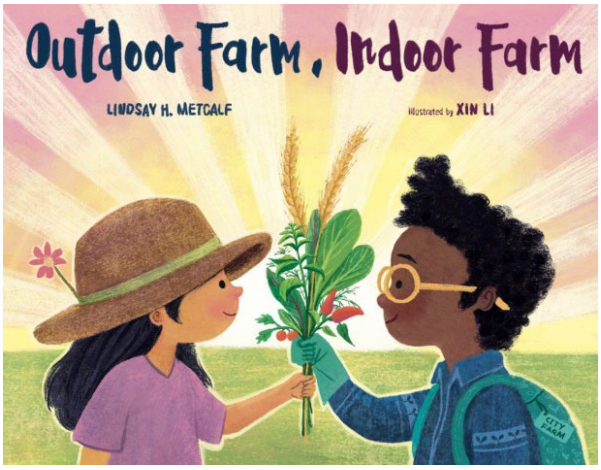
The Book Planter

Ag in the Classroom

FARM BUREAU NORTH CAROLINA
Post Office Box 27766 | Raleigh, NC 27611 | (919) 782-1705
ncagintheclassroom.com



January 2025
Outdoor Farm, Indoor Farm
Written by: Lindsay H. Metcalf
Illustrated by: Xin Li

With energetic, enchanting verse and sunshiny, colorful illustrations, discover how the food you eat is grown both outside—and inside! Join two children as they explore the inner workings of an outdoor farm and an indoor farm. You'll see how a variety of amazing machinery like tractors and drones along with innovative farming techniques yield the wonderful food we all love to enjoy.

Engage[1]

1. Provide each student with a blank piece of paper and ask them to draw a farm.
2. Compare the drawings. How are they similar or different? Address any misconceptions or stereotypes. (Examples may include: Not all farms have big, red barns, or farmers with overalls, not all farms have livestock, etc.)
3. Clarify that not all farms are the same.
4. Show students the cover of the book *Outdoor Farm, Indoor Farm*. Ask students what they think an indoor farm is.
5. Read the book to students.

After Reading[2]

1. 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.
2. Ask the students, "Do plants need soil?"
3. Show students the video How Does it Grow? Hydroponic Spinach Video
4. Refer back to the question, "Do plants need soil?" Discuss the hydroponic system from the video as evidence that plants can be grown without soil. Define hydroponics as the science of growing plants without soil.
5. 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 1: Plant Nutrients[2]

1. Show the students the Plants Growing in Soil photo. Ask the students to point out where the plant nutrients are found in the picture.

2. Discuss how plants growing in soil receive nutrients. Use the following points to guide the discussion:
    - Soil contains nutrients.
    - Fertilizer can be applied to the soil to add nutrients that may be deficient.
    - Plants absorb nutrients and water from the soil through their roots.
3. Show the students the Plants growing in a Hydroponic System photo. Ask the students to point out where the plant nutrients are found in the picture.

4. Discuss how plants growing in a hydroponic system receive nutrients. Use the following points to guide the discussion:
    - Plants grown hydroponically are not grown in soil.
    - Nutrients are delivered through a nutrient solution that is added to water.
    - Plants absorb water and nutrients from the solution through the plant roots.
5. Show the students a container of hydroponic nutrient solution or the Hydroponic Nutrient Solution Photo. Point out the three numbers on the container. Explain that these numbers

represent the percentage of nitrogen (N), phosphorus (P), and potassium (K) in the solution.

6. Use the information in the Plant Nutrients handout to discuss the importance of N, P, and K for plant growth and what happens when too much of each nutrient is present.

Activity 2: Test Tube Hydroponics[2]

Materials

- Rockwool*, 1 cube per student
- Seed-starter tray*, 1 space per student
- Soybean seeds*, 1 per student
- Plant tags*, 1 per student
- Permanent markers
- Plastic, flat-bottom test tubes*, 1 per student
- Bowl of water, 1 per group
- Pipettes*, 1 per student
- Bowl of hydroponic nutrient solution mixed with water (We tested 1/4 tsp of General Hydroponics FloraGro per 1 gallon of water.)
- 1 gallon container (A milk or juice container works great.)
- Aluminum foil
- Rubber gloves
- Safety glasses
- Plant Observation Sheets

*These items are included in the Test Tube Hydroponics Kit, which is available for purchase from agclassroomstore.com. A Test Tube Hydroponics Refill Kit is also available.

