**Resources to Help You to Prepare Your Own Plant Diversity Course**

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The resources available here are intended to help young faculty members put together a course on plant diversity. The materials were developed over the course of more than 15 years and have all been tested in the classroom. They can be used in whole or in part to help develop a new course. They include both lecture and laboratory materials, as well as homework, quizzes, and exams.

The philosophy underlying these materials is that it is the instructor’s job to get the students to do the work of the course. The more that the students do on their own work, the better they will learn. This philosophy is reflected in the way the laboratories are designed, and especially in the homework, which forms an important part of the course.

These materials have been used with several different course formats pre- and post-Covid. I will discuss several ways of using them below.

**Lectures**

The lecture sections met for 1 ¼ hours two times a week, but the lecture material can easily be organized into three 50-minute lectures. For many years the lectures were given face-to-face, but were recorded during Covid and are now available on YouTube (see below). An advantage of using recorded lectures is that I felt comfortable requiring students to take and turn in their lecture notes for a grade. The lecture notes were turned in on our learning management system (Canvas) and graded on a mastery basis. Students who did an adequate job received full credit. Students whose notes were judged to be inadequate received half credit. Students who did not turn in any notes received no credit. Because of this I was able to grade the lecture notes very quickly, often with a glance at the first page or two. Students turned in the notes by photographing them with their phone using a free pdf “scanner” like Genius Scan (<https://thegrizzlylabs.com/genius-scan/>). Two examples of excellent student notes can be found in the file ***Two examples of excellent student lecture notes.pdf***, in the root directory. The first example is illustrated with images from my PowerPoint files. The second is illustrated with student drawings based on images in these files.

Prior to each lecture I distributed an electronic copy of my PowerPoint presentation to the students using our learning management system. These presentations consisted almost exclusively of images, which I then annotated during the lecture using a tablet/convertible computer. An external graphics tablet like the Wacom Intuos can also be used for this purpose. During in person lectures, students were encouraged to print my slides and annotate them as they followed my explanations. I did not collect their lecture notes during in person lectures, but this could be done in your class.

My original lecture notes for the course are in the ***Lecture Notes*** folder. These notes were prepared in WordPerfect outline format, which does not easily convert to Word. I have therefore also made them available in pdf format. I stopped updating these notes when I began annotating my PowerPoint slides, so they are somewhat out of date with reference to these slides.

My original and annotated PowerPoint slides are in the folder ***PowerPoint lecture files, original and annotated***.

**Laboratories**

The laboratories were designed to supplement and expand on the material the students were exposed to in lecture. The lectures introduce the students to the organisms and their lifecycles. In the laboratory they had the opportunity to look at the organisms, review their characteristics, and take micrographs. During Covid the laboratories were reduced from 2 hours and 50 minutes to 1 ½ hours to allow us to reduce the class size to one half. To make this work we asked the students to complete the exercises in their lab manual prior to coming to lab (see the file ***00 Lab Manual-full, assembled.pdf*** in the ***Lab manual and lab assignments*** folder). As the laboratory began, I would circulate around the class and check that they had completed this assignment. They received full credit if they had completed the exercises, and no credit if they did not. It was extremely rare for me to give partial credit on this assignment. Once I had verified that they had completed the pre-lab assignment, I distributed an in-class datasheet that they completed during the lab (see the assignments in the ***02 Lab Assignments for students to do in lab*** subfolder in the ***Lab manual and lab assignments***folder). Over the course of teaching this class I have assigned these sheets both to student groups and to individual students. When they are assigned to a group, the group collaborates on the answers and hands in a single group answer sheet. This simplifies grading. When individual assignments are given each student hands in their own work. However, I found that even when students were given individual assignments, they worked together to complete them.

