

# PALEOBIOLOGY & PALEONTOLOGY

**4 Credits**

**Prerequisites:** Geos 112 or Biol 103 or Biol 115  
Engl 111 and Engl 211 or Engl 213

## Geos 315W Course Syllabus

**Lectures:** MWF 9:15 AM –10:15 AM  
233 Reichardt

**Labs:** M 2:15-5:15 PM  
M 6:00-9:00 PM  
229 Reichardt

Professor: **Sarah J. Fowell**  
E-mail: **sjfowell@alaska.edu**  
Office: **326 Reichardt**  
Phone: **474-7810**  
Hours: **M 11:30–1:00 W 3:30-5:00**

TA: **Katherine Anderson**  
E-mail: **klanderson3@alaska.edu**  
Office: **312 Reichardt**  
Phone: **474-7585**  
Hours: **M 10:30-12:30**

### Required Materials:

- **Textbook:** Benton & Harper, 2009. Introduction to Paleobiology and the Fossil Record. Wiley-Blackwell, 592 pages. ISBN: 978-1-4051-4157-4

- **i>clicker:** i>clickers will be checked out to students for a \$30 deposit (*cash only*).

You will get your deposit back when you return the clicker at the end of the semester. If you lose your clicker or fail to return it, the department will retain your deposit and put it toward the purchase of a replacement. Go to the Geology Department office (308 Reichardt) to pay your deposit and check out a clicker. Scored clicking will begin on Friday, September 7.

**P**aleontological investigations seek to describe temporal and spatial changes in Earth's flora and fauna within the context of geological processes, stratigraphy, and evolution. Consequently, the study of paleontology requires a working knowledge of more than one discipline. One of the principal goals of this course is to demonstrate the interdependence of scientific disciplines in any investigation of large-scale patterns and events in the natural world.

**Course Objectives:** Fossil organisms are crucial to studies of stratigraphy, paleoecology, and paleoclimatology. Along with radiometric dating, fossils are a fundamental geochronological tool. They are also important sources of qualitative and quantitative climate data essential for paleoecological reconstructions and for ground truth testing of climate models. Therefore, no practicing geologist should be without a basic knowledge of the morphology and geologic range of common invertebrate fossils. For all of these reasons, labs, discussions, and homework are designed to help you achieve following objectives: **1)** Observe and examine the anatomy, morphology and evolutionary history of invertebrate animals, plants, and protists commonly found as fossils. **2)** Understand the biological requirements and limitations of common fossil organisms and use this information to interpret the depositional history and paleoenvironment of the surrounding rock. **3)** Explore the contributions that studies of fossil organisms have made to diverse fields of geology and biology, including paleoecology, biostratigraphy, biogeography, and evolutionary taxonomy.

**Learning Outcomes:** This is an upper-level geology course *and* a writing-intensive course. Lab exercises, homework assignments, and class activities will emphasize retention of vocabulary and interpretation of geologic samples. Essays will encourage you to apply critical thinking skills and express your ideas in an organized format. Upon completion of this course, you should be able to:

- 🌐 Recognize and identify members of 9 fossil animal phyla
- 🌐 Label key anatomical features and explain their function
- 🌐 Identify, compare and contrast 2 groups of modern and fossil protists
- 🌐 Recognize and classify fossil plant organs and animal traces
- 🌐 Reconstruct the taphonomic history of a given fossil or fossil assemblage
- 🌐 Use fossils to constrain the age of the enclosing rock
- 🌐 Reconstruct the environment of deposition of a fossil-bearing rock
- 🌐 Construct a cladogram to show the relationships between any set of 3 or more organisms
- 🌐 Locate, read, and concisely summarize journal articles on a selected paleontological theme
- 🌐 Compare and contrast 2 or more related articles using a point-by-point format

**Lecture Format:** The best way to learn and retain the material is by actively participating. Therefore, I will not spend the entire class time talking while you take notes. Instead, I will encourage you to participate in class activities, including group discussions and “clicker questions”. Your participation will be rewarded with a better grasp of the material and credit toward your participation grade.

