

Science
Life Science
Grade 4
Seeds

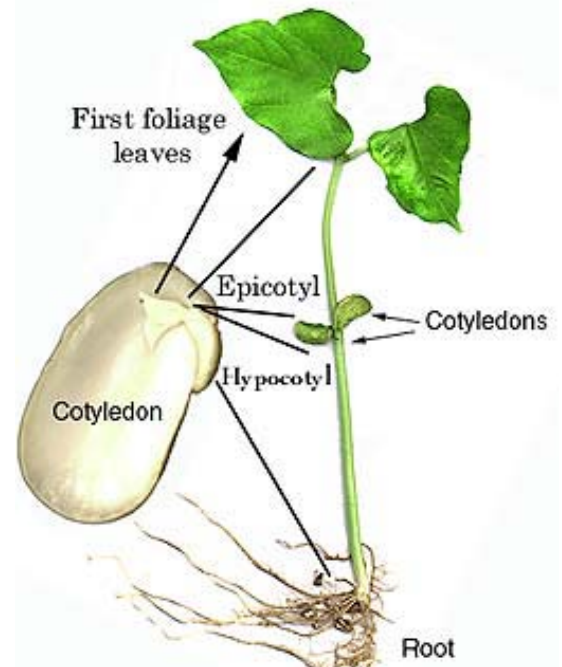
Overview (For the teacher)

Part 1

Seeds have a variety of parts that serve specific functions. The plant embryo actually occupies only a fraction of the volume of the total seed. Most of seed volume is composed of stored food. Students will discover this fact by separating the seed cotyledons leaving the plant embryo on only one cotyledon. Students will observe the embryo grow into a plant and will conclude that the cotyledon by itself does not contain the right material to produce a new plant.

Part 2

The life science content presented in this lesson is deliberately simple in order to allow students to focus on the experimental design. An experiment starts with a testable question. There are an infinite number of questions that can be asked about the natural world, but not all are testable. For instance, can the sky turn green? If a question is not testable, there is no way to find out if it is true.



Early Development of the Plant Body
http://www.wisc.edu/botit/Botany_130/Anatomy/seed_seedling.html

There must be a reliable method to evaluate the results of a test so you can be sure of the information gained from an investigation. Measurement is an important feature of the scientific process. Numbers are an unambiguous method of describing observations. Word descriptions, on the other hand, can have many shades of meaning. If an observation is made that an object turned blue, the description is ambiguous. The word “blue” has multiple meanings. You can feel blue or you can turn blue.

On the other hand, if the same object is described as increasing 2.0 cm. in length, there are no other meanings for the description of 2.0 cm. Numbers are a very important method of describing the results of scientific investigations because their meaning is exact.

An experiment is constructed in such a way that leaves no room for doubt about the conclusion. For example, you think light makes plants grow, so you grow plants in light and compare them to plants grown without light, while leaving **all other conditions constant**. The comparison allows certainty in the conclusion.

The factor (like light) causing an effect is the **independent (experimental) variable** and it is usually plotted on the **x-axis**. The effect (like plant growth) that the independent variable has on the organism or object is the **dependent variable(s)**. This variable is usually plotted on the **y-axis**. Graphs present measurements of the results of a test in an easy-to-read format.

Resources

What are the Parts of a Seed?

<http://www.urbanext.uiuc.edu/gpe/case3/c3m2.html>

Early Development of the Plant Body

http://www.wisc.edu/botit/Botany_130/Anatomy/seed_seedling.html

The Great Plant Escape

Detective LePlant guides students through the information they need about plants and the part they play in our lives. In six multi-disciplinary lessons, plants, dirt, flowers, and bulbs are the center of attention. A teachers' guide integrates the lessons and online quizzes with other classroom ideas.

