

# SESSION THREE

## GERMINATING SEEDS

### PURPOSE

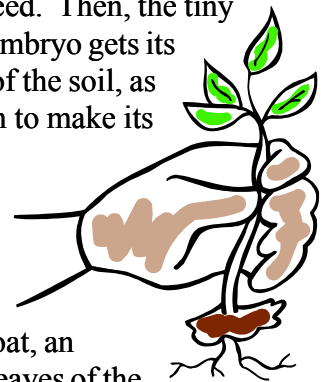
- To understand how seeds germinate
- To develop and use the experimenting techniques of observing, communicating, comparing, relating, and inferring then applying the new knowledge to understand the variables of germinating seeds
- To understand the effects of temperature, moisture, light, and depth of the seed on germination and plant growth.

### BACKGROUND INFORMATION

Every seed contains a tiny plant, stored food and is covered by a seed coat. All three of these parts are important. Without them, a plant could not grow out of the seed. The tiny plant inside the seed is called an embryo. The embryo has roots, a stem and leaves. The stored food in the seed gives the embryo energy to grow. The seed coat is a protective layer that protects it until it is time for the embryo to grow.

Seeds need warmth, moisture and air to grow. When these three things are present in the right amounts, the seed will swell and the embryo will begin to grow. This is called germination. Moisture and warmth soften the seed coat. This makes it easier for the growing embryo to break out of the seed. First, the beginning of the root system will push out of the seed. Then, the tiny stem with buds for the first leaves will appear. During germination, the embryo gets its energy from the stored food. After the stem breaks through the surface of the soil, as the leaves open up to the sun and roots take in water, the plant can begin to make its own food.

There are two basic types of plants and seeds, dicots and monocots. “Mono” means one; these plants start life with one leaf, like a grass. “Di” means two; these plants like beans or radishes, start life with two leaves. Monocot and dicot seeds have three things in common; a seed coat, an embryo or baby plant and a food supply. Cotyledons are the initial seed leaves of the plant. Monocots have one seed leaf and dicots have two. When mature, the leaves of monocots are long and thin (lilies, and grasses like corn, wheat and rice); dicots’ leaves are broad (almost all other plants).



Each plant has its own requirements for germination, which includes availability of water and specific temperatures. For some, it is warm rains or a spring thaw, while others require the intense heat of a

forest fire or a flash flood in a riverbed. To continue growth, all plants have the same requirements. They need air, water, nutrients, light, and an optimal temperature. Different plants like differing amounts of water, different types of soil and grow in different temperature ranges. For example, broccoli grows well in cool temperatures but melons need heat. Strawberries like acidic soil, potatoes don't thrive in it. Too much heat and sunlight will make lettuce taste bitter and go to seed; tomato plants won't make tomatoes if they don't get enough light and warmth.

Seeds do best when planted just deep enough, but not too deep. The tiniest seeds often need just a sprinkling of soil over them. Others need to be an inch underground so the roots are anchored solidly. All seedlings need to stay moist at first. Often seeds are planted close together and then later when plants are up and growing they are thinned to an appropriate density. Plants that are left too close together will compete for moisture and nutrients and stunt



each other's growth.

Some plants do not produce seeds. So, how do we grow these plants without seeds? Taking cuttings from a "mother" plant reproduces some agricultural crops. This is also called plant propagation. Some of the methods include rooting plant cuttings (perennial plants); by runners and rootstocks (i.e. strawberries, Kentucky bluegrass, lily of the Nile, buffalo grass); by stem tubers (i.e. Irish potatoes); by fleshy roots (i.e. sweet potato); by bulbs (i.e. onion sets); and starting plants from leaves (i.e. African Violets, hydrangea). Some trees are also grafted; joining a bud of one species to the rootstock of another species. Grafting is a simple method of insuring plants with desired flowering or fruiting qualities. It is usually done during the dormant season. Budding is another form of grafting but is done during the growing season after new growth has stopped.