**Class Participation:** Participation in class discussions and activities enhances your understanding and retention of the material. Therefore, 10% of your final grade will be based on participation. Please try to remain punctual! If you arrive late, you may miss activities that will document your presence.

**Blackboard:** Course graphics will be available on Blackboard. Go to [www.uaf.edu](http://www.uaf.edu) and select Blackboard from the menu at the top. You will need your UA username (usually your initials and last name) and password (the same one you use to access your google mail). Once you are logged in, select Geos 315 from the menu at the right and open the course materials folder.

**Labs:** Hands-on experience with fossils is essential to a complete understanding of the morphology and paleoenvironmental significance of the organisms discussed in class. The record of marine invertebrates is longer and probably more complete than that of marine vertebrates, terrestrial invertebrates, terrestrial vertebrates, or plants. Consequently, labs will focus on marine invertebrate fossils.

Each lab will begin with a brief review of the anatomy and taxonomy of the fossil group to be studied and/or a brief quiz on the lab material covered the previous week, so you will find it advantageous to be on time. If you are unable to finish the exercise during the allotted lab time, lab materials will be left out in room 229 until the end of the week. Labs will be due weekly, at the beginning of the following lab period. The grade will decrease by 1 point for each day that the exercise is late. Permission will not be given to work on the next exercise until the late one is turned in.

**Compare & Contrast Papers:** This is a writing intensive course (315W). Consequently, you will be expected to produce multiple drafts of a research paper (see below) and to explain your answers and ideas in short written paragraphs on lab exercises and exams. Writing is a skill that becomes easier with practice (really!). Hence, the goal of these assignments is to provide you with many opportunities to stretch your writing talents. No one (faculty included) produces a flawless draft on the first attempt. Remember to focus on progress, rather than perfection, and don't be afraid to modify your own work! In order to assess your current strengths and weaknesses behind the pen (or keyboard), you will be asked to write two short (~2 pages) essays comparing and contrasting pairs of assigned papers. The feedback you receive will guide you as you prepare the first draft of your research paper. At the end of the semester, you can look back and review your progress.

**Research Papers:** Each student will complete an original research paper on the subject of their choice. This assignment is designed to encourage you to delve into the literature in your particular area of interest. In addition to exploring a new topic, the paper gives you a chance to be graded on something other than your performance on exams and lab exercises. I will provide you with a list of topics to choose from, and I'm happy to help you find the references that will form the basis of your paper. The final paper should not be a "book report." I expect you to compare and contrast a variety of opinions on your selected subject. In order to do this, you will need to consult multiple sources, all of which should be research papers. Your paper **must be based on at least 5 journal articles**, not encyclopedias, textbooks, or websites. The latter may be consulted only to provide supporting graphics or supplement understanding of technical terms.

Research papers must be referenced throughout and must include a bibliography. I will provide you with a format for citations and references. To help avoid end-of-the-semester panic, first drafts will be due on or before **November 2**. Because of the early deadline, you will need to select your topic by October 5. Prior to submission of your first draft, I will schedule a brief conference with each of you, during which you will be asked to read several sections of your paper aloud. This is intended to help you identify structural or grammatical problems and initiate a discussion on how to edit your work. Revised, final drafts are due on **November 28**. Late drafts will be assessed a 10-point penalty. Both drafts will be graded, but different rubrics will be used. In particular, I will be looking for evidence of editing and improvement in your final draft, because the revision process is extremely important. Revisions are not intended as a penalty, but as a chance for you to get some feedback regarding the content or style of your paper so that you can improve your grade. Ultimately, revisions offer you the opportunity to correct oversights and hone your science-writing skills. However, it is important to note that revision requires additional effort. Your final score will drop if you do not edit and/or improve upon your first draft.

