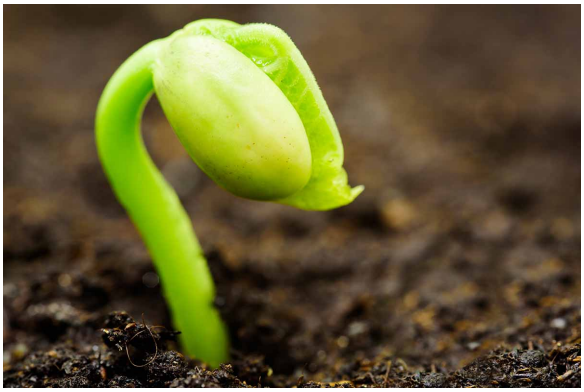
Effect of Gravitational Changes on Bean Germination.



Background

When a seed is planted in soil on Earth, gravity causes the seed to orient itself with the root growing downward, a process known as geotropism. Plants perceive gravity using statoliths, cellular organelles located in root tips. These organelles help to orient the plant so that roots grow downward toward water and nutrients, and shoots grow upward for photosynthesis. In space, the absence of gravity can affect plant root and shoot growth, and therefore plant development. Studies on the International Space Station have shown a 48 hour delayed germination of *Arabidopsis* seed compared to seed grown on Earth. Parabolic flight is a good opportunity to test seed and seedling response to temporary changes in gravity.

This experiment investigates the effect of gravitational changes on the germination of bean (or other) seeds.

Target Grade Level: 3rd-8th
Suggested Time Frame: 7 Days (germination)

US Next Generation Science Standards (NGSS)

Force and Motion PS2.A, PS2.B
Space Systems ESS1.A, ESS1.B
From Molecules to Organisms: Structures and Processes LS1.1, LS1.2, LS1.3, LS1.4, LS1.5, LS1.6
Ecosystems, Energy, and Dynamics LS2.1, LS2.2, LS2.4, LS2.5
Biological Evolution: Unity and Diversity LS4.4, LS4.5, LS4.6

Purpose: To Determine the Effect of Gravitational Changes on Bean Seed Germination

Hypothesis

Materials:

- Bean seeds
- Petri dishes or Ziplock bags
- Filter paper or paper towels
- Distilled water

Procedure:

1. Divide seed into two group: Control (1 g), and Parabolic (1.8 g, 0.38-g, 0.16-g, 0-g)
2. Carry all seed to hanger, so that all seed experiences the same travel conditions
3. Leave Control group at hanger, carry Parabolic group on G-Force One.
4. In classroom: fold and mist paper towels. Paper towels should be damp, not wet.
5. Lay 5 seed on paper towel and place in Ziplock bag
6. Label Bag with date and Control or Parabolic
7. Repeat for all seed
8. Record the number of germinated seeds and length of sprout for for 7 days

Results: Seed Germination over 7 days

DATE	# germinated	sprout length	observations	# germinated	sprout length	observations
Day 1:						
Day 2:						
Day 3:						
Day 4:						
Day 5:						
Day 6:						
Day 7:						
	% germination	Avg sprout length		% germination	Avg sprout length	

Reflection

1. What was the purpose of this experiment?
2. In the procedures, why were all seeds taken to the Zero-G hanger?
3. What were the differences observed between the germination of the seeds flown on G-Force One and the control group seeds (1-g)?
4. If there are differences, do you feel this answers the question? Why or why not?
5. What are some of the challenges associated with growing plants in space and how could the results of this experiment be used to address those challenges?
6. What are some potential applications for the findings of this experiment in fields such as agriculture and space exploration?
7. What questions could you ask to build upon this experiment?
8. How would you improve this experiment?

Research the VEGGIE system on board the International Space Station.
Describe how the VEGGIE system is engineered so that plants can grow in microgravity! What types of plants have they grown? If you were an astronaut, what plant would you want to grow?