Food Deserts

Home Connection

Dear Family,

During the last few weeks, students designed hydroponic systems that could be used to grow lettuce. They acted just like engineers! They . . .

- identified and learned about a problem
- planned ways to solve the problem
- made and tested a prototype hydroponic system
- revised their design to make it even better

In this challenge, students developed an understanding of the importance of fresh fruits and vegetables in the human diet and how some people live in places where there is no access to fresh produce (such places are called food deserts). Students learned about the materials that plants need to live and grow and how hydroponic systems allow plants to grow without soil. They also learned about the engineering design process and practiced skills such as developing and using prototypes, analyzing data, making claims based on evidence, and communicating technical information.

Let your child tell you what his or her team did in this engineering challenge. Prompt your child if he or she needs help.

- What was the problem you were solving?
- What were the criteria (goals) that your design had to meet?
- What constraints (limits) did you have to work within?
- What materials did you use to make your prototype system?
- Where did you get the plants you used in your tests?
- How did you measure the success of your design?
- How did you improve your design? What information did you learn that led to that improvement?

On the back of this sheet, work with your child to extend his or her work in the challenge.

This STEM project has been developed in partnership with Texas A&M University.

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About Hydroponics

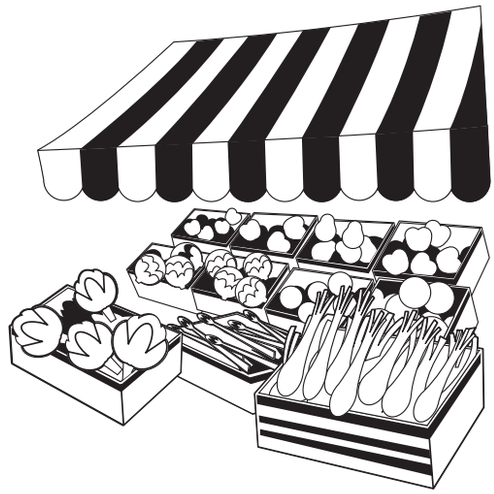
Hydroponics is a method of growing plants in water instead of in soil. The mineral nutrients that plants need for growth are added to the water. Hydroponic systems are carefully managed to give plants the precise conditions that they need for optimal growth. For this reason, hydroponics is an extremely effective and cost efficient form of agriculture. Ask your child to identify the things that plants need to grow and then to explain how a hydroponic system meets these needs. Prompt your child, if needed:

- How do plants make their own food? What materials do they need for this process?
- What other materials do plants need to live and grow?
- How does a hydroponic system provide a plant with each of the things it needs to grow?
- How could the use of hydroponics help people who live in places where there is no access to fresh fruits and vegetables?

Try It!

Where do the fruits and vegetables that your family eats come from? Examine fruits or vegetables in your home. Look for labels that say where they were grown. Make a list of the different kinds of produce and their place of origin. How many foods were grown locally? How many traveled a long distance before you purchased them? Can you find any foods that were grown by hydroponics?

If possible, have your child accompany you to a local grocery store or farmers' market. What kinds of fresh fruits and vegetables do you see? Where do they come from? Were they grown in soil or by hydroponics?



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Grow Lettuce Seeds

Name _____

Follow these steps.

1. Place a coffee filter on the plate. Sprinkle 30 mL of water on the coffee filter. Make sure the entire coffee filter is wet.
2. Place 30 lettuce seeds on the coffee filter in rows that are about 3 cm apart.
3. Place another coffee filter on top of the seeds. Sprinkle it with water so it is wet.
4. Write your team's name on a zip bag. Place the plate into the bag. Do not seal it.
5. Place your bag in a warm place, but not in direct sunlight.
6. Observe the seeds each day for a week. Record what you see in the chart. Add water if the coffee filters feel dry.
7. The seedlings are ready when they have roots, stems, and young leaves.

Day	Number of seeds germinated	Number of seedlings alive	Do seedlings have roots, stems, or leaves?	Other observations
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				

Compare Substrates

Name _____

Follow these steps.

1. **Measure** 100 mL of each substrate. Pour each substrate into a separate plastic cup.
2. **Measure** Pour 50 mL of water into one of the substrates.
3. **Observe** how the water soaks into the substrate. Record what you see in the chart.

Substrate	How did the water soak in? (quick/slow)	Volume of excess water (mL)	Volume of water absorbed (mL)
Gravel			
Perlite			
Vermiculite			

4. Place a screen over the top of the cup. Attach it firmly with a rubberband.
5. **Measure** Place a funnel in the graduated cylinder. Pour the excess water from the cup into the cylinder. Record the volume of excess water in the chart.
6. **Repeat** Steps 2 –5 for the other substrates.
7. **Calculate** Subtract the volume of excess water from 50 mL, the amount added to each substrate. This is how much water was absorbed. Record this amount in the chart.
8. **Compare** the volume of water absorbed by the substrates.
   List the substrates in order of their ability to hold water.