**Disabilities Services:** The Office of Disability Services implements the Americans with Disabilities Act (ADA) and ensures that UAF students have equal access to the campus and course materials. I will work with the Office of Disabilities Services (474-7043) to provide reasonable accommodation to students with disabilities. Please let me know at the beginning of the course if accommodations should be provided.

**Course Policies:** The final exam will be given only on the day and time scheduled by the university, so make travel and work plans accordingly. Make-up examinations will be given *only* under extenuating circumstances; a written explanation from your doctor or dentist will be required in the case of a medical emergency. The **Student Code of Conduct** (p. 52 in the UAF 2012-2013 Catalog) outlines your rights and responsibilities, as well as prohibited forms of conduct. Please be aware of the contents of the code.

**Grading:** Grades will be weighted as follows: 60% class and 40% lab. The class grade will be determined by performance on two midterm exams, a comprehensive final exam, homework exercises, participation, and a research paper. The research paper grade will be the average of two drafts. The lab portion of the grade will be based upon lab exercises, weekly quizzes, and a final lab practicum.

**Class**

2 Midterm Exams: 20% (10% each)  
Final Exam: 10%  
Research Paper: 10%  
Homework Exercises: 10%  
Participation: 10%

**Lab**

Laboratory Exercises: 25%  
Laboratory Practicum: 10%  
Lab Quizzes: 5%

**Grade Scale:** Quizzes, homework, laboratory exercises, term papers, and participation/attendance will be graded according to the following scale: 100-91% = A, 90% = A-, 89% = B+, 88-81% = B, 80% = B-, 79% = C+, 78-71% = C, 70% = C-, 69% = D+, 68-61% = D, 60% = D-, <60% = F. Midterm exams, final exams, and final weighted scores will be graded on a curve.

# Lecture and Lab Schedule

Day	Topic	Reading	Lab Exercises	Due
Friday 8/31	Introduction: Fossils and the history of life on Earth	Ch. 3: 70-77 20: 546-552		
Monday 9/3	<b>Labor Day! No Class!!!!</b>			
Wednesday 9/5	How does your skeleton grow? Ontogeny & the species concept	Ch. 6 137-144		
Friday 9/7	Fossil taxa: Preservation and bias in the fossil record			<b>Illuminated Fossil</b>
Monday 9/10	Fossilization: 1 million years to rock hard abs	Ch. 3 57-70	1: Modes of Fossilization	
Wednesday 9/12	Stromatolites: Earth's oldest fossils	Ch. 8 183-195		
Friday 9/14	Eukaryotes and the emergence of animals	Ch. 8 195-202		<b>C/C Paper 1</b>
Monday 9/17	Sponges: Obligate colonies that breathe and feed as one	Ch. 11 260-271	2: Primordial Reefs: Stromatolites, Sponges, and Archaeocyaths	Lab #1
Wednesday 9/19	Predation, skeletalization, and the Cambrian explosion	Ch. 10 249-257		
Friday 9/21	Ordering Cnidarians: How to make a body from a 2-ply bag	Ch. 10 249-257		<b>Cambrian Analogies</b>
Monday 9/24	Ediacaran Fauna: Multicellular test drive or coral kin?	Ch. 11 271-296	3: Cnidarians Join the Reef Community	Lab #2
Wednesday 9/26	Taphonomy: Death is just the beginning...			
Friday 9/38	Brachiopod vs. Clam: Convergence and competition	Ch. 12 297-313		<b>C/C Paper 2</b>
Monday 10/1	Of lophophores and pedicles: Anatomy of the brachiopods		4: Lophophorates I: Paleozoic – The age of Brachiopods	Lab #3
Wednesday 10/3	<b>Exam #1</b>			
Friday 10/5	Communal living: Comparative byozoan anatomy	Ch. 12 313-324		<b>Thesis &amp; References</b>

