

Lab 4. Pea Lab—Application of the Scientific Method

Prelab Assignment

Before coming to lab, carefully read the pages of the pea lab, review read carefully the handout on the [Scientific Method given to you during the first week of the quarter](#) and then answer the prelab questions on the first page of the [Lab 4 Report Sheet](#). Be prepared to discuss and/or hand in your responses to the pre-lab questions at the start of lab.

Goals of this Lab Activity

- To understand and apply the mechanisms used in the scientific method
- Design an experiment and carry out the steps of a scientific experiment to determine whether the phenotype of a genetically dwarf pea plant be altered by the addition of a plant hormone called gibberellic acid.
- To work cooperatively in establishing a protocol for a scientific experiment

Introduction

This lab is an opportunity to enhance your understanding and appreciation of the scientific process in a semi-structured situation similar to that used by researchers in their work.

Teams of two to three students should carry out the activities in this lab. The division of labor is the responsibility of the team. The success of the group depends on the careful and conscientious effort of each person. This dependence on others is also characteristic of research and many other aspects of life (as you may already know).

The work required for this lab spans two to four weeks depending a number of factors. Your instructor will explain the methods of storage for your experimental set-ups, and how to arrange for the use of the rooms and greenhouse to do your work.

In its simplest form, an experiment involves a check or **control group** compared with an **experimental group** or test group. The control is held under constant conditions while the experimental group is exposed to the affects of a specific factor known as the **independent variable**. Any changes that occur in the experimental group, but not in the control group, are assumed to be the result of the independent variable. Each treatment, including the control, should be replicated, and the replicate organisms should be carefully distributed so that no individuals being treated will be favored more than others.

In the activity that follows, you will investigate a small portion of a problem in biology that lends itself very neatly to the experimental method (i.e. the scientific method). It is concerned with coordination of growth and development in plants by chemical regulators called hormones. A certain disease in rice plants results in overly rapid growth of seedlings. The seedlings become tall and weak and finally fall over. Scientists found that a fungus caused the disease. Japanese scientists were able to produce symptoms of the disease with cell-free extracts of the fungus. From the extracts they isolated a substance, named **gibberellin**, which was shown to be the active agent causing the disease. Later research revealed that gibberellins are produced naturally by plants and are involved with regulating stem growth and other processes.

In this project you will study the affect of **gibberellic acid** on pea plants whose **genotype** (genetic constitution) for the trait of height is dwarf. The expression of a genotype is termed a **phenotype**. The purpose of this lab is to determine whether the dwarf phenotype can be modified by the application of gibberellic acid to these plants.

Materials (per student team of 2 to 3 students)

- 20 Little Marvel pea seeds (located in biology lab)
- Atomizer containing gibberellic acid solution (located in biology lab refrigerator)
- Atomizer containing distilled water (located in biology lab refrigerator)
- Growth medium (vermiculite) (located in the greenhouse on the 3rd floor of the SC-building)
- 2 flower pots (located in the greenhouse on the 3rd floor of the SC-building)

Procedure

Each team should decide on its organization, discuss the problem/hypothesis, and plan the experiment. Gather the materials needed and begin the activity. Prepare your seeds planting by following the following method.

1. **Seed Preparation.** Place 20 pea seeds in a beaker and cover them with tap water so that the water level is about 2 cm above the level of the pea seeds. Label the beaker with team identification and date. Place it in a dark cupboard in the biology lab and let the pea seeds soak overnight (i.e. 12-24 hours). The soaked seeds should now be planted as directed below.
2. **Planting the Seeds.** After the seeds have soaked overnight take them to the greenhouse. Prepare two 15-cm flowerpots by adding a growth medium (vermiculite) to each. The containers should be about 3/4 full. Moisten the medium. In each pot, plant ten of the soaked seeds at a depth of 2-3 cm. Tamp the growing medium over the seeds. Label each pot with team identification and date and keep them in the greenhouse. Keep the medium moist, but not soggy wet.
3. When the seedlings are 2-3 cm high measure their height in millimeters. This is done by measuring the distance from the growth medium surface to the tip of the shoot apex. Measure each seedling and record your data. These lengths are the initial measurements. Hormonal treatment of the plants follows immediately!
4. **Spraying the seeds with gibberellic acid.** Do the spraying *outside* of the greenhouse! Using a hand atomizer containing ***gibberellic acid*** spray the plants of one pot—label this pot as your ***experimental group***. Spray the other potted plants with the deionized water atomizer—label this pot as the ***control group***. Since some of the spray for the experimental treatment may drift, do all spraying outside of the greenhouse. Spray the plants until the leaves and shoot apex are wet enough to form droplets which will almost run off, but ***do not permit*** appreciable amounts to drop onto the growing medium. The spray treatment is done **ONLY** one time. ***Control variables:*** Be sure that both of the pots are exposed to similar light conditions. Keep the growth medium of both pots uniformly moist, but do not spray water over the plants themselves. Keep both pots in the greenhouse.
 - Ideally, it would be best to start this part of the experiment by spraying the plants on a Monday, and then continue making measurements once a day for the rest of the week and then make the last measurements on the following Monday—i.e. six measurements in all.

