IB 181L

— Course Summary and Syllabus —

Paleobotany: The 500-million year history of a greening planet

This course serves as an introduction to the evolution of plants and terrestrial ecosystems through time. From the invasion of land to the present, we will follow the evolution of major plant groups through important moments of the Phanerozoic eon (the past 540 million years). By studying fossilized plant assemblages, we will interpret how major environmental changes unfolded across landscapes in the past and how plants have influenced the shaping of our planet. Lectures will be complemented by an interactive laboratory covering paleobotanical research techniques, study of fossil and living plant form and function in the lab and field, and analysis of peer-reviewed literature.

Format: Three hours lecture and three hours lab each week

Units: 4

Class Schedule

Lectures	Tues/Thurs: 3:30-5:00pm,	130 Wheeler Hall	(Cindy Looy)
Lab 101	Wed: 2:00-5:00pm	3007 Valley Life Sciences Bldg.	(Jeff Benca)
Lab 102	Thurs: 9:00am-12:00pm	3007 Valley Life Sciences Bldg.	(Jeff Benca)

Contact

Instructor:	**Cindy Looy**
Instructor e-mail:	looy@berkeley.edu
Instructor office hours:	Wednesdays 1:00-2:00am, 4101 VLSB
GSI:	**Jeff Benca**
GSI e-mail:	jbenca@berkeley.edu
GSI office hours:	Thursdays 12:00-1:00pm, 3003 VLSB

Text book

Kathy Willis & Jennifer McElwain, 2014. ***The Evolution of Plants***. Oxford University Press; 2nd Edition.

bCourses

When you are enrolled in this course, a tab for this course will be added to your personal bcourses account. **Make sure the IB 181 tab is active**. If the tab for this course does not appear on your bcourses site, go to 'My Workspace' then click 'Preferences' and add IB 181 to your active tabs. Here you will find this syllabus and a forum, where you can share your thoughts and questions with fellow students and the instructors.

Course Policies

Grading Distribution:

One midterm, (material from Part I):	**25%**
One final exam, (material from Part II):	**40%**
Presentation and lab section performance:	**25%**
Quizzes:	**10%**

Grading: This course will NOT be graded on a curve.

Regrades: If you feel that we have made a mistake in grading your exam, you may only submit it for a regrade to the GSI **three days after the exam** has been returned to you. Likewise, if you do not submit your exam **within one week** after it was given back to you, the GSI will not regrade unless under special circumstances (e.g. doctor's note). Be aware that regrades can sometimes result in *point deductions* as well.

Midterm and Final: Exams will be mostly short-answer. The **Midterm** will cover topics in lecture, discussion, debate, lab exercises, and class readings during Part I of the course. The **Final** will cover topics in lecture, discussion, debate, lab exercises, and class readings during Part II of the course. The final is not technically "*cumulative*;" but will call upon foundational concepts from Part I necessary to understanding material in Part II.

Weekly Quizzes: Weekly quizzes cover required reading in the

Attendance and class participation: Attendance is highly recommended for all lectures and **required** for the lab sections. You will be graded on participation and will need to partake in the discussions to receive credit. If you must be absent due to a family emergency or illness, please contact the instructor and GSI as soon as possible.

Classroom etiquette

As UC Berkeley students, you are expected to comply with this institution's standards of academic integrity and honesty and behave in manner that does not diminish the learning atmosphere of your classroom. *No cell phone use during class.* If the instructor or GSI sees you texting/chatting/etc. on your computer/tablet/phone, points will be deducted for class participation!

Missed exams and missed or late assignments: You are expected to take all exams at their scheduled date and time. How we deal with missed exams and missed or late assignment will be decided on an individual basis by the instructor. If you know you are going to miss an exam, contact the instructor in advance. When you have missed and exam or assignment it is **up to you** to contact the instructor about this.

Reporting illness and family emergencies: If illness or a family emergency does prevent you from attending class, attending section or making an exam, let one of us know as soon as possible. We will require written proof of the situation.

Extra credit opportunities: One extra credit exercise will be offered in lecture, points TBD.

UC Berkeley Honor Code

The student community at UC Berkeley has adopted the following Honor Code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." The hope and expectation is that you will adhere to this code.

Collaboration and Independence: You will be working frequently groups this semester in both lecture and lab. In lab, you will be required to work in a group to present a discussion paper (you will evaluate and grade your peers' participation for these presentation projects). You will also be working in debate 'teams' for the two lab debates. In addition, partaking in study groups outside of class for the MIDTERM and FINAL is permitted and encouraged.

Reviewing lecture and reading materials and studying for exams can be enjoyable and enriching things to do with fellow students. This is recommended. However, unless otherwise instructed, homework assignments are to be completed independently and materials submitted as homework should be the result of one's own independent work.

