Digital Laboratory Framework via Canvas for LIFE courses at Colorado State University

Goal: support foundational scientific competencies and scaffolded research experiences in a 100 level introductory biology sequence for both face to face and online distribution


Lab Exercise #7: Vascular Plants with Enclosed Seeds (Angiosperms)

WHAT MAKES ANGIOSPERMS THE MOST SUCCESSFUL LAND PLANT GROUP?

The angiosperms, or flowering plants, are the largest group of plants, with approximately 250,000 species. They are also the youngest major group of plants. The oldest fossils of angiosperms date from the Cretaceous period, approximately 130 million years ago. The group evolved rapidly. By 100 million years ago, angiosperms formed the dominant vegetation on Earth.

What characteristics make angiosperms so successful?

Click on the headers below to expand and complete the lab activity!

- What makes angiosperms the most successful land plant group?

The next time you are outside, look around you. Chances are, the majority of the plants that you see around you are angiosperms, plants that reproduce with flowers and enclose their seeds in fruits. These are the two unique innovations of the angiosperms. Let's consider how these innovations have led to the incredible success and diversity of the angiosperms!

At the end of this lab you will be able to:

- Identify the anatomical features of flowers and their function.
- Explain how trends in flower characteristics and symmetry parallel coevolution with animal pollinators.
- Identify the anatomical features of a variety of fruits and what plant tissues they represent.
- Explain the function of fruits in seed dispersal.
- Predict the impact of seed dispersal mechanisms on reproductive success of angiosperms.

Learning objectives clearly communicated


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- What makes angiosperms the most successful land plant group?
- Learning objectives
- Your pre-lab assignment
- What we will do in lab
- Lab assignment
- Study room and office hours
- Dig deeper:

All lab materials available through a single accordion style page, including embedded readings, assessments, and rubrics

Opportunities to interact with media rich content


An important trend observed in angiosperm evolution is the trend towards flowers with bilateral symmetry. Think about what bilateral symmetry means for a pollinator. Are there specific places that a pollinator must land in order to access nectar? If the pollinator lands in the right place, can the stamens or pistils be oriented to place/receive pollinator in a specific place on the animal body?

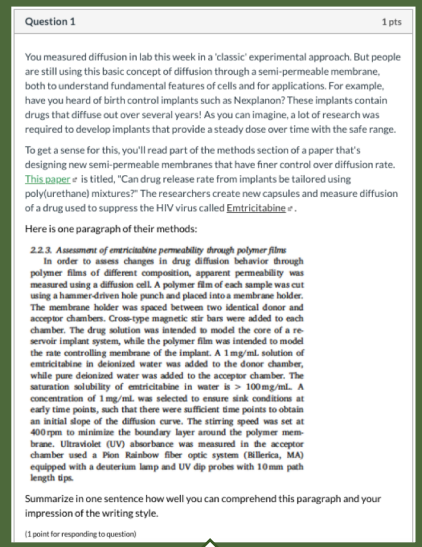
In general, bilaterally symmetrical flowers illustrate that the angiosperm species has a more specific interaction with an animal pollinator than a radially symmetrical flower.

See an example of bilateral symmetry:

Part II: Fruits and Seed Dispersal

Angiosperms are named for their fruits, their "enclosed seeds." When an ovule is fertilized, it becomes a seed. The seed contains a new plant embryo (the new sporophyte), some tissue to serve as nutrition for the developing embryo (the endosperm), and a seed coat to protect the seed from a potentially inhospitable environment. After fertilization, the ovary tissue that encloses the ovule changes, becoming the fruit.

Inquiry driven format includes opportunities to read and interpret literature and data


Question 1 — 1 pts

You measured diffusion in lab this week in a 'classic' experimental approach. But people are still using this basic concept of diffusion through a semi-permeable membrane, both to understand fundamental features of cells and for applications. For example, have you heard of birth control implants such as Nexplanon? These implants contain drugs that diffuse out over several years! As you can imagine, a lot of research was required to develop implants that provide a steady dose over time with the safe range.

To get a sense for this, you'll read part of the methods section of a paper that's designing new semi-permeable membranes that have finer control over diffusion rate. This paper is titled, "Can drug release rate from implants be tailored using poly(urethane) mixtures?" The researchers create new capsules and measure diffusion of a drug used to suppress the HIV virus called Emtricitabine.

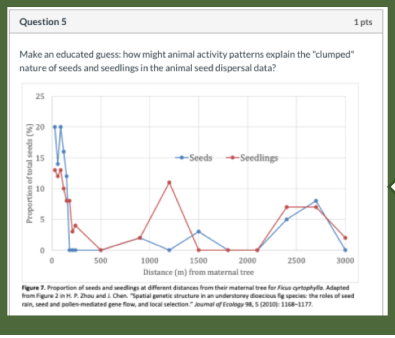
Here is one paragraph of their methods:

2.2.3. Assessment of emtricitabine permeability through polymer films

In order to assess changes in drug diffusion behavior through polymer films of different composition, apparent permeability was measured using a diffusion cell. A polymer film of each sample was cut using a hammer-driven hole punch and placed into a membrane holder. The membrane holder was spaced between two identical donor and acceptor chambers. Cross-type magnetic stir bars were added to each chamber. The drug solution was intended to model the core of a reservoir implant system, while the polymer film was intended to model the rate controlling membrane of the implant. A 1 mg/mL solution of emtricitabine in deionized water was added to the donor chamber, while pure deionized water was added to the acceptor chamber. The saturation solubility of emtricitabine in water is > 100 mg/mL. A concentration of 1 mg/mL was selected to ensure sink conditions at early time points, such that there were sufficient time points to obtain an initial slope of the diffusion curve. The stirring speed was set at 400 rpm to minimize the boundary layer around the polymer membrane. Ultraviolet (UV) absorbance was measured in the acceptor chamber used a Pion Rainbow fiber optic system (Billerica, MA) equipped with a deuterium lamp and UV dip probes with 10 mm path length tips.

Summarize in one sentence how well you can comprehend this paragraph and your impression of the writing style.

(1 point for responding to question)


Question 5 — 1 pts

Make an educated guess: how might animal activity patterns explain the "clumped" nature of seeds and seedlings in the animal seed dispersal data?

Figure 7. Proportion of seeds and seedlings at different distances from their maternal tree for *Ficus cyrtophylla*. Adapted from Figure 2 in H. P. Zhou and J. Chen. "Spatial genetic structure in an understorey dioecious fig species: the roles of seed rain, seed and pollen-mediated gene flow, and local selection." *Journal of Ecology* 98, 5 (2010): 1168–1177.