Bending Plant Roots with Gravity

Name: _____

Date: _____

Student worksheet

Directions: Answer the questions below before you do your experiment.

1. Pre-Experiment

How do you expect the roots of the seeds will grow over time in each bag? Write down your expectations below.

Bag labeled "V" (seeds grow vertically):

Bag labeled "R" (growth direction is rotated every 2 days):

Bag labeled "H" (seeds grow horizontally):

2. Experiment

Follow these steps to do your experiments. You will work in teams of 2—4 students. Divide and share tasks throughout the experiment.

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Name: _____

Directions: Follow the steps below to do your experiment.



1. Prepare a large cardboard box to make sure that no light can get inside by taping any cracks.
2. Label all four edges of each of the three zip-lock bags on one side: "Up," "Down," "Left," and "Right," as shown in the Figure on the right.
3. For each bag, fold a full-sheet paper towel in half twice so it fits in the bag (or stack two half-sheet paper towels on top of each other and fold them in half once).
4. Put the folded paper towels in plastic bags, making sure an open edge (not a folded edge) is at the top of the bag.
5. Pour about two tablespoons of water in each bag, close it, and swish the water around. The paper should be damp, but not soaked.



6. Open each bag and peel apart the paper towels so there are two layers on each side. Place five seeds in the middle of the bags as shown in the Figure on the right. The seeds should be evenly spaced from each other. None of the seeds should be close to the sides of the bag. Press down on the paper towels so the seeds stick to them.
7. Zip the bags closed, leaving some air in each. Make sure the seeds are still in place.



8. Use strong tape to attach two of the seed bags to a vertical side in the cardboard box. Make sure the "Up" label is at the top. Tape the third bag to the bottom surface in the cardboard box as shown in the Figure to the right.
9. Write a "V" on one of the vertical bags to stand for "vertical." On the other vertical bag, write an "R" for "rotate." You will rotate this bag 90 degrees clockwise every two days, starting in two days. On the bag lying flat, write an "H" for "horizontal."
10. Close the box and make sure that no light can get in (tape the lid shut if necessary). Put the box at a place where it can be undisturbed for two days.

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Name: _____

Directions: Continue following the steps below to do your experiment.

Day 3

11. Carefully remove each bag from the box, one at a time. Do not leave any bag exposed to the light for more than 10 minutes. Briefly hold the bags up to a light to look at the seeds and feel the bag with your fingers to check for root formation and root growth direction.
12. Write down your observations in the table below, such as how many seeds sprouted and the direction the roots are growing, for each bag. Include a drawing of how the roots grew.

Day	Bag label	Observations	Drawings
3	"Vertical"		
3	"Rotate"		
3	"Horizontal"		

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Name: _____

Directions: Continue following the steps below to do your experiment.

13. If water has collected in any bag, pour the water out. If any paper towels got too dry in any bag, add more water. Seal each bag, leaving some air in each. Then put the bags back in their original location. *Rotate* the bag marked with the "R" 90 degrees clockwise (so that "Left" is on top and "Right" on bottom) before securing it in place.

Day 5

14. Repeat the same steps as on day 3 (steps 11—13), and again rotate the bag marked with the "R" 90 degrees clockwise (so that "Down" is on top and "Up" is on the bottom) before securing it in place.

Day	Bag label	Observations	Drawings
5	"Vertical"		
5	"Rotate"		
5	"Horizontal"		

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Name: _____

Directions: Continue following the steps below to do your experiment.

Day 7

15. Six days after putting the seeds in the bags, carefully remove each bag from the box and hold it up to a light again to look at the seedlings. Feel the roots through the paper with your fingers if it is difficult to see them.
16. Then open each bag and take out the paper towel, making sure to keep its orientation the same as it was inside the bag. Carefully open the paper towels to expose the sprouted seeds, trying not to break the fragile roots or stems.
17. Write down your observations in the table below, such as the direction the roots are growing in each bag, and make drawings of the roots.

Day	Bag label	Observations	Drawings
7	"Vertical"		
7	"Rotate"		
7	"Horizontal"		

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Name: _____

Directions: Answer the questions below about your experiment.

3. Reflect

a. Describe how the roots grew over time in the three different bags ("V," "R," and "H"). Did you expect these results?

b. Considering your results and your answer in question 3.a, state which factor(s) influenced the root growth in your experiment and explain how.

c. During your experiment, did you also notice which way the plant shoots grew compared to the roots? Can you explain why the shoots grew this way?