Cheating: A good lifetime strategy is always to act in such a way that no one would ever imagine that you would even consider cheating. Anyone caught cheating on a quiz or exam in this course will receive a failing grade in the course and will also be reported to the University Center for Student Conduct. In order to guarantee that you are not suspected of cheating, please keep your eyes on your own materials and do not converse with others during the quizzes and exams.

Plagiarism: Failing to acknowledge work that is not your own is plagiarism and there are serious academic consequences for this. In the case of this course, any instance of plagiarism will result in an automatic zero on the respective assignment. If you use information or an idea in any activity relating to this course that is not your own, (i.e. *there is literature in existence that suggests you were not the first person on this planet to think of an idea*) you must cite or acknowledge the primary source of that idea or information. Likewise if you are citing a classmate you must acknowledge your source.

There are exceptions such as common knowledge (e.g. *there are 24hrs in a day, the sky is blue*). Please also cite the sources for photos, figures, and tables that are not your own used in your powerpoints. If you need clarification regarding whether or not to cite a specific fact or information email the GSI or contact the Student Learning Center for assistance. For additional information on plagiarism and how to avoid it, see, for example:

http://www.lib.berkeley.edu/instruct/guides/citations.html#Plagiarism
http://gsi.berkeley.edu/teachingguide/misconduct/prevent-plag.html

Academic Integrity and Ethics: Cheating on exams and plagiarism are two common examples of dishonest, unethical behavior. Honesty and integrity are of great importance in all facets of life. They help to build a sense of self-confidence, and are key to building trust within relationships, whether personal or professional. There is no tolerance for dishonesty in the academic world, for it undermines what we are dedicated to doing – furthering knowledge for the benefit of humanity.

Your experience as a student at UC Berkeley is hopefully fueled by passion for learning and replete with fulfilling activities. And we also appreciate that being a student can be stressful. There may be times when there is temptation to engage in some kind of cheating in order to improve a grade or otherwise advance your career. This could be as blatant as having someone

else sit for you in an exam, or submitting a written assignment that has been copied from another source. And it could be as subtle as glancing at a fellow student's exam when you are unsure of an answer to a question and are looking for some confirmation. One might do any of these things and potentially not get caught. However, if you cheat, no matter how much you may have learned in this class, you have failed to learn perhaps the most important lesson of all.

Lab Structure

Labs in this course are designed to achieve three objectives:

1) Provide opportunities to work in teams and present your evaluations of a scientific paper and evaluate your peers' presentations.
2) Equip you with hands-on experience in observing and interpreting both fossil and living plants to complement lecture materials.
3) Give chances to think critically and (as a team) advocate a position regarding major controversies in paleobotany and paleoecology via a subject debate: What caused the End-Permian Ecological Crisis?

Typical Lab itinerary:

Time (minute #)	Activity
1-9 min	Arrive/prepare for quiz
10-20 min	Quiz
21-40 min	Paper presentation
41-60 min	Discussion
61-75 min	Lab introduction
76-105 min	Lab exercise and fossil observation
106-120 min	Discuss lab exercise questions

Lab Components

1) Quizzes: You will have a lab quiz with several short-answer questions from all of your assigned readings. These quizzes are a significant source of points for your grade so do not treat them lightly. Take good notes on key concepts and findings of your reading materials as you read. The quizzes are good practice for those on the midterm and final.

2) Paper presentations: Students will be given the opportunity to choose and sign up for a presentation topic from a list of papers on bspace. Students will work alone or in pairs to present one discussion reading during the semester. For this assignment students will read the paper, make a PowerPoint or Prezi presentation, and present to the class after the quiz.

Presenter duties — Presentations will be no longer than 20 minutes in length and each person must speak for half this time (10 minutes). You must read the entire paper you are assigned to present, then divide the following sections equally between you and your partner to cover during the presentation:

1) Introduction
2) Materials and methods
3) Key results
4) Discussion and conclusion

In addition to presenting, you will need to write a brief outline to be used as a study guide for the rest of the class regarding key findings and how they impact our view of paleobiology. Exam questions will touch upon what you have taken from these papers so remember that you are providing the exam material for your peers.

Audience duties — If you are not presenting, you have two tasks: Ask questions after the presentation; is there anything you don't understand? You will grade the presentation via a rubric you will receive in lab

3) Lab exercises: Lab exercises provide a list of short-answer questions intended to delve into concepts discussed in lectures. These exercises will be handed into the GSIs at the end of each lab and graded each week. Since these exercises will provide some of the content for the exams it is important that you ask questions to the GSIs during lab and/or office hours if any concepts are unclear.

