# Prelab Information

Purpose Explore the process of succession in a microhabitat using a controlled experiment.

Time *Virtual Lab:* Approximately 45 minutes

*Hands-On Version:* Approximately 3 weeks

Question How does the presence of additional nutrients affect the process of succession?

Hypothesis If nutrients are added to an ecosystem, then the composition of the plant community at different stages of succession will also change because different species take advantage of different soil conditions.

Variables *Independent Variable: presence of compost*

*Dependent Variable #1: average number of sprouts for each species*

*Dependent Variable #2: average height of the sprouts for each species*

Summary You will conduct a controlled experiment within a large plot of land. Half of the plot will receive nutrients, and the other half, as the control, will not. The plot will be divided into 1’ x 1’ sections, called quadrats. You will be examining a quadrat from both the nutrient portion and the control portion of the plot. You will measure both the number of new sprouts and their heights over a three-week period. At four different points, samples will be taken for comparison and analysis between the two different groups: areas with additional nutrients and areas without additional nutrients. Note: If you are completing the virtual lab, you will only be taking samples for comparison and analysis at two different points in time instead of four.

# Safety

* Wear appropriate clothing for working outside including long pants and closed-toe shoes. Use appropriate gloves for working in the soil and eyewear for the sun.
* Ensure that behavior in the field is purposeful. Do not play with the soil or plants or eat any of the seeds.
* Review compost contents, and follow any guidance and warnings provided on the packaging.
* Wash hands thoroughly after handling all lab materials and making observations outside.
* Treat living organisms, such as the plants and insects you find outside, with respect, and provide proper care.
* Report all accidents – no matter how big or small – to your teacher.

# Lab Procedure

1. **Gather Materials**

|  |  |  |
| --- | --- | --- |
| * ball of twine (minimum 60’) * 45 sticks (approx. 12”) * one 5 lb. bag of compost * 4’ x 8’ location with sunlight or growth lights * water * scissors | * craft sticks (32 for labeling quadrats and an additional 4 for each student) * glue * black permanent marker * measuring tape * meter stick | * bucket * seeds appropriate for local climate and growing season (100 each)   sunflower seeds  birch tree seeds |

1. **Set Up Area of Investigation**
   1. Measure an area of the school campus that is 8 ft long by 4 ft wide, and mark the corners with the sticks.
   2. Insert a new stick into the ground every 12 inches along the length and width to establish your columns and rows for the rest of the grid.
   3. Establish the interior points of your grid by marking 3 more rows, with sticks 1 foot apart, for a total of 45 sticks. Each stick will be 1 ft from the next stick in the 8 ft by 4 ft grid.
   4. Connect the sticks with twine, pulling the line tight at each stick and marking the area off from interference by landscapers, students, or other passersby.
   5. Label each 1 square foot area with a craft stick numbered from #1 through #16 in one 8 ft x 2 ft section and #17 through #32 in the other 8 ft x 2 ft section. Place each numbered craft stick in the middle of the corresponding quadrat.
   6. Add a thin layer of compost (less than 1 cm) to quadrats #1 through #16.
   7. Post a sign on the area indicating that an ecology experiment is in progress and to please not disturb. You may want to add an end date to your sign so that people will know when the area will be returned to its normal state.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** |
| **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** |

