

ESci 1007

From Microbes to Mammoths: History of Life on Earth

Fall, 2012 4 credits

Satisfies CLE requirements for biological science with lab

LECTURES

001 TTh 9:45-11 AM
275 Nicholson Hall

Professors

Jake Bailey
377 Shepherd Labs
baileyj@umn.edu
612-624-1603

Office hours:

Th 2:30-3:30 PM
or by appointment

David Fox
207 Pillsbury Hall
dlfox@umn.edu
612-624-6361

Office hours:

W 12:30-1:30 PM
or by appointment

Dan Jones
375 Shepherd Labs
dsjones@umn.edu
612-624-1603

Office hours by appointment

LABS

- All labs are in 105 Pillsbury Hall
- **No labs first week of classes**
- Labs start Monday, 10 Sept
- You must go to the lab for which you are registered
- Lab assignments will be available on the course moodle page

Lab sections

101 M 10:10 AM-12:05 PM
102 M 12:20 PM-2:15 PM
103 M 2:30 PM-4:25 PM
104 T 11:15 AM-1:10 PM
105 T 1:25 PM-3:20 PM
106 T 3:35 PM-5:30 PM
107 W 11:15 AM-1:10 PM
108 W 1:25 PM-3:20 PM
109 Th 11:15 AM-1:10 PM
110 Th 1:25 PM-3:20 PM

Contact information for lab teaching assistants will be posted to the moodle site and also provided in your first lab section meeting

COURSE DESCRIPTION

This course will examine the scientific evidence from biology, paleontology, and geology for the origin and subsequent evolution of life over the 4.5 billion year history of our Earth. Earth appears to be a unique planet in its presence of life. The origin of life on Earth was one of the most important events in our planet's history as the evolution of life affects the atmosphere's and ocean's chemical composition, changes the nature and rate of geological processes such as weathering and sedimentation, and fundamentally alters cycling of the major elements critical for living organisms.

The course will introduce fundamental concepts in modern biology and geology, such as the nature and biochemical basis of life, natural selection and the origin of species, genetics, phylogeny reconstruction, plate tectonics, and the geological timescale. Throughout the course, we will consider the many interactions between biological and geological processes, such as the cycling of elements critical to life on Earth, and how biological and geological processes and events have altered biogeochemical cycles. All of these fundamental concepts are basic tools for understanding the history of life, including the origin of life from non-biological materials, the origin of multicellular organisms, the Cambrian explosion and the origin of the major lineages of modern animals, the origin of vertebrates, the evolution of terrestrial ecosystems, the Permo-Triassic mass extinction that almost erased all life from Earth, and the evolution of dinosaurs, whales, and humans.

Laboratory exercises will allow students to explore basic concepts and methods in geobiology, including natural selection, gene sequences, phylogenetic analysis, the carbon cycle, biostratigraphy, and analysis of evolutionary rates. In doing so, the laboratory activities will engage students in the ways of knowing common to all sciences.

This course is designed for undergraduate non-majors and satisfies the CLE requirements for a biological science lab course.

COURSE OBJECTIVES

- Understand science is a way of viewing and explaining the world around us and is a social and historical process, not simply a growing collection of "facts" handed down by people older or deader than you.
- Learn some of the major basic principles and techniques and unifying theories of biology and also Earth science.
- Understand that major scientific theories, such as the theory of evolution in biology, plate tectonics in Earth science, the Big Bang in cosmology, or general relativity and quantum mechanics in physics, are subject to change and refinement and could even be abandoned in the face of incontrovertible evidence from conflicting observations, but that these major, unifying scientific theories are so generally accepted by scientists because they explain a wide range of observations that conform to predictions better than any other theories so far. These are not theories in the sense of a hunch or idea, but rather are far reaching sets of ideas within entire scientific disciplines that unify diverse fields.
- Understand that the Earth and its life have been and are far more dynamic than our short attention spans allow us to recognize easily and that the more things change, the less they are like they used to be.
- Learn some of the details of the history of the Earth and its life forms.
- Turn you all into Earth Science majors specializing in either geobiology or paleontology!