<http://www.urbanext.uiuc.edu/gpe/>

Benchmarks

- SI-E-A2** Planning and/or designing and conducting a scientific investigation
- SI-E-A3** Communicating that observations are made with one's senses
- SI-E-A7** Utilizing safety procedures during experiments
- LS-E-A3** Locating and comparing major plant and animal structures and their functions
- LS-E-B1** Observing and describing the life cycles of some plants and animals

Teacher Preparation

1. Buy dried lima beans from the grocery store. Check the date on the package to get the freshest beans.
2. Soak the beans overnight until the seed coats slide off easily. If you detect a foul odor, discard the beans and start over.
3. If the beans will not germinate, you either have old beans or a fungus. If you suspect fungus, prepare a 10% solution of household bleach. **Rinse** the dried beans in the bleach solution and then rinse the beans in tap water to remove the bleach.

****Do not soak the beans in bleach and do not use the bleach solution in class.***

4. Students may have trouble separating the seed halves without damaging the plant embryo. Make sure you have extra hydrated seeds on hand.
5. If you are in a classroom without running water, you can store and use water necessary for the activity in clean 2 liter plastic bottles.
6. Assemble all the materials in a central location.

Open Day 1

Class Discussion- 20 minutes

To the teacher: Each student will need a piece of paper and pencil. Group students in pairs. Ask the following questions to each pair of students in turn.

1. Where do new plants come from?
[Seeds]

2. What is in a seed?

Teacher Direction: Give each student a soaked lima bean to take apart. Following students' answers, suggest to them that they will discover the accurate answer to this question as they investigate in class.

3. Is the whole seed a small plant ready to grow or are there different parts to a seed?

Teacher Direction: Allow as many students to answer the question as possible. Write the responses on the board. As a class, agree on one best guess.

[Answers may vary. For example, the whole seed is a baby plant. Do not tell students the correct answer.]

4. The teacher should now hold up the large picture of the cotyledon located at the end of the activity.

5. Ask the following: Can you find this part of the seed? Can you find any other seed parts?

Teacher Directions: Make sure students see the plant embryo attached to the cotyledon, but do not explain its function. You may have to hold up the picture of the cotyledon with embryo located at the end of the activity to stimulate the discovery. *[Answers may vary. Do not tell students the correct answer.]*

2. Why is important to wash your hands after the lab activity?

[It is important to wash your hands after a lab activity to make sure that your hands are free of any hazardous substances.]

3. Why is it important to clean your work area after the lab activity?

[It is important to clean the work are after a lab activity to make sure that the work area is free of any hazardous substances.]

Activity- 15 Minutes

To the teacher: At the end of the activity, direct students to place their Ziploc bags in a location that gets *indirect* light. Lay the bags flat and do not stack. Have students put their names on their handout and collect them so they can be redistributed for the data collection in 3 to 4 days. If you begin the activity on Friday, you can collect data on Monday.

Close

Journal Entry- 10 Minutes

Ask students to keep a science journal. Use student entries to plan future lessons. At the end of the class period ask students to enter the responses to these prompts into their journals:

1. What did you learn today?
2. What questions would you like to ask about the lesson?
3. What would you like to know more about?

Open Day 2

Class Discussion- 15 minutes

To the teacher: Introduce the activity with the following discussion.

1. What have we done to the seeds?
[We split the seed parts, sorted the parts, wrapped two different groups of seed parts in wet paper towel and slipped in a Ziploc bags.]
2. What are we trying to find out?
[We are trying to see which seed parts will germinate.]

Body of the Lesson

To the teacher: Students should be assembled into pairs. Distribute the activity handout, *Seed Graphing*. Introduce the activity with the following discussion.

1. What are you going to do with the seeds next?
(Exclude the first day setup this time.) Look at the handout to answer.
[Let students call out the step-by-step procedure written in the activity.]
2. What are we going to do with our hands and work area when we finish?
[Wash and clean up.]

Data Collection- 15 Minutes

To the teacher: The germinated seeds can either be discarded or grown in plastic cups. You can use shredded paper towels instead of soil to cut down on the mess. Students can design another investigation using the plants.

