



Kentucky Agriculture &  
Environment in the Classroom, Inc.



# SOYBEAN SCIENCE

Let's Learn About Germination, Plant Life Cycles, and Structures



# All About Soybeans

Soybeans are one of Kentucky's top cash crops because they provide a good source of protein and oil. The beans are often crushed into meal for livestock feed, and the oil can be used in many ways. Soybeans are also important for crop rotation since they are a legume and can fix their own nitrogen. This reduces the amount of fertilizers that need to be applied to the soil.

## History

Soybeans originally came from China, where they had been grown for thousands of years. Americans began growing them in the mid-1800s, and they are now grown across the United States, as well as the world.

## Soybeans in Kentucky

Some Kentucky farmers plant soybeans in May and harvest them in September. If they have a crop of winter wheat or other cool-season grain, however, farmers will harvest the wheat in June and immediately plant soybeans in the same fields. Harvest is delayed until October or November, but this allows farmers to grow two crops in one year on the same land. The practice is called double-cropping. Once soybeans are harvested, they may be sold to a soybean processing plant or a grain elevator that will transport the soybeans to where they are needed. Many of Kentucky's soybeans are exported and shipped around the world to feed people and livestock.



## Soybean Uses

The soybean is high in oil (20 percent) and is the only bean that is considered a complete protein (40 percent) containing all the essential amino acids. This nutrition factor makes it a healthy choice for both humans and animals.

Whole soybeans can also be processed into soy milk, soy sauce, soy flour, tofu, tempeh, and miso. If the oil is extracted for food and industrial uses, the remaining protein, fiber, and carbohydrates are processed into soybean meal. Most U.S. soybean meal is used to feed livestock. Poultry consume the most soybean meal in Kentucky, but it is also fed to pigs, beef cattle, dairy cattle, horses, and fish, among other animals.

Soybean oil is one of the leading vegetable oils used worldwide and can be found in many American food products:

- Coffee Creamers
- Bakery Products
- Cooking Oils, Shortenings, and Sprays
- Candies
- Margarine
- Chocolate Coatings
- Mayonnaise and Salad Dressings

Soybean oil is also used to make soy lecithin, which makes chocolate and other foods smooth and creamy.

Renewable soybeans are also used in many industrial products such as biodiesel fuel, particle board, soaps and cosmetics, printing inks, and protective coatings on CDs and DVDs.



# Let's Sprout a Soybean!

## Seed Germination Adaptations provided for Grades K-3

### Students will:

- Use observations to describe what a seed needs to germinate, and what a plant needs to survive.
- Make observations to connect a soybean seed to the plant that grows from the seed.
- Plan and conduct an investigation to determine if plants need sunlight and water to grow.
- Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- Be introduced to the process of photosynthesis.
- Develop models to describe that a soybean has a unique and diverse life cycle.

### Kentucky Academic Standards Connections - NGSS

- K-LS1-1
- 1-LS3-1
- 2-LS2-1
- 3-LS1-1 & 3-LS4-3
- Engineering and Design

### Why is this important?

Plants provide our primary source of energy, so it is imperative that we understand how plants reproduce and grow. This knowledge will ensure that we always have food.

### Resources & Materials Needed

Located at [www.teachkyag.org/lessons/soybeanscience-k-3](http://www.teachkyag.org/lessons/soybeanscience-k-3)

- Digital Google Slide Presentations
- Soybean Germination Kit - Included with this guide
- Soybean Worksheets – Several options depending on grade level
- Optional Resources:
  - ❖ Kentucky Farms Feed Me Virtual Field Trip to a Soybean Farm
  - ❖ Soy-The Miracle Bean informational poster
  - ❖ Soybean Facts
  - ❖ Soybean Ag Mag
  - ❖ *Full of Beans: Henry Ford Grows a Car*

*This lesson was developed by Farm Scholar, LLC for Kentucky Agriculture in the Classroom.*



## Why use soybeans?

**They germinate quickly! In the right conditions, we have seen the root shoot appear within a few hours.**

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# Kindergarten/1st Grade

## Kentucky Academic Standards

### NGSS

K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.

