Biology 555: Paleobotany
Tuesday-Thursday 9:30-10:45 , Wilson 133
Lab, Thursday 1:00-4:00, Wilson 140
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Text: none. But become acquainted with Stewart and Rothwell, 1993 (SR) and Taylor, Taylor and Krings, 2010 (TTK). Readings will be assigned and provided, probably as pdfs.

Goals of the course: A major goal is to acquaint you with evidence of the past history of plant groups and floras, including the existence and nature of now-extinct plant types (over 90 % of all species that ever lived are extinct). Using this evidence, I hope we can develop an understanding of the significance of the fossil record as a means of measuring the history of evolutionary changes, its usefulness in understanding the phylogenetic relationships of plants, as well as its applicability to paleoecology and climate reconstruction, stratigraphy and biogeography. Also, you will obtain a background which will enable you to read paleontological literature, particularly about plants, and critically evaluate interpretations or conclusions made from fossils. Some broader paleobiological issues, such as extinctions, past climates, coevolution/ plant-animal interactions, and paleoecology will be incorporated as we examine the evolutionary history of various plant groups.

Some basic information: 1. Unless otherwise indicated on the lecture/lab schedule, labs will illustrate and supplement lecture topics. Included will be preparation of differently preserved plant fossils, in order to master techniques and understand how to interpret remains, examination of examples of major plant types from different periods of geologic time, and examination of illustrations in pertinent publications or books to supplement available fossils. You will be able to "read" coal balls.

2. There will be 3 lecture exams, each = 30 points and biweekly lab quizzes , each= 8-10 points, plus one final exam = 60 points. The final will be at least partially cumulative. There also will be two projects at 15 pts each, designed to tie together some of the information obtained from fossils and illustrate the variety of ways questions can be asked once the record is known. Your final grade is determined by dividing total points earned by maximum points possible. The percentage scale I employ is close to: A=90% or above, B=80% or above, C=70 %or above, D=62%or above. Sometimes there is some final scaling of grades, but this gives you an estimate of the minimum grade you may have earned.

3. Lab materials will be placed in the large oak cabinet in 140 Wilson upon completion of labs and thus will still be available for review for one to two weeks. If they have to be put away, arrangements will be made for access to the collections before lab quizzes. I encourage you to bring your computers to lab (and class if you want).

4. I plan 2-3 field trips to collect fossils. At least one will be a day trip in state, to the Triassic deposits near Sanford, NC, where a variety of plants can be found. The second is either a day, or an overnight trip, to Virginia, to sample Lower Carboniferous localities,

probably as part of a weekend. The third will be a day trip in North Carolina, to be determined. These trips will provide important insight to aspects of paleobotany and we will use materials collected to practice techniques and analyses. Dates to be determined.

5. The assigned readings are designed to provide essential background information or are papers that deal with issues such as problems in analysis of particular fossils or questions, extinction in the plant fossil record, factors influencing evolution, or "classic" accounts of floras, major evolutionary events, etc. Numerous papers will be put out to illustrate and aid you in interpreting specimens in lab; unless otherwise indicated you do not have to read them completely but should look at the parts indicated. You should take good notes in any lecture, or about other students' presentations. . Any posted powerpoints represent only part of the information needed to do well in this course.

LABORATORY PROCEDURE

Something distinctive to paleontology is that quite often only a single specimen, or a very few specimens, of a fossil plant or animal are found or are available for your study. One cannot always collect what one wants nor can very much be ordered from biological supply houses. Some specimens are obtained by exchange. Often, we will have to use images from papers extensively, and especially reconstructions. You will want to consider how well they reflect what the specimens show. Image collections on the internet are increasing and aid in supplementing individual collections, but quality of image, and accuracy in identification, varies. Look for some of these. The UCMP Berkeley website, including the Paleontology Portal, is an excellent resource: http://www.ucmp.berkeley.edu/exhibits/index.php.

When sketches, diagrams and such are called for (and you should always make a record of what you have observed in lab), always record whatever information is available concerning: the classification of the fossil plant, the geographical and geological origin, plus its age in terms of geological time. MAKE DRAWINGS, PREFERABLY ON UNLINED PAPER- they help you evaluate critically. ALSO, I have designed the lab manual so you can include drawings there.

Appropriate specialized literature will be available in the lab that illustrates or interprets the plants being studied. Use these in conjunction with your study of the specimens to obtain as much information about them as possible and record such references in your lab notes.

