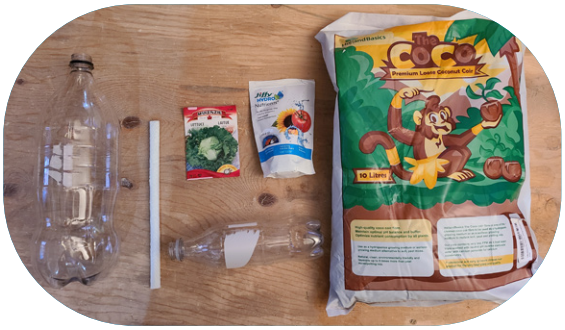
Pop Bottle Hydroponics

A DIY PROJECT!

What is Hydroponics?

Hydroponics is growing plants without soil and using water to deliver what they need. ("Hydro-" means water.) The plants are given everything that soil would provide:

- Water
- Nutrients, oxygen and carbon dioxide
- Support
- Good growing environment (warm temperature and a lot of light)



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Material List

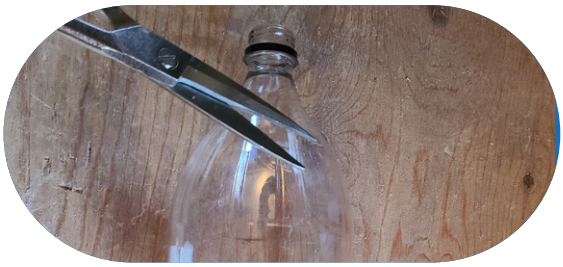
- Water *(If you have a lot of minerals in your tap water, you should use bottled spring water.)*
- Scissors, protective gloves
- Refundable plastic pop bottle (2L works best but smaller ones can be used.)
- Hydroponic nutrient powder like Jiffy Hydro Nutrient 10-5-10
  https://www.homehardware.ca/en/256g-10-5-10-hydroponic-plant-fertilizer/p/5026541
  https://www.canadiantire.ca/en/pdp/jiffy-hydro-hydroponics-nutrients-9-oz-1590287p.html
- Measuring cup
- 1/4 tsp measuring spoon
- Container to mix in (1L or more)
- Coconut **coir** *(see side bar info)*
- Wick - lantern wick or cotton yarn, a strip from an old sock or t-shirt, etc.
- Seeds - leaf lettuce, kale, spinach are the easiest. Or try chives, herbs (basil, mint) and even strawberries.

Watch the video instructions (optional):

https://www.youtube.com/watch?v=87A06gzcZZ0

Step 1

Soak the coconut coir in water for at least 15 minutes before use. Warning - dry coir can absorb 10x its weight in water so it might expand quite a bit.



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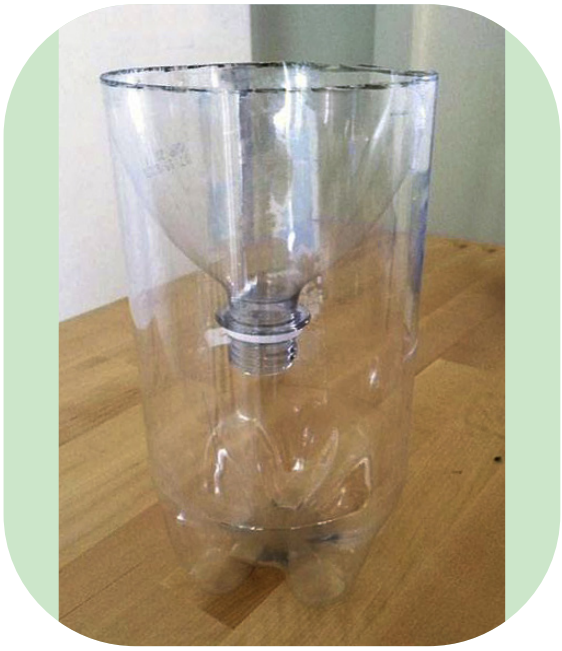
Step 2

Cut the top of the plastic bottle off, where the bottle begins to form a cone shape.

Step 3

Flip the top of the bottle upside down and place into bottom section.



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Did You Know?

Coir (pronounced COY-er) comes from coconut husks and is used for rugs, ropes, brushes, and to grow plants.

