# **Bean Seed Germination Experiment Lesson Plan**

This multiday lesson is best suited for students in grades 3-5. Students conduct an experiment in which they will germinate their own bean seeds! During this experiment students will also hypothesize, sketch, and note other observations in an Experiment Guide. This cross-curricular lesson also addresses Common Core Math Standards and includes an opportunity for students to graph the data they collected in the experiment and write about any trends they see. At the end of the experiment, you can encourage your students to take their sprouted bean seeds home with them to grow into full plants!

**Standards:**

**Next Generation Science Standards:**

* **3rd Grade:**
  + **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.
  + **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.
* **4th Grade:**
  + **4-LS1-1** – Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
* **5th Grade:** 
  + **5-LS1-1** – Support an argument that plants get the materials they need for growth chiefly from air and water.

**Common Core State Standards:**

* **3rd Grade:**
  + **CCSS.Math.Content.3.MD.B.3** – Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.
  + **CCSS.Math.Content.3.MD.B.4** – Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units, whole numbers, halves, or quarters.
* **4th Grade:** 
  + **CCSS.Math.Content.4.MD.B.4** – Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots.
* **5th Grade:** 
  + **CCSS.Math.Content.5.MD.B.2** – Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations of fractions for this grade to solve problems involving information presented in line plots.
  + **CCSS.Math.Content.5.G.A.1** – Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., axis and x-coordinate, y-axis, and y-coordinate).
  + **CCSS.Math.Content.5.G.A.2** – Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

**Objectives:**

* Students will be able to sequence and describe the major stages within a plant’s life cycle.
* Students will be able to make and describe scientific observations as well as draw conclusions at the end of an experiment.

**Lesson Duration:** Because this lesson and experiment require multiple days, see the suggested pacing below.

* First Day: Introduction, setting up the experiment, and observing – approximately 45-60 minutes
* Throughout the Experiment: Observing – approximately 15-20 minutes per day
* Final Day: Observing, graphing, and closure – approximately 45-60 minutes

**Materials:**

* The Building Blocks of Animals and Plants series, specifically Plant Life Cycles
* Bean Seed Life Cycle Sequence Activity (2 per student if using as a pre- and post-assessment)
* Bean Seed Experiment Guide (2 double-sided pages per student for a total of 8 observation days)
* Graphing Options:
  + Bean Seed Germination Graphing – Line Plots (recommended for all grades)
  + Bean Seed Germination Graphing – Coordinate Grids (recommended for 5th grade and students with enrichment or extension needs)
* For each experiment:
  + 2-3 navy or lima bean seeds, soaked in water overnight
  + Small plastic zipper storage bag (transparent)
  + Paper towel
  + Water
  + Tape
  + Space in a window, preferably one that faces the sun.

**Requisite Prior Knowledge:**

* Before engaging in this experiment, students should have general knowledge of life cycles. They should understand that all living things, including plants, experience birth, growth, reproduction, and death. Students should also have a basic understanding of plant germination and what seeds need to grow. In addition, students should have experience using a ruler and understand fractional amounts when measuring.
* Students should also have prior experience making observations and taking notes during an experiment. If your students have not had many opportunities to practice these skills, consider modeling more than suggested in the lesson plan. If your students are more independent with these skills, consider using less modeling and giving students more responsibility in their experiment and learning.

**Assessments:**

* Bean Seed Life Cycle Sequence Activity (can be used as a pre- and post-assessment)
* The Bean Seed Germination Experiment Guide
* Bean Seed Germination Graphing (Line Plot, Coordinate Grid, or both)

**Vocabulary:**

* Germination – the process through which a seed sprouts and a plant begins to grow
* Life Cycle – the stages that a living thing goes through as it develops
* Seedling – a young plant

**Differentiation Considerations:**

* Consider your students’ math abilities and needs before determining which graphing activity is most appropriate for them. Two graphing activities have been provided. The Line Plot activity focuses on class data whereas the Coordinate Grid activity involves analyzing one’s own data and experiment.
* Consider extending students’ thinking by posing the following: We’ve seen what happens when we placed all the bean seeds in the sunny window. What might happen if we place them elsewhere? What else could we change about the way we conducted our experiment in order to learn more about our bean seeds or how they germinate?