Data Analysis- 25 Minutes

Read each *Data Analysis* question to the class. Call on each student pair in turn for the answers. Students may write the answers to the questions on their handouts during the discussion. (Student Sheets: pages 61 – 67)

1. What were you testing in this activity?
[the function of seed parts]
2. What happened?
[We separated the seeds and put them in wet paper towels in a plastic bag to see which seed part will grow into a new plant. The seed halves with the extra structure grew into new plants. The smooth seed halves turned green but did not grow.]
3. How do you know what part of the seed part grew into the new plant?
[You can compare the smooth seed half group with seed halves with the extra structure to see which seed part grew into a new plant.]

4. A test of a “guess” is called an experiment. An experiment should include a control group and an experimental group. The experimental group is the test of your guess. Describe your experimental group.

[Answers may vary depending upon the hypothesis. Students may be testing the guess that the extra structure will grow into the new plant. In that case the group of seed halves with the extra structure is the experimental group.]

5. The control group is used to compare to the outcome of the test so you are sure what is responsible for what happened in the test. Describe your control group.

[Answers may vary depending upon the hypothesis. Students may be testing the guess that the extra structure will grow into the new plant. In that case the group of smooth seed halves is the control group.]

6. Write the hypothesis for the experiment. Fill in the blanks below.

Key → The seed part with extra structure will grow into a new plant .
Tested Variable Outcome

Teacher Direction: Refer students to the hypothesis they gave you on the first day of the lab activity. It should be on the board.

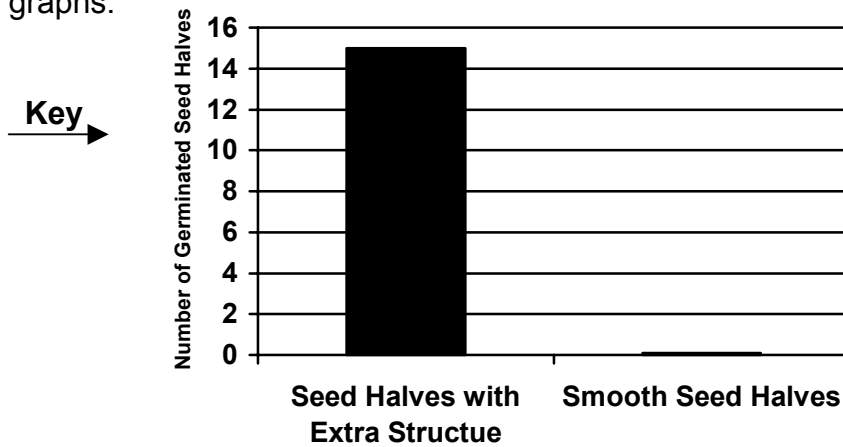
7. Fill in the data table from the information contained in the description of the experiment.

Key

Ziploc Bag Contents	Number of Germinated Seeds	Color of Halves
Smooth Seed Halves	0	<i>White</i>
Seed Halves with Extra Structure	10	<i>Green</i>

8. A bar graph shows comparisons. Label the x-axis where you intend to draw a bar for the control and experimental groups. Hold up your papers and show your labels. *[x-axis: Smooth Seed Halves, Seed Halves with Extra Structure]*

9. Use the data in table to draw a bar to the correct height on the graph for the experimental group and the control group. Hold up your papers and show your graphs.



10. According to the data, is the hypothesis proven? What evidence supports your statement?

[Answers may vary depending upon the hypothesis. Students may be testing the guess that the extra structure will grow into the new plant. In that case: No the hypothesis is not supported. Seed halves with the extra structure all grew new plants, but the smooth seed halves did not grow new plants.]

* *Students may hypothesize that the seed halves with the extra structure grew plants.*

Close

Journal Entry - 10 Minutes

Ask students to keep a science journal. Use student entries to plan future lessons. At the end of the class period ask students to enter the responses to these prompts into their journals:

1. What did you learn today?
2. What questions would you like to ask about the lesson?
3. What would you like to know more about?

