EARTH 101: INVERTEBRATE PALEOBIOLOGY

2017 Course Summary:

Instructor and Contact Info: Matthew Clapham: mclapham@ucsc.edu, EMS A208, 459-1276.

Office Hours: Official times are Tuesdays from 2-3 or Wednesdays from 11-12. I have an open door policy, so you are welcome to drop by at other times if I am in my office. You can also contact me to schedule a meeting. I am here to support your learning and to help you succeed, so please take advantage!

Lectures: MWF 1:20-2:25, EMS D250

Course Website: At Canvas (https://canvas.ucsc.edu, log in with your UCSC user name and Gold password). Handouts and assignments will be posted there and you will also need to log in to submit papers.

Course Goals: By the end of this class, you should be able to:

1) Identify an unfamiliar fossil (or at least narrow down its identification).

2) Use fossils to solve geological and environmental problems.

3) Create and test hypotheses about evolutionary pattern and process.

There are two additional "skills" goals:

First, there is a focus on scientific writing. Clear, concise, and accurate written communication is the most important skill for a future career.

Second, you will also learn to critically examine quantitative claims. The class is not about math or statistics but many of the lecture and lab exercises will involve thinking analytically and using data to test hypotheses. A good sense of quantitative intuition (i.e., whether claims are reasonable or not) and skeptical assessment of apparent patterns (are they real or simply random fluctuations?) are valuable tools for a scientist.

Class Structure and Assignments

We will use a "flipped" class structure for this course, because it is far more effective for student learning than the traditional lecture format. In this structure, you will watch a short video (10-15 minutes long) from the YouTube playlist or complete a short reading prior to most classes. You should take notes and try to understand the key concepts, asking for clarification if necessary. I anticipate that you won't need to spend more 30-45 minutes on each video, perhaps longer on some of the readings. If the explanation of a concept still isn't clear after the video, please come to see me so I can try to explain the idea in a different way.

In-class work: You will then spend the class period working individually or in small groups on hands-on exercises that use fossil specimens or actual data. You will get the most out of these exercises if you are familiar with the information from the video and come prepared to use it to solve problems.

The in-class exercises are designed to challenge you and push you outside of your comfort zone. You may feel confused at times but that is actually good – a little confusion is an important step in learning! It's a sign that you are building strong connections in your brain, and learning is much more likely to stick with you if it takes effort. Also, you learn more when trying to solve a problem, especially if you haven't already been taught the solution.

The TA and I will be on hand to guide you through the in-class assignments, so make sure to ask questions and ensure that you understand the material. Exercises will be graded only for completion, not based on the correctness of your answers, so try to focus on achieving a deep understanding of the material.

Projects and reports: Because of the emphasis on writing, you will write three papers. The first is on environmental reconstruction and will use your knowledge of taphonomy and environmental preferences of organisms (length approximately 6 pages). We will discuss organization, structure, and style of the first report in class on Oct 4. The second paper will be based on data collected on the field trip and will focus on archaeocyath ecology and reef-building (length about 6 pages). The third report will cover morphology and evolution using trilobites as example organisms (length about 8-10 pages).

Report 1 (environmental reconstruction): in-class work Oct. 4 and 7, **report due Oct 20**

Report 2 (archaeocyath reefs): field trip Oct. 13-15, in-class work Oct. 23 and 25, **report due Nov 10**

Report 3: (trilobite paper): in-class work Nov. 8, 22, 27, **report due Dec 1**

Report revisions: I will return your reports with feedback, which you should incorporate in your revision and on subsequent reports. You will also work in class with a peer to review and revise your reports. For the first two reports, you should submit a revised version along with a separate page explaining how you addressed the feedback given on your original draft. I will grade your revised version with the same rubric. Report 1 peer review will occur on Oct. 27 and the revision should be submitted on Oct. 30. Report 2 peer review will occur on Nov. 17 and the revision should be submitted on Nov. 20.

Final exam: The final exam will include the same types of questions that you will do in the in-class work. The exam is intended to evaluate whether you can apply your knowledge to solve problems, not whether you can memorize facts. Because of that goal, you will be allowed to use any hard-copy material (notes, printed material, etc.) for reference during the exam, but no electronic devices (unless needed for disability accommodation).

