



# BIG GREEN LESSONS

Germination: 6<sup>th</sup> - 8<sup>th</sup> Grade

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## Lesson Outcomes

In this lesson, students will identify that all grains are seeds and that seeds germinate into seedlings.

- All whole grains are seeds.
- Monocots and dicots have the same seed structure.
- Corn is a monocot and beans are a dicot.

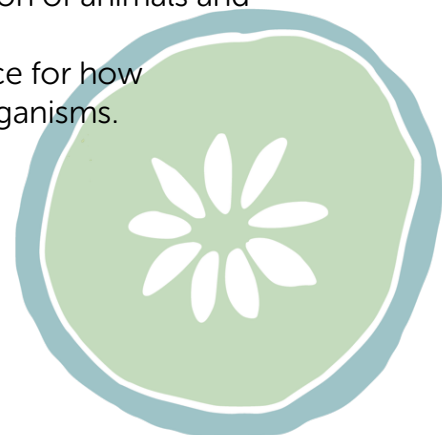
## Standards Alignment

Common Core – English Language Arts

- SL.6.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues building on others' ideas and expressing their own clearly.
- SL.6.4. Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL.7.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts and issues, building on others' ideas and expressing their own clearly.
- SL.7.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- SL.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume and clear pronunciation.

Next Generation Science Standards

- MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.



## Materials & Preparation

- **One week before the Classroom Activity:** students set up germination experiment
  - **One day before the Garden Activity:** soak seeds (preferably lima beans) for seed dissection
  - Familiarize yourself with your Learning Garden
- Reminder: Big Green's Garden Educators are always available for additional support via email or by phone call

### Germination Rate Experiment:

- Seeds (any variety) – 10 per student or small group
- Paper towels - at least 1 per student or small group
- Zip lock plastic bags - 1 per student or small group
- Spray bottles - enough for easy sharing
- Labels or a piece of masking tape - 1 per student or small group
- Pens or pencils
- Seed Germination Rate Experiment worksheet (front and back) - 1 per student

### Monocot Seed Dissection Work Station:

- Soaked seed - at least 1 per student (preferably lima beans from the grocery store)
- Magnifying glasses - enough for easy sharing at work station
- Paper towels - at least 1 per student
- Seed Dissection Work Station worksheet - 1 per group or workstation

### Dicot Dissection Work Station:

- Soaked seed - at least 1 per student (preferably dried lima beans from the grocery store)
- Magnifying glasses - enough for easy sharing at workstation
- Paper towels - at least 1 per student
- Dicot Dissection Workstation worksheet - 1 per group or workstation

## Teacher Background

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.

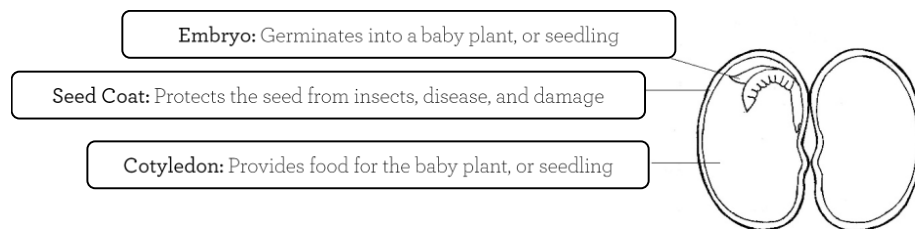
All flowering plants are classified as either a monocot (one cotyledon) or a dicot (two cotyledons). In a monocot, one cotyledon, or one seed leaf, will emerge from the germinating seed. In a dicot, two cotyledons, or two seed leaves, will emerge from the germinating seed. There are other differences 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.