TEXT

Life Ascending: The Ten Great Inventions of Evolution, Nick Lane, W.W. Norton & Company, New York, 344 p. (available at the Coffman Union bookstore)

COURSE WEB PAGE

You can access the moodle2 page for ESci 1007 via the MyU portal (www.myu.umn.edu). The course information on this handout, the schedule for the lectures, and all materials you should have before each lab will always be available here. We will also include other course information for you, such as reminders about upcoming exams, study guides, class handouts, and the homework assignments. You will complete the (mostly) biweekly homework assignments via moodle2 and your results and the answers will also be available via the moodle2 site for the course. The web page will have links for all of the lectures that will include either notes for some lectures or pdf versions of Powerpoint presentations. You should download and print the slides the evening or morning before lecture and bring them to class to help you take notes. You are responsible for taking your own complete lecture notes. If something is unclear during lecture, raise your hand and ask a question or ask us after class. If you discover something is unclear in your notes later on, ask one of us about it in class or at office hours or make an appointment or send an email. We are responsible for teaching you what you don't know yet about science, biology, geology, and the history of life on Earth; you are responsible for telling us what you still don't understand. Remember, if you do not understand, chances are you are not the only one!

GRADING

30% laboratories. Your TA will cover the basics of the labs **when they start next week!** Be certain to go to the lab for which you are registered. Check which lab section you are in before hand!

25% moodle2 homework assignments. About every two weeks, you will be assigned an open book and open note homework assignment to be completed via the moodle2 page for ESci 1007. The questions for the homeworks will be similar to those on the exams, and some questions may even reappear on the exams. Each homework will have about 15 questions in a variety of formats that should be easily answered based on information in the lectures and the textbook. Some questions will require actual thinking. For each homework, the questions will become available via moodle2 after lecture on the Thursday for which the assignment is scheduled on the syllabus, and they will stay available until just before the start of the Thursday lecture the following week, after which the scores and correct answers will be available (i.e., you have most of eight days for each assignment). While each homework is available, you can make multiple attempts at all questions and you can save attempts for continued work later. You are expected to complete homeworks on your own; working with others will be considered cheating. If you miss a homework assignment for an unexcused absence from campus (see UM policy below), then you cannot make up that homework. With a little effort and a little diligence, the homeworks are essentially free points (and knowledge!).

- 15% Exam 1.** In class, Thursday, 11 October. Based on lectures and text, about one hour long, various types of questions.
- 15% Exam 2.** In class, Tuesday, 20 November (the week of Thanksgiving). Based on lectures and text, about one hour long, various types of questions.
- 15% Final exam.** In this room, 8-10 AM, Saturday, 15 December. Cumulative, but emphasizing material since Exam 2.

Following University of Minnesota policy, the major letter grades in this course are defined as follows: A, achievement that is outstanding relative to the level necessary to meet course requirements; B, achievement that is significantly above the level necessary to meet the course requirements; C, achievement that meets the course requirements in every respect; D, achievement that is worthy of credit even though it fails to meet fully the course requirements; F, achievement not worthy of credit or a course not completed and no agreement with the instructors about assigning an Incomplete. For additional information, please refer to:

<http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>.

The average overall score in the course after all points for all assignments are accounted for will determine the C+/B- boundary. If you score above the overall average, you will get at least a B-; if you score below the average, you will get at most a C+. The other divisions and subdivisions will be based on the distribution of the scores around the average (i.e., based on the standard deviation around the average score). If the average is above the B/C boundary without a curve (i.e., above 80%), there will be no curve for the final grade. It is possible for everyone to get an A.

No extra credit is available. We will look over any exam or homework questions you think are not graded correctly and adjust your score as appropriate, but we will not negotiate your final grade for even a fraction of a point. If you are having trouble in class for academic or any other reasons and are concerned about your grade, you should talk to us early on so we can discuss how you can improve your understanding and your performance.

You can take the course S-N if you choose and it fits with your degree requirements. A grade of S represents achievement that is satisfactory and is equivalent to a C- or better; a grade of N represents achievement not worthy of credit or a course not completed and no agreement with the instructors about assigning an Incomplete. By University policy, we will notify you in the sixth week of the semester if you are at risk of scoring a D, F, or N. This notice will be based on your grade on course work through that point in the semester.