Procedure

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 a soybean 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.*)
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 prepare the nutrient solution in a gallon container by combining the fertilizer with water 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 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. Wrap aluminum foil around the outside of each test tube, and place the test tubes by a sunny window or under a grow light.
13. Ask the students, "Now that the seeds have germinated, what will the plants need to grow?" (*air, water, light, and nutrients*)
14. Ask the students to make predictions about how the plants in each test tube will grow. Will all of the plant needs be met?
15. 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.
16. 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:
    - Can plants be grown without soil?
    - Did the soybean plants grow better in the water or the nutrient solution?
    - What did you observe as the plants were growing?
    - What conclusions can be drawn?
    - 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*)

Sources

1. https://utah.agclassroom.org/matrix/lesson/860/
2. https://utah.agclassroom.org/matrix/lesson/654/

K-5 Subject Areas: English Language Arts, and Science

English Language Arts

- RL.K.1 With guidance and support, identify a detail in a familiar text.
- RL.K.2 With guidance and support, identify the main topic of a familiar text.
- RL1.1 Identify details in a familiar text.
- RL.1.2 Identify the main topic and retell key details of a text.
- RL.2.2 Identify the main topic of text.
- RL.2.4 Identify words that relate to the topic of a text.
- RL.3.2 Identify the main topic and retell key details of a text.
- RL.3.4 Identify key words that complete sentences in a text.
- RL.3.5 Locate key facts or information in a familiar text.
- RL.4.1 Identify explicit details in an informational text.
- RL.4.4 Determine the meaning of words in a text.
- RL.4.7 Interpret information presented visually, orally, or quantitatively and explain how the information contributes to an understanding of the text in which it appears.
- RL.5.1 Identify words in the text to answer a question about explicit information.

Science

- PS.K.1 Understand how objects are described based on their physical properties and how they are used.
- PS.K.2 Understand the positions and motions of objects and organisms observed in the environment.
- LS.K.1 Understand the characteristics of living organisms and nonliving things.
- LS.K.2 Understand characteristics of organisms that make them alike and different.
- LS.1.1 Understand the basic needs of a variety of plants and animals in different ecosystems.
- ESS.1.2 Understand the physical properties of Earth materials.
- ESS.1.3 Understand that natural resources are important to humans.
- LS.2.2 Understand that organisms differ from or are similar to their parents and other offspring based on characteristics of the organism.
- LS.3.2 Understand how plant structures aid in survival.
- LS.3.3 Understand how environmental factors aid in the survival of plants.
- LS.4.1 Understand the effects of environmental changes, adaptations, and behaviors that enable organisms to survive in changing habitats.
- LS.5.2 Understand the interdependence of plants and animals within their ecosystem.
- PS.2.1 Understand properties of solids and liquids and the changes they undergo.
- PS.3.1 Understand the structure and properties of matter before and after they undergo a change.
- PS.3.3 Understand how energy can be transferred from one object to another.
- PS.5.1 Understand the interactions of matter and energy and the changes that occur.

Plant Nutrients

Nutrients are essential to plant growth. Nitrogen (N), phosphorous (P), and potassium (K) are primary macronutrients. The positive effects of the presence of these nutrients at optimum levels and the negative effects of deficient or excess levels can be visually observed in plants.

Nitrogen (N):

- **Optimum:** Plants are rich green and the protein content increases.
- **Deficient:** Plants are stunted and light green in color, the lower leaves are yellow, and the stem is slender.
- **Excessive:** Plants have a very lush foliage with sappy, soft stems and flowering is delayed.

Phosphorous (P):

- **Optimum:** Phosphorous stimulates root formation and growth, giving the plants a vigorous start. Phosphorous also stimulates flowering and aids in seed formation.
- **Deficient:** Plants have slower growth and delayed flower and pod development, the leaves are dark green and dull, the root system is poor with little branching, and the stem is slender.
- **Excessive:** Plants have very lush foliage with sappy, soft stems and flowering is delayed.

Potassium (K):

- **Optimum:** Potassium imparts increased vigor and disease resistance.
- **Deficient:** Leaves can be mottled or chlorotic, small necrotic spots may appear between veins or near leaf tips and margins, the flowers do not achieve vibrant yellow color, and the stem is slender.
- **Excessive:** Plants have dark foliage, stiff stems, and leaf branches.

Information sourced from *Investigating Plant Physiology with Wisconsin Fast Plants™* found at https://fastplants.org/wp-content/uploads/2017/02/WFPphysiology-06web.pdf.

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