BC 1501

ANGIOSPERM SEED GERMINATION

OVERVIEW

The Big Picture*: Angiosperms, or flowering plants, can be grouped into two classes: monocots (plants whose embryos bear one cotyledon) and dicots (plants whose embryos bear two cotyledons). The flowers are the reproductive parts of these plants, and an embryo is produced by the union of a sperm-carrying pollen grain with an egg cell. These fertilized embryos develop within a mature seed, still attached to the maternal plant. Since it would be disadvantageous for seedlings to germinate while attached to the maternal plant, maturation involves arresting development of the embryo inside the seed. Today we will examine the anatomy of monocot and dicot seeds, and begin to study hormonal and nutritional factors that regulate this arrested state and the early phases of seedling growth.*

Before lab	• **Prepare for your lab practical midterm exam** (The practical will occupy less than one hour. This week's pre-lab quiz and lab exercises follow the practical.) • Background Information o Russell et al., CH 34
During lab	• **Lab Practical Exam** • Part A: Angiosperm Seed Anatomy • Part B: Corn embryo germination experiment.
Assignments (Due at the end of this week's lab	• Worksheet 6: Seed Germination (Individual): ***Due before you leave lab today*** • Embryo Germination Hypothesis Worksheet (Group); ***Due before you leave lab today***

Discussion questions:

- How is corn used as a food? What part of the plant is consumed?
- Why is aseptic technique so important in this lab?
- Corn seeds obviously do not germinate and grow in an aseptic environment in nature. How do they manage?
- Could this experiment be done with a dicot such as the bean? How might the approach and the results differ?

Learning Objectives

(1) To observe the major anatomical features of seeds.

(2) To understand the difference between most dicot and monocot seeds.

(3) To study the development of an isolated plant embryo into a seedling.

(4) To learn *in vitro* plant culture techniques, in particular the aseptic culture of living embryos.

(5) To investigate some of the nutritional and hormonal factors that control development from embryo to seedling in corn by manipulating the contents of the culture medium on which the isolated embryo is grown.

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PART A: ANGIOSPERM SEED ANATOMY (BEANS AND CORN)

- Background on angiosperms
- Seed histology

PART B: CORN EMBRYO GERMINATION

- Role of plant hormones gibberellic acid and abscisic acid in seed germination
- Explanation of *in vitro* versus *in vivo* experiments
- Explication of aseptic technique

Experimental Design

Today in lab, we will dissect corn and remove embryos, separating them from the nutritious endosperm tissue and the protective seed coat. We will investigate how the embryo inside of a seed emerges from its arrested state of development and begins to grow. You will perform two different experiments examining the effects of different factors on aspects of embryo germination.

Experiment 1 will examine the effect of two different hormones, gibberellic acid (GA) and abscisic acid (ABA) on corn embryo germination. Gibberellic acid (GA) generally promotes cell elongation. ABA generally regulates the arrested state of development of an embryo within a seed. In this experiment embryos will be grown on four different types of media, as diagrammed below:

Plate A	Plate B	Plate C	Plate D
ABA absent GA absent	ABA absent GA present	ABA present GA absent	ABA present GA present

Experiment 2 will examine the effect of the hormone GA and the nutrient glucose (GLUC) on corn embryo germination. As stated above, GA generally promotes cell elongation, and GLUC is a source of nutrition. In this experiment embryos will be grown on four different types of media, as diagrammed below:

Plate E	Plate F	Plate G	Plate H
GLUC absent GA absent	GLUC absent GA present	GLUC present GA absent	GLUC present GA present

To investigate the effect of these hormones and/or nutrients on embryo germination, we will work with embryos on sterile Petri plates filled with plant media. The media in the Petri plates are already embedded with the correct concentrations of glucose and the hormones.

This laboratory will require three sessions for completion of data collection and analysis. This week, you will set up the embryos on the appropriate media. The embryos will remain on this media for one week at controlled temperatures (about 22ºC) in 24 hours per day of fluorescent lighting. If sterile technique was successful, it should be possible to observe seedlings with roots growing into the media in the plates and green shoots growing above the media under the plate. Before you leave lab, you should think about what types of results you expect and turn in the hypothesis worksheet. Next week, you will collect data about the length of shoots and roots formed. The data collected during this second session will be contributed to a pool of class data. During the third week, you will use a statistical test, ANOVA, to analyze the pooled class data to determine what effect glucose, ABA, and GA had on the length of shoots and roots. You will then write a lab report, analyzing the results of this multi-week experiment. **Your lab report will be due during Lab 10 (week of 11/16-11/20).**

PROCEDURE B: Isolation and Culture of Embryos

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WORKSHEET 6: ANGIOSPERM SEED ANATOMY (10 pts)

We are performing two different, yet related, experiments in lab today. To help formalize your thinking about the data from this experiment, answer these questions on this Embryo Germination Hypothesis Worksheet. You and your lab partners should confer about your hypotheses, and **hand in only one Hypothesis Worksheet for the entire group of 4 individuals.** This worksheet must be handed in **before you leave lab today.**

For Experiment 1, consider the effects of ABA and GA, alone and in combination.

Media	**Plate A** **ABA absent** **GA absent**	**Plate B** **ABA absent** **GA present**	**Plate C** **ABA present** **GA absent**	**Plate D** **ABA present** **GA present**

Use the space below to explain your predictions about the length of roots and shoots you'll find next week on each different plate.

For Experiment 2, consider the effects of GA and GLUC, alone and in combination.

Media	**Plate E** **GLUC absent** **GA absent**	**Plate F** **GLUC absent** **GA present**	**Plate G** **GLUC present** **GA absent**	**Plate H** **GLUC present** **GA present**

Use the space below to explain your predictions the length of roots and shoots you'll find next week.