Key: **Assessment** (page 68)

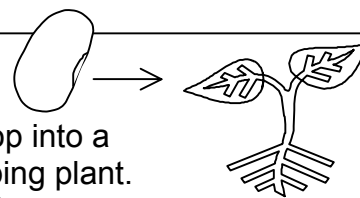
Quiz- 10 Minutes

1. B
2. C
3. Rejected; the plants grown in green light have an average length of 22 cm, and the plants grown in sunlight had an average length of 45 cm.
4. When you grow seed parts, only one part will grow into a new plant. The largest part of the seed does not make the new plant.

Activity Sheets

SEED GRAPHING

The Experiment



Seeds are made of different parts. One part of the seed will develop into a new plant. Other parts of the seed are used to nourish the developing plant. In this experiment you will discover the function of different parts of the seed.

Materials Per Student Group

2 Small Ziploc Bags
15 Dry Lima Bean Seeds
1 Paper Towel
Water (Bottle)
Pan for Waste Water
Colors

Safety

Directions: Use common knowledge to answer the questions.

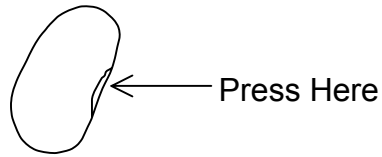
1. Why is important to wash your hands after each lab activity?

2. Why is it important to clean your work area after each lab activity?

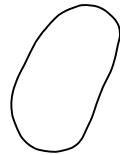
Activity

1. Carefully rub off the seed coat from 15 lima bean seeds that have been soaked overnight. The seed coat should easily rub off if the seed has been soaked long enough.

2. **Gently** press the seed to separate the halves that have an extra structure on one end from the halves that are smooth.



3. Sort the seed halves into two groups. Be very careful not to damage the seed halves. Fifteen of the halves on one paper towel should be **smooth** and 15 of the halves should have an **extra structure** as shown below.

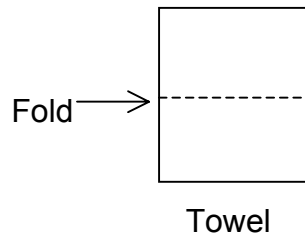


Smooth Seed Halves

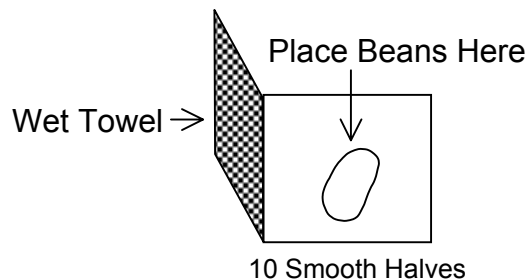
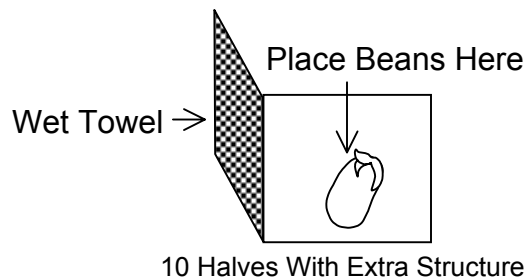


Seed Halves with Extra Structure

4. Fold 2 paper towels into quarters.

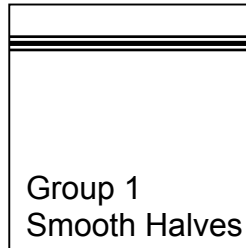


5. Wet each paper towel with water by soaking the towel in water. **Squeeze the paper towel to remove excess water.** (The paper towels should not drip.)
6. Place ten **undamaged** smooth seed halves on a wet paper towel. Arrange the halves so that they do not touch each other.



7. Repeat for the seed halves with the extra structure.

8. Fold the towel so the bean halves are covered.
9. Slip the folded towels with the seeds in separate Ziploc bags. Label each bag as shown below.



10. Store the Ziploc bag in a safe place for 10 days in the light.

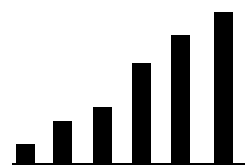
Data Collection

1. Open each bag and record your observations in the table below.

Ziploc Bag Contents	Number of Germinated Seeds	Color of Halves
Smooth Seed Halves		
Seed Halves with Extra Structure		

Data Analysis

Data are observations or measurements that are recorded to assist the experimenter in determining the results of the experiment. Examples: measurements in cm, mass in grams, photographs, or objective descriptions. Analyze your data by answering the questions below.



