Agricultural Literacy Curriculum Matrix

Nebraska Agriculture in the Classroom

Topsy-Turvy Soybeans

Grade Levels

3 - 5

Purpose

Students will observe how plants respond to gravity by germinating soybeans in a CD case and rotating the case as they grow.

Estimated Time

20 minutes with short daily observations for two weeks

Materials Needed

- Paper towels
- Permanent markers
- Large binder clips
- Water
- 4 soybeans for each student or team of students. (Soybean seeds can be obtained from some local stores in their gardening and seed section or through an online seed distributor)
- 1 clear plastic CD case for each student or team of students (must be the thick cd case, not the newer thin style)

Essential File (map, chart, picture, or document)

- Topsy-Turvy Observation Worksheet (https://cdn.agclassroom.org/media/uploads/2015/01/26/Topsy-turvy_Observation_Chart.pdf)

Vocabulary Words

geotropism: growth of a plant in response to the force of gravity

germination: process of a plant emerging from a seed and beginning to grow

hilum: the point where the seed attaches to the pod; usually a slight reddish color and elliptical in shape

statocytes: cells that surround the rootlet tips

Did You Know? (Ag Facts)

- The soybean or bean is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses.
- Soybeans are used to feed livestock, make biodiesel, and processed into many food and household products.
- Iowa and Illinois are the top soybean producing states in the country.

Background Agricultural Connections

Did you know that plants are able to sense their environment and actually respond appropriately? One of the key parameters that every plant must respond to is the direction of gravity: stems go up (opposite to the pull of gravity) and roots go down (in the same direction as the force of gravity).

By sensing gravity, plants can turn sideways, upside down, etc. Scientists first theorized that the plant could tell by the warmth of the soil, but now we know that they sense gravity and automatically know where down is and grow upwards. This is a crucial skill for the plant because they need to grow upwards and get their leaves out of the soil so they can reach the sunlight and grow. Even though it seems easy to understand that plants sense gravity, the actual mechanisms inside the plant roots are quite complicated.

Statocytes are a kind of cell that surrounds the rootlet tips. Inside statocytes, the statoliths act as a motion sensor. Movements of these small bodies allow the roots to understand the direction of gravity.

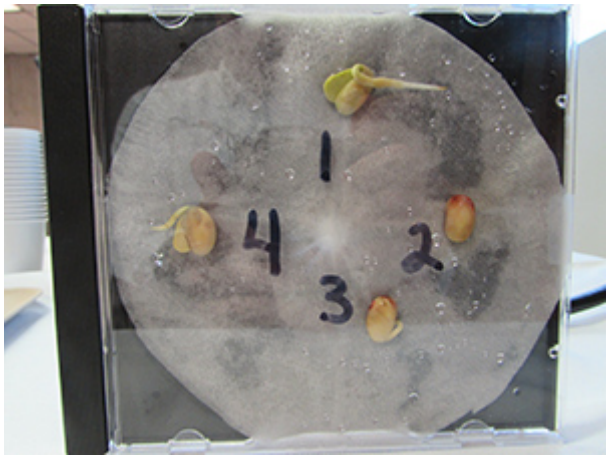
Interest Approach - Engagement

1. Ask students to close their eyes and bend over. Do they know which way is up and which way is down? How can you tell?
2. Ask students how gravity affects the way we perceive the world? Are other organisms affected by gravity?

3. Discuss the question, "If you plant a seed upside-down will the roots grow up?" Inform your students that they will be performing an experiment to answer this question.

Procedures

1. Cut the paper towel or blotting paper so it fits inside the CD case.
2. Moisten the paper towel and lay it in the case.
3. Evenly place four soybeans on the paper towel. Orient the soybeans in at least two different directions (note the direction of bean's hilum).
4. Close the CD case so that the beans are held snugly. Tape the case shut.
5. Using a marker, number the soybeans 1,2,3,4 on the outside of the case.
6. Set the CD case in an upright position. Attach a binder clip to the bottom to help keep the case upright.
7. Keep the paper towel moist. As the seeds begin to sprout, note the direction in which the roots and stems are growing. Does the direction the seed is turned affect the direction of growth?
8. Two days after the seeds have begun to grow, rotate the CD case 90° on its side. Continue rotating the case every two days. Did rotating the case effect the growth?



Concept Elaboration and Evaluation

After conducting these activities, review and summarize the following key concepts:

- Plants can sense gravity allowing the roots to always grow down and the stem to grow up.
- Plants rely on the sun, soil, and water for healthy growth.

We welcome your feedback (https://usu.co1.qualtrics.com/jfe/form/SV_4HhIVpN4L8IC2lT)!

Please take a minute to tell us how to make this lesson better or to give us a few gold stars!

Enriching Activities

During the two week observation period, have students record daily journal entries using full sentences and good grammar to describe what they see. At the end of the observation period, have students write a reflection paper explaining what they witnessed and what they think happened considering all the results of the experiment.

Visit the "Pod to Plate" (http://www.podtoplate.org) website for more free resources about Soybeans.

For an additional lesson on tropism in plants, see Tropism Twist (https://iframe.agclassroom.org/nebraska/lesson/352/).

Sources

Original idea from Montana Agriculture in the Classroom.

Suggested Companion Resources

- How to Use a Ragdoll Test to Estimate Field Germination (https://iframe.agclassroom.org/nebraska/resource/619/)
- Auntie Yang's Great Soybean Picnic (https://iframe.agclassroom.org/nebraska/resource/506/)
- Full of Beans: Henry Ford Grows a Car (https://iframe.agclassroom.org/nebraska/resource/1008/)
- My Family's Farm Book Series (https://iframe.agclassroom.org/nebraska/resource/1006/)
- My Family's Soybean Farm (https://iframe.agclassroom.org/nebraska/resource/1102/)
- Soybeans in the Story of Agriculture (https://iframe.agclassroom.org/nebraska/resource/280/)
- Grains and Legumes of the World (https://iframe.agclassroom.org/nebraska/resource/447/)
- Bottle Biology (https://iframe.agclassroom.org/nebraska/resource/743/)
- Into the Outdoors: Farm Science (https://iframe.agclassroom.org/nebraska/resource/338/)

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