   1. _____ (least water-holding capacity)
   2. _____
   3. _____ (greatest water-holding capacity)

9. **Conclude** Which substrate would be best for a hydroponic system? Why? _____

   _____

Hydroponic System Design Plan

Name _____

Follow these steps.

1. **Think** about what plants need. How will you make a hydroponic system that can support at least 10 lettuce plants?

2. **Decide** Will you use a floating platform system or a wicking system?

   _____

   Reason for choosing this system: _____

   _____

3. **Decide** If you use a wicking system, which substrate will you use? _____

   Reason for choosing this substrate: _____

   _____

4. **Observe** the materials that can be used to make your system. Think about how each of these materials could contribute to its structure.

5. **Design a Prototype** Draw a diagram of your design. Label the materials in your hydroponic system. Show where you will put the lettuce plants.

Measure pH

Name _____

Test Acid and Base Solutions

1. **Review** How can you tell if a substance is an acid or a base?

   _____

2. **Measure** Dip the pH strip in the vinegar. Observe and compare the color of the strip to the pH scale. Record the pH in the chart. Repeat for the baking soda solution and the additional solution your team chooses.

Liquid	pH	Classification: acid or base?
Vinegar		
Baking soda solution		

3. **Classify** each liquid as an acid or base. Record it in the chart.

Prepare the Nutrient Solution

4. **Measure** Dip the pH strip in the nutrient solution in your team's tank. Observe and compare the color of the strip to the pH scale.

5. **Record** the pH of your tank's nutrient solution in the Test 1 row.

	pH	Too acidic or too basic?	Action taken
Test 1			
Test 2			
Test 3			
Test 4			

6. The nutrient solution should have a pH of 6. Too high? Add 5 drops of vinegar. Too low? Add 5 drops of baking soda solution. Record what you did in the chart.

7. **Measure** the pH of the solution again.

8. Continue to add drops of vinegar or baking soda solution until the pH is 6.

Test the Hydroponic System

Name _____

Follow these steps to set up your system.

1. Plant at least 10 lettuce seedlings in your hydroponic system. If you are using a floating platform system, thread the roots through the holes in the screen.

2. If you damage a seedling when you try to plant it, replace it with another one.

3. When all of the seedlings are in place, put your hydroponic system in the tank under the grow light. Make sure the air stone is bubbling in your tank.

Observe your hydroponic system. Record your observations.

	Number of seedlings alive	Condition of seedlings	Largest leaf length	Other observations (pH adjustments?)
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				
Day 8				
Day 9				
Day 10				
Day 11				
Day 12				
Day 13				
Day 14				
Day 15				

Test Results

Name _____

Measure Plant Growth

1. **Count** How many lettuce plants did your system have on Day 1? _____
2. At the end of 2 weeks, remove your lettuce plants from the system. Be careful to collect all of the roots and leaves.
3. **Observe** How many lettuce plants are still alive?_____
4. **Measure** Place the lettuce plants on a paper towel and pat them dry.

   Weigh a paper towel. Weight of paper towel: _____
5. **Measure** Place the dry lettuce plants on the paper towel and weigh them. Weight of paper towel and lettuce plants: _____
6. **Calculate** Subtract the weight of the paper towel from the weight of the paper towel and lettuce plants. This is the total weight of your lettuce plants: _____

Analyze Data

1. **Analyze** Did your hydroponic system meet the criteria of the problem?

   ☐ Support at least 10 lettuce plants.

   ☐ Keep at least 10 plants alive for 2 weeks.

   ☐ Yield a crop of 10 lettuce plants that weighs more than 0.5g after 2 weeks.
2. **Calculate** One lettuce seed weighs about 0.001g.

   How much would 10 lettuce seeds weigh? _____
3. **Analyze** How did the weight of the 10 lettuce seeds change during this activity?

   _____
4. **Make claims** Use the results of your tests and what you know about plants to support an argument that plants get most of the materials they need for growth from air and water.

Reflect On It

Name _____

Use your plan, prototype system, and test results to finish these sentences.

Hydroponic System Plan

1. We used this system and materials:_____

   _____

   _____

2. We selected these materials because _____

   _____

   _____

Prototype System

3. Our system met these criteria: _____

   _____

4. Our system did not meet these criteria:_____

   _____

5. One part of our system that worked well was _____

   because _____

6. One part of our system that did not work well was _____

   because _____

Compare Systems

7. We compared our system to Group _____. I observed that _____

   _____

8. The most successful system was made by Group _____. It may have been the most successful because _____

   _____