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Coir is the middle fibrous coat of a coconut

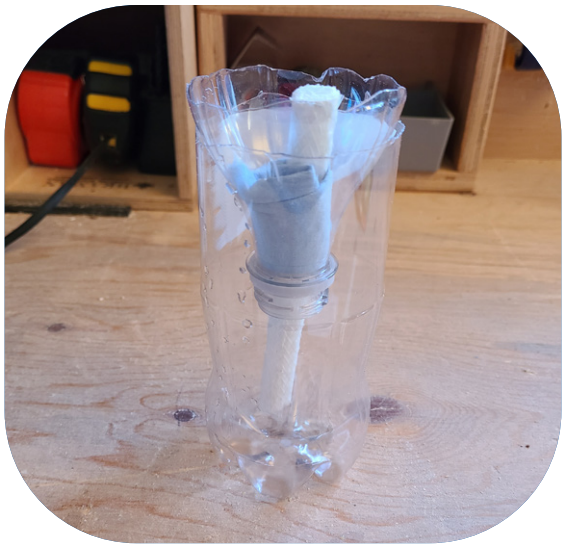
Coir does not rot easily and helps keeps air in the soil, even when wet. It holds 30 percent more water than peat moss.

It is ideal for growing plants.

Don't have Coir?
You can use an equal mixture of peat moss and Perlite (or vermiculite). Use clean peat moss so you don't grow unwanted mold.

Step 4

Measure the wick so that it will reach from the plant to the bottom of the bottle. You may need to leave enough length to tie a knot to prevent it from falling through.



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Step 5

Wrap the wick with enough paper towel to plug just the spout and stuff it in.

Step 6

Place coconut coir into the top cone of the bottle.

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Step 7

While wearing gloves, read the back of the nutrient package and measure out the water into a container. Add the correct amount of powdered nutrient and mix.

For JIFFY Hydro Nutrient 10-5-10:

Mix 4 cups of water with 1/4 teaspoon of nutrient powder.

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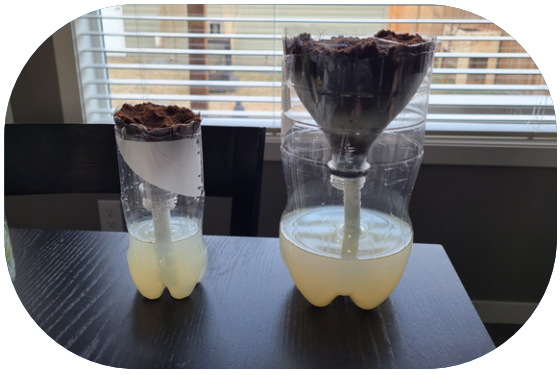
Step 8

Pour nutrient mixture into the bottom of your bottle, until the wick is half covered. Keep any leftover nutrient mixture in a cool dark place for future use.

Step 9

Plant 2 or 3 seeds. (Not all seeds will sprout so you need to plant extra.)



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Taking Care of Your Plant

- **Keep it warm** while you wait for the seeds to sprout. Once they do, keep them in a sun lit area.
- **Keep seed area moist** for the first couple of days, check daily. (As the plant grows, its roots will go deeper and will reach the nutrients sucked up by the wick.)
- **Stir the nutrient solution twice a day** This keeps the nutrients from settling and mixes air into the liquid.
- **Top up the nutrient** water solution as needed
- **Replace nutrient solution totally every two weeks** (due to evaporation and preventing algae/bacteria growth.)
- **Clip off the weakest** looking seedlings with a pair of scissors, leaving only a single healthy plant.

Did You Know?

What's in that powder used to feed the plants? Look at the back of the package:

- nitrogen 10%
- phosphate 5%
- potassium (potash) 10%

There is also "trace" (very small) amounts of the following:

- calcium
- magnesium
- sulfur
- boron
- copper
- iron
- manganese
- molybdenum
- zinc

These are needed for plant growth but the coir does not supply them.

How Does The Water Move?