To reduce student stress, make grading easier, and increase student comprehension of the material, I offered to check the students work before they handed in the in-class assignments. I would quickly review each page and tell them the number of questions that they got wrong on that page. I would not tell them which questions were wrong. This required them to go back and rethink all their answers to find their mistakes. I was very happy with this way of giving the assignments as I saw the students engage with the material in ways that I did not see with other types of assignments.

In pre-Covid times the students would complete both the “pre-lab” and the in-lab material during the 2 hour and 50-minute lab period. I would check the “pre-lab” work in the same way as described above before handing out the in-lab assignment.

In addition to completing the lab assignments, the students also took a micrograph of one of that week’s organisms. They also made a measurement of the organism using the ocular micrometer on the microscope at their lab station. They calibrated the ocular micrometers and were taught to use the photomicroscopes during the first lab (see the file ***00 Lab Manual-full, assembled.pdf*** in the ***Lab manual and lab assignments*** folder). The grading sheet for the micrographs is in the file ***Lab Assignment-Form for photography through the Microscope-blank for printing.docx****.* Excel sheets for recording their measurements are in the ***03 Lab Measurements for students to do in lab-Excel files*** subfolder. I displayed these files on the lab classroom projector so we could discuss their measurements as they made them.

At the end of the lab the students handed it (1) their micrograph and (2) their in-lab assignment sheet.

The prep manual for the laboratories is in the ***Lab Prep Manual*** folder in both Microsoft Publisher and PDF formats.

**Homework**

Effective homework is an essential part of any course. The vast majority of homework in this course was assigned using open-source software I developed to teach plant life cycles and plant morphology terminology. The software is free and can be downloaded from <https://sites.google.com/uncg.edu/image-quiz/home>. More information on the software and how it was used in the class is in the folder ***Image Quiz use and assignments***. Image Quiz (IQ) assignments were given on a mastery basis. The students could repeat the assignments as many times as they chose until they achieved the level of mastery I set for the assignment (never less than 93%). They completed at least two assignments per week using the software and were encouraged to use it to study on their own. The use if the IQ software was the most effective part of the course. The software is easy to customize so you can create your own version for use in your class (see the folder ***How to create your own IQ program using our template***). You can also use the pre-existing versions as they stand.

The only other homework assignment was the requirement that the students research and learn the characteristics of the Phaeophyta (brown algae) on their own. I did not lecture on this division. The video on the Phaeophyta (see below) is a supplement that was provided to the students after they turned in their assignment. There are two parts to the Phaeophyta assignment. The students research the division at home and fill in a worksheet. When they arrive in lab I check the worksheet for completion (complete and good effort = full credit; not complete = ½ credit; poor effort or not done = no credit). They students then use their work and the materials available in lab to complete a lab Phaeophyta assignment, which they turn in at the end of the lab for a grade. The Phaeophyta assignment files and keys are in the folder ***Homework-Phaeophyta Assignment***.

**Speaking Assignments**

This course carried a “speaking intensive” marker at my university. To fulfill this requirement the students gave two presentations in lab during the semester. The presentations covered the organisms that they learned the previous week. The students prepared for the presentations as a lab group but spoke individually. The speaking assignment and grading rubric are in the ***Speaking Assignments*** folder.

**Quizzes**

The most effective quizzes I used were given once each week, in lecture, using a flipped classroom model. I used this model during Covid with recorded lectures that the students watched on YouTube. Because most of the work was done outside of class, I cancelled one lecture each week and used the other lecture in this way: a quiz was given during the first part of the lecture period. The students were asked to identify two organisms and draw a life cycle from memory. Several days prior I gave them a list of two life cycles, one of which would be on the quiz. I did not tell them which organisms would appear. There were familiar with a standardized way of drawing life cycles from the lectures and from the *IQ-Life Cycles* software, which is very effective in teaching them the life cycles. Student grades on these quizzes were very high, with most students receiving a score above 80%. The 11 and quizzes keys are in the subfolder ***Ver 01 - 11 quizzes per semester, weekly***.