8 ft

4 ft

Compost

Added

No Compost

**Key**

1. **Randomize and Assign Quadrats**
   1. Each student will pick a number from a hat, and that will be his/her quadrat number to observe and for which to record the data.
   2. If there are fewer than 32 students in a class, half should randomly choose numbers from a hat containing quadrats #1 through #16 with the added nutrients, and the other half should randomly pick numbers from quadrats #17 through #32 without the added nutrients.
2. **Make Initial Observations**
   1. Observe your quadrat. Is it a bare area, or are there plants there already?
   2. If the ground is bare, record this and skip to Step 5.
   3. If plants are present in small numbers, count the number of plants of each type in your quadrat.
   4. Measure the heights of all plants that are in your quadrat according to type, and record the average height in your data table. Remember, to compute the average, add all the heights and divide by the number of plants.
   5. If you are starting off in a grassy area where it is impractical to count and measure every blade of grass, then estimate using a random sample.
      1. Take 4 craft sticks and cut each one so it is exactly 4 inches long.
      2. Construct a square using the 4 craft sticks so that it looks like a frame. The craft sticks should overlap so that each side of the square frame is 4 inches long. Glue the craft sticks in place. Allow the glue to dry before proceeding.
      3. Toss the square craft stick frame so that it lands randomly within your quadrat.
      4. Count the number of blades of grass within the open part of the square frame.
      5. Determine the number of square frames that will fit in your quadrat. The square frame is 4 in. by 4 in., so the total area of the frame is 16 in2. The quadrat is 12 in. by 12 in., so the total area of the quadrat is 144 in2. To determine the number of frames that fit in your quadrat, divide the total area of the *quadrat* by the total area of the *frame*.
      6. Multiply the number of blades of grass you counted by the number of craft-stick frames that fit in your quadrat.
      7. Record the number of blades of grass in Table A.
      8. Measure the height of each blade of grass within the open part of the square frame using a meter stick. Measure to the nearest tenth of a centimeter.
      9. Record the individual heights of the blades of grass that you measured in Table A.
      10. Calculate the average height of the grass by adding up the individual heights and then dividing by the total number of blades of grass in the frame.
      11. Record the average height of the grass in Table A.
3. **Mix and Spread Seeds**
   1. Take 100 seeds each from the two different types of plant species, and mix them in a bucket with a lid. Shake the bucket such that the seeds are randomized fairly well.
   2. Spread the mixed seed by throwing it over the quadrats, handfuls at a time, such that the seed is dispersed, or spread, over the whole area in a roughly equivalent pattern.
4. **Measure the Number and Height of the Plants at the End of Week 1**
   1. Toss the square craft stick frame so that it lands randomly within your quadrat.
   2. Count the number of blades of grass within the open part of the square frame.
   3. Recall the number of square frames that fit in your quadrat. You determined this in Step 4e.
   4. Multiply the number of blades of grass you counted by the number of craft stick frames that fit in your quadrat.
   5. Record the number of blades of grass in Table A.
   6. Measure the height of each blade of grass within the open part of the square frame using a meter stick. Measure to the nearest tenth of a centimeter.
   7. Record the individual heights of the blades of grass in the frame in Table A.
   8. Calculate the average height of the grass by adding up the individual heights and then dividing by the total number of blades of grass in the frame.
   9. Record the average height of the grass in Table A.
   10. Mark new sprouts on your quadrat map, and record any qualitative observations in your data table such as color, shape, texture, etc., that will help you to identify the sprouts later.

Quadrat: #6 ↑ Direction: **Northeast**

6C

6A

6B

6D

Mark any new sprouts with a circle, and code them with the number of your quadrat and a letter for each plant. For example, if you are observing quadrat 6, then the first plant that you observe sprouting would be 6A, the next one 6B, and so on. Record observations on each sprout in the data table on the next page. In this way, you can keep track of sprouts and monitor their progress next time without confusing plants within your quadrat or confusing information about your plants with the sprouts from another student’s quadrat.

* 1. Measure the height of each new sprout in your quadrat using a meter stick. Measure to the nearest tenth of a centimeter.
  2. Record the type and height of each plant in Table B.

1. **Measure the Number and Height of the Plants at the End of Week 2**
   1. Repeat Steps 6a–6l with particular attention to any new sprouts that you see emerging.
2. **Measure the Number and Height of the Plants at the End of Week 3**
   1. Repeat Steps 6a–6l with particular attention to any new sprouts that you see emerging.
3. **Summarize Data**
   1. To aid in viewing the total number of plants in your quadrat, transfer the number of blades of grass from Table A to Table C.
   2. Add up the total number of sprouts of each type from Table B, and record this data in Table C.
   3. To aid in viewing the average height of the plants in your quadrat, transfer the average height of the blades of grass from Table A to Table D.
   4. Calculate the average height of each type of sprout in your quadrat using the information in Table B, and record these averages in Table D.
4. **Combine and Analyze Data from all Quadrats**
   1. To build confidence in your data and minimize sampling error, combine the *number of plants* from your quadrat with the number of plants from all other quadrats. Record the total number of plants for all quadrats (experimental and control) in Table E.
   2. To further minimize sampling error, combine the *average heights of the plants* in your quadrat with the average heights of the plants in all other quadrats. Record the average height of the plants in all quadrats (experimental and control) in Table F.
5. **Construct Graphs** 
   1. Follow these directions to construct graphs of your data. Sketch your graphs in your Lab Report Guide, Section 2.
   2. Construct a bar graph to compare the average height of plants in the experimental group to the average height of plants in the control group at the end of three weeks.
      1. First, plot the average height of each type of plant (grass, sunflowers, and birch trees) for the experimental group at the end of three weeks.
      2. Then, on the same graph, plot the average height of each type of plant (grass, sunflowers, and birch trees) for the control group at the end of three weeks.
   3. Construct a bar graph to compare the number of sprouts in the experimental group to the number of sprouts in the control group at the end of three weeks.
      1. First, plot the number of sprouts of each type of plant (sunflowers and birch trees) for the experimental group at the end of three weeks.
      2. Then, on the same graph, plot the number of sprouts of each type of plant (sunflowers and birch trees) for the control group at the end of three weeks.
6. **Clean Up**
   1. Remove sticks, twine, and other equipment from the area, and return the area to the original state in which you found it.

