FORMAT

The course will be conducted in a seminar-tutorial-project format. We will frame/outline the course together to best design it for the needs of class members, whether students are grad students or undergrads. We will then explore various topics together and the professor may range from an expert, to something of a tour guide, to even a co-explorer with the students. Learning is a life-long experience for all of us, so learning how to keep learning is an important skill. Students are expected to take an active role in discussion of assigned readings. This course will emphasize the literature on paleobiology/paleontology and, thus, each student is required to keep up with the reading assignments (this requirement cannot be over-emphasized). If it becomes apparent that students are not doing the readings, we will have pop quizzes. From time to time during the semester, each student may be required to present a paper from the literature of the listed topics. Later in the semester, we will do a research project together on crinoids and blastozoans for the NSF project: *Assembling the Echinoderm Tree of Life (AEToL)*.

PURPOSE

Paleobiology/paleontology is a huge field with many subdisciplines and, thus, it is not possible to comprehensively cover the field in a single semester, or even a lifetime! For some scientists, paleobiology and paleontology are essentially synonymous. Others parse the definitions so that paleobiology focuses on the evolutionary biology of these once living organisms now part of the fossil record, and paleontology focuses on their systematics and as objects in rocks for taphonomic, biostratigraphic, evolutionary, or paleoecologic studies. But for many geoscientists such distinctions are not necessary.

In this course we will attempt to understand 1) the methods of how paleontology is done (taxonomic methods, systematics, and cladistics); 2) look at paleobiology’s contribution to evolutionary theory; 3) review some current topics of interest mutually agreed upon; 4) learn the paleontology of a few taxonomic groups of interest; 5) visit museums to see how paleontology is practiced; 6) collect fossils on our own; and 7) demonstrate expertise by creating a poster suitable for the *Annual Meeting of the Geological Society of America*, which could be presented in Charlotte, NC, Nov. 4-7,
2012. The ultimate goal of the course is to prepare you to conduct research in paleobiology/paleontology.

**GRADES**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Presentations, Short Exercises, &amp; Participation</td>
<td>45%</td>
</tr>
<tr>
<td>Project(s)/Longer Exercises</td>
<td>30%</td>
</tr>
<tr>
<td>GSA Style Poster</td>
<td>25%</td>
</tr>
</tbody>
</table>

Research Poster: During the course of the semester we will conduct research together on the phylogenetics of Paleozoic crinoids. Each student will produce a poster on which they are first author for possible presentation at the GSA Meeting in November 2012. Having a poster to present will allow each graduate student to apply for travel funds from various sources (Geology Program, Shumaker Fund). You are encouraged, but not required, to submit a poster and attend the GSA meeting.

**FIELD TRIPS**

**Museums**
- Carnegie Museum of Natural History - a one-day trip, Thursday, Jan. 26 (weather permitting). We will start an exercise on cladistic methods by coding characters on the dinosaurs on exhibit. We will then bring that data back to WVU for computer analysis using parsimony-based methods.
- Smithsonian Institution's National Museum of Natural History - an overnight visit to see the research collections and public displays: Thursday and Friday, March 15-16. Exercise: provide a written summary and analysis of one of the paleontologic displays, including those in Oceans Hall, Human Evolution, or Dinosaurs and Fossil Invertebrates.

**Fossil collecting**
- Cincinnatian of Richmond, Indiana or Mayesville, Kentucky: overnight trip, Friday and Saturday, April 20-21, to collect Upper Ordovician marine invertebrate fossils. Students will research the paleontology and stratigraphy of the Cincinnatian of Indiana/Ohio/Kentucky and make class presentations prior to the trip. Each student will be responsible for a different topic.

**TOPICS**

**Introduction**: Read Chapters 3 and 5 of Benton and Harper, 2009, Introduction to Paleobiology and the Fossil Record. PDF on class web page.
**Systematics/Taxonomy/Classification**: the foundation of accurate studies. Minimum of 4-5 weeks.

**Systematics**: organizing taxa, hopefully in an evolutionary context. Cladistics is the mechanical means of creating a phylogenetic hypothesis. Cladistic analysis - creating phylogenetic hypotheses using the software in PAST, or **PAUP, Phylogenetic Analysis Using Parsimony**. Exercise: work with practice data sets. Project/exercise: Assemble data sets and analyze using PAST or PAUP.

**Taxonomic and Photographic Methods**: describing and illustrating specimens. How is taxonomy actually done? How can we use GEOREF? Project/exercise: Describe and illustrate a species in *Journal of Paleontology* format. Learn photographic methods. Each student may choose an appropriate specimen(s) from the Paleo collection. Perhaps from the Ordovician fossils of the Cincinnati Arch region? Good prep for later field trip.

**Working with Research Specimens**: We will catalog and pack for shipping a collection of Mississippian ammonoids. These are to be returned to the US National Museum of the Smithsonian Institution, and Ohio State University. We will also pack up specimens of crinoids from the Mississippian of Ohio to return to the Cincinnati Museum Center and the Cleveland Museum of Natural History. These specimens are the basis of a paper to be published in 2012 in the *Journal of Paleontology*, which we will review as part of class.

**Fossil Groups**

**Crinoids** - major evolutionary trends and morphology - readings from the literature. Minimum of 2-3 weeks. Analyze date in Sallan et al., 2011, on evolutionary paleoecologic patterns in Mississippian crinoids. Also work on phylogenetics of crinoids for *Assembling the Echinoderm Tree of Life (AEToL)*.

**Dinosaurs** - their evolution and paleobiology - readings from the literature.

**Possible Project** - evaluation of paleontological websites for G104 and G331.
References for Advanced Paleontology (a work in progress)

General

Dinosaurs
Sheehan, P.M. et al. 2000. Dinosaur abundance was not declining in a "3 m gap" at the top of the Hell Creek Formation, Montana and North Dakota. Geology, 28:523-526.

Systematics and Classification


PAUP data sets: [http://palaeo.gly.bris.ac.uk/services.html](http://palaeo.gly.bris.ac.uk/services.html) University of Bristol, Palaeontology Group. See Cladestore for downloadable data sets.


Origin of Phyla


**Crinoids – see separate reading list to be distributed later.**

**Readings on the Ordovician of the Cincinnati Arch for Field Trip**

Students will construct a bibliography as a class project. We will then read papers to prepare for the field trip. There may be exercises associated with preparation for the field trip in late April.


SEPM Sequence Stratigraphy Web: [http://www.sepmstrata.org/](http://www.sepmstrata.org/)

Steven Holland’s UGA Stratigraphy Lab: [http://strata.uga.edu/](http://strata.uga.edu/)

Sequence Stratigraphy: [http://strata.uga.edu/sequence/index.html](http://strata.uga.edu/sequence/index.html)

Cincinnatian Fossils and Strata: [http://strata.uga.edu/cincy/index.html](http://strata.uga.edu/cincy/index.html)