1. Structure, Function, and Information Processing

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.



The **Kentucky Farms Feed Me Virtual Field Trip Series** includes a video field trip to a soybean farm, but it is also a great collection to teach concepts in Primary Careers Studies and Social Studies.

See all the field trips at [www.kyfarmsfeedme.org](http://www.kyfarmsfeedme.org).

### Procedures:

1. Use the **Let's Sprout a Soybean Google Slide Presentation** - link available at [www.teachkyag.org/lessons/soybeanscience-k-3](http://www.teachkyag.org/lessons/soybeanscience-k-3).
2. Interest approach: Show the students the photo of the soybeans and ask if they know what they are called?
3. Using the next slide, explain that they are soybean seeds, and they will grow into new plants that will make more soybean seeds.
4. The following slide provides a few photos of how soybeans are used. Most of Kentucky's soybeans are fed to animals or are exported (travelling on the Ohio River to the Mississippi River).
5. Show the students the **Kentucky Farms Feed Me Soybean Farm virtual field trip video** and allow them to color the included soybean coloring sheet or the page in their passport booklet. You can request the booklets at <https://www.teachkyag.org/passport>.
6. With assistance, walk students through the steps of making their germination greenhouses.
7. Explain that a seed contains a tiny plant waiting for the right amount of water, temperature, and space to sprout and grow.
8. Provide students with **materials** to create their soybean seed germination greenhouse:
  - Plastic zip-top bag with a hole if you would like them to wear their necklace
  - 2-4 sheets of paper towel to hold moisture
  - Soybean seed
  - Sun – represents warmth
  - Confetti – represents nutrients
  - Water in a spray bottle
9. As you hand each component, explain its purpose using the presentation:
  - **Paper Towel = Soil** – the seed needs an environment to sprout and to hold on to its roots.
  - **Seed** – contains the tiny plant
  - **Sun = Warmth** – the environment needs to be the right temperature. The sun warms the soil to a temperature that tells the seed it can germinate. NOTE: a soybean will not germinate below 54 degrees F.
  - **Confetti = Nutrients** – just like we need food and vitamins to be healthy, the seed also needs food and vitamins to grow well. The seed provides a food source for the tiny plant until it can

produce its own food (glucose) through photosynthesis. Other nutrients such as nitrogen, phosphorus, and potassium can be found in the soil and water.

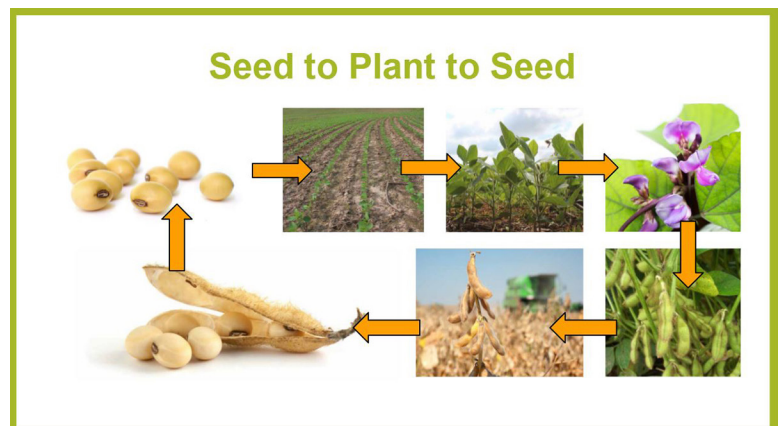
- **Water** – all living things need water to live. The moisture enters the seed and triggers it to start growing (if all other factors are present). You may want to assign an adult to add the water. A spray bottle or mister is ideal, and the towel only needs to be damp. Too much water will not give positive results; 2-4 sprays is usually sufficient.
- **Breath = Air** – you may ask them to blow into the bag to provide air. While carbon dioxide is not needed for germination, the soybean seed does need space and air, just like we do.