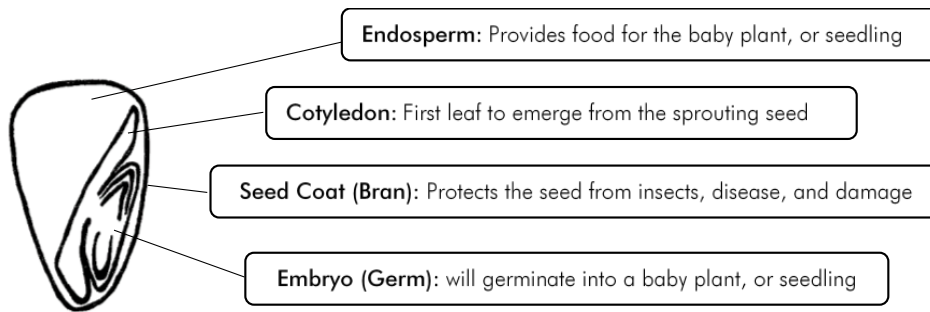
Monocot Examples:		Dicot Examples:	
Garlic	Onion	Tomato	Beans
Corn	Wheat	Pepper	Peas
Rice	Grasses	Carrot	Cauliflower

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 look different than the true leaves of the plant that grow once the stem and roots are established.

Dicot Diagram:



Monocot Diagram:



## Introduction

Spend time discussing the following introductory question:

- What does a seed need to sprout?

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 terms “germination” and “germination rate,” and review the two things seeds need to germinate: warmth and water.

## CLASSROOM ACTIVITY

During the classroom portion of today’s lesson, students will create a hypothesis and make observations on the results of their seed germination rate experiment.

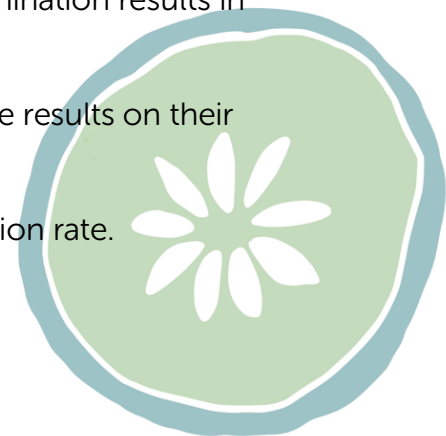
NOTE: At least one week ahead of time, have your students work in groups to set up the germination rate experiment. Use the worksheet Seed Germination Rate Experiment and invite your students to collect the experiment supplies and follow steps 1 through 5. Place the sealed bags in different locations throughout the classroom – select group #1 to act as the control group and leave their experiment on a desk in the classroom.

Have your students to gather their seed germination rate experiment. Pass back their worksheet, Seed Germination Rate Experiment, and have the groups work to define germination and germination rate and to create a hypothesis.

Review the remainder of the Seed Germination Rate Experiment worksheet with your students. Give each group 5 minutes to review and record their germination results in the correct row. Remember to assign each group a group number.

Have the groups share their results while the other groups record the results on their own worksheet.

Use this information to calculate your classroom’s average germination rate.



Discuss the results of their hypothesis and what they've learned from completing this experiment.

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

## GARDEN ACTIVITY

Assemble and welcome your students into the Learning Garden. Address the entire group and establish the expectation that this is a time for learning. If appropriate, review the agenda for the Garden Activity with your students.

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 two different seeds!

1. Let your students know that today they will be in workstation-groups to dissect and explore the inside of two different seeds, a monocot and a dicot.
2. Introduce the terms "monocot" and "dicot" to students; give examples of each type of seed.
3. Introduce the supplies at each workstation.
4. Break students up into workstation-groups. Be sure to bring enough supplies for each workstation.
5. Give your students 10 minutes to complete both seed dissection activities and as groups finish, have them complete the seed dissection diagrams. If students do not complete the seed dissection diagrams before you gather students back together, have them complete it as a group.
6. Gather your students back together to review the parts of each seed and to make comparisons between the two seeds, focusing on the seed structure and the resulting plant type.