# ACTIVITY A: Looking at Lima Beans

**OBJECTIVE:** Participants will explore the parts of a seed . . . embryo, seed coat and food storage.

## MATERIALS YOU WILL NEED

Lima beans- 15 beans per participant or pair  
Plastic bowl- 1 per participant or pair  
Paper towels- 1 roll  
Water – 1 to 2 gallons  
Pitcher- 2  
Magnifying Lens – 1 for each pair  
Paring Knives (*optional*) – 1 for each pair  
*Looking at Lima Beans Worksheet*, one per pair



## GETTING READY

Obtain all necessary materials.

Sample A: Pre-soak lima beans (one per participant) 3-4 days before the activity covered in water Be sure to rinse and change the water daily.

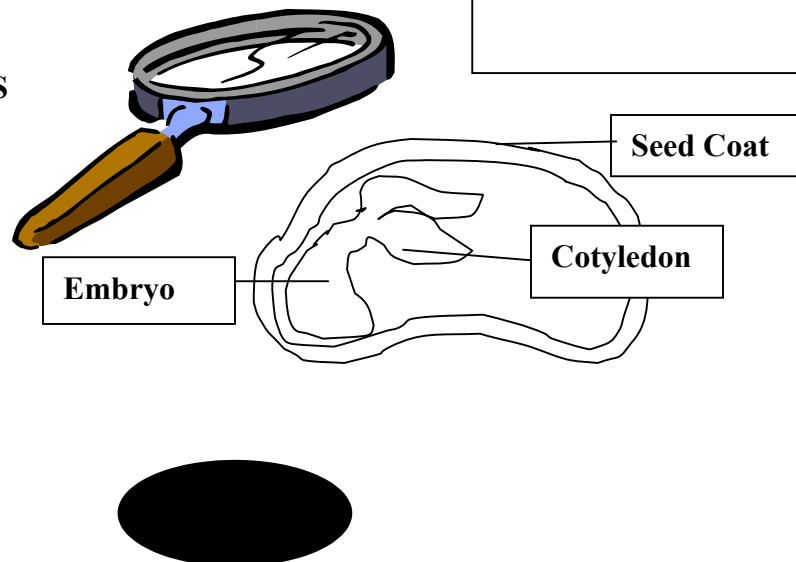
Sample B: Pre-soak more lima beans (one per participant) overnight

### Hint:

*Purchase 1 pound bags of lima beans in the grocery store; they are less expensive than seed packets and they work well for this activity.*

## SUGGESTED GROUPINGS

Individuals or pairs



## **ACTION (Observing, communicating, comparing and inferring)**

### Part 1:

1. Distribute the following for each participant or pair:
  - 1 un-soaked lima bean seed
  - 1 “Sample A” lima bean seed, soaked 3-4 days
  - 1 “Sample B” lima bean seed, soaked overnight
2. Observe and compare the presoaked lima beans and the un-soaked lima bean.
3. Remove the seed coat from all of the three beans. Notice the differences.
4. Carefully split open the three seeds. Notice the differences.
5. Observe the split soaked seeds. Look for the embryo (young) plant inside. Can you find the leaves, roots, and stem?

### Part 2:

1. Give each participant or pair a plastic bowl, paper towels and twelve lima beans, un-soaked.
2. Instruct the participants to fold the paper towel and place it in the bowl. Place the seeds on top of the towel. Add water to moisten the paper towel.
3. Instruct participants to take the bowl of seeds home and care for them. Place the bowl of seeds in a warm sunny location. Keep the towel moist.
4. Tell participants to open one seed each day to observe the new growth and record their observations in pictures or words on the *Looking at Lima Beans Worksheet*.
5. Participants will share their findings at the next meeting.

#### **TIP:**

Seeds will stop growing if they are kept too wet or allowed to dry out.

## **SCIENCING**

### **Observing and communicating:**

- What differences did you observe in the presoaked and un-soaked seeds?
- Were there any differences in the smell? Feel?
- How did seeds soaked overnight compare to the seeds soaked 3-4 days?
- What did you notice about the seed coats on the seeds?
- When you split the seed open, what did you see inside?
- Could you recognize the plant parts?