10. Once the students have added all the components, help them seal the bags and write their names (labels could also be used).
11. We suggest that you collect the seeds and put them a dark place to allow them to germinate. Little hands tend to fiddle with the seeds, and they may damage them.
12. Bring a few greenhouses out every few hours to track their process. If you complete this activity in the morning, you may see that the seeds have swelled, and the root shoot is popping out of the seed coat by the end of the school day.
13. Once you have a sprout with roots and leaves, use the string to tie to the bag and make a necklace. They can wear their soybean sprouts home.
14. Discuss again what the seed needed to germinate.

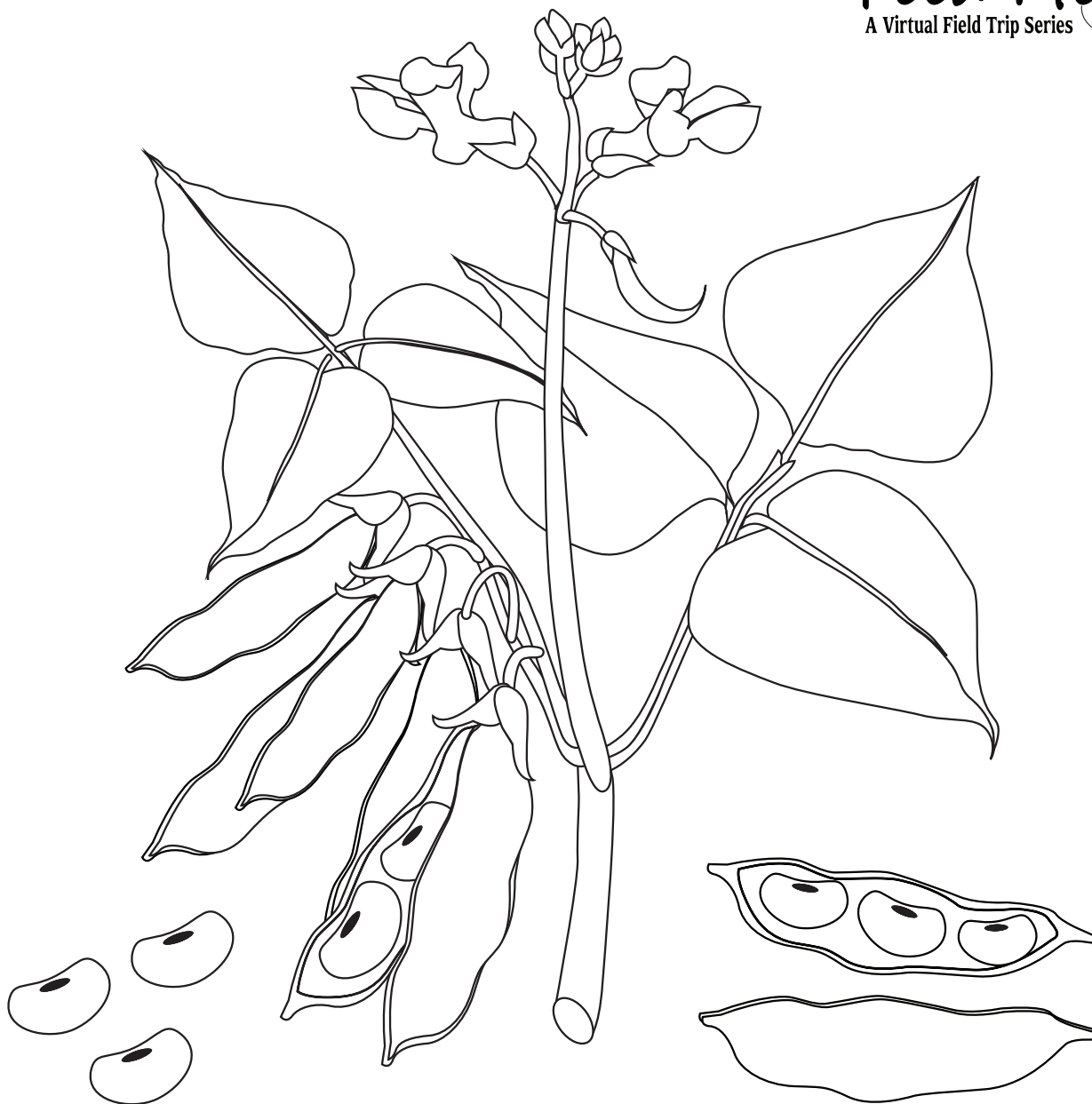
**Not all seeds will germinate.  
You may want to make a few extra greenhouse necklaces in case a student's seed does not sprout.**

