**4th Grade STEM**

**Science Standard**

* Standard 3: Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.
	+ Objective 3: Observe the basic components of soil and relate the components to plant growth.
		- e. Research and investigate ways to provide mineral nutrients for plants to grow without soil (e.g., grow plants in wet towels, grow plants in wet gravel, grow plants in water).

Math Standard

* **Unit 5: Measurement** – Converting Measurements, Perimeter and Area

**Title: Hydroponics**

**Description:** Students will grow plants without soil and design a hydroponic system to see who can grow the biggest plants with the least water and take up the least space.

**Materials:** bean seeds (uncooked), cups, various media (paper towels, gravel, vermiculite, cotton balls, Styrofoam pellets) plastic wrap, rulers, balance, camera or phone, graduated cylinder or measuring cup

**Procedures:**

1. **Lesson 1: Engineering Story**: Read and respond to the “Hydroponics” material with a literacy activity.
2. **Lesson 2: A Broad View of an Engineering Field.**
3. **Lesson 3. Scientific Data to Inform Engineering Design.** Allow students a week to grow their own plants from a seed using any medium they want, except soil. If you don’t have that much time, start a few seeds a week or two before you start this activity so you have something real to show them.
4. Show students the power point and have them write in answers as they go. They should discuss answers with one another before they write. Discuss the correct answers after each slide.
5. **Lesson 4. Engineering Design Challenge.** Discuss the challenge. Student should work in groups of 2-4 and discuss and draw what they want to do. There is a space on their student sheet for the drawing.
6. Ask students to build their prototype. It will work best if you give them a couple of days and they have a chance to go home and get materials. Many parents will be helpful.
7. If possible, allow students time to use the internet to look at different systems. There are many good sites: http://www.kidsgardening.org/node/3760 P

<http://www.simplyhydro.com>

1. Provide time in class to build the model, provide a maximum size so that you can

manage it in your classroom. A shoebox size is a suggestion.

1. If you have not yet introduced the math concepts of area and perimeter, the students should understand that the area that their model requires as it sits on a table is going to be its “size”. It can be measured by setting it on graph paper.
2. Give the students 6 beans each. They should weigh them on the balance before planting them in their greenhouse. The greenhouses can be designed any way the students wish.
3. The students must measure how much water they use and write it down.
4. Take a picture or have students draw the beans. The picture can be saved and printed during the project and when it is finished.
5. The beans should have the same amount of light. If a student wants to add fertilizer, that is OK but try to reinforce the idea that air is the main builder of plant mass.
6. When you wish the project to end, have the student pull the plants out of the greenhouse and weigh them. The winner should be determined by the group with the greatest gain in mass that used the least water and space. It may be a little fuzzy.

Student Sheet Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Teacher\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Follow along on the power point presentation:

1. What is unusual about the plants you have grown or those in the picture?
2. Can plants grow without soil?
3. Where does the “stuff” come from to make them tall and green?
4. Where are most plants grown?
5. What is the job of the soil?
6. What if we did not have enough soil?
7. Could we still grow lots of food?
8. How is this farm different from the one in the last photo?
9. What is hydroponics?

**Hydroponic Challenge**-Which group can build a hydroponic system that grows the biggest beans in the least area with the least water?

**Instructions:**

1. You will get 6 bean seeds and any materials the teacher provides or that you bring from home.
2. You must mass (weigh) the beans first and measure the area that your greenhouse takes up on the table. (graph paper?) Write these numbers down. Your teacher will tell you how tall it can be but you can make it smaller.
3. Your group will design and build the system. You will write down how much water you use and take a picture or draw your plants every time you look at them.
4. Draw the design your group agrees on below:

**Data:**

**Mass of beans** Start: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 End: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Difference: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Area of greenhouse**: Perimeter: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Area: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Amount of water used:**

Week 1

Day 1 \_\_\_\_\_\_\_\_

Day 2 \_\_\_\_\_\_\_\_

Day 3 \_\_\_\_\_\_\_\_

Day 4 \_\_\_\_\_\_\_\_

Day 5 \_\_\_\_\_\_\_\_

Total \_\_\_\_\_\_\_\_\_

Week 2

Day 1 \_\_\_\_\_\_\_\_

Day 2 \_\_\_\_\_\_\_\_

Day 3 \_\_\_\_\_\_\_\_

Day 4 \_\_\_\_\_\_\_\_

Day 5 \_\_\_\_\_\_\_\_

 Total \_\_\_\_\_\_\_\_

Week 3

Day 1 \_\_\_\_\_\_\_\_

Day 2 \_\_\_\_\_\_\_\_

Day 3 \_\_\_\_\_\_\_\_

Day 4 \_\_\_\_\_\_\_\_

Day 5 \_\_\_\_\_\_\_\_

Total \_\_\_\_\_\_\_\_\_

Total water used: \_\_\_\_\_\_\_\_\_\_\_\_

**Pictures or drawings:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ |
| Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ |
| Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ |
| Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ |
| Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ |
| Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ | Day \_\_\_\_\_ |