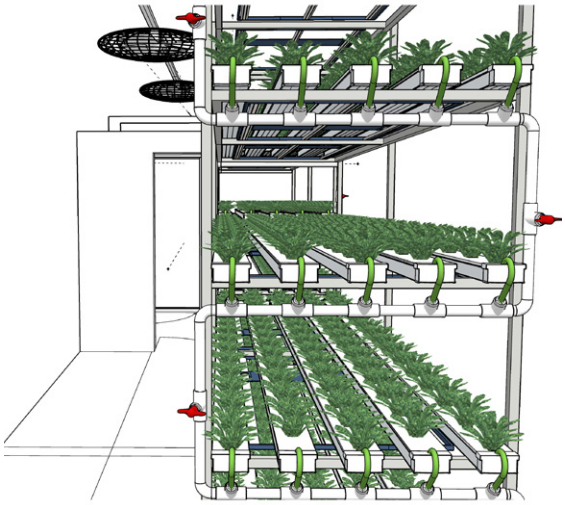
The water and nutrients travel or "wick" up from the bottom of the pop bottle through the coir to where the plant roots are.

This is known as "capillary action".

Capillary action: when a liquid flows in narrow spaces without any help and even goes against gravity. You can see this happen with liquids between the hairs of a paint-brush, in paper towels and sand. It occurs because molecules of the liquid are lightly attracted to the molecules of the surrounding solid surfaces. It only works in very small spaces.

- If you are growing spinach, lettuce, or basil, harvest the outer leaves and leave the smaller, less developed leaves to grow. You can keep harvesting over and over for at least a month using this method!
- Since the coconut coir is not providing nutrients like soil does, you can wash and reuse it up to 4 times.

For Fun
Space Farming Video - CBC Kids
https://www.cbc.ca/kidscbc2/the-feed/five-things-canada-has-contributed-to-space-exploration



thegrowcer.ca

Troubleshooting

If your plants do not do well, that is also an important observation. Troubleshoot the problem. Did you miss an instruction? Does the design or instructions need to be improved?

Check the Internet for help, like:

https://smartgardenguide.com/problems-with-hydroponics/

Extra Resources

3NE Hydroponics 101 Fact Sheet
https://www.3ne.ca/wp-content/uploads/2020/10/Hydroponics-101-Fact-Sheet-e.pdf

5 Ways to Start Hydroponic Gardening - The Spruce
https://www.thespruce.com/beginners-guide-to-hydroponics-1939215

Hydroponic Lettuce - University of Saskatchewan
https://gardening.usask.ca/article-lists/articles-growing-information/hydroponic-lettuce.php

Small-scale hydroponics - University of Minnesota
https://extension.umn.edu/how/small-scale-hydroponics#growing-systems-2644460

Hydroponics systems - Hydroponic Urban Gardening
https://www.hydroponic-urban-gardening.com/hydroponics-guide/various-hydroponics-systems/

VIDEO: How Does It Grow - Hydroponic Spinach - PBS
https://www.pbs.org/video/how-does-it-grow-how-does-it-grow-hydroponic-spinach/

Did You Know?

To help stop algae growth, wrap aluminum foil, dark plastic, or paper around the setup to block light from the water and roots.

What is Aquaculture?
Video - Ontario food bank harvesting fresh fish and greens indoors - Canadian Press
https://www.youtube.com/watch?v=Phek-1qpqoGo

CHALLENGE!

Share your photo records with other people doing this activity. Compare what worked and what didn't. Networking can help everyone learn more.

Why Use Hydroponics?

- Hydroponics is done indoors so weather and climate are not a problem. Growing seasons are longer.
- Hydroponics allows food to be grown in areas not normally used for farming.
- Plants grow faster in hydroponic gardens because they don't use up energy growing long roots. That energy can go into growing leaves, flowers and fruit.
- Hydroponics recycles water so it uses less water than regular soil farming.

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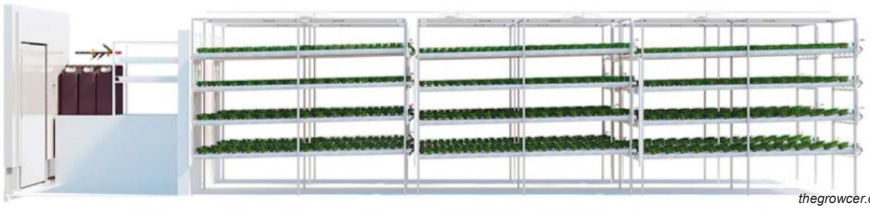

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This is the hydroponics system in the ACFN Growcer Unit in Fort Chipewyan. It has electric pumps that move water from the nutrient tank (on the left) up to the top of plant beds on the right so it runs downhill and back to the nutrient tank. There are bright grow lights over every plant bed.