Even though several specimens of a particular plant may be available for study they will often reveal different aspects of it. Observe several specimens if they are available and collaborate freely with your fellow students.

This is intended as an approximate guide to the laboratory studies. Other materials may be introduced when it seems appropriate to do so and some that are noted may be deleted. More detailed instructions will be given at the start of each lab period.

A resource for techniques: Jones, T. P. and N. P. Rowe. 1999. *Fossil Plants and Spores: modern techniques.* The Geological Society, London.

Other books we will often refer to:
Willis and McElwain, 2001. *The Evolution of Plants.* Oxford Press.
Niklas, 1997. *The Evolutionary Biology of Plants,* U. Chicago Press
Kenrick and Crane, 1997. The origin and early diversification of land plants. Smithsonian Press.
Graham, 1999. Late Cretaceous and Cenozoic history of North American Vegetation. Oxford University Press.

TENTATIVE SCHEDULE: not all reading assignments are included- more soon!.

Lecture/lab Schedule Assigned Reading (Read BEFORE the lecture)

Aug. 24: Background- why study fossils? Deposition, fossilization of plants and preservation types. Major plant groups. SR pdf, ch 2 OR TTK, ch. 1

Aug. 26: Discuss readings about Geological time; how rocks are dated and correlated; Evolution. See urls below for reading in preparation for this.

Readings: http://vulcan.wr.usgs.gov/Glossary/geo_time_scale.html and http://www.kheper.auz.com/gaia/timescale/geological_timescale.htm http://www.amnh.org/education/resources/rfl/web/essaybooks/earth/cs_zircon_chronolgy.htm

Lab: preservation types. Techniques, examples of living plant groups

Aug.31: Tree-thinking, plant organization — Tree thinking essay And problems (pdfs)

Sept. 2 Plant organization, contd; — Bold, ch. 13 (pdf)

Lab: Overview of basic plant structures, plant groups

Sept. 7 Origin of land plants: some basic considerations, — Gensel, 2008; Wellman and Gray, 2000

Sept. 9 Radiation of early plants- Early Devonian — Kenrick and Crane, 1997 Gensel et al., 2001

Lab: Silurian and Early Devonian plants

Sept. 14-16: work on the Rhynie Chert project

The Rhynie Chert lagerstat as a window on an early terrestrial landscape- www.unimuenster.de/GeoPalaeontologie/Palaeo/Palbot/erhynie.html www. — Handout

Sept. 21 — What are spores and pollen grains and how do they relate to studies of plant evolution? Chaloner paper? Other? — Assigned reading

Sept. 23 — Lycopsid evolution, — Gensel/Berry 2001; Pigg 2001

Lab: palynology, early lycopsids

Sept. 28 — Exam 1: through early Lycopsid evolution

Sept. 30 — Analysis of Tertiary leaves…. Discuss Wilf papers

Lab: later lycopsids

Oct. 5 — Wilf lecture: Tertiary leaf studies.

Oct 7 — continue Tertiary leaf studies, paleoclimatic analyses

Oct. 12 — Transitions from early plants to more complex ones, first trees

Oct. 14 Middle-Late Devonian plants- cladoxyls, iridopterids
Origin and evolution of sphenopsids
Lab: cladoxyls, iridopterids, sphenopsids

Oct. 19 Origin and evolution of ferns

Oct. 21 **Fall Break**

Oct. 26 Progymnosperms, Secondary xylem, trees

Oct. 28 Evolution of seed plant reproduction and early seed plant groups.
Lab: Fossil Ferns, progymnosperms

Nov. 2 Late Paleozoic seed plants- lyginopterids, medullosans

Nov. 4 Cycads, Bennettitaleans
Lab: Early seed plants, Lyginopterids, Medullosans

Nov. 9 Exam 2: Spores through Early Seed plants

Nov. 11 Other Mesozoic seed plants, Ginkgos, Glossopterids, Caytonialeans
Many of these are extinct today

Nov. 16 Conifer and Cordaites

Nov. 18 Conifers become modern, Mesozoic ferns;

Nov. 23 Origin and early radiation of angiosperms:
Basics, leaves, pollen, flowers

Nov. 25: THANKSGIVING

Nov. 30 Early radiation of angiosperms, cont'd.

Dec. 2: Modernization of plants; Cretaceous-Tertiary boundary

Dec. 6: Tertiary floras, climates, biogeography

Final Exam: Fri., Dec. 17, 8 AM