

## Lab 3: Plant Growth Experiments

### Objectives

- To provide an authentic and introductory research experience.

### Pre-Lab Questions

1. Turn in 3 primary literature references that examine growth differences between sexes and/or populations of a moss species or methods for moss growth. You will need references for your final poster. Websites and textbooks will not be accepted for these references (Your best bet is searching through Google Scholar)! For each article write a 3-sentence summary.

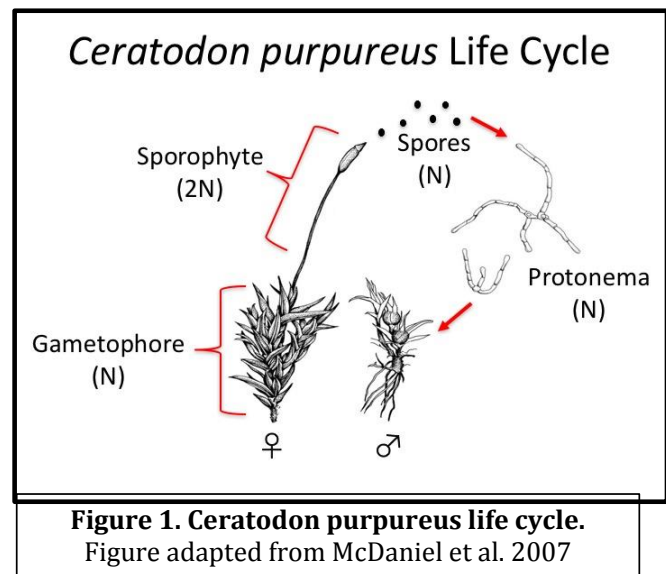
### Related Textbook Chapters: 5-11

### Background

The plants that each group will work are mosses. Mosses are a great system for growth experiments because of their ability to be clonally propagated, so many genetically identical replicates can be generated. In addition, mosses are small, so many isolates can be grown with limited space (don't need a whole field like with sunflowers!)

The species of moss we have available for you is *Ceratodon purpureus* commonly named fire moss. It is a recently emerged model system for studies in genetics because in addition to the aforementioned utilities of a moss system, one can do gene transformations (ability to put a different gene into its genome) and has its genome (all of the DNA in an organism) sequenced. We have 14 isolates available to you; 7 males and 7 females (Fun fact: *Ceratodon purpureus* has sex chromosomes! These are not common in plants!) These mosses have been isolated from populations spanning the globe; from Alaska all the way down to Southern Chile. From each population is 1 male and 1 female that are siblings (that is, they come from the same sporophyte; see Fig. 1). This reduces the amount of genetic variation between males and females within a population down to differences we can observe between the sexes (e.g. the sex chromosomes). But there is plenty of genetic variation between the populations!

To develop a good project (and thus work toward receiving a good grade) you will need to gather references and read previous work for relevant background information. Scientists do not start experiments without researching the relevant background information. It should be explicitly clear what you are going to measure, how you are going to measure it, what results you plan to report, how you will report them, etc. See what other researchers have done before. Plant growth experiments have been conducted for years and there is plenty of literature on whatever your topic may be, including on mosses. As one example, you should be able to find information on what light cycle is appropriate for moss growth. You may want to look into techniques for culturing the mosses *Ceratodon purpureus* and *Physcomitrella patens*. Try using one of these search engines:



<http://scholar.google.com/>  
[http://apps.webofknowledge.com/WOS\\_GeneralSearch\\_input.do?product=WOS&search\\_mode=GeneralSearch&SID=4B58frRBbzuKDMZ4Kz4&preferencesSaved=](http://apps.webofknowledge.com/WOS_GeneralSearch_input.do?product=WOS&search_mode=GeneralSearch&SID=4B58frRBbzuKDMZ4Kz4&preferencesSaved=)

As we extend each step of the process, it is expected that you will measure 1 outcome: area of moss growth. Each group will only work with one male and female sibling pair from one population.

#### **More information about *Ceratodon purpureus*:**

<http://www.rook.org/earl/bwca/nature/moss/ceratodon.html>

<http://mcdaniellab.biology.ufl.edu/data/>

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.717.1276&rep=rep1&type=pdf>

#### **Materials Available**

- Petri dishes and agar
- Growth chambers
- Moss tissue

#### **Procedures**

As mentioned before, your experiment will span the entire semester, from initial planning to final communication of your results.