1. What were you testing in this activity?

2. What happened in the test?

3. How do you know which part of the seed part grew into the plant?

4. A test of a “guess” is called an experiment. An experiment should include a control group and an experimental group. The experimental group is the test of your guess. Describe your experimental group.

5. The control group is used to compare to the outcome of the test so you are sure what is responsible for what happened in the test. Describe your control group.

6. Write the hypothesis for the experiment. Fill in the blanks below.

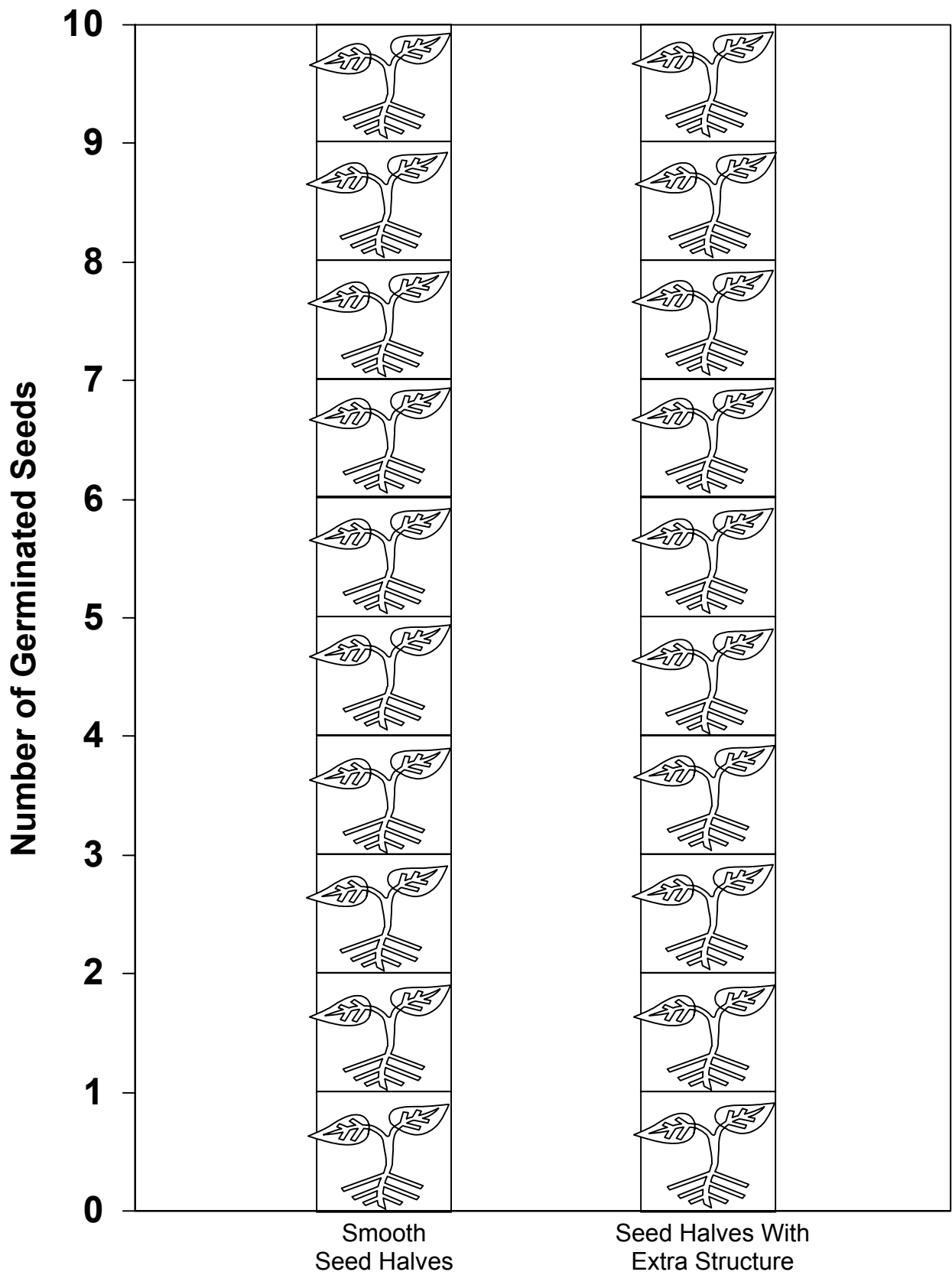
The _____ will cause
Tested Variable
_____.
Outcome