**Lesson and Instruction:**

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| **Lesson Components and Time Guidelines** | **Teacher Actions** | **Notes** |
| **Introduction/Hook**  \*Pre-assessment opportunity  Approximately 10-15 minutes | Provide students with the Bean Seed Life Cycle Sequence Activity. This can be used as a pre-assessment if you would like! Have students use their background knowledge to order the cycle as best they can and draw sketches to match each stage. It is more than alright if students make mistakes here! We will revisit this sequence throughout the multi-day lesson.  After students have had time to work, discuss students’ life cycles and any strategies students used to help them complete the sequence activity. |  |
| **Direct Instruction and Modeling**  **First Day:**  Approximately 20-25 minutes  **Throughout the Experiment:**  Approximately 15-20 minutes per day, depending on how detailed students are in their observations and sketches  **Final Day:**  Approximately 20-25 minutes | Explain to students that they will follow a series of steps to set up their experiments. Each day they will use their Experiment Guide to sketch what they observe as well as record any observations about their seeds and life cycles. Describe each aspect of the guide and model how to complete observations as needed. Highlight the fact that we will be observing and taking notes on the height of our sprouts so we will need to practice/review our measuring skills.  **First Day: Setting up the Experiment**  -Provide the appropriate materials for each group and model how to wet your paper towel and fold it so it fits inside your zipper baggie.  -Model how to situate your bean seeds so they are about 2-3 centimeters apart and not sitting in any water. They should be pressed against the paper towel. Flatten the baggie and seal it, leaving a small opening near the top so the growing plants can get some air.  -Model how to use the Experiment Guide to sketch what you observe and take notes. Be detailed here so students know they are expected to be detailed as well.  -Transition and allow students time to set up their own experiments, sketch their first picture, make observations, and complete the question in their Experiment Guide.  **Throughout the Experiment**  -Each day, return to the bean seed experiment and make new observations. Sketch what you see, discuss any life cycle changes your bean goes through, and take detailed observation notes. Repeat this process daily until students’ bean seeds have sprouted (approximately 3-5 days) and have grown as seedlings (1-3 days more). Once bean seeds have sprouted, make sure to review how to properly measure the height using a ruler so students can record accurate data.  **Final Day: Connections to Math**  -After your students’ bean seeds have sprouted and you have collected some data as a class, transition to the graphing assignments. Consider using the Line Plot, the Coordinate Grid, or both depending on students’ needs.  LINE PLOT: Determine the maximum height of each students’ seedling and record it in the space provided. Students should list this data from least to greatest. Next, model and/or have students create a line plot to show the most common heights of the seedlings germinated in your class. Finally, model and/or have students answer the questions associated with the graph.  COORDINATE GRID: Have students use the data they gathered throughout their experiment to complete the data table. Remind students that the x-axis should represent time (days) and the y-axis should represent the height. Next, have students label their coordinate grid accordingly and begin to plot their data. Finally, students should transition to the questions associated with the graph. |  |
| **Closure**  Approximately 10-15 minutes | Explain to students that they were able to observe parts of a plant’s life cycle as they germinated their own bean seeds. Now that students have seen this for themselves, they should be ready to complete the post-assessment. Provide students another copy of the Bean Seed Life Cycle Sequence Activity and have them describe and sketch each stage of a plant’s life cycle.  Finally, close the lesson by reviewing the objective and linking to any future learning. *Your work on your experiment, guide, and graphing allowed you to examine the life cycle of a bean seed. You saw that a seed’s coat first splits open, a root pushes into the ground, and a tiny stem begins to push up toward the sun. Next the leaves began to grow, and the cotyledon fell away. The seed you started with turned into a seedling! Finally, the seedling will mature into an adult plant and start the cycle over again. All life cycles start with birth, and experience growth and reproduction before ending in death. This is true for all living things, even plants!* |  |

**Next Steps and Reflection:**

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| What went well? |  |
| What changes might be beneficial? |  |
| Reteaching needs |  |
| Extension needs |  |