Activity Title: The Journey Of A Seed

Recommended Grades

Kindergarten, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5, Grade 6

Curriculum Connections

Matter
- K – examine properties of objects
- 1 – how properties of objects can be changed
- 2 – investigated properties of materials, relate to a purpose
- 3 – changes of state, permanent and impermanent changes

Energy
- 2 – behaviours of light and sound (sunlight)

Earth Systems
- K – how environments can be explored, environments include plants, changes in environment can be observed, ways environment can be protected
- 1 – seasonal changes in plants, responsibility to care for environments
- 2 – components of Earth include plants
- 3 – activities which change Earth's surface, composition of soil
- 4 – conservation practices
- 5 – conservation agriculture

Living Systems
- 1 – how do plants survive?
- 2 – how do plants live and grow?
- 3 – plants respond to water, temperature, and light; plants depend of environment for survival
- 6 – role of plants in ecosystems

Computer Science
- K – instructions to be followed, have steps
- 1 – instructions to be followed, have steps

Scientific Methods
- 1 – carry out an investigation, data recorded
- 2 – methods and processes used in investigation, data collection
- 4 – representations of data
- 5 – variables
- 6 – hypotheses, graphs, tables

Time

30 minutes for set up and lesson, daily follow up ~5 minutes.

Skills Focused On

• Critical Thinking • Hypothesizing • Observation	• Planning • Problem-solving • Resourcefulness

Materials Needed

- Seeds – bean seeds are a good option due to the size and relatively fast germination rate, however could add species exploration as a level to the experiment
- Ziploc
- Paper towels
- Water
- Optional – container to put seeds in
- Data sheet

Background Information

Close your eyes and think about a **healthy Earth**. What do you see? Animals? Clean water? The sun shining? All of those things are part of a healthy Earth, but one of the main things I see are plants. All different types and sizes of plants.

Why do we need plants? Well, there are lots of reasons.

1. We all like to breathe right? Plants produce oxygen through a process called photosynthesis where carbon dioxide and water are transformed using sunlight.
2. By transforming carbon dioxide into oxygen, and by storing carbon in their tissues, plants also help reduce the effects of climate change, as carbon dioxide is a key greenhouse gas.
3. All animals, including us humans, require plants for food, shelter, etc.
4. Plants are important for maintaining healthy soil. Plant roots keep soil from eroding and plant litter adds essential nutrients and other components as it breaks down.
5. Humans use plants for medicine, clothing, and many other products in our daily lives.
6. What other reasons do we need plants?

But, we remove plants when we build cities, cut down trees for building materials, and mine for important mineral resources. That's a problem because we know plants are important for a healthy Earth so we need to make sure we revegetate, bring plants back, after those activities are done. **Revegetation** is a key step of land reclamation which is the process of converting damaged or disturbed land back to its previous condition or to something new.

Plants come in all different shapes and sizes. They may all have different requirements to grow, and also to germinate. **Germination** is when a plant emerges from a seed and turns into a seedling.

What is happening during germination?

1. First, the seed soaks up water and the outside starts to swell and soften. This step is called imbibition.
2. Next we have the lag period where everything starts to happen inside, the seed breathes and starts to make and store food and proteins.
3. Finally we have the step we are looking for, root emergence, as the plant starts to grow and emerge from the seed. The white part that emerges from the seed is the radicle which forms the root, the first thing that emerges from the seed. In nature it will attach to the ground, keeping the plant where it is and starting to absorb water.

Testing germination is an important part of revegetation–any ideas why?

Let's say we plant 10 seeds because we want 10 plants to grow in an area. If they all germinate, that's great! I have a germination rate of 100 % and 10 seedlings will emerge! … though they could die or be eaten after germination. If only 5 seedlings grew from my 10 seeds, I would have a 50% germination rate. A lot of the time, many seeds do not germinate. This might be because we don't have the right temperature, amount of water, or light conditions for the seed to germinate. It is important to know what conditions our seeds need to germinate, and the number of seeds we can expect to develop into seedlings. Knowing germination rate is important so that we can plant the right number of seeds to get the number of plants we want! Testing germination can also help us find the right conditions for seeds to germinate. This will help us determine the best way to grow them and plant them so they are successful.

Experimental Steps

In this experiment, we will explore seed germination, what factors can affect it, and different ways to present it.