In other semesters I used more standard quizzes. Two versions of these quizzes are in the folders ***Ver 02 - 4 quizzes per semester*** and ***Ver 03 - 8 quizzes per semester***. There is also a question bank in the folder ***Question Bank***. Grades on these quizzes were significantly lower than on those descried above.

**Exams**

A question bank of exam questions, organized by division, can be found in the folder ***Exam questions***. These questions have all been tested on real exams that were given on paper. During Covid a database of exam questions was created on Canvas, but I do not have a way to effectively deliver this database to anyone outside of my university.

**Questions for a Student Response System**

When the course met face-to-face I began each lecture with a joke slide (while students were entering) and two student response system questions. A set of these questions in the order I used them is in the folder ***Questions for student response system***. There is also a database of other possible questions in the subfolder ***Database of other questions***.

**Images**

All images in the ***Images*** folder are licensed CCO (<https://creativecommons.org/share-your-work/public-omain/cc0/>). This means that I have declared them to be in the public domain. You do not need to cite me (or anyone) as the author when you use the images. You may use them in any manner you wish, including placing them on a website or publishing them in a book or article.

The images are mainly micrographs of the organisms. They are arranged into subfolders based on division. There are also some life cycle images in the subfolder ***00 Life Cycle images***.

**List of Lectures on YouTube**

**The Best Way to Study – The White Paper Method**

<https://youtu.be/Gyu4KQPekx0>

Twenty-nine lectures covering a full course in Plant Diversity (see the file ***Syllabus-Plant Diversity.docx*** and below for details) are available on YouTube.

**License**

All of the linked YouTube video are licensed CC-BY 3.0 (<https://creativecommons.org/licenses/by/3.0/legalcode>). This means that you can use the videos in any way you choose, including downloading them and uploading them to another service, as long as you acknowledge me, Dr. Bruce Kirchoff, as the author. The license is embedded in the metadata of the videos on YouTube.