Late Policy

Reports: The due dates (all assignments due at 5 PM on the date) are chosen so that you can receive timely feedback to be applied to your next assignment. There should be sufficient time to complete the papers, especially if you minimize procrastination, but I recognize that deadlines and exams from other courses can occasionally all occur at the same time. Because of that, each due date has a two-day grace period; you can turn in the paper up to two days after the posted deadline with no questions asked. If you have circumstances that you feel prevent you from completing your best work even with the grace period, please meet with me before the end of the grace period. I am happy to arrange an additional no-penalty extension, as long as you are making progress and we can come up with a plan and timeline to help you succeed.

In-class work: Ideally, in-class exercises will be turned in at the end of class, so I can provide rapid feedback by the next meeting. However, if you feel like additional time would help you gain a better understanding of the concepts, you can turn in the exercise at the next class. I strongly encourage you to attend class to maximize your learning and to take advantage of guidance from the instructors and your fellow classmates. Because If you are unable to attend class, in case of illness, personal or family issues, workload in other courses, or any other situation, the exercises will be available online and I am happy to help during office hours or outside of class. If you anticipate missing multiple consecutive classes, please let me know so we can come up with a plan to make sure you are keeping up with the material.

Lecture Grading Scheme

In-class work:	10%
	Each exercise is allocated 5 points: 1 for completed notes on the video or reading, 2 for in-class participation, and 2 for completion of the exercise at any time
Environmental reconstruction report:	15% (10% for initial, 5% for revision)
Field trip report:	15% (10% for initial, 5% for revision)
Trilobite report:	35%
Final exam:	25%
Total:	100%

There may be a curve upward but you will be guaranteed the following letter grades if you achieve a given percentage grade:

>90% = A+	>85% = A	>80% = A-
>76% = B+	>73% = B	>70% = B-
>65% = C+	>60% = C	>50% = D

An A grade is achieved for *excellent mastery* of the course material. To earn an A, students will be able to apply material from the class to solve novel problems and will write clearly, in detail, and with sophisticated interpretations. Grades in the B range indicate *good mastery* of the topics and skills, such as the ability to solve problems similar to previously-encountered questions. Writing that receives a B will contain interpretations supported by the data but may lack detail or nuance. A C grade indicates only *adequate mastery* of the course. This means that a student may only be able to solve some problems or the writing may lack clarity or have limited interpretation without clear support from the data.

Grades for all assignments will be posted to Canvas. Please let me know if you spot any mistakes made during data entry and I will correct the error. Aside from correcting errors from counting of points or data entry, I do not regrade assignments or provide extra credit work because it would not be fair to students who are less outgoing (and who therefore might not ask) or who have other time commitments.

Writing and Plagiarism

The scientific method builds upon previous results, but it is extremely important to give credit whenever you are using ideas from other sources and always to rephrase those ideas in your own words. Rewriting and proper citation is important not only because it is ethical, but also because plagiarism hinders you from achieving a deeper understanding of concepts and prevents you from practicing important skills like writing. We will discuss scientific citation in more detail before the second paper. Because academic dishonesty circumvents the learning process, I have a zero-tolerance policy for plagiarism. The penalty for academic dishonesty is, at a minimum, zero on the assignment and may also include a formal filing with your college for particularly serious cases.

You are encouraged to work in groups during the labs, field exercises, and on in-class assignments so you can learn from each other, but your written answers must be original.

Disability Accommodation

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body, as am I. If you require accommodations to achieve equal access in this course, please stop by my office with your letter from the Disability Resource Center (DRC), preferably within the first two weeks of the quarter, so we can discuss ways to ensure your full participation in the course. I encourage all students who may benefit from learning more about DRC services to contact DRC by phone at 831-459-2089 or by email at drc@ucsc.edu.

Textbooks: There are no required textbooks and I will not assign specific readings from a text (papers for reading will be provided). However, if you would like a reference, these books are good choices:

Benton, M.J. and Harper, D.A.T. (2009). Introduction to Paleobiology and the Fossil Record. In my view this is the best paleo textbook; it strikes a good balance between coverage of taxonomic groups and of analytical topics like diversity and extinction. The library has a copy and I have a couple copies that I can also lend out.