5. Measure the height of all pea plants in each pot daily for five consecutive days (not counting weekends) from the time you first spray with the gibberellic acid and de-ionized water. When you measure record the heights of the plants in each pot, take note of the general health (leaf/stem color and stem diameter) and appearance of the plants, and record the data on **Table 1** on the report sheet. As the plants grow tall, it may be necessary to place stakes in the pots and tie the plants loosely to them.
6. In addition to measuring the height of the plants, on the last day measure the following:
 - i. Measure an **internode length** (see figure 1) on each plant in both the experimental and control groups.
 - ii. Count the number of **leaflets** (see figure 1) on each plant in both the experimental and control groups.
7. At the conclusion of the activity, **CLEAN UP** all materials and equipment. Empty the used vermiculite into the appropriate container in greenhouse.
8. Answer the questions on the report sheet and hand in at the next laboratory period.

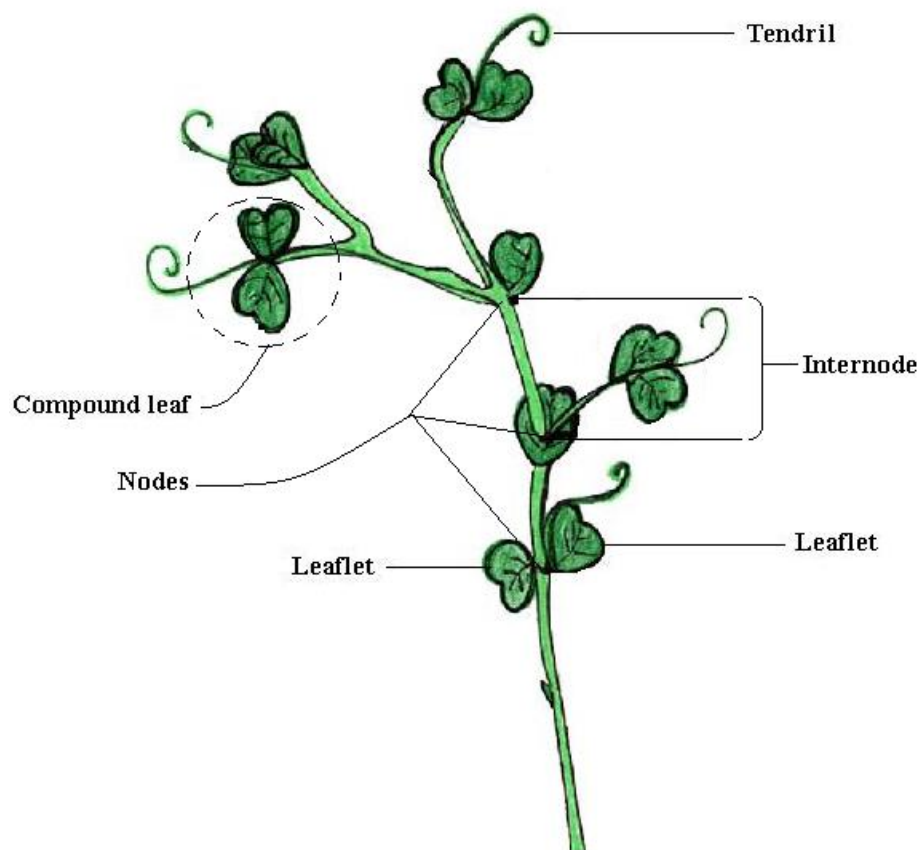


Figure 1. Pea Plant Anatomy. This drawing is to be used to guide the measurement of the internode length and the number of leaflets.