**Playlist of all Plant Diversity lectures:** <https://www.youtube.com/playlist?list=PLBv80Zf7plGMYHX2D8CoNaEDG13SQjXhy>

**Individual lectures in order used in the class:**

01 Introduction to Plant Diversity <https://youtu.be/j81How3z6DE>

02 Introduction to Algae, Chlorophyta <https://youtu.be/PES6Y7uUuks>

03 Chlorophyceae <https://youtu.be/8ixgmfeI1eI>

04 Ulvophyceae <https://youtu.be/xlwiDX-06Zc>

05 Charophyceae <https://youtu.be/BY-7XWPLmxA>

06 Rhodophyta <https://youtu.be/YdXzGcad6lo>

07 Euglenophyta <https://youtu.be/jsmCEo-p8u4>

08 Phaeophyta – supplement to the homework assignment <https://youtu.be/_Bk3j7kWSiI>

09 Introduction to the Fungi <https://youtu.be/BUka7EpRacc>

10 Zygomycota <https://youtu.be/edVCQqVQ7N4>

11 Ascomycota <https://youtu.be/wsMeyhxpffU>

12 Basidiomycota (no Teliomycetes) <https://youtu.be/Zkn_r8Y0eEU>

13 Teliomycetes of Basidiomycota <https://youtu.be/56BVQ-Xlnm4>

14 Lichens <https://youtu.be/DuoBo0y4J9M>

15 Myxomycota <https://youtu.be/hOve9pGMxXs>

16 Acrasiomycota <https://youtu.be/GaUdp-ewVoc>

17 Bryophyta <https://youtu.be/LxWBYPvfg4s>

18 Introduction to Vascular Plants <https://youtu.be/8LIFj88khlA>

19 Lycophyta <https://youtu.be/fTSbpUuLsOM>

20 Psilotophyta <https://youtu.be/Hj4IbnG7BmQ>

21 Arthophyta <https://youtu.be/28gt4w3qh5Y>

22 Pteridophyta <https://youtu.be/3hByqJs1qcs>

23 Introduction to Gymnosperms <https://youtu.be/0NQOJiQNow8>

24 Cycadophyta <https://youtu.be/_nxtj14MM8A>

25 Ginkgophyta <https://youtu.be/ygJgENWhlRk>

26 Coniferophyta <https://youtu.be/Wce_uBLH7EI>

27 Gnetophyta <https://youtu.be/yMme_AeWpfw>

28.1 Angiosperms PART 1 <https://youtu.be/ujNXL4zym6Y>

28.2 Angiosperms PART 2 <https://youtu.be/O3e4_hfew0M>

I hope you find these materials useful. I would be pleased to hear from you if you did.

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| **List of Folder and Subfolders & in the Archive** | **Notes on Folder Contents** |
| **Exam questions** | Databases of exam questions arranged by division. In Word Format. |
| **Homework-Phaeophyta Assignment** | There is no lecture on the Phaeophyta. The students complete this assignment to learn the characteristics of the division. |
| **Image Quiz use and assignments** | Image Quiz is free, open-source visual learning software. |
| Assignments-IQ Life Cycles and Plant Diversity only | A semester's worth of assignments using two IQ programs |
| Assignments-IQ Life Cycles, Plant Diversity, Algae, Fungi | A semester's worth of assignments using four IQ programs |
| How to create your own IQ program using our template | How to create your own IQ programs or add images to the existing programs. |
| **Images** | Images arranged by division. These images are licensed CC0 = declared to be in the public domain. |
| 00 Life Cycle images |  |
| Acrasiomycota |  |
| Anthophyta |  |
| Arthrophyta |  |
| Ascomycota |  |
| Basidiomycota |  |
| Bryophyta |  |
| Chlorophyta |  |
| Coniferophyta |  |
| Cycadophyta |  |
| Euglenophyta |  |
| Ginkgophyta |  |
| Gnetophyta |  |
| Lichen |  |
| Lycophyta |  |
| Myxomycota |  |
| Phaeophyta |  |
| Psilotophyta |  |
| Pteridophyta |  |
| Rhodophyta |  |
| Zygomycota |  |
| **Lab manual and lab assignments** | Lab manual and assignments as both individual files, and as a single pdf. |
| 00 Lab Manual-original Word documents |  |
| 01 Lab Manual-data sheets from within lab manual-Keys  |
| 02 Lab Assignments for students to do in lab |  |
| 03 Lab Measurements for students to do in lab-Excel files |
| **Lab Prep Manual** | Lab preparation files in two formats.  |
| Lab prep manual as PDF |  |
| Lab prep manual for Microsoft Publisher |  |
| **Lecture Notes** | These are my lecture notes from the first few times I offered the course. They are a bit out of date. |
| Original WordPerfect Files (convert poorly to Word) | I used WordPerfect in outline mode to create my notes. These files do not convert well to Word. |
| PDFs of lecture notes |  |
| **PowerPoint lecture files, original and annotated** | These are the PowerPoint files I used in my lectures, and in the lecture videos on YouTube. |
| PowerPoints use in lectures & videos | These are the files prior to adding my annotations during lecture. |
| PowerPoints use in lectures & videos-annotated | These are the annotated files. |
| **Questions for student response system** | These questions are tied to the lectures and can be used for review at the beginning of each lecture. |
| Database of other questions |  |
| Questions used at start of in-person lectures |  |
| **Quizzes** | Three versions of quizzes |
| Question Bank | A question bank of extra quiz questions. |
| Ver 01 - 4 quizzes per semester | Four quizzes per semester - I gave them in lab |
| Ver 02 - 8 quizzes per semester | Eight quizzes per semester - I have them in lab |
| Ver 03 - 11 quizzes per semester, weekly | Week quizzes - I flipped the classroom and gave them in lecture. |
| **Speaking Assignments** | Assignment files for students to present the organisms covered the previous week. Students worked as a group to prepare their presentations but presented individually. |