Observation Sheet

Learning involves good observation.

Pro Tip - *If it is possible, use a smart phone or camera to record your information. Be sure to use good lighting. Place a ruler next to your plant to show the actual size when taking each photo.*

DATE (yyyy/mm/dd)	**OBSERVATION** - Record ALL observations - plant condition, nutrient addition/ changes, insects, mold, etc.	**HEIGHT (cm)**
	When were the seeds planted?	
	When did the first sprouts appear?	
	When did the second set of leaves develop?	
	week 1	
	week 2	
	week 3	
	week 4	
	week 5	
	week 6	
	week 7	

QUESTIONS

1. Explain what “hydroponics” means.

2. Plants need nutrients to grow and what else?

3. Where does coir come from?

4. Name 3 reasons coir is used for growing plants.

5. List the three main nutrients needed by plants.

6. Name four reasons for using hydroponics?

Fill In The Blanks

7. When sprouting seeds, _____ is more important than light.

8. It is important that the area around the seed is kept _____ for the first couple of days.

9. Mix the nutrient solution _____ a day to keep the nutrients from settling.

10. Replace nutrient water solution totally every _____. to avoid the risk of _____growth.

11. Help stop algae growth in the nutrient solution by wrapping the bottle in _____.

12. Capillary action is when a liquid flows in _____ _____ without any help and even goes against _____.

TEACHER RESOURCES

ANSWER KEY (Out of 30 points)

1. Explain what “hydroponics” means. 4

   Hydroponics grows plants with no soil.

2. Plant need nutrients to grow and what else? 6

   -water, warmth, light, support, oxygen and carbon dioxide

3. Where does coir come from? 2

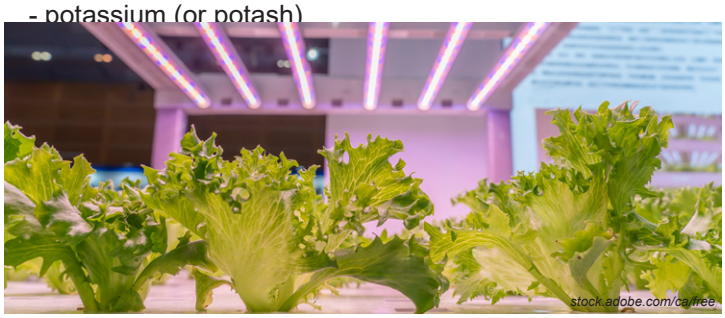
   Coir comes from the middle (fibrous) coat of a coconut

4. Name 3 reasons coir is used for growing plants. 3

   - is very rot-resistant
   - helps keeps air in the soil
   -absorbs a lot of water (30% more than peat moss)

5. List the three macro-nutrients needed by plants. 3

   - nitrogen
   - phosphate
   - potassium (or potash)



6. Name four reasons for using hydroponics? 4

   weather is not an issue / food can be grown anywhere / plants grow faster / it uses less water / more food is needed.

Fill In The Blanks 8

7. When sprouting seeds, **warmth** is more important than light.
8. It is important that the area around the seed is kept **moist** for the first couple of days.
9. Mix the nutrient solution **twice** a day to keep the nutrients from settling.
10. Replace nutrient water solution totally every **two weeks** to avoid the risk of **algae/bacteria** growth.
11. Help stop algae growth in the nutrient solution by wrapping the bottle in **aluminum foil**.
12. Capillary action is when a liquid flows in **narrow spaces** without any help and even goes against **gravity**.

More Challenges

Set up experiments to test any of the following

Remember to state a hypothesis, plan your procedures, include a control and take good records of your observations.

- Rate of plant growth in nutrient rich solutions versus nutrient poor solutions in a hydroponic system.
  - Hint: plant seeds in identical hydroponics containers. Give half of the plants nutrient enriched water and the other half pure water.
- Rate of plant growth in traditional (nutrient rich) soil versus a hydroponics system.

More Videos

Who Needs Dirt? - Crash Course Kids
https://www.youtube.com/watch?v=eCSIrlk0GTs

Video: Hydroponic farming looks to offer food stability across Canada - CBC
https://www.youtube.com/watch?v=GjCDQgjRcMo

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Be sure to visit www.3NE.ca

- **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	Curriculum Connection	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.