1. Take the paper towel and get it wet. You can squeeze out the excess water so it is not dripping everywhere, but it should be quite wet.
2. Place a known number of seeds on the wet paper towel. Five or ten is a good number to test.
3. Fold the paper towel so that the seeds don't fall out and place it inside the Ziploc. Do not fold the paper towel too tightly. Do not seal the Ziploc as the seeds need air.
    a. If you are using a container, you do not need to fold the paper towel. Just place the container in the Ziploc and make sure not to seal the bag.
4. Find a place for your seeds. They need to be checked every day to make sure it is an accessible space
5. Every day check your seeds to see if any are germinating. It may take anywhere from a few days to a couple weeks to start germinating. Count and record the number of germinated seeds each day.
    a. If you are finding that your seedlings are going moldy or dying after they have germinated, you can remove the seeds that have germinated each day and add them to a running count to determine the total number of seeds.

6. Add water to the paper towel whenever it is drying out as the seeds need to remain wet.
    a. How often you need to add water depends where your seeds are placed – a sunny place would need to be watered more often than seeds in the dark.
7. Continue monitoring your seeds until no more germinate. This could mean 1 week of no new germination or even longer.

What To Do With Your Germination Data?

Germination Rate

Calculate your germination rate using this equation:

(Total Number of Seeds Germinated / Total Number of Seeds) x 100%.

Graph Germination Pattern

Create a graph with Number of Seeds Germinated on the Y axis and Number of Days along the X axis. Record the number of seeds germinated for each day.

Experimental Extensions

1. You may want to try the experiment multiple times, placing the seeds in different conditions to see if results change. Have the students hypothesize the impact of the condition on the germination rate or pattern.
2. For a seed to germinate, it needs the right conditions– the right amount of water, the right temperature and light. Different seeds may have different needs to germinate. **Compare different species.**
3. Some seeds require light whereas others require darkness. Imagine if your seed is buried in soil or underneath snow, it would need to be able to germinate in the dark. So **maybe you should test your seeds in the light and the dark.**
4. It may be too warm or too cold where you are testing your seeds. Usually between 15 and 20 degrees Celsius is a good temperature, the temperature of springtime when most of our seeds germinate. **Try a few places that may have different temperatures and see if that changes your results.**

Moisture Challenges - You need to make sure that seeds stay damp, so anytime the paper towel looks like it is drying out, add a bit more water. This can be difficult when plants are growing out in nature because sometimes it won't rain for a long time, or maybe the soil where the seed is doesn't hold enough water. Discuss moisture challenges in nature, in different environments, etc.

Species Selection - When we want to revegetate an area, we have to select the species we want present. The decision may be based on what was there before, what the animals in that

area need, what plants may be useful, or all of the above and more. Consider an area and what plants would need to be revegetated there.

Germination Limitations - Some seeds may never germinate under the conditions you are testing. This could mean that the seed is dead OR it could mean that the seed is dormant. This means that the seed is in a sleep period which prevents the seeds from germinating until there are the exact perfect conditions! We might be able to break dormancy by replicating these conditions–storing the seed in cold replicates winter conditions some seeds need to go through before they germinate. Others might need to be eaten by animals so that a hard outer layer of the seed can be removed–in this case we can scratch the seed surface to encourage germination. Some seeds need to be exposed to different chemicals, light conditions, temperatures or even fire. When these conditions are met, it signals to the plant that environmental conditions are best for plants to grow! This is when seeds wake up and germinate! We know what many plant species need to germinate, but for others we are still learning.

Data Sheets

Any or all of the following data sheets can be used. Teachers can also adapt them to better fit their class needs.

- Germination Monitoring Sheet
- Germination Rate
- Germination Observation Sheet
- 5 Seed Graph and Table
- 10 Seed Graph and Table

Additional Resources

Journey of a Seed experimental video produced by Future Energy Systems - provides background information and instructions for experiment: https://youtu.be/0fAcw1B-nqM.

Learn more about Future Energy Systems (https://www.futureenergysystems.ca/) and access more learning content, including storytimes, lab tours, ask an experts and more (https://www.futureenergysystems.ca/engage/learning https://www.youtube.com/channel/UCJr8N9KyFJ6d-t36TPtUlwg).