**Inferring:**

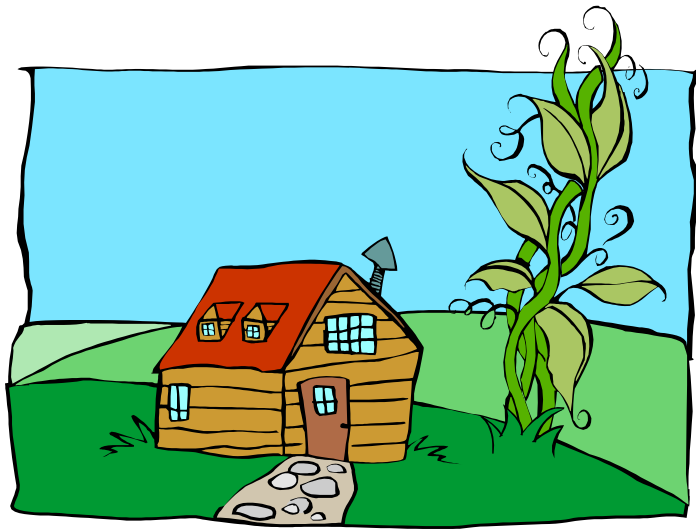
- What do you think the seed coat is for?
- What do you think you will notice each day when you split open a new seed from your bowl?

**Observing and communicating:**

- At the next meeting, discuss the results of this activity.
- Explain what happened to the seeds and young embryo plant each day.

**Communicating and applying:**

- What foods do we eat that are germinated seeds?



## **ACTIVITY A: Looking at Lima Beans Worksheet Part 2**

Draw or describe the lima beans each day. Label the parts.

<b>DAY 1:</b>	<b>DAY 2:</b>	<b>DAY 3:</b>
<b>DAY 4:</b>	<b>DAY 5:</b>	<b>DAY 6:</b>
<b>DAY 7:</b>	<b>DAY 8:</b>	<b>DAY 9:</b>
<b>DAY 10:</b>	<b>DAY 11:</b>	<b>DAY 12:</b>

## ACTIVITY B: It's Simple as 1,2,3 (Soak, Drain and Grow)

**OBJECTIVE:** Participants will grow a crop of “sprouts” to observe and understand the growing needs of plants. We will NOT be eating these sprouts because of food safety issues.

### MATERIALS YOU WILL NEED

Seeds (Untreated), 1/4 cup per person of alfalfa, mung beans, lentils, cabbage, broccoli, radish, or kale  
Clean wide mouth quart canning jar with screw-top ring only - 1 per participant  
Cheesecloth, cut 6” x 6” squares -1 per participant  
Water - 1 cup per participant  
Room thermometer- 1 for large group to share

### GETTING READY

Gather all necessary supplies.

When purchasing seeds for sprouting, be sure to get seeds that have not been treated with a fungicide, insecticide or any other materials. This type of seed is available at health food stores and many supermarkets.

### SUGGESTED GROUPING

Individually

### IMPORTANT!

Do **NOT** eat the homegrown sprouts in this activity!

*Since 1995, raw sprouts have emerged as a significant source of food borne illness in the US. These illnesses have involved the pathogenic bacteria Salmonella and E. coli O157:H7. The best conditions for sprouting are also ideal for multiplication of these pathogenic bacteria. Therefore, the US Food and Drug Administration and the California Department of Health Services have issued warning to consumers that children, elderly, and persons with weakened immune systems should not eat raw sprouts.*

### **ACTION (Observing, communicating, and applying)**

1. Cover the bottom of the jar with the desired amount of seed, generally NOT more than 1/4 cup.
2. Cover the mouth of the jar with cheesecloth and secure with screw-top ring.
3. Soak the seeds for 8-12 hours in a volume of water at least double that of the seeds.
4. After soaking, drain off the water and rinse the seeds.
5. After the rinse water has been drained off, invert the jar and prop it at an angle so the seeds are evenly distributed along the side of the jar.
6. Keep the jar in a dark place, at 68 F degrees to 70 F degrees.
7. Each day observe the seeds. Continue to rinse the seeds two to four times a day until they have sprouted and grown to the desired length. Always be sure that the excess water is drained off the sprouts. Most sprouts will take two to five days to grow to their optimum size.