8. Fill in the data table from the information contained in the description of the experiment.

Key

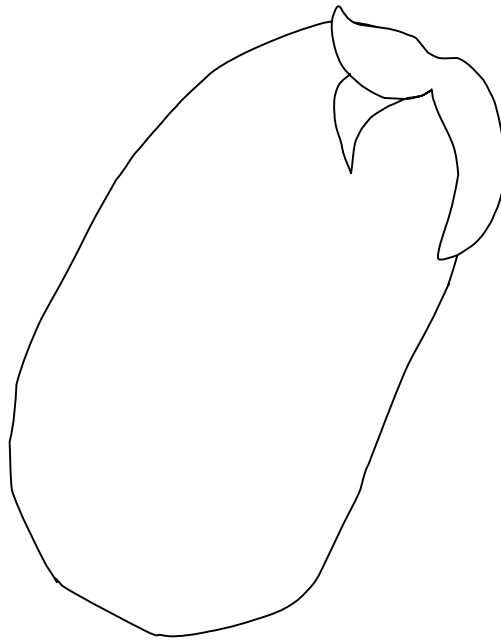
Ziploc Bag Contents	Number of Germinated Seeds	Color of Halves
Smooth Seed Halves	<i>0</i>	<i>White</i>
Seed Halves with Extra Structure	<i>10</i>	<i>Green</i>

8. A bar graph shows comparisons. Label the x-axis where you intend to draw a bar for the control and experimental groups. Hold up your papers and show your labels.
9. Use the data in table to shade in the correct number of plants on the bar graph for the experimental group and the control group. Hold up your papers and show your graphs.



10. According to the data, is the hypothesis proven? What evidence supports your statement?

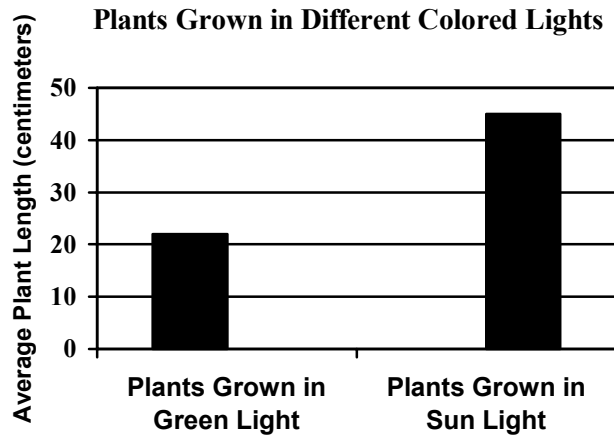
11. Color the part of the seed orange that is not able to develop into a new plant. Color the part of the seed green that is able to develop into a new plant.



12. How did you make the decisions? Use your data to justify your answer.

Seed Graphing Assessment

Directions: Use the graph to answer each question below.