Class schedule

Week	Lecture, presentation and lab topics	
Jan 19	**Lecture 1**	Fossil plant preservation
Jan 21	**Lecture 2**	The paleobotanical toolbox
Jan 20-21	**Lab**	Fossilization and Preservation No lab presentation
Jan 26	**Lecture 3**	Earliest plant life
Jan 28	**Lecture 4**	The transition to land
Jan 27-28	**Lab**	Transitioning to land/earliest land plants Lab presentation: Fossil charcoal
Feb 2	**Lecture 5**	Emerging terrestrial ecosystems
Feb 4	**Lecture 6**	A frozen ecosystem: the Early Devonian Rhynie Chert
Feb 3-4	**Lab**	Siluro-Devonian plant form and ecology Lab Presentation: Life history and biology of early land plants
Feb 9	**Lecture 7**	Silurian and Devonian innovations - leaves and size
Feb 11	**Lecture 8**	Silurian and Devonian innovations - heterospory and seeds
Feb 10-11	**Lab**	Devonian innovations Lab Presentation: Key innovations, convergence, and success
Feb 16	**Lecture 9**	The Late Carboniferous coal swamps
Feb 18	**Lecture 10**	The Permian rise of gymnosperms
Feb 17-18	**Lab**	Carboniferous coal swamps Lab Presentation: How plants changed Earth's history
Feb 23	**Lecture 11**	The end-Permian biotic crisis
Feb 25	**Lecture 12**	Early Triassic survival and recovery
Feb 24-25	**Lab**	**Debate and Review session**

Mar 1		**MIDTERM EXAM**
Mar 3	**Lecture 13**	Testing a proposed driver of the end-Permian crisis
Mar 2-3	**Lab**	Paleozoic gymnosperms
Mar 8	**Lecture 14**	Paleozoic Puzzles: *Prototaxites*
Mar 10	**Lecture 15**	Paleozoic Puzzles: Local examples
Mar 9-10	**Lab**	Interpreting the plant fossil record
Mar 15	**Lecture 16**	Mesozoic ecosystems
Mar 17	**Lecture 17**	Mesozoic seed plant relationships
Mar 16-17	**Lab**	Seed plant field trip botanical garden
Mar 21-25		**SPRING BREAK**
Mar 29	**Lecture 18**	Flowering plant origins
Mar 31	**Lecture 19**	The rise of flowering plants
Mar 29-30	**Lab**	Early angiosperms Lab Presentation: Origin of angiosperms is still a mystery
Apr 5	**Lecture 20**	Angiosperm-insect pollination and the fossil record
Apr 7	**Lecture 21**	The K-T [Cretaceous-Paleogene] biotic crisis and its aftermath
Apr 6-7	**Lab**	Interpreting paleoclimate from leaves Lab Presentation: Cretaceous-Tertiary boundary leaf assemblages
Apr 12	**Lecture 22**	Plants as paleoclimate and paleoatmosphere indicators
Apr 14	**Lecture 23**	The Paleocene-Eocene biotic response to a global warming event
Apr 13-14	**Lab**	Plant-insect interaction Lab Presentation: Ancient death-grip leaf scars
Apr 19	**Lecture 24**	The rise and demise of polar forests
Apr 21	**Lecture 25**	Oligocene-Miocene rise of grasslands or mystery guest…
Apr 19-20	**Lab**	Phytoliths Lab Presentation: 400 million years of plant silica fossils
Apr 26	**Lecture 26**	Quaternary climatic fluctuations and plant migration patterns
Apr 28	**Lecture 27**	The Anthropocene: our impact on the vegetation and climate
Apr 27-28	**Lab**	Plant responses to climate change Lab Presentation: Novel climates and no-analog communities
May 2-6		**RRR week** No lectures
May 3	**Review session**	
May 9-13	**Final Exam**	3-6 pm - location TBA

Reading Schedule

Week	Presentation and lab texts
Jan 19-21	**Presentation** No readings **Lab** No readings
Jan 26-28	**Presentation** Scott AC and Jones TP, 1991. Fossil charcoal: a plant-fossil record preserved by fire. Geology Today 7: 214-216. **Quiz & Lab** Willis and McElwain, 2014. The Evolution of Plants, Second Edition. Oxford University Press. pp. 58–62, 64–66, 77–83: *-Formation of Soils,* *-Development of suitable climatic and atmospheric conditions,* *-Reduction of dependence on water for reproduction,* *-Protection against desiccation* *-3.4: Evolutionary trends: green algae to land plants*
Feb 2-4	**Presentation** Lenton et al. 2012. First plants cooled the Ordovician. Nature Geoscience 5: 86–89. **Quiz & Lab** Willis and McElwain, 2014. The Evolution of Plants, Second Edition. Oxford University Press. pp. 62–64, 66–71, 72–77, 83–89, 91: *-Modification of the life cycle* *-Development of specialized cells for water and nutrient uptake–3.3* *-3.3 Examples of earliest land plants in the fossil record* *-Development of specialized cells for water and nutrient uptake* *-3.5 Evolutionary trends in land plants: non-vascular to vascular–Summary*
Feb 9-11	**Presentation** Taylor TN, Hans Kerp H, and Hass H, 2005. Life history biology of early land plants: deciphering the gametophyte phase. PNAS 102: 5892–5897. **Quiz & Lab** Willis and McElwain, 2014. The Evolution of Plants, Second Edition. Oxford University Press. pp. 98–113: *- 4.2 Major changes and innovations in the plant fossil record during the mid Devonian to end Carboniferous* *-4.3 Evidence for further plant adaptations to land dwelling between mid Devonian and end Carboniferous (~394–299 Ma)* *-4.4 Further adaptations to the plant life cycle*