### **SCIENCING**

#### **Communicating and inferring:**

- Why do the seeds need to be soaked 8-12 hours?  
*(This will soften the seed coat for sprouting.)*

#### **Communicating, observing and inferring:**

- Why is it important to drain the sprouts thoroughly?  
*(If the sprouts remain in the water they could ferment and spoil.)*
- Why should we place the jar at an angle?  
*(By placing the jar at an angle, the sprouts will have good drainage and air circulation.)*

#### **Communicating, relating and inferring:**

- What would happen if you placed the jar in the light?  
*(Sprouts grown a lighted or sunny location will turn green)*
- Why should we NOT eat our sprouts?  
*( This is an ideal environment for bacteria to grow; moist and warm with a food source.)*



Guide to Growing Sprouts – a list of suggested seed and yield.

<b>Seed</b>	<b>Desired sprout length</b>	<b>Average sprouting time</b>	<b>Amount of seeds used</b>	<b>Amount of sprouts produced</b>	<b>Proper sprouting method</b>
<b>Alfalfa</b>	1- 1½ inches	1-2 days	1 cup	2 ½ cups	Soak & Rinse
<b>Bean</b>	½ - 1½ inches	3-5 days	¼ cup	1 ¼	Soak & Rinse
<b>Cabbage, broccoli, kale, brussels sprouts, cauliflower</b>	½ to 1 inch	3-5 days	¼ cup	1 ¼ cups	Soak & Rinse
<b>Lentil</b>	¼ to ½ inch	3-5 days	1 cup	2 cups	Soak & Rinse
<b>Mung Bean</b>	½ to 3 inches	3-8 days	1 cup	4 cups	Soak & Rinse
<b>Radishes</b>	½ to 1 inch	2-4 days	1 Tbsp.	¾ cup	Soak & Rinse
<b>Soybean</b>	¾ to 1 inch	4-6 days	1 cup	3 ½ cups	Soak & Rinse 4-6 times a day
<b>Wheat</b>	Seed length	4-5 days	1 cup	4 cups	Soak & Rinse

## ACTIVITY C: Does Cold, Cool or Warm Make a Difference?

**OBJECTIVE:** Participants will explore at what temperature seeds germinate best.

### MATERIALS THAT YOU WILL NEED

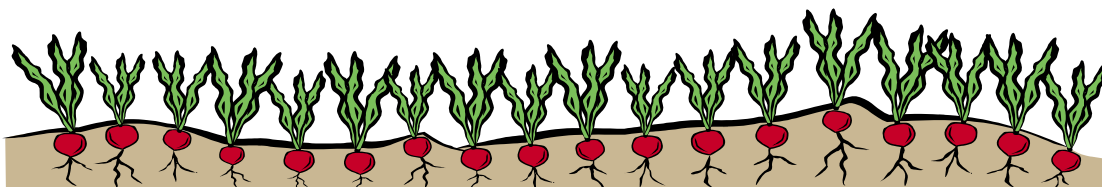
Sponges, 4"x 6", less than 1 inch thick, 3 different colors – 1/3 of a sponge of each color for each participant or group

Water – 1 or 2 gallons

Small waterproof pans or plates, 6"x 6"- 3 for each participant or group

Different types of small seeds, 3 different seeds for each participant  
(i.e. radish, lettuce, broccoli, Brussels sprouts, sesame)

*"Does Cold, Cool or Warm Make a Difference?" Data Sheet*, one per group



### GETTING READY

Cut the sponges in thirds to (4" x 2"). Give each participant three different colors of sponges, 4" x 2" each. Now, cut the sponges again in thirds so there are a total of nine (9) small sponges (2" x 1.25") for each participant or group.

### SUGGESTED GROUPINGS

Individually, if participants will be taking the experiment home to care for. Or one set if the participants will be able to observe what is happening every 1-2 days.