<b>Day</b>	<b>Topic</b>	<b>Reading</b>	<b>Lab Exercises</b>	<b>Due</b>
Monday 10/8	Evolutionary synthesis: Selection, mutation, speciation	Ch. 5 116-128	5: Lophophorates II: Bryozoans - Kings of the Bioherm!	Lab #4
Wednesday 10/10	Does Darwinism = gradualism? Heterochrony, hopeful monsters	Ch. 6 144-150		
Friday 10/12	Mollusca: A phylum with lots of class	Ch. 13 326-332		<b>Paper Outline</b>

Monday 10/15	Lifestyles of the blind and bivalved	Ch. 13 332-338	6: Molluscs I: How To Tell Bi-valved Animals Apart	Lab #5
Wednesday 10/17	What's wrong with evolutionary taxonomy?			
Friday 10/19	Primitive vs. Derived: Some states are more equal than others	Ch. 5 128-136		

Monday 10/22	Constructing a cladogram; Cladistics and phylogeny		7: Molluscs II: Pelecypod Dissection	Lab #6
Wednesday 10/24	Class Gastropoda: A new twist on mollusks	Ch. 13 338-344		<b>Cladogram 1</b>
Friday 10/26	Class Cephalopoda: A lot of nerve, but no backbone	Ch. 13 344-360		<b>Paper Conferences</b>

Monday 10/29	<i>Encountering Sea Monsters:</i> Cephalopods on DVD		8: Molluscs III: Cephalopods & Gastropods: Nervous and Twisted	Lab #7
Wednesday 10/31	Trilobites: Cockroaches of the Cambrian seas	Ch. 14 360-375		<b>Cladogram 2</b>
Friday 11/2	The Arthropoda: Phylum or Superphylum?	Ch. 14 375-387		<b>First Draft</b>

Monday 11/5	Paleoecology of the Cretaceous North Slope (Pat Druckenmiller)		9: Arthropods from Sea to Land	Lab #8
Wednesday 11/7	<b>Exam #2</b>			
Friday 11/9	Echinoderms I: Echinoids and asteroids have stars upon thars	Ch. 15 389-409		

Monday 11/12	Echinoderms II: Crinoids and blastoids in undersea meadows		10: Mouth in the Middle: Radial Symmetry and Echinoderms	Lab #9
Wednesday 11/14	Get a backbone! Enigmatic animal microfossils	Ch. 15 409-425		
Friday 11/16	Of conodonts and craniates	Ch. 16 427-435		<b>Cladogram 3</b>

<b>Day</b>	<b>Topic</b>	<b>Reading</b>	<b>Lab Exercises</b>	<b>Due</b>
Monday 11/19	Kingdom Protista: A very full wastebasket	Ch. 9 204-208	11: Microscopic Animalia: Conodonts and Graptolites	Lab #10
Wednesday 11/21	Sink or swim! Siliceous and calcareous microfossils	Ch. 9 208-232		
Friday 11/23	<b>Thanksgiving Break: No Class!!!!</b>			

Monday 11/26	Ichnofossils I: Digging deeper and chewing	Ch. 19 509-531	12: Freshwater & Marine Protists: Forams, Rads, and Diatoms	Lab #11
Wednesday 11/28	Ichnofossils II: Vertebrates at rest and in motion	19: Boxes 19.3-19.5		<b>Final Draft</b>
Friday 11/30	Paleothermometers: Leaves, wood and testate amoebas	Ch. 18 479-507		<b>Experiment Design</b>

Monday 12/3	Permian mass extinction I: Sepkoski's evolutionary faunas	Ch. 20 531-546	13: Ichnofossils and Animal Behavior	Lab #12
Wednesday 12/5	Permian mass extinction II: Toxic oceans or thin air?	Ch. 7 162-181		
Friday 12/7	Biogeography I: Realms, biomes, and boundaries	Ch. 2 41-55		

Monday 12/10	Biogeography II: Travel in the Phanerozoic Era		<b>Final Laboratory Exam</b>	Lab #13
Wednesday 12/12 8-10 AM	<b>Final Exam</b>			