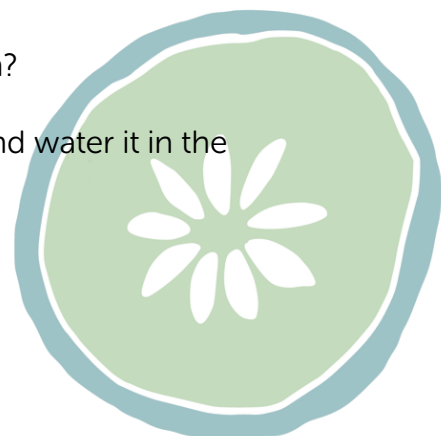
NOTE: As the teacher, be aware of poisonous plants and other hazards in and around your Learning Garden and review those concerns with your students. Review any additional Learning Garden rules with the students. Inquire about known bee/wasp sting allergies before going into the Learning Garden.

## Conclusion

Have students share key parts of the day's activity and review the Key Understandings for this lesson.

Review the following questions with your students:

- Why did we soak the seeds in water before we dissected them?
  - What does the water do to the seeds?
  - Would the same thing happen when we plant a seed and water it in the ground?



- Think back on our previous lesson about plant life cycles and what we learned today about germination. What does the structure of seeds and the process of germination tell you about how plants have evolved to survive in different conditions?
- Why would a gardener start seeds inside and then plant that seedling outside in the Learning Garden rather than just put all seeds right in the ground where they will grow?
- What if you discover that your seeds have a low germination rate, how would you adjust how those seeds will be planted in the Learning Garden?
- Look at how our seeds have germinated in the Learning Garden; did we get uniform and even germination? If not, what can we do better to make sure we get the best possible germination?

Students should clean up the Learning Garden as needed.



# SEED GERMINATION EXPERIMENT WORKSHEET

Name:

Date:

Please collect the following supplies:

- 3-5 Seeds
- 1 Paper Towel
- 1 Plastic Bag
- 1 spray bottle (you may need to share)
- 1 label or piece of masking tape and a marker

Please follow these steps when setting up your germination experiment:

1. Label the plastic bag with your name, the date, and the seed name
2. Fold a paper towel, make sure it will fit in your plastic bag
3. Spray or dampen your paper towel with water
4. Place 3 – 5 seeds in the folds of your paper towel
5. Carefully insert your paper towel (with seeds) into your plastic bag, seal, and label
6. Select a germination location in your classroom.

**STOP HERE.** You will complete the rest of the lesson in one week.

Define germination.

Define germination rate.

Create a hypothesis.

I germinated my seeds under the following conditions:

I hypothesize the rate of germination will be:

# SEED GERMINATION EXPERIMENT WORKSHEET

Please follow these steps when analyzing your germination experiment:

1. Find your plastic bag, labeled with your name, date, and seed name
2. Open your plastic bag and carefully remove the paper towel (with seeds)
3. Unfold your paper towel to expose the seeds that have been germinated
4. Observe your seeds, then complete the Germination Results section for your Group

## Germination Rate Results

Seed Variety:						
Group #	Location (Describe)	# of seeds planted	# of seeds germinated	Fraction of seeds germinated	Fraction with denominator of 100	Percentage of seeds that germinated
1	Control: classroom desk					
2						
3						
4						
5						
6						
7						
8						
<b>AVERAGE GERMINATION RATE PERCENTAGE</b>						

Was your hypothesis correct? Explain why or why not.