### 1st Grade Extensions:

- At the conclusion of the activity, and each student has a sprout, ask them to compare their sprout to pictures of more mature soybean plants (in the digital presentation). Can they see where the new seeds form on the plants?
- Bring in other seeds and photos of the plants/fruits in which they belong and have students match them up. Test Your Seed Sense is ready for you to use - <https://www.teachkyag.org/resources/test-your-seed-sense>.



# Visit a Kentucky Soybean Farm



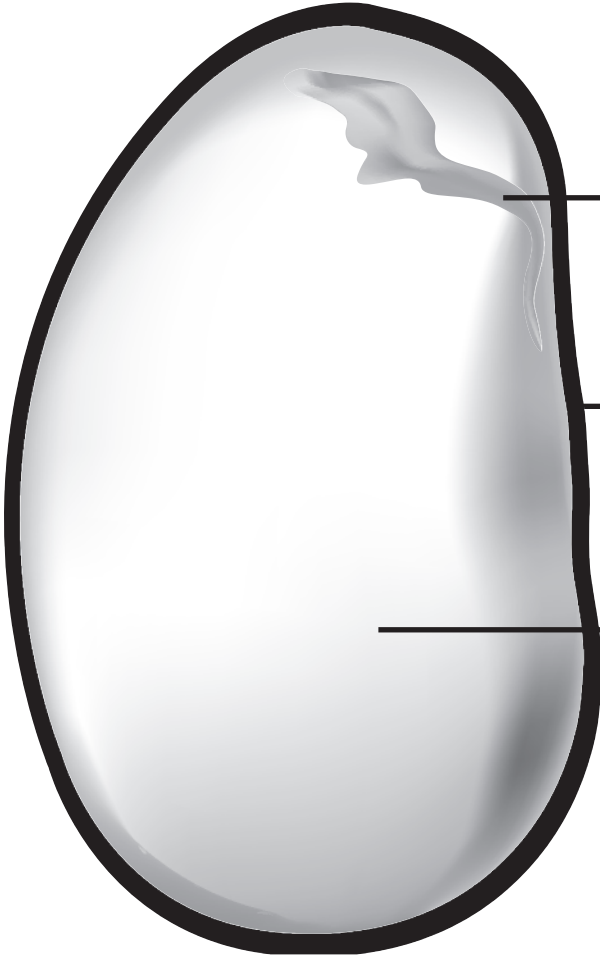
**Soybeans are an important crop in Kentucky. They are fed to animals and used for food and cooking oils. They are also made into crayons and hundreds of products we use every day.**



Kentucky Agriculture &  
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Worksheet - Primary

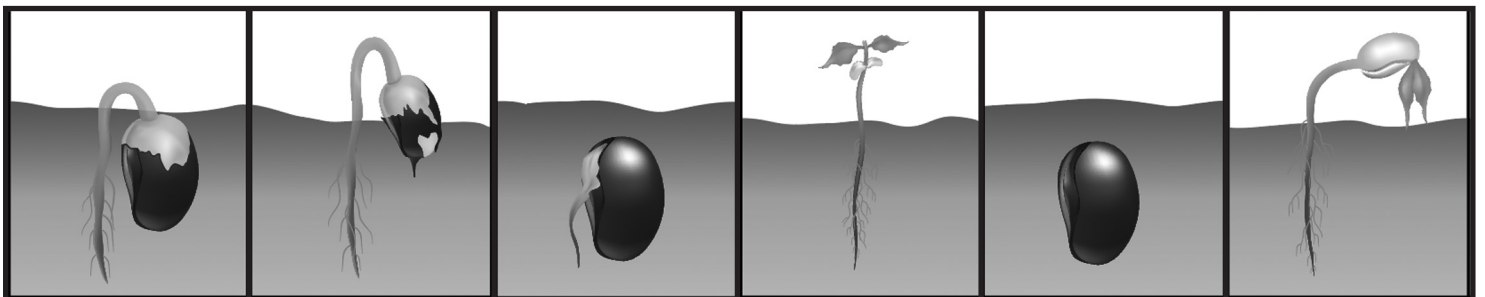
# Parts of a Seed

Use the word bank below to label the parts of the seed.



