Test Tube Hydroponics

Grade Level: 3-5

Essential Skills: 4, 5, 9

NGSS: 4-LS1,5-ESS3, 5-LS1

CCSS: 3.RL.1, 3.RI.1, 3.SL.1, 4.RI.1, 4.SL.1, 5.RI.1, 5.SL.1

Time: 60 minutes

Materials:
- Plant Observation Sheet
- Test tube
- Spinach seeds
- Rockwool
- Nutrient solution
- Gallon of water
- Safety glasses
- Rubber gloves

AITC Library Resources:
Books:
From Seed to Plant
How a Plant Grows
Seed, Soil, Sun

More Lessons:
Soil Nutrients
Flower Power
Exploring Aquaponics
How does your garden grow?

Description:
Students investigate the importance of nutrients for plant growth and discover how plants grow without soil by growing and observing plants in a test tube hydroponic system.

Activity Directions:
Activity 1: Plant Nutrients
1. Explain to students that today they will be learning about plant needs. Read the book, *Farmer Will Allen and the Growing Table* by Jacqueline Briggs Martin.

2. After reading, ask student the following questions:
   a. How did Will Allen grow food in the city?
   b. What methods of growing food did Will Allen use? (i.e. aquaponics and hydroponic systems)

3. Have the students make a list of what plants need to grow. Write every requirement the students come up with on the board, regardless of whether or not it is correct .

4. Ask the students, "Do plants need soil?"

5. Show the class the the video, *Hydroponic Spinach: How Does it Grow?* by True Food TV. https://youtu.be/tG9bV2enwI0

6. Refer back to the students' list of plant needs. Circle (or add and circle) the four main growth requirements—air, light, water, and nutrients.

Activity 2: Test Tube Hydroponics
1. Explain to the class that they are going to try to grow plants without soil. They will conduct an investigation to determine the importance of nutrients to their plants' growth.

2. Organize the students into groups of two. Each group will germinate seeds in two test tubes, one containing water and the other containing a hydroponic nutrient solution and water. Once the plants germinate, the students will track the growth of each plant.

3. Have each student place a rockwool cube into a seed-starter tray. Place 1 tsp of seed into the center hole of the rockwool cube and water the cube. Have the students label their spaces in the tray by writing their name on a plant tag and inserting it into the rockwool. When all students have planted their seeds, place the clear lids onto the trays.

4. Ask the students, "What do seeds need to germinate?" (air, moisture, and warmth)

5. As a class, discuss how the germination requirements will be met for the seeds in their test tubes. (There is air in the seed-starter trays and the rockwool holds water which provides moisture for the seeds. Placing the seed-starter trays by the window can provide warmth from the sun.)

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Lesson Adopted from National Center for Agricultural Literacy's Test Tube Hydroponics

6. Explain to the students that it will typically take about 3-7 days for the seeds to germinate.

7. After the roots are growing down past the bottom of the rockwool (about one week), a teacher or other adult should combine 1.5 teaspoons of the nutrient solution fertilizer in a gallon container per the instructions on the fertilizer container for seedlings. Safety Note: Use rubber gloves and safety glasses when handling fertilizer to avoid contact with skin and eyes.

8. Organize students back into their groups. Provide each group with a bowl of water (labeled), a bowl of nutrient solution (labeled) two test tubes, two pipettes, rubber gloves, and safety glasses.

9. Using a permanent marker, have the students label one of their test tubes "water" and the other "nutrient solution." Both test tubes should also be labeled with their names and the date.

10. Using a pipette, have one student from each group draw water from the bowl and fill the test tube labeled "water" to the 35 mL mark. The other student or teacher will wear rubber gloves and safety glasses and will use a pipette to draw nutrient solution from the bowl and fill the test tube labeled "nutrient solution" to the 35 mL mark. Pipettes should be saved to add water and nutrient solution to the corresponding test tubes as needed.

11. Each student should carefully place the rockwool with their seedling into the test tube they prepared so that the top lip of the rockwool rests on the top edge of the test tube and the roots, but not the rockwool, are in the liquid.

12. Ask the students, "Now that the seeds have germinated, what will the plants need to grow?" (air, water, light, and nutrients)

13. Ask the students to make predictions about how the plants in each test tube will grow. Will all of the plant needs be met?

14. Provide each student with a set of *Plant Observation Sheets.* Have the students record their observations twice a week for one month. Use the pipettes to add water and nutrient solution to the corresponding test tubes as needed to maintain the level of the liquid at 35 mL.

15. After one month, lead a discussion comparing the plant in the "water" test tube with the plant in the "nutrient solution" test tube. Use the following questions to guide the discussion:

a. Can plants be grown without soil?
b. Did the soybean plants grow better in the water or the nutrient solution?
c. What did you observe as the plants were growing?
d. What conclusions can be drawn?
e. What are the benefits of growing plants in hydroponic systems? (allows for greater control over the growing process with consistent results; eliminates risks of soil-borne diseases, pests, and weeds; more plants can be grown in a smaller space; plants mature faster and produce greater yields; water and fertilizer can be reused; plants can be grown in highly populated areas or locations with non-arable land or harsh climates)

Plant Observation Sheet
Week 1

Date _____		Date _____	
Water	Nutrient Solution	Water	Nutrient Solution

Plant Observation Sheet
Week 2

Date _____		Date _____	
Water	Nutrient Solution	Water	Nutrient Solution

Plant Observation Sheet
Week 3

Date _____		Date _____	
Water	Nutrient Solution	Water	Nutrient Solution

Plant Observation Sheet
Week 4

Date _____		Date _____	
Water	Nutrient Solution	Water	Nutrient Solution