# DICOT DISSECTION WORKSHEET

Name:

Date:

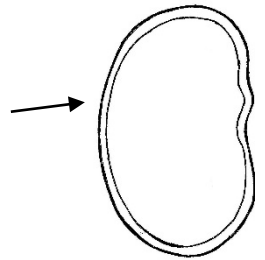
## Dicot Dissection Work Station

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:

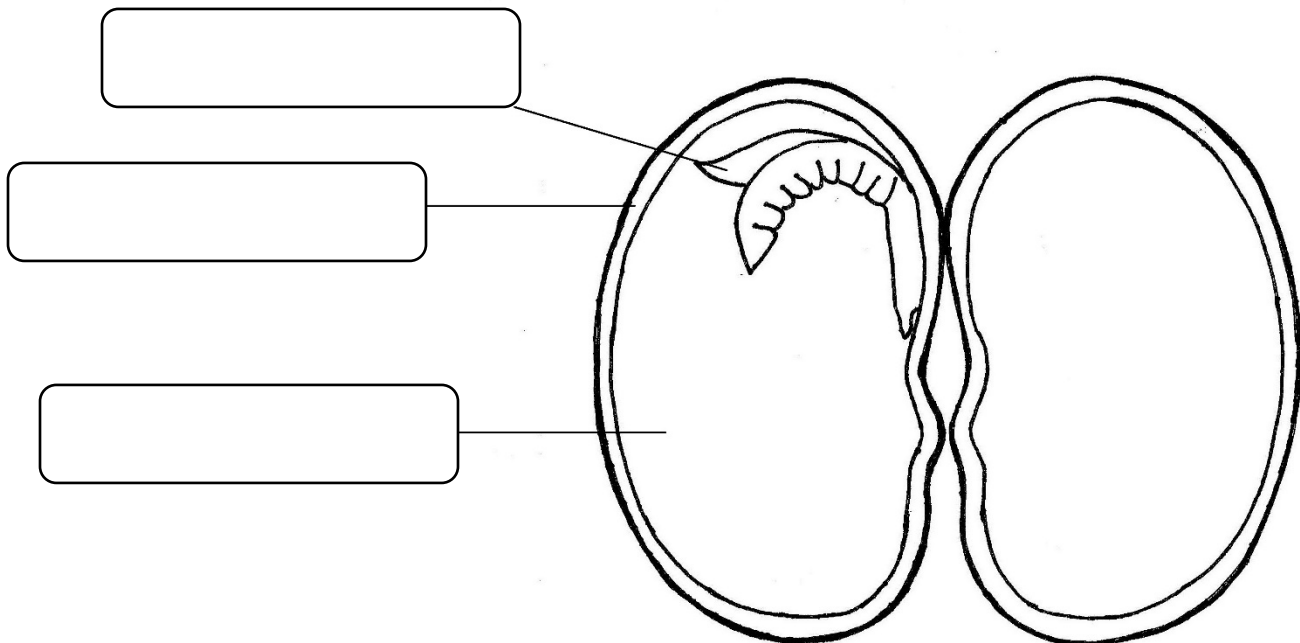
1. Select a soaked seed and run your finger nail along the rounded edge
2. Carefully split open your seed into two separate sections
3. Remove the skin surrounding your seed
4. Place the three different seed parts on a paper towel
5. Review the following diagram and identify the seed parts on your seed



### Parts of a Dicot:

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

In your Work Station Group label the parts of the lima bean seed, a dicot.



# MONOCOT DISSECTION WORKSHEET

Name:

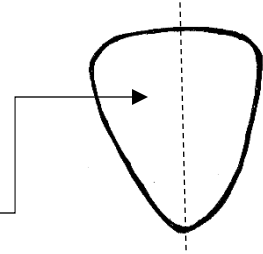
Date:

Make sure your work station has the following supplies:

- Fresh corn seed, 1 per student
- Magnifying glasses, for sharing
- Plastic knife, or dissecting knife
- Paper towels

Complete the following steps to successfully dissect your seed:

1. Select a seed and cut lengthwise down the center
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 Monocot:

Cotyledon	Seed Coat	Embryo
Provides food for the baby plant, or seedling	Also called the bran. Protects the seed from insects, disease, and damage	Also called the germ. Germinates into a baby plant, or seedling

In your Work Station Group label the parts of the corn seed, a monocot.

