



# **Principles of Paleobiology**

(CLFS 609F)

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*"Being a paleontologist is like being a coroner except that all the witnesses are dead and all the evidence has been left out in the rain for 65 million years."* – Mike Brett-Surman, 1994

The organisms currently living on the Earth represent the tiniest fraction of those that have existed. Reconstructing the life styles of these extinct organisms requires a suite of sophisticated techniques that are conceptually more akin to forensics, than to those typically used in studying living organisms. This course (1) surveys the methodologies used by paleobiologists to investigate the biology of extinct animals and (2) uses these techniques to assess the plausibility of a number of current, and in many cases, highly controversial reconstructions for a diverse range of animals.

In this course, we will tend to emphasize the reconstructions of extinct vertebrates, since these are more familiar to most of you than the extraordinary range of extinct invertebrates. This emphasis is entirely pragmatic and does not to imply that there are no exciting extinct invertebrates. Rather it reflects the inordinate difficulty of learning a completely new, and typically complex, set of structural terms for each group of organisms. By restricting ourselves to vertebrates and a few selected invertebrates, we will greatly simplify the task of learning to reconstruct animals, without becoming mired in volumes of arcane terminology.

## **Course Content**

The course contains ten units, each of which involves a reconstruction of a specific animal or animals. The first four units provide an overview of the techniques and problems of paleobiological reconstructions. The final six units are case studies where the principles learned in the first four units will be applied to broader groups of animals.

## **Grading**

Course grades are based on a cooperative learning model with participants assigned to study groups for each of the ten units within the course. At the end of every unit, each study group will electronically submit its written reconstruction of their selected animal for grading (see Reconstruction Tips under

Course Info for suggestions). For the first four units (= module 1), all groups will reconstruct the same animal. For units 5-10, each group is free to select any of the three listed animals for reconstruction.

To facilitate work on the reconstructions and to assess individual contributions to reconstructions, the following time table will be followed:

**Monday:** The new unit officially begins.

**Thursday:** Individual drafts of the unit reconstruction are due.

**Sunday:** Final group reconstruction is due.

The grade for each reconstruction will be based on both the submitted reconstruction and each individual's contributions to this reconstruction. The submitted reconstructions will be graded on a 10 point scale, with the grade determined by its overall scope and completeness.

The individual grades are based on 15 points, and the grading for individual contributions is more complicated:

**6 points** for submitting an individual draft of the reconstruction to the group's discussion space. The individual drafts should be electronically submitted to both the 'Assignment' link and your group 'Files' or 'Discussion' areas. Individual drafts should reflect a concerted effort to find, evaluate and document the available information on the animal being reconstructed in each unit. The drafts are not graded on specific details, but rather on a demonstrated effort to provide an extensive overview of the available information from reliable sources for use by the group in preparing the final group reconstruction:

- **1-2 points** = superficial review of available evidence; based on relatively few reliable references
- **3-4 points** = moderately complete review of available evidence; based on a modest number of reliable references
- **5-6 points** = extensive review of available evidence; based on large number of reliable references

**2 points** for completing the individual reconstruction on time (i.e., by Thursday).

**4 points** for actively participating in group discussions during the completion of the final reconstruction to be submitted for grading. Active participation will be defined as providing **two substantive suggestions** that move the discussion forward. Comments such as "*I don't think this portion of the answer is clear. Perhaps we should rewrite it as ...*", or "*I think \_\_\_\_\_ is more important to this process and we should place greater emphasis on it.*" would be substantive and would clearly indicate active participation. Responses such as "*Good job!*" or "*I completely agree.*" would not be considered substantive.

**3 points** for work beyond the minimum necessary for completing the reconstruction. For example, someone who made more than the minimum two substantive suggestions during the completion of the final reconstruction or who took the lead in substantially rewriting the final reconstruction would receive these points.

Note that if someone does the minimum work for a reconstruction (i.e., submits an individual response, submits it on time, and provides two substantive suggestions during the drafting of the final reconstruction), they would receive a total of 12 points (= 80%, or a B) for the individual portion of the unit discussion question. To receive an A for this portion of the grade, they would need to do work beyond the minimum and earn the remaining 2 points.

Group submissions to the unit discussion questions are due on Sunday and should be electronically posted to the 'Assignments' link. As this is a group assignment, it only needs to be posted once for all group members.

There is an additional 100 point reconstruction during the final unit of the course. Unlike the other reconstructions in the course, this one is done individually, rather than within research groups. Individual reconstructions can be done on any of the animals listed in units 5-10 that were not submitted by an individual's study group. In other words, if a group chose to submit *Opabinia* as the group assignment in unit 5, then individuals in that group could submit either *Hallucigenia* or *Anomalocaris* as their individual contribution. Unlike the other reconstructions in the course, the individual reconstructions should be submitted as PowerPoint-based TIPs (Teaching Innovations Projects), since this will provide you with an opportunity to demonstrate your ability to teach paleobiology to others.

The course grade is based on 350 points; 250 points for the ten units (15 points for individual contributions and 10 points for the group reconstruction for each unit) and 100 points for the final, individual reconstruction. ***Although the course uses a collaborative learning model with research groups, fully 83% of the points (i.e., 15 points from each of the ten units and 100 points for the final reconstruction) are due to your individual efforts.***

## Missed Work

Occasionally, course participants may miss a unit due to other obligations (e.g., illness, family obligations, etc.) Notify both the members of your group and the course staff of any absences. Missed work will be completed as an individual, rather than a group, assignment *within one week of returning to the course*.

## Readings

There is no required textbook for CLFS 609F. Most paleobiology textbooks tend to focus very heavily on the taxonomy and anatomy of specific fossil groups, while treating the critical principles of functional morphology fairly superficially.

To overcome the absence of a textbook, there are readings within the first four units that provide a condensed introduction to the use of form-function relationships in interpreting the life styles of extinct animals. These readings are provided as PDF files so they can be easily downloaded and printed. They will provide you with a thorough review of methodologies used to reconstruct life styles for extinct animals.

## Study Units

Unit	Topics/Readings	Reconstruction(s)
1	<a href="#">Paradigms Lost &amp; Found</a>	<i>Tullimonstrum</i> (chordate?)
2	<a href="#">The Problems of Scaling</a>	<i>Tupandactylus</i> (pterosaur)
3	<a href="#">The Quest for Speed</a>	<i>Stenopterygius</i> (ichthyosaur)
4	<a href="#">Ingestion by Any Means Possible</a>	<i>Pterygotus</i> (eurypterid)
5	<a href="#">Case Study 1: Protoarthropods</a>	<i>Anomalocaris, Hallucigenia, Opabinia</i>
6	<a href="#">Case Study 2: Paleozoic Sharks</a>	<i>Edestus, Helicoprion, Stethacanthus</i>
7	<a href="#">Case Study 3: Early Amphibians</a>	<i>Acanthostega, Diplocaulus, Mastodonsaurus</i>
8	<a href="#">Case Study 4: Giant Theropods</a>	<i>Giganotosaurus, Spinosaurus, Therizinosaurus</i>
9	<a href="#">Case Study 5: Mesozoic ‘Birds’</a>	<i>Ambonychia, Microraptor, Rahonavis</i>
10	<a href="#">Case Study 6: Early Whales</a>	<i>Ambulocetus, Basilosaurus, Odobenocetops</i>