# Data

Record your data in the maps and tables below. Be sure to record any qualitative observations in your data table.

### Figure #1: Map of Quadrats

Record your numbering system for quadrats. Indicate which section of your area of investigation is the experimental group with additional nutrients and which section is the control group where no additional nutrients are added.

Group: \_\_\_\_\_\_\_\_\_\_\_

Group: \_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

### Figure #2: Map of Your Quadrat

↑ Direction: \_\_\_\_\_\_\_\_\_\_\_

Mark any new sprouts with a circle, and code them with the number of your quadrat and a letter for each plant. For example, if you are observing quadrat 6, then the first plant that you observe sprouting would be 6A, the next one 6B, and so on. Record observations on each sprout in the data table on the next page. In this way, you can keep track of sprouts and monitor their progress next time without confusing plants within your quadrat or confusing information about your plants with the sprouts from another student’s quadrat.

**Table A: Grass Data**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Quadrat # \_\_\_** | **Day 1** | **End of Week 1** | **End of Week 2** | **End of Week 3** | **Qualitative**  **Observations** |
| **Number of Blades** |  |  |  |  |  |
| **Heights of Individual Blades in Square Frame (cm)** |  |  |  |  |  |
| **Average Height (cm)** |  |  |  |  |  |

### Table B: Raw Data for New Sprouts

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | ***Heights (cm)*** | | | |  |  |
| **Quadrat # \_\_\_** | **Day 1** | **End of Week 1** | **End of Week 2** | **End of Week 3** | **Qualitative Observations** | **Type** |
| **Plant A** |  |  |  |  |  |  |
| **Plant B** |  |  |  |  |  |  |
| **Plant C** |  |  |  |  |  |  |
| **Plant D** |  |  |  |  |  |  |
| **Plant E** |  |  |  |  |  |  |
| **Plant F** |  |  |  |  |  |  |
| **Plant G** |  |  |  |  |  |  |
| **Plant H** |  |  |  |  |  |  |
| **Plant I** |  |  |  |  |  |  |
| **Plant J** |  |  |  |  |  |  |
| **Plant K** |  |  |  |  |  |  |
| **Plant L** |  |  |  |  |  |  |

**Summary Tables**

### Table C: Number of Plants over Time for Quadrat # \_\_\_\_\_\_\_\_

Add up the total number of plants from the previous page, and record data for your quadrat in this table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of Plant** | **Day 1** | **End of Week 1** | **End of Week 2** | **End of Week 3** |
| **Grass** |  |  |  |  |
| **Sunflower** |  |  |  |  |
| **Birch Tree** |  |  |  |  |
| **Other/Unknown** |  |  |  |  |

### Table D: Average Height over Time for Quadrat # \_\_\_\_\_\_\_\_\_ (cm)

Calculate the average height of the plants in your quadrat at the end of each week by adding up the individual plant heights and then dividing by the total number of plants of that type. Enter your answers in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of Plant** | **Day 1** | **End of Week 1** | **End of Week 2** | **End of Week 3** |
| **Grass** |  |  |  |  |
| **Sunflower** |  |  |  |  |
| **Birch Tree** |  |  |  |  |

### Table E: Total Number of Plants for All Quadrats

To build confidence in your data and minimize sampling error, combine the results from your quadrat with the results from all other quadrats. Record the totals for all quadrats in the table below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of Plant** | **Day 1** | | **End of Week 1** | | **End of Week 2** | | **End of Week 3** | |
| **Nutrients Added** | **No Nutrients** | **Nutrients**  **Added** | **No**  **Nutrients** | **Nutrients**  **Added** | **No**  **Nutrients** | **Nutrients**  **Added** | **No**  **Nutrients** |
| **Grass** |  |  |  |  |  |  |  |  |
| **Sunflower** |  |  |  |  |  |  |  |  |
| **Birch Tree** |  |  |  |  |  |  |  |  |
| **Other/ Unknown** |  |  |  |  |  |  |  |  |

### Table F: Average Height of Plants for All Quadrats (cm)

To build confidence in your data and minimize sampling error, combine the results from your quadrat with the results from all other quadrats. Record the totals for all quadrats in the table below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Type of Plant** | **Day 1** | | **End of Week 1** | | **End of Week 2** | | **End of Week 3** | |
| **Nutrients Added** | **No Nutrients** | **Nutrients**  **Added** | **No**  **Nutrients** | **Nutrients**  **Added** | **No**  **Nutrients** | **Nutrients**  **Added** | **No**  **Nutrients** |
| **Grass** |  |  |  |  |  |  |  |  |
| **Sunflower** |  |  |  |  |  |  |  |  |
| **Birch Tree** |  |  |  |  |  |  |  |  |