Feb 16-18	**Presentation** Beerling DJ, 2007. Leaves, genes, and greenhouse gasses. In: The Emerald Planet: How Plants Changed Earth's History. Oxford University Press, pp 8–34. **Quiz & Lab** Bonner, 2015. When Fish Got Feet, When Bugs Were Big, & When Dinos Dawned. National Geographic Kids: pp. 45-55: -"*Welcome to the coal swamps*"
Feb 23-25	**No Presentation** **Quiz & Lab** Willis and McElwain, 2014. The Evolution of Plants, Second Edition. Oxford University Press. pp. 287–296: *- 8.3 Why no mass extinction in the plant fossil record?* *-8.4 Evidence for persistence in the plant fossil record* *-8.5 Adaptations of plants for persistence through intervals of environmental change* + Debate paper
Mar 1-3	**MIDTERM EXAM** **No presentation** **Quiz & Lab** Willis and McElwain, 2014. The Evolution of Plants, Second Edition. Oxford University Press. pp. 146– 164 *- 5.1 Environmental changes during the Permian (299–252 Ma)* *-5.2 Evolution of cycads, bennettites, ginkgos, glossopterids, and gnetales*
Mar 8-10	**Presentation** Falcon-Lang et al. 2009. Incised channel fills containing conifers indicate that seasonally dry vegetation dominated Pennsylvanian tropical lowlands. Geology 37: 923–926. **Quiz & Lab** Looy et al. 2014. The late Paleozoic ecological-evolutionary laboratory, a land-plant fossil record perspective. The Sedimentary Record 12: 4–10.
Mar 15-17	**No Presentation**
Seed plant field trip to botanical garden	No readings/quiz
Mar 21-25	**SPRING BREAK**

Mar 29-31		
	Presentation	
	Frohlich MW and Chase MW, 2007. After a dozen years of progress the origin of angiosperms is still a great mystery. Nature 450: 1184–1189.	
	Quiz & Lab	
	Willis and McElwain, 2014. The Evolution of Plants, Second Edition. Oxford University Press. pp. 196–216:	
	- 6.2 Nature and distribution of the earliest angiosperms *-6.3 Why so late?*	
Apr 5-7	**Presentation**	
	Wolfe JA and Upchurch GR Jr, 1987. Leaf assemblages across the Cretaceous-Tertiary boundary in the Raton Basin, New Mexico and Colorado. PNAS 84: 5096–5100.	
	Quiz & Lab	
	Royer and Wilf, 2006. Why do toothed leaves correlate with cold climates? Gas exchange at leaf margins provides new insights into a classic paleotemperature proxy. International Journal of Plant Sciences 167: 11–18.	
Apr 12-14	**Presentation**	
	Hughes DP, Wappler T, Labandeira CC, 2011. Ancient death-grip leaf scars reveal ant-fungal parasitism. Biology Letters. 7(1): 61–70.	
	Quiz & Lab	
	Wilf, 2008. Insect-damaged fossil leaves record food web response to ancient climate change and extinction. New Phytologist 178: 486–502.	
Apr 19-21	**Presentation**	
	Trembath-Reichert E, JP Wilson, SE McGlynn, and WW Fischer. 2015. Four hundred million years of silica biomineralization in land plants. Proceedings of the National Academy of Sciences 112: 5449–5454.	
	Quiz & Lab	
	Strömberg et al. 2013. Decoupling the spread of grasslands from the evolution of grazer-type herbivores in South America. Nature Communications 4: 148.	
Apr 26-28	**Presentation**	
	Williams JW and Jackson ST, 2007. Novel climates, no-analog communities, and ecological surprises: past and future. Frontiers in Ecology and the Environment 5: 475–482.	
	Quiz & Lab	
	Wing and Currano, 2013. Plant response to a global greenhouse event 56 million years ago. American Journal of Botany 100: 1234–1254.	
May 2-6	**RRR week**	Review session
May 9-13	**Final Exam Date TBD**	