Foote, M.J. and Miller, A.I. (2007). Principles of Paleontology. This book is by far the best text on quantitative or analytical aspects of paleobiology, such as morphology, evolution, and extinction. It does not include descriptions of taxonomic groups. The library has a copy, and I can lend my copy also.

Prothero, D.R. (2013). Bringing Fossils to Life: An Introduction to Paleobiology. I prefer the Benton book, but the library has online access to the third edition and has a paper copy of the second edition (from 2004). The first edition (also at the library, from 1998) is a bit out of date now.

Labs: TA Stephanie Bosch (A201, sbosch@ucsc.edu). Labs will be held most weeks (Tuesday 10 AM-1 PM, Tuesday 4-7 PM) in D250. Lab exercises will involve a combination of in-class examination of specimens, focusing on important aspects of morphology and classification, and exercises on topics like biogeography and evolution. Lab grades will be separate from lecture grades.

Field Trip: We have a field trip from Friday October 13 (8 AM) to Sunday October 15. You will gain valuable expertise in observing fossils and collecting data to test hypotheses. Because you will collect data for a report, field trip attendance is extremely important. If you cannot reschedule conflicts and are unable to participate, please come talk to me as soon as possible, so we can discuss alternative options.

Class Schedule – Fall 2017

*In-class exercise will use a computer (but you can work in groups)

Date	Topic	Pre-Lecture Video/Reading	Due Dates
Sept 29	Introduction; taphonomy (preservation)	*No video*	
Oct 2	Environmental preferences/reconstruction	Environmental prefs/marine org	
Oct 4	*Environmental reconstruction (report 1)	Species composition and diversity	
Oct 6	*Environmental reconstruction (report 1)	*Schimel chapters 2 and 3*	
Oct 9	*Taphonomy (time-averaging)	Taphonomy (time-averaging)	
Oct 11	Functional morphology: suspension-feeding	Morphology of suspension feeders	
Oct 13	*No class (field trip)*		
Oct 13-15	**Required field trip (fossil reefs of Nevada)**		
Oct 16	Scientific writing (body of the paper)	*Read assigned paper*	
Oct 18	*Functional morphology: reef-builders	Functional morphology: reefbuilding	
Oct 20	Functional morphology: substrate	Substrate adaptations	**Report 1**
Oct 23	*No class (work on report 2)*		
Oct 25	*No class (work on report 2)*		
Oct 27	Report 1 peer review/revision	*Schimel chapter 4*	
Oct 30	*Evolution: species concepts/morphometrics	Species concepts and classification	**Revision 1**
Nov 1	Evolution: classification and cladistics	Phenetics and cladistics	
Nov 3	Growth and morphometrics	Landmark morphometrics	
Nov 6	Evolution: ontogeny and heterochrony	Ontogeny and heterochrony	
Nov 8	*Trilobite heterochrony (report 3)	*Schimel chapters 5 and 11*	
Nov 10	*No class (Veterans Day)*		**Report 2**
Nov 13	*Evolution: pattern and process	Evolutionary pattern and process	
Nov 15	*Evolution: evolutionary trends	Evolutionary trends vs random walks	
Nov 17	Report 2 peer review/revision	*Schimel chapters 6 and 7*	
Nov 20	*Biostratigraphy	Biostratigraphy	**Revision 2**
Nov 22	*Trilobite evolutionary trends (report 3)	*Schimel chapter 8*	
Nov 24	*No class (Thanksgiving)*		
Nov 27	*Trilobite paper writing (report 3)	*Schimel chapters 9 and 10*	
Nov 29	Biogeography	Biogeography	
Dec 1	Biogeography: vicariance and dispersal	Biogeography: vicariance/dispersal	**Report 3**
Dec 4	*Diversity: extinction and origination	Extinction and origination	
Dec 6	*Diversity: spatial/environmental patterns	Diversity: spatial/environ. patterns	
Dec 8	Diversity: guilds and evolutionary faunas	Guilds and evolutionary faunas	
Dec 12	**FINAL EXAM (4-7 PM)**		