**food source      seed coat**  
**plant embryo**

Write the correct order number, from 1 to 6, under the seed germination pictures below, or cut them out and glue them in order on another sheet of paper.



# 2nd & 3rd Grade

## Procedures:

1. Use the **Soybean Science Google Slide Presentation**—link available at [www.teachkyag.org/lessons/soybeanscience-k-3](http://www.teachkyag.org/lessons/soybeanscience-k-3)—and provide students with a copy of the **Soybean Science Lab Worksheet**.
2. Have students watch the Kentucky Farms Feed Me **Visit a Soybean Farm virtual field trip** and discuss what needs to happen for the soybeans to grow. Have them listen for when Mr. Alexander says he plants his soybeans. Why spring? How do farmers know when and where (3rd grade extension) to plant their seeds? The soil is warm enough (at least 54 degrees) and days are longer – more sunlight. Spring is also a time of the year that it is more likely to rain, which will activate the seeds to grow. Then the soybeans will need regular rainfall. Very few soybean fields are irrigated in Kentucky.
3. If you want to introduce other components of an ecosystem, you could briefly mention soil and climate. Show them the different images of plant habitats and ask if they believe the soybeans will grow. Why or why not? Much of Kentucky’s land (last photo in presentation) and climate are good for growing soybeans. You will see very little soybean production in eastern Kentucky, however, since most of the land is covered in forest, and it is too steep on the hills and mountains to use the large machinery.



4. Then ask students if they remember what seeds need to germinate and plants need to grow? Go through the presentation slides on what is needed to germinate a seed.
5. Ask students how they will conduct an experiment to investigate if plants need sunlight and water to grow. Discuss their answers.
6. Complete the germination activity (see K/1 lesson) but change the components to determine what the seed needs to germinate, i.e. some students do not add water or some students place their seed in a dark location. It has been our experience that the soybean seeds tend to germinate more quickly in a dark location – mimicking being under the soil. It is also possible that the seeds

## Kentucky Academic Standards


### NGSS

2. Interdependent Relationships in Ecosystems  
2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.

3. Interdependent Relationships in Ecosystems  
3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.







3. Inheritance and Variation of Traits: Life Cycles and Traits  
3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

## Bonus Worksheet on Page 12



### Soybean Germination

Write a description of what is happening in each step of the soybean germination process.

<b>1</b> 	<b>2</b> 
<b>3</b> 	<b>4</b> 
<b>5</b> 	<b>6</b> 

Name two things that a seed needs to germinate?  
\_\_\_\_\_

An answer key is available on our website.



get too warm in the window, and they won't germinate. Once the beans have sprouted, you could move a portion to a sunlit area.

7. Students should set up their data table in the following way to test if plants need sunlight and water. WATER: We recommend using a spray bottle and keeping the number of sprays consistent for 2nd grade students (2-4 sprays depending on the water flow – the towel should be damp, not saturated).

### Let's Experiment

Factor 1	Factor 2	Will It Grow?	Result
Water	Sunlight		
Water	No Sunlight		
No Water	Sunlight		
No Water	No Sunlight		

### More 3rd Grade Extensions:

Ask 3rd grade students to think about other factors they could test. Our suggestion is **temperature** and the amount of **water** since they should understand that seeds need water to germinate, and sunlight is needed following germination.

1. Place students into one of three groups: School temperature (about 70 degrees), outside temperature (use a thermometer or check local forecasts and keep in mind that the temperature will fluctuate), and cold (refrigerator – about 40 degrees). Temperature is your first factor. See **“How to Use a Thermometer”** at <https://www.kyreadysetgrow.org/curriculum/how-to-use-a-thermometer> if your students need help.
2. Each group will test the second factor, the amount of water. Be sure that individual students vary the amount of water (# of sprays or teaspoons) in their germination greenhouses and record the amount on the bag. Be sure one student uses very little water, and at least one other student in the group saturates their seed too much.
3. Allow students to observe the plants every day for a week and record notes in their science journals.
4. Discuss the results of the investigation and have them complete their worksheets. Explain that this experiment could be conducted for different types of seeds and they could get different results for each.

