Germination

Germination is defined as the beginning of growth. The term is most commonly associated with plants, describing the process of a seed sprouting into a seedling. The term germination can also be applied to spores or buds.

When seeds are dry and hard they are dormant. For a seed to germinate the dormancy period will need to be broken with water and warmth. When a seed is moistened, it will absorb water, breaking the seed coat and initiating the food supply in the cotyledon through the activation of enzymes that produces energy for the seed to sprout.
Temperatures must fall between a specific range for seeds to germinate. Most seeds grown in the Learning Garden germinate between 60° and 90° Fahrenheit (15° and 32° Celsius), but each seed has a unique temperature range for germination.

Sunlight supports the germination process as it provides warmth to the soil. Although uncommon, some seeds do even need direct contact with sunlight to germinate. Sunlight warms the soil to help initiate germination and once leaves have sprouted, and it is also the primary energy source for plant growth through the process of photosynthesis.

All flowering plants are classified as either a monocot (one cotyledon), or a dicot (two cotyledons). In a monocot, one cotyledon, or one seed leaf, will emerge from the germinating seed. In a dicot, two cotyledons, or two seed leaves, will emerge from the germinating seed. There are other differences between a monocot and a dicot, most notably the leaf structure. In a monocot, the leaf veins are paralleled, like a blade of grass. In a dicot, the leaf veins are netted like an oak leaf.

Use the chart below to help familiarize yourself with monocot and dicot examples.

<table>
<thead>
<tr>
<th>Monocot Examples:</th>
<th>Dicot Examples:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garlic</td>
<td>Onion</td>
</tr>
<tr>
<td>Corn</td>
<td>Wheat</td>
</tr>
<tr>
<td>Rice</td>
<td>Grasses</td>
</tr>
<tr>
<td></td>
<td>Tomato</td>
</tr>
<tr>
<td></td>
<td>Pepper</td>
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<tr>
<td></td>
<td>Peas</td>
</tr>
<tr>
<td></td>
<td>Carrot</td>
</tr>
<tr>
<td></td>
<td>Cauliflower</td>
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</tbody>
</table>

When seeds sprout in the soil, the radicle, or embryonic root, will be the first to emerge from the seed coat. The developing stem, described as the epicotyl, will emerge next and will grow towards the surface of the soil, eventually pushing its way through. The developing stem will bring the cotyledon along, which appears as the first two sprouting leaves, which looks different than the true leaves of the plant that grow once the stem and roots are established.

Embryo: Germinates into a baby plant, or seedling
Seed Coat: Protects the seed from insects, disease, and damage
Cotyledon: Provides food for the baby plant, or seedling

Spend time discussing the following introductory question:
- What does a seed need to sprout?
- Review the definition of a hypothesis.

Make a list of student responses on the board and group or categorize responses together, discuss and strike any responses that are not needed to germinate a seed.
Introduce and define the word germination and review the two things seeds need to germinate – warmth and water. Let students know that today they will be exploring the inside of the seed so they understand how a seed germinates – from the inside out!

**CLASSROOM ACTIVITY**
During the classroom portion of today’s lesson students will be crafting a hypothesis and making observations about the seed germination experiment.

NOTE: Have your students set up the germination experiment at least one week ahead of time. Use the worksheet Seed Germination Experiment and invite your students to collect the experiment supplies and follow steps 1 through 5. Place their sealed bags in a warm spot. Remember, it doesn’t have to be in the sunlight.

1. Use complete sentences and give clear directions about how the teacher will engage with the students.

2. Invite your students to collect their seed germination experiment. Pass back out their worksheet, Seed Germination Experiment, and have your students quietly review the rest of the worksheet.

3. Review the remainder of the Seed Germination Experiment worksheet with your students. Ask for students to raise their hand and volunteer to read each section.

4. Give students 10 minutes to complete the Seed Germination Experiment worksheet individually.

5. Have students pair and share the results of their experiment and review the two things seeds need to germinate – warmth and water.

Break here if this lesson will be taught in two sections.

**GARDEN ACTIVITY**
Welcome your students to the Learning Garden and line students up along one side of the Learning Garden. Stand on the opposite side of the Learning Garden so you can address the entire group.

Ask students if they know what they will be doing in the Learning Garden for the day’s lesson. Let them know they will be dissecting a seed and learning about the parts of a seed.
1. Use complete sentences and give clear directions about how the teacher will engage with the students.

2. Let your students know that today they will be working in work station groups to dissect and explore the inside of a seed. Ask for a student volunteer to review the definition of germination.

3. Introduce the supplies at each work station.

4. Break students up into work station groups. Be sure to bring enough supplies for each work station.

5. Give your students 10 minutes to complete the seed dissection activity and as groups finish, have them complete the seed dissection diagram.

6. Gather your students back together and review the parts of a seed and the function of each plant part.

NOTE: As the teacher, be aware of poisonous plants and other hazards in and around your Learning Garden and review those concerns with your students. Review any additional rules of the Learning Garden. Ask students about known bee/wasp sting allergies before going into the Learning Garden.

CONCLUSION

Have students share out key parts of the day’s activities and review the Key Understandings for this lesson.

- Ask students why seeds are so important. What part do they play in plant survival?
- Ask students to think about the location of seeds for different plants in the Learning Garden.

Students should clean-up the Learning Garden as needed.
Define germination.

Germination is...

Create a hypothesis. When my seed germinates, it will look like this:

(use drawings and words to describe your hypothesis)
Seed Germination Experiment

Please follow these steps when reviewing your germination experiment:
1. Locate your plastic bag – it should be labeled with your name, date, and the seed type
2. Open your plastic bag and carefully remove the paper towel (with seeds)
3. Unfold your paper towel to expose the seeds
4. Observe your seeds, then complete the germination results section below

**Germination Results.**

<table>
<thead>
<tr>
<th>Sketch what you see</th>
</tr>
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<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Observations and description</th>
</tr>
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<table>
<thead>
<tr>
<th>Was your hypothesis correct? Explain.</th>
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</table>

**Reflect.** A seed needs the following two things to germinate:

1. 
2. 
Name: __________________________ Date: __________________________

Seed Germination Work Station

Make sure your work station has the following supplies:
- Soaked seeds, 1 per student
- Magnifying glasses for sharing
- Paper towels

Complete the following steps to successfully dissect your seed:
1. Select a soaked seed and run your finger nail along the rounded edge
2. Carefully split open your seed into two separate sections
3. Remove the skin surrounding your seed
4. Place the three different seed parts on a paper towel
5. Review the following diagram and identify the seed parts on your seed

Parts of a Seed:

<table>
<thead>
<tr>
<th>Cotyledon</th>
<th>Seed Coat</th>
<th>Embryo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides food for the baby plant, or seedling</td>
<td>Protects the seed from insects, disease, and damage</td>
<td>This will germinate into a baby plant, or seedling</td>
</tr>
</tbody>
</table>

Label the parts of the seed with your work station group.