## **ACTION (Communicating, and Organizing)**

1. Wet all sponges, squeeze excess water.
2. Have each participant sprinkle about 10 radish seeds on three sponges of the same color. Do the same with each type of seed. Be sure to keep the same color of sponge for each type of seed. Try to make the seeds go into the holes of the sponges.
3. Place three sponges, one of each color, on a plate and add water to each container to the middle of the depth of the sponge. Do the same for all three colors of sponges.
4. Place one set of sponges in a warm place like a sunny window sill; another in the refrigerator, and the third on a counter where it is not too warm.
5. The sponges can dry out very quickly, particularly if they are in the sun. Poke the sponge every day to see if it is still wet. If it starts to dry out, add water right away.
6. Use the *How Does Cold, Cool or Warm Make a Difference? Data Sheet* to record what happens to the three different types of seeds in the three different locations.

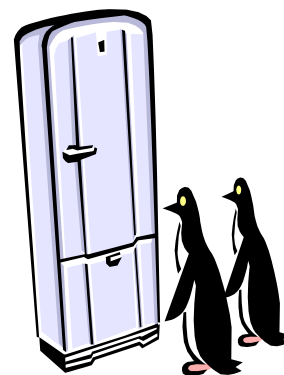
## **SCIENCING**

### **Communicating, organizing and inferring:**

- What do you expect will happen?
- Which seeds do you think will sprout first? Where?
- What did you notice about the environmental conditions in which the seeds were placed? How were they different or similar?
- What did you notice about the rate of germination with your three dishes?

### **Observing and inferring:**

- If the sponge dries out, even for a short time, will this experiment work properly? Why not? (*Being dry even a short time may kill the seed or seedling.*)
- What do you think caused the difference in the rate of germination between the three groups of seeds?
- Is the temperature or light or both that influenced the germination of seeds?



### **Communicating, comparing, relating, and inferring:**

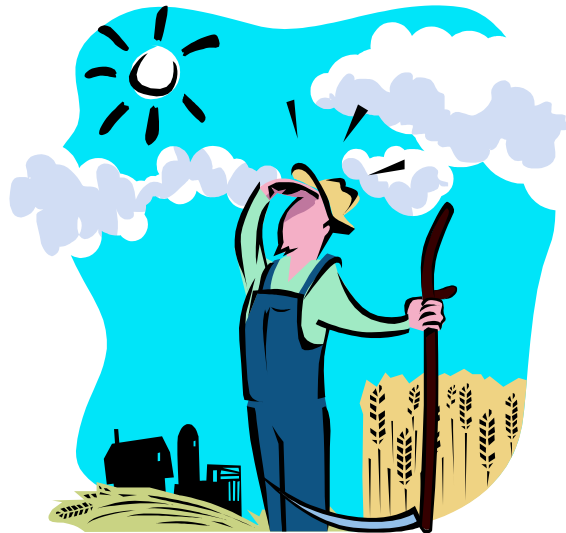
- At the next meeting, share what did happen.
- Did they sprout sooner in a warm growing spot or a cool growing spot?
- Did they sprout in the cold refrigerator?
- Do you think seeds will sprout outside if the weather is cold or there is snow on the ground?
- Do some seeds like different temperatures to sprout?
- Is there a difference between air and soil temperatures?
- How does light affect the seeds germinating?

### **Communicating and applying:**

- What affects does temperature have on a germinating seed?
- How could the change in amount of daylight hours affect the germination rate of plants with respect to temperature?
- How does the weather or climate play a role?
- How does the farmer know when to plant his crop seeds?

### **Applying:**

- What crops are grown in your state or region?
- Why are these crops grown here?
- Is the season and/or weather important to the farmer?
- Does the air temperature affect when the crop will be ready to harvest?



## ACTIVITY C: Does Cold, Cool or Warm Make a Difference? DATA SHEET

Record the results of your experiment in the chart below: Make additional pages, if needed.