OTHER THINGS

Attendance at both lecture and your lab section is required and expected. Lecture starts at 9:45AM. Please be prompt and ready to start at that time. If you cannot arrive to lecture on time, do not come to lecture as your entrance will disrupt the lecture and disturb those students who did arrive on time.

Turn off all cell phones, MP3 players, pocket weasels, and other gadgetry before you come to class and remove any headphones or headsets. If your cell phone rings during lecture or an exam, **we will answer it for you**. This is no joke, but it will be funny.

Unless specifically allowed by us or the TAs, no devices that allow communication of any kind may be used during examinations (tests, quizzes, final exams, etc.) in this course. This includes, but is not limited to, cell phones, pagers, messaging devices, PDAs (a.k.a. pocket weasels), computers with wireless network connections, and calculators with IR communications capabilities. Laptops and other electronic note taking devices are allowed on normal lecture days, however, all laptop users are required to sit in the back two rows of class so that you do not distract others. If you are looking for an electronic note taking device that also records the lecture audio and doesn't distract your classmates – consider the LiveScribe SmartPen.

You must notify us in advance of any travel plans for university-sponsored events (athletics or other activities) that will interfere with scheduled course work, including exams. If you are sick and miss scheduled course work, you must bring in medical verification of your illness. Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events (see Administrative Policy: *Intercollegiate Athletic Events during Study Day and Finals Weeks: Twin Cities*, which prohibits intercollegiate athletic competition during study and finals week except under certain circumstances), subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances also include activities sponsored by the University if identified by the senior academic officer for the campus or his or her designee as the basis for excused absences. Such circumstances do not include voting in local, state, or national elections. You will not be allowed to make up work missed for unexcused absences. For complete information, please see: <http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html>.

If you have any physical or learning needs that might impact your learning and evaluation in this course, please let us know as soon as you can so we can make any necessary arrangements with you. The University has a multitude of resources so don't hesitate to let us know.

According to University policy, you should expect to spend a total of 12 hours per week working to earn your 4 credits in this class. This includes lecture and lab, which account for 5 of those 12 hours. The remainder should be spent reading your textbook, studying your notes, or coming to office hours. Reviewing your notes over a cup of coffee or soda for just 30 minutes after each lecture will be tremendously helpful as a review and for identifying concepts you do not understand or gaps in your notes. We will cover many topics, most of which will be new and unfamiliar to most of you. We will do our part to make it as clear and accessible as possible; you do your part and do your reading and review your notes day to day. I think you will be surprised how manageable exams become when you are already prepared before you start studying.

UM policy statements

Scholastic Dishonesty

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html>.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

Academic Freedom and Responsibility

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

** Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".*

Student Conduct Code

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the

University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: *Student Conduct Code*. To review the Student Conduct Code, please see: http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html.

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

Sexual Harassment

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy: <http://www1.umn.edu/regents/policies/humanresources/SexHarassment.html>

Appropriate Student Use of Class Notes and Course Materials

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/CLASSNOTESSTUDENTS.html>.

Equity, Diversity, Equal Opportunity, and Affirmative Action

The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: http://www1.umn.edu/regents/policies/administrative/Equity_Diversity_EO_AA.html.

Disability Accommodations

The University is committed to providing quality education to all students regardless of ability. Determining appropriate disability accommodations is a collaborative process. You as a student must register with Disability Services and provide documentation of

your disability. The course instructor must provide information regarding a course's content, methods, and essential components. The combination of this information will be used by Disability Services to determine appropriate accommodations for a particular student in a particular course. For more information, please reference Disability Services: <http://ds.umn.edu/student-services.html>.

Mental Health Services

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

Other important dates

For other important academic dates during the semester and the academic year, including drop/add dates and policies, see information at this webpage: <http://onestop.umn.edu/calendars/>

ESci 1007: From Microbes to Mammoths

Fall, 2012 4 credits

TTh 9:45-11:00 AM 275 Nicholson Hall

LA is the textbook, *Life Ascending* by Nick Lane; readings are to be completed by the beginning of the indicated week

Homeworks: available on moodle2 after Thursday lecture on listed dates until before the following Thursday lecture

