



UNIT PROJECT WORKSHEET

Investigating Plant Systems

We depend on growing plants to sustain life on Earth. What factors contribute to seeds sprouting and growing into healthy plants? What happens inside the seed, and how does homeostasis regulate this process?

Over the course of the next three weeks, you will grow seedlings under different conditions. You will select variables that may affect the growth of seedlings, and investigate how engineering can help solve problems related to plant growth.

PREDICT

1. What environmental factors will affect the growth of your seedlings?

2. What role will homeostasis play in their growth and development?

3. What evidence do you need to gather to answer Questions 1 and 2?

MATERIALS

- container, large, with a lid, or an aquarium
- graduated cylinder, 100 mL
- grow light or access to sunlight, along with other growing conditions, such as a refrigerator
- measuring scale
- peat moss
- planting pot, 5-10
- potting soil
- saline solution (optional)
- seeds from any plants in the cabbage family
- water
- weather thermometer



PROCEDURE

1. First, decide on conditions that you would like to test as you grow seedlings. These may include different amounts of water, soil acidity or salinity, amount of light, high or low temperature, etc. You will set up one or more variable groups, and one control group to test against. The control group should be grown under conditions considered optimal.
2. Prepare planting pots by filling each pot with the same amount of soil, measured on a scale, or a mixture of soil and peat moss mixed 1:1.
3. For each group, plant seeds $\frac{1}{4}$ " to $\frac{1}{2}$ " deep with adequate spacing, covering each seed with a light layer of soil. Each group should have 5–10 seeds. Water the seeds.
4. Label each group according to the conditions under which they are grown. For example: a) control group, b) drought, c) cold, d) heat, e) high acidity/salinity, f) low light, and so on.
5. Depending on the variables you have chosen, place pots in sunlight, partial sunlight, darkness, in cold conditions, and so on.
6. Each day or class period, check on the conditions of each group of seedlings/plants. You should measure and add a predetermined amount of water, and monitor temperature, or apply a predetermined amount of light/sunlight.

7. In your Evidence Notebook, keep a record of plant growth and other characteristics. Begin your qualitative and quantitative observations on the day after planting, and continue until the end of the unit. At the end of the unit, plants and their roots may be examined for evidence of homeostatic adaptations, such as growing longer roots.
8. Develop conclusions about the conditions and growth of each group. Consult with your teacher to try to account for any uncontrolled conditions that have occurred during the experiment.
9. Develop conclusions and share with other students or peer groups. If some data seem to vary greatly, think about the possible causes.
10. Work with your peers to determine the most advantageous factors for plant growth. How could engineering solutions help to solve problems you encountered? If time allows, implement these design solutions and continue the trial.

DATA COLLECTION

Over the course of three weeks, you will collect both qualitative and quantitative data. You will need to observe your seedlings for a few minutes every day. Write up a data collection plan for your teacher to approve. Include sample data tables, and explain which data you can graph and how you can present the end of the experiment.

Examples of qualitative data to record:

- what the control group and variable groups look like every day and how they change
- the colors and textures of each sample
- noticeable changes over time for each group
- daily photos to track the growth and viability of your seedlings

Examples of quantitative data to record:

- number of seeds that are alive and dead
- the heights of plants and number of new leaves
- light, temperature, water, and other conditions in each group
- measurements of roots and other parts of one plant from each group

LESSON 1: LIFE IN THE EARTH SYSTEM

In your Evidence Notebook, draw a diagram demonstrating how various systems affect the growth of your seedlings.

Answer the following questions in your Evidence Notebook:

1. What different systems interacted to influence the growth and development of your seedlings? How did abiotic parts of the ecosystem affect the plants?
2. What energy and matter inputs led to the growth and development of your seedlings? Use evidence to support your claims.

LESSON 2: ORGANISMS: CELLS TO BODY SYSTEMS

In your Evidence Notebook, draw a model of a plant cell. In your model, explain the roles of cell walls, vacuoles, and chloroplasts in maintaining the cell.

Name:

Date:

Answer the following questions in your Evidence Notebook:

1. Describe the hierarchical organization in organisms, from cells to organ systems. What levels of organization are present in your plant? Use evidence to support your claims.
2. How do different systems in the plant interact to carry out functions such as water uptake, photosynthesis, and growth? How did the variable you tested affect these functions?

LESSON 3: MECHANISMS OF HOMEOSTASIS

In your Evidence Notebook, make a chart indicating the development of your seedlings, including your control group and variable groups.

Answer the following questions in your Evidence Notebook:

1. Describe conditions that must remain relatively stable for ideal plant growth. Explain how you altered these conditions in your experiment.
2. Explain how plants use homeostasis to maintain balance over a period of less than ideal conditions. What evidence of homeostasis do you observe in your seedlings?

LESSON 4: BIOENGINEERING

Answer the following questions in your Evidence Notebook:

1. What problems did you experience in the course of growing your seedlings?
2. How can the engineering design process be used to solve problems related to growing seedlings? How can the design solution be optimized?

CONCLUDE

Write a conclusion demonstrating your findings from this experiment in your Evidence Notebook. Include all data you collected and create at least one graphic representation of your data. In your conclusion, answer the following questions:

1. What variables did you test in growing your seedlings? How did you maintain the variables throughout the experiment?
2. What qualities did you use for the control group?
3. Which changes within each group did you observe?
4. Were your predictions about variables confirmed? Why or why not?
5. Which changes in your experiment surprised you the most? What did you learn from observing the changes?

EXTEND

Designing Experiments Alter your seedling experiment in one of the following ways, and monitor the results of the changes: double the amount of plants in each group to gather more accurate data; change the type of seeds used; increase the intensity of the variables—for example, give each plant even less water for a longer period of time; experiment with a different soil type, such as rocky soil or soil with high salinity; experiment with a type of natural fertilizer.

Name: _____

Date: _____

PRESENT

Develop a presentation that answers the questions from the beginning of this experiment:

1. What environmental factors will affect the growth of your seeds?
2. What role will homeostasis play in their growth and development?
3. What evidence do you need to gather to answer Questions 1 and 2?

Use evidence gathered over the course of the experiment to support your claims. Photos, drawings, data tables, and graphs may be useful evidence to include in your presentation.