Activity Title: Can Plants Grow Without Soil?

Recommended Grades

Kindergarten, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5, Grade 6

Curriculum Connections

Matter
- 3 – changes of state (ice melting)
- 6 – how water responds to temperature change

Energy
- 2 - sources of light (the Sun)

Earth Systems
- K – how environments can be explored, environments include plants, changes in environment can be observed, ways environment can be protected
- 1 – responsibility to care for environments
- 2 – components of Earth (land, water, air plants, humans, animals)
- 3 – activities which change Earth's surface
- 4 – Earth's systems interact, environments sustain life (conservation)
- 5 – what is climate? (agricultural practices include hydroponics)
- 6 – changes in climate caused by human activities

Living Systems
- 1 – how do plants survive? (exist in all shapes and sizes, basic needs of plants, ways humans can meet needs and ways plants help humans)
- 2 – how do plants live and grow?
- 3 – plants responding to water, temperature, and light, plants depend on environment for survival
- 6 - role of plants in ecosystems

Computer Science
- K – instructions to be followed, have steps
- 1 – instructions to be followed, have steps

Time

15-25 minutes

Skills Focused On

• Critical Thinking • Decision-making • Hypothesizing	• Observation • Resourcefulness

Materials Needed

Experiment 1: Climate Change	**Experiment 2: Make a Hydroponics System**

• Two similar clear containers
• Cling wrap
• Damp soil
• Elastic
• Two ice cubes
• A sunny window sill or bright light bulb
	• A plant with its roots intact
	  o Spider plant
	  o Pothos
	  o Fiddle Leaf Fig
	  o African violets
	  o Coleus
	  o Plants you can eat: Basil, chives, oregano, mint, rosemary, sage
	• A pop/soda bottle
	• Water

Background Information

Humans have a lot of impacts on the environment. One is **the greenhouse effect!** The sun shines on the Earth. Some heat is absorbed by the Earth and some is reflected. Some of the reflected heat is trapped in the Earth's atmosphere by greenhouse gases, like carbon dioxide, methane, etc. This results in the Earth warming up. In experiment 1, we will explore the greenhouse effect using items you can find around your house!

Humans also use lots of resources from the Earth, like water, soil, etc., and we need to find ways to use less. One strategy is aquaponics which has the potential to use 90% less water when growing crops. Aquaponics is a system that combines conventional aquaculture (raising aquatic organisms) with hydroponics (cultivating plants in water) in a symbiotic environment. There is a relationship between all of the parts of the system. The fish are fed food, they produce waste which is pumped through a biofilter which has bacteria in it. The bacteria makes the nitrogen in the waste available for the plants, so the water is pumped to the plants allowing them to grow which removes the nitrogen from the water. This now clean water is pumped back to the fish and the cycle continues. This technology would allow us to use new places for farming (like rooftops), help make food available in remote areas, reduce the resources we use and more. In experiment 2, you'll get to build you own hydroponic system!

Experimental Steps

Experiment 1: Climate Change

1. Before you start, make ice cubes the night before!
2. Place an equal amount of damp soil in the bottom of the clear containers.
3. Place an ice cube on top of the soil in each container at the same time.
4. Cover one container with cling wrap and secure with an elastic.
5. Put both containers in a sunny window or the same distance from a light bulb.
6. Observe what happens. *Hint:* how fast does the ice cube melt?

Image source: publicdomainpictures.net

Experiment 2: Make a Hydroponics System

1. Before you start, have an adult cut the plastic water bottle in half (the top and bottom).
2. Carefully remove a small plant from the soil, making sure to keep the roots intact.
3. Take the cut water bottle and fill the bottom halfway with water.
4. Gently pull the roots of the plant through the bottle opening in the bottle top, with the mouth of the bottle pointing down.
5. Place the bottle and roots into the water so they are partially submerged.

6. Place in sunlight and when the water level drops, add more water to keep the roots submerged.
7. Watch your plant grow!

Discussion/Experimental Extensions

Experiment 1: Climate Change

Which ice cube melted faster? The ice cube with the cling wrap should melt faster.

How did the cling wrap affect the melting time? The cling wrap blocked the escape of heat from the container and caused the temperature in the cup to be higher than the uncovered cup. The cling wrap allows for light to pass unhindered since it is transparent. Both ice cubes receive the same amount of light. Light rays are absorbed by the dark soil and released as heat through infrared rays (which we can't see with our eyes). The cling wrap blocks these rays from easily escaping the container.

What are sources of greenhouse gases causing global warming? What are solutions to reduce our greenhouse gas emissions?

How else can we reduce the resources we use?

Experiment 2: Make a Hydroponics System

Do you think all plants can grow without soil? Do plants need certain kinds of water to grow? Are there plants that grow in the ocean, or in rivers?

Optional extension: Make a second hydroponics plant. Place it in a different location than your first plant - somewhere with different lighting (darker or brighter), or different temperature (warmer or colder). Which plant grows fastest? Why do you think that is?

Additional Resources

Learn more about greenhouse effect, aquaponics and how they are all related in https://youtu.be/TB0kJI0GlJc with Ahmed Mostafa, president of the University of Alberta Permaculture Group.

This video was produced as part of Future Energy Systems Learning Resources, by Ahmed Mostafa, president of the University of Alberta Permaculture Group.

This activity was developed by Future Energy Systems as part of a larger collaboration with WISEST (Women in Scholarship, Engineering, Science and Technology) and Cybermentor to provide meaningful STEM (science, technology, engineering and mathematics) activities to the Girl Guides of Alberta. This collaboration was made possible through the support of the Natural Sciences and Engineering Research Council of Canada (NSERC) Promoscience Grant.

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more learning content, including storytimes, lab tours, ask an experts and more (https://www.futureenergysystems.ca/engage/learning https://www.youtube.com/channel/UCJr8N9KyFJ6d-t36TPtUlwg).
Check out in Women in STEAM playlist https://www.youtube.com/playlist?list=PLwhyRzP6sRaRPX8yerrVVDfxkbHnqDDgN.
Check out the Science playlist https://www.youtube.com/playlist?list=PLwhyRzP6sRaRksOzDVBJ5VVBAH-09R-bJ
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