Date	Activity (in lab, unless otherwise stated)
Sept 12 -14	Assignment of groups, discussion of hypotheses, experimental design & set-up.
Oct 10-12	Collect growth-experiment data, and clean-up experiments
Oct 31 –Nov 2	Data Analysis: Statistics workshop. Download R-Studio before coming to lab.
Nov 14-16	Science Communication: Posters and presenting workshop. Bring electronic version of poster.
Dec 5-7	Poster symposium – formally present results (During lecture, location TBD)

#### **Topic**

There are countless factors, both abiotic and biotic, that influence plant growth. Your instructors have decided to narrow that list down, and we will focus only on the effects of sex and population.

#### **Data Analysis**

- It is expected that each group will complete data analyses. Attending the in-lab statistics workshop will prepare you to do this, and will introduce you R, an open source computer programming language and software environment for statistical computing and graphics.
- Each group is required to have graphs depicting comparisons between groups based on sex and population of experimental plants.

## Assignments

- I. Create & present a poster for December 5 and 7 symposium. A grading rubric, which will give you a good idea about our expectations, is in Appendix III. The in-Lab science communication and poster workshop is meant to help you refine your posters. To receive credit in lab that day, make sure to bring a digital draft to lab with you Nov. 14 & 16.

Make your poster 36" tall x 48" wide. You can make posters in Microsoft PowerPoint. You will need to change the page set up so that it matches the dimensions given. Posters can be printed on campus (\$3 per linear foot) at the Architecture, CSE and Weil computer labs. **Do not** wait until the last minute to print your poster! Posters take 20-120 minutes to print, depending on how many people are in line in front of you. Ask one of the attendants in the lab for help. Posters by graduate students in biology are posted in the halls of Bartram & Carr – worth viewing before you plan yours. Please keep in mind that the text should be large enough to easily read, and thus you will have to be concise with your wording—no need for complete sentences. Remember that a poster is not a manuscript plastered on the wall—it should be aesthetically pleasing and clear (i.e. people should want to stop and look at it). Although your group as a whole is responsible for the entire poster, you need to divide up the sections so that each group member completes at least 1 section. You will be rating each other on how well everyone contributed to the project, and your instructor will use those ratings in assigning grades.

Your poster should contain the following sections (that need not be titled as such, but should be obvious from the flow on the poster):

- **Introduction** - Why is your study scientifically relevant? Why is your topic interesting?
- **Hypothesis**
- **Methods** - What was your treatment(s)? How often was it applied? What data did you collect? How often?
- **Results** - Graphs, tables and pictures. There should be a growth graph and a reproductive output graph.
- **Conclusions** - What did you find? Does this match your hypothesis?
- **Future directions** - If you were to continue your research on this topic what experiment would you do next? Why would you do this new experiment? How does it compliment your current study?

## Websites that may be helpful:

<http://www.writing.engr.psu.edu/posters.html>  
<http://www.swarthmore.edu/NatSci/cpurrrin1/posteradvice.htm>  
<http://www.cns.cornell.edu/documents/ScientificPosters.pdf>  
<http://poly.libguides.com/posters>

**Posters should be *digital and printed out*.** There are poster printing resources on campus including at the Computing Help Desk in the HUB. UF resources including an optional template and info on dimensions:

<http://helpdesk.ufl.edu/application-support-center/department-paid-printing/poster-print-information/>  
<http://print.at.ufl.edu/posters.shtml>

Make sure you pay attention to the maximum dimensions the printer can accommodate (in addition to setting the size in whatever program you chose). Images should be high resolution and be sure to save as pdf and check your poster before printing. While posters can be made in Microsoft Powerpoint, if you are familiar with Adobe software such as Illustrator or In Design those are good options.

**\*\*Please do not wait until the last minute to begin this process--posters take time to complete.\*\***

#### **A few other tips/Content:**

Text should be limited to one paragraph per section. A bulleted list is often an appropriate format—instead of complete sentences, use symbols. Overall, try to limit the amount of text on the poster.

The *main things to remember* are that: 1. You include all important components; 2. The poster is visually pleasing; and, 3. It is easy for the reader to navigate.

#### **LITERATURE CITED**

McDaniel, S.F., J.H. Willis, and A.J. Shaw. 2007. A linkage map reveals a complex basis for segregation distortion in an interpopulation cross in the moss *Ceratodon purpureus*. *Genetics* 176.4: 2489-2500.

#### **Post-lab Assignment**

- Write in detail the methods you performed in lab today
- If necessary, revise your hypotheses for your experiment