

Plant Hormone Lab

Plant hormones influence many aspects of plant growth, particularly cell proliferation and elongation. Different hormones are synthesized in different parts of the plant, and have complex effects on growth.

Auxin is produced in the shoot apical meristem, and is transported downward. It generally promotes cell division and elongation (except in very high concentrations), and is important in phototropism, gravitropism, and maintaining apical dominance.

Cytokinins are produced in the root apical meristem, and are transported upward. They promote cell division, and are particularly important in promoting the growth of axial buds.

Gibberellins (GA) are involved in cell elongation, particularly in the stem.

Ethylene is a gaseous hormone that produces the “triple response” in seedlings; shorter stems, wider stems, and epinasty (leaves curving downwards).

Gravitropism

Both roots and shoots exhibit gravitropism; that is, growth in response to gravity. We will investigate the importance of the hormone auxin in affecting gravitropism in pea seedlings. Auxin is produced in the shoot apical meristem; thus, removing the meristem removes the source of auxin for the plant. By removing the tip of the plant and covering it with either pure lanolin or lanolin with auxin dissolved in it, we can investigate the effects of specifically auxin on the plant’s response to gravity.

Each group will use 3 pea seedlings.

For your first plant, cut off the tip, and use the syringe to apply a small amount of **pure lanolin**. Then tip the plant on its side and leave it.

For your second plant, cut off the tip, and use the syringe to apply a small amount of **1% auxin in lanolin**. Tip the plant on its side and leave it.

For your third plant, do not cut off the tip. Apply an aqueous solution of auxin on one side of the stem (use a piece of tape on the edge of the pot to mark which side). Leave the plant upright.

We’ll come back in a few days, and next week, to observe these plants.

What do you expect to happen to the first plant?

What do you expect to happen to the second plant?

What do you expect to happen to the third plant?

Independent investigation

Experimental design

Working with your partner, you will design an independent investigation into the effects of plant hormones on plant growth. Resources that we currently have available include:

Plants

12-day-old FastPlants (*Brassica rapa*)

12-day-old dwarf FastPlants

6-day-old FastPlants

6-day-old dwarf FastPlants

10-day-old pea seedlings

6-day-old pea seedlings

Hormone solutions

Available hormones include 1-Naphthaleneacetic acid (1-NAA), a synthetic auxin substitute, gibberellic acid, 6-Benzylaminopurine (BA), a cytokinin, and ripening bananas, which will be emitting ethylene. Specific solutions include:

Pure lanolin

1% 1-NAA (a synthetic replacement for auxin) in lanolin

1 mM aqueous 1-NAA

0.1 mM aqueous 1-NAA

1 mM aqueous gibberellin

0.1 mM aqueous gibberellin

1.5 mM aqueous BA

0.1 mM aqueous BA

Ripening bananas (1, 2, or 3 can be added to a bag with the plants)

Distilled water

What hormone do you and your partner want to investigate?

What aspect of growth do you expect this hormone to affect?

When designing your experiment, I want to you come up with a question that is more complex than just comparing plants that have been exposed to a hormone and plants that have not. This could include comparing the effects of different concentrations of hormone, whether the effects differ depending on the age of the plant, the number or frequency of applications, etc. For example, one similar project compared growth in seedlings that were exposed to gibberellins once, seedlings that were exposed to gibberellins multiple times, and control group that was exposed only to water. Think about an experiment that would involve 2-3 experimental treatments and a control.

I also want you to use at least 4 plants per treatment, so that you can do some statistical analyses of your results.

What question do you want to investigate?

What do you predict will happen?

What experimental design will you use to investigate this question?

After you come up with a plan, put the number of plants that you want to use up on the board, and come check in with me.

Setting up your experiment

The details of you set up your plants will depend on your experimental design. A few things to keep in mind:

The plants are not all the same size to start out with, so be sure to record a measurement for each of them at the beginning of the experiment.

Be sure to label your plants clearly so that you can keep track of individuals as well as which treatment they're in.

Space under the grow lights is limited, so there probably won't be a lot of extra space in the trays.

Unless you specifically request otherwise, I'll take care of watering all the plants.

Data collection

We will have some time in lab next week to collect data, but you may also want to measure your plants at other times. What data are you going to collect, and when/how?

Due Thursday, May 10

A write-up of the plant hormone lab. **You and your partner will write this together and turn in one paper.** Discuss the background for your experiment, your findings and your results. For this lab, I will expect statistical analysis of the results to be included; we'll talk briefly about appropriate tests in lab, and if you have any questions about how to do the tests we can talk about it. All of the tests should be ones that you're familiar with from Bio 210, so we'll just do a quick review.

Below are some of the things to think about as you write each section. Be sure to keep in mind throughout that you want to be making predictions and talking about your results within a physiological context.

Introduction

- Is the function and synthesis of the hormone(s) described?
- Are there relevant references from the primary literature that describe the effects of the hormone, in similar experiments to the one you did?
- Is a clear hypothesis/prediction articulated?
- Is the rationale behind the prediction clearly and explicitly supported by the explanation of the physiological function of the hormone(s)?
- Are the references attributed and cited correctly? Is a consistent and appropriate format used for them?

Methods

- Number, species specified (the species were *Brassica rapa* (FastPlants), or *Pisum sativum* (peas))
- Are the number of treatments and the sample size in each clearly mentioned?
- Are the treatments described clearly enough that I could re-create them exactly?
- Is it clear what you measured, when, and how?
- Were the correct statistical tests used, and was sufficient information included about them?

Results

- If figures and/or tables are used, are they an appropriate format?
 - Axes clearly labelled
 - No raw data shown
 - The right type of graph for the data used
 - Error bars if appropriate
 - Legends are clear, and complete enough that I could understand the basic idea of the figure even if I didn't read the text
- Are the patterns/trends of the data summarized in the text, as well as in figures and tables?

- Is all of the appropriate information about the statistical tests reported?
- Overall, do the results accurately represent the findings?

Discussion

- Are the findings summarized sufficiently to give context to the interpretation?
- Are the results discussed with respect to previous research and your hypothesis/prediction?
- Do you explore physiological explanations of your results, as well as potential complicating factors?