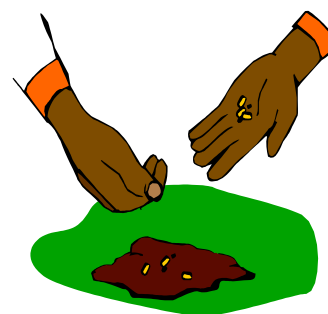
Date of Observation	TYPE OF SEED & Color of Sponge	COLD	COOL	WARM
Date of Observation	TYPE OF SEED & Color of Sponge	COLD	COOL	WARM
Date of Observation	TYPE OF SEED & Color of Sponge	COLD	COOL	WARM

## ACTIVITY D: Can Seeds Be Planted Too Deep To Grow?

**OBJECTIVE:** Participants will experiment how deep seeds can be planted and still germinate.

### MATERIALS YOU WILL NEED

Radish Seeds – 30 to 40 per person  
Bean Seeds - 10 to 12 per person  
Nails – 5 to 6  
8 oz Paper or other planting containers - 8 per participant  
Water – 1 to 2 gallons  
Potting soil – 2 dry quarts  
Permanent marking pens - 4  
Masking tape - 4 rolls  
Pitcher, 2  
“Can Seeds Be Planted Too Deep to Grow?” Data Sheet, one per group



### GETTING READY

Gather all the necessary materials. If using bean seeds, soak overnight. Wet the potting soil so it is evenly moist. Poke several small holes at the bottom of each cup with a pencil.

### SUGGESTED GROUPING

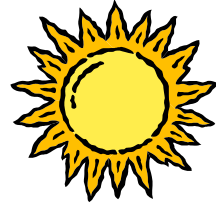
If participants will be taking the experiment home to care for it, do the activity individually. Or one set, if the participants will be able to observe what is happening every 2-3 days for several weeks.



### ACTION (communicating, relating and inferring)

1. Fill two containers with 1 inch of potting soil. Place two bean seeds in one container and sprinkle some radish seeds in the other container. Cover with 3 inches of soil. Label as bean or radish and 3 inches.

2. Fill two more containers with 2 inches of potting soil. Place two bean seeds in one container and sprinkle some radish seeds in the other container. Cover with 2 inches of soil. Label as bean or radish and 2 inches.



3. Fill two more containers with 3 inches of potting soil. Place two bean seeds in one container and sprinkle some radish seeds in the other container. Cover with 1 inch of soil. Label as bean or radish and 1 inch.
4. Fill the last two containers with 4 inches of potting soil. Place two bean seeds  $\frac{1}{4}$  inch deep in one container and sprinkle some radish seeds in the other container and lightly cover with soil. Label as bean or radish and 0 inches.
5. Add  $\frac{1}{4}$  cup of water to each container.
4. Place all containers in a sunny, warm place. Do not let the containers dry out.
7. Keep a record of how the seeds grow.

## SCIENCING

### Communicating, observing and comparing:

- What do you think will happen? Which seeds will grow first?

### Communicating, observing and comparing:

- At the next meeting, share your results.
- Which seed and at what depth started growing first? Second?
- Were there any seeds that do not grow at all?

### Inferring and Relating:

- Why did some seeds not grow?
- Did they sprout and then die? Why?

### Applying:

- Think about other seeds.
- Does the size of the seed make a difference on how deep you plant it?
- What will happen if the seed is planted too shallow? Too deep?
- How does a farmer know how deep to plant his seeds?



## ACTIVITY D: Can Seeds Be Planted Too Deep To Grow? Data Sheet

Record the results of your experiment in the chart below: Make additional pages, if needed.

<b>Date of Observation</b>	<b>Type of Seed</b>	<b>0" or ¼" Depth</b>	<b>1" Depth</b>	<b>2" Depth</b>	<b>3" Depth</b>
	<b>Beans</b>				
	<b>Radish</b>				
	<b>Beans</b>				
	<b>Radish</b>				
	<b>Beans</b>				
	<b>Radish</b>				
	<b>Beans</b>				
	<b>Radish</b>				
	<b>Beans</b>				
	<b>Radish</b>				