Name

# Soybean Science Lab Worksheet 2

While watching the Kentucky Farms Feed Me Virtual Field Trip on Soybeans, listen for when Mr. Alexander says he plants the soybeans. **They plant their early soybeans in \_\_\_\_\_ and their double-cropped soybeans in \_\_\_\_\_ after they harvest the wheat.**

How do farmers know when and where to plant their seeds? Are there certain locations that grow soybeans better than others? Plan an investigation that will tell the farmer if sunlight and water are needed to grow soybeans.

### Let's Experiment:

Factor 1	Factor 2	Will it grow?	Result

Based on your observations, explain what is needed to grow soybeans?

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Should Mr. Alexander plant his soybeans under a shady tree? Use evidence to explain why or why not?

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What would happen if it didn't rain on Mr. Alexander's farm? Can you think of a solution that would help Mr. Alexander? \_\_\_\_\_

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Name

## Science Lab Worksheet 3

While watching the Kentucky Farms Feed Me Virtual Field Trip on Soybeans, listen for when Mr. Alexander says he plants the soybeans. **They plant their early soybeans in \_\_\_\_\_ and their double-cropped soybeans in \_\_\_\_\_ after they harvest the wheat.**

How do farmers know when and where to plant their seeds? What factors are important to consider before planting? Conduct an experiment that will tell Mr. Alexander the correct temperature and amount of water that is needed to germinate his soybean seeds.

### Let's Experiment:

Temperature	Amount of Water	Will it sprout?	Result

Based on your experiment, what time of the year would you tell Mr. Alexander to plant his soybean seeds. Use evidence.

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Could you tell Mr. Alexander how much water is needed to germinate the soybean? What amount was not enough? What amount was too much?

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What other factors in the environment could you test?

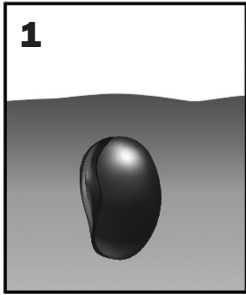
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# Soybean Germination

Write a description of what is happening in each step of the soybean germination process.



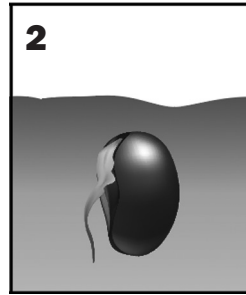
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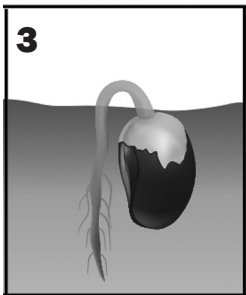
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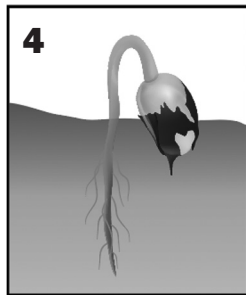
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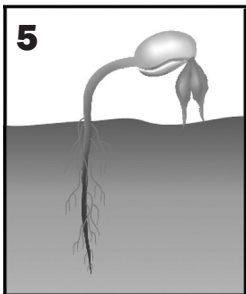
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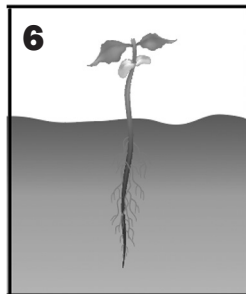
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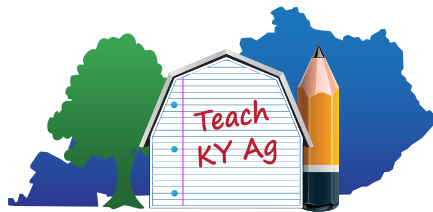
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Name two things that a seed needs to germinate?

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