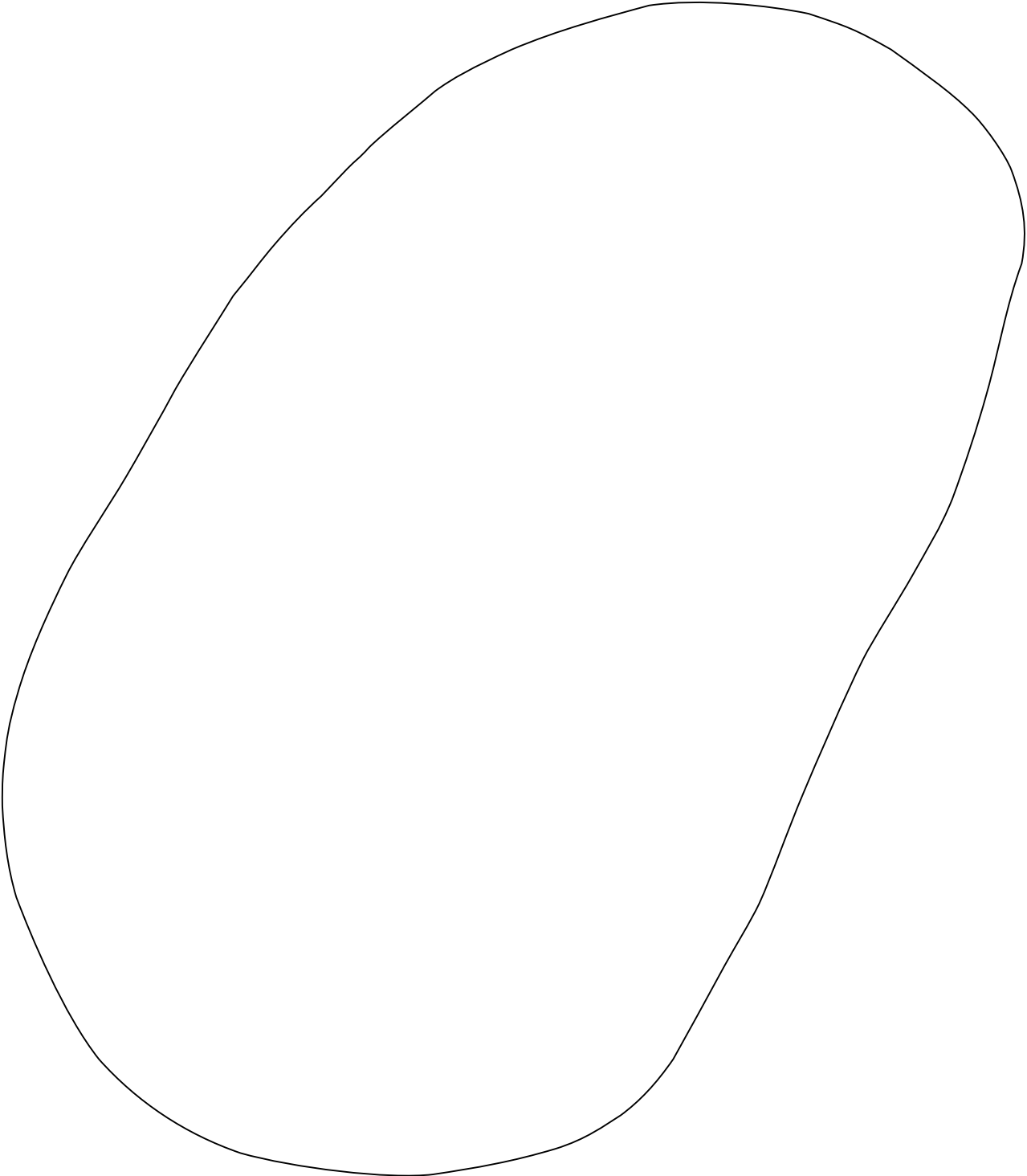


1. What is being tested according to the bar graph above?
 - a) plant length
 - b) effect of different light
 - c) mass of plants
 - d) number of plants
2. What is the average length of plants grown in red light?
 - a) 2 cm
 - b) 20 cm
 - c) 22 cm
 - d) 25 cm
3. According to the data, would the hypothesis below be supported or rejected? Discuss the evidence that supports your statement.

Hypothesis: Plants grown in green light will grow as well as plants grown in sunlight.

4. Do seeds have different parts? If so, are their functions the same? How do you know?

Smooth Seed Halves



Seed Halves with Extra Structure