			Prof	HW
Week 1: Introduction to the course, life, the Earth, and geological time				
1	T	4-Sep Course introduction, What is Life?	DF&JB	
2	Th	6-Sep Earth as a system: The Geosphere and the Biosphere	DF	
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Lab	No lab			
Week 2: The nature of life on Earth				
3	T	11-Sep Introduction to geologic time, Basic properties of life: element	JB	
4	Th	13-Sep Basic properties of life: homeostasis and information	JB	HW1
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Lab	1 Natural selection			
Read <i>LA</i> Ch 1 The Origin of Life				
Week 3: The origin of life and evolution				
5	T	18-Sep Evolution and natural selection	DJ	
6	Th	20-Sep Origin of life and the Universal Tree of Life	DJ	HW1
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Lab	2 Genetics: Punnett squares (and set up Winogradsky columns)			
Read <i>LA</i> Ch 2 DNA				
Week 4: Life during the Archean				
7	T	25-Sep Lifestyles of the Archean	DJ	
8	Th	27-Sep Photosynthesis	JB	HW2
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Lab	3 Genetics: Hardy-Weinberg and population genetics			
Read <i>LA</i> Ch 3 Photosynthesis, Ch 4 The Complex Cell				
Week 5: Complex cellular organisms				
9	T	2-Oct Heterotrophy	JB	
10	Th	4-Oct Oxygen and origin of Eukarya	JB	HW2
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Lab	4 Phylogenetic trees			
Read <i>LA</i> Ch 5 Sex				
Week 6: Snowball Earth				
11	T	9-Oct The origin and significance of sex	DJ	
	Th	11-Oct Exam 1		
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Lab	5 Life under a microscope			
Week 7: The Cambrian Explosion and Paleozoic diversity				
12	T	16-Oct Snowball Earths and Multicellularity	DF	
13	Th	18-Oct The Cambrian: Explosions and Revolutions	JB	
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Lab	6 Fossils			
Read <i>LA</i> Ch 6 Movement				

Week 8: Origin and early evolution of vertebrates

14	T	23-Oct	Diversity and ecology of Paleozoic animals in the sea	DF	
15	Th	25-Oct	Land plants, CO ₂ , and extinction	DF	HW3
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	Lab	7	Bioinformatics		
			Read <i>LA</i> Ch 7 Sight		

Week 9: Plants and fungi

16	T	30-Oct	Evo-devo: evolution of jaws in vertebrates	DF	
17	Th	1-Nov	Carboniferous coal swamps and atmospheric O ₂	DF	HW3
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	Lab	8	Molecular clock		

Week 10: Terrestrial ecosystems, life nearly goes extinct

18	T	6-Nov	Permo-Triassic mass extinction	DF	
Election Day: VOTE! VOTE! VOTE!					
MN voting requirements: http://www.sos.state.mn.us/index.aspx?page=204					
Find your polling place in MN: http://pollfinder.sos.state.mn.us/					
19	Th	8-Nov	Divergence and diversification of terrestrial vertebrates	DF	HW4
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	Lab	9	Biogeochemical cycles		

Week 11: Dinosaurs at last!

20	T	13-Nov	The opening of the Atlantic Ocean, climate, and dinosaurs	DF	
21	Th	15-Nov	Cretaceous-Paleogene mass extinction: impact and recovery	DF	HW4
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	Lab	10	Vertebrate evolution		
			Read <i>LA</i> Ch 8 Hot blood		

Week 12: What have you learned?

	T	20-Nov	Exam 2		
	Th	22-Nov	Thanksgiving: no class		
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	Lab		No lab		

Week 13: Diversification of modern mammals

22	T	27-Nov	Paleocene-Eocene Thermal Maximum and modern mammals	DF	
23	Th	29-Nov	Origin of grasslands	DF	
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	Lab	11	Evolution and development: cats and dogs		

Week 14: Human evolution and the Ice Ages

24	T	4-Dec	Human evolution: Do humans matter?	DF	
25	Th	6-Dec	The Ice Ages and the Late Pleistocene Mass Extinction	DF	HW5
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	Lab	12	Winogradsky columns		
			Read <i>LA</i> Ch 9 Consciousness		

Week 15: Are we alone?

26	T	11-Dec	Life elsewhere?	JB, DF	
	Th	13-Dec	no class		HW5
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	Lab	13	No lab		
			Read <i>LA</i> Ch 10 Death		

Final exam 8:00 a.m.-10:00 AM, Saturday, 15 December, 2012