On The Cutting Edge Workshop

Innovative Approaches to Teaching Sedimentary Geology, Geomorphology, & Paleontology

16-20 June 2014

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The following is an example of a semester length set of scaffolded exercises designed to develop a student's skill set with the goals of: (1) an introduction to the sources of primary literature in paleontology; (2) providing a focused set of questions that should be asked of any scientific publication, and identification of the major points of a peer-reviewed manuscript; (3) critically reading, comparing, and contrasting two, seemingly, unrelated papers in which pertinent data in one directly affects what conclusions are drawn in the other; (4) developing an annotated bibliography of a selection of papers in preparation to write a draft manuscript; (5) proposing an original hypothesis, obtaining a paleontological data set to test the hypothesis, evaluating the trends in the data, and compiling these into a coherent, logically presented report; and (6) combining these experiences to form the basis for a term project paper, which may originate from a field-based project or topical selection of the student's choice (depending on academic year).

WHAT DO THE PALEONTOLOGISTS OF THE PRESENT DO FOR A PAYCHECK?

This question is posed to you for you to investigate. The exercise is to acquaint you with the geological literature and periodicals in the College's Library available for your studies. Your first assignment is to search through the current literature (shelved periodicals and Electronic Databases; e.g., GeoRef, Web of Science, etc.) and find recent articles published by paleontologists from 2012 to 2013 (ONLY). You are to acquaint yourself with several of the journals and electronic databases to identify paleontological articles.

You must develop a Reference list of twenty (20) articles. You are to find 3-5 articles for any four or more of the following paleontological disciplines:

Taphonomy	Evolution	Invertebrate Paleontology
Vertebrate Paleontology	Paleobotany	Palynology
Paleoecology	Paleoclimatology	Protist & Invertebrate Microfossils

- The twenty articles (20) must represent manuscripts from at least 5 different journals.
- There may not be more than 4 articles from any one journal.
- Submit a typed list of the articles in Word that is in alphabetical and chronological order, following the standard scientific format used by the Society for Sedimentary Geology (SEPM), which is available online: http://palaios.ku.edu/instructions.html
- This assignment is to be uploaded to Moodle no later than 12:00 am (midnight), Sunday, 8 September 2013.

ABSTRACTING SCIENTIFIC LITERATURE

After you have completed your bibliographic list, your second assignment is to select ONE (1) article from your submitted list of twenty to read and critique. Read the article and present a two-to-three page type-written, double spaced summary (approximately 450 words, minimum) of that article in the following format.

5. Full Bibliographic Citation.
6. Abstract - In your own words briefly describe the purpose of the manuscript, the results of the investigation, and the implications or significance of the research.
7. Using the block-copy function in Adobe, include the original abstract at the end of the paper.
8. Materials & Methods - What materials were used in the investigation, and what were the methods employed in the study?
9. Results - What did the investigator find and describe?
10. Significance - What importance or implications do the results of this investigation have on the original objectives of the study?
11. Opinion - Each researcher must objectively evaluate the information that he/she reads. In your opinion:
    a. Did the researcher complete all of the project goals?
    b. Are his/her data good data?
    c. What would you do to have modified the study (if anything)?
    d. What problems do you see with the work (if any)?
    e. Did the investigator provide sound conclusions based on his/her data set?
    f. Did you understand the manuscript? (Was it written in a manner that was easily read?)

Your file upload is due no later than 12:00 am Sunday, 15 September 2013.

ACTUALISTIC PLANT TAPHONOMY

The purpose of this exercise is to critically examine two publications related to plant taphonomy. The goal of the assignment is to have you test the hypotheses of a paleontological report with the findings of a modern botanical survey. By comparing two related articles, you will gain an understanding of how primary literature is used for synthetic purposes, and can apply this skill to the Discussion section of the term project.

You must read both of the following articles, downloadable from the Moodle site:

Meldahl, K.H., Scott, D., and Carney, K., 1995, Autochthonous leaf assemblages as records of deciduous forest communities: An actualistic study: Lethaia, v. 28, p. 383-394.

Bray, J.R., and Gorham, E., 1964, Litter Production in Forests of the World: in Cragg, J.B., ed., Advances in Ecological Research: Academic Press, New York, v. 2, p. 101-157.

- You are to write a short essay on the hypothesis(es), materials & methods, and results of Meldahl et al. (1995).
- Then you are to compare their conclusions with pertinent data presented in Bray and Gorham's summary paper. This paper has been cited more than 650 times in the literature since its publication.

- Use the data presented in Bray and Gorham's work to substantiate or refute Meldahl's et al. hypothesis(es) and research conclusions.

Your essay should be a minimum of three (3) and a maximum of five (5) double spaced pages, 12 point font. Upload your document no later than 12:30 am, Wednesday, 29 September.

There will be a one-hour class discussion concerning these assigned readings on the due date. Participation is mandatory.

Record of Life — Term Paper

Your assignments, to date, have been designed to develop your abilities in: (1) finding peer-reviewed paleontological literature across the array of disciplines and professional journals in which original research is published; (2) reading primary literature to understand what research an author has undertaken, the methodologies employed, the results obtained, and their significance; and (3) used two seemingly unrelated publications to synthesize data presented to critically evaluate a research project, and confirm or refute the author's conclusions. Now, it's time to apply these skills to a larger project.

You are required to research a paleontological topic of your choice and (1) present a 12-minute PowerPoint (or equivalent) lecture to the class after which (2) write a 5-10 page paper (double spaced, 12 point font, 1 inch margins) on that topic. The format of the paper follows: standard scientific mechanics with illustrative figures; citations indicated in the text, included at the end in a list and **NOT** incorporated as footnotes (does not count towards lower page limit), and requires an abstract of no more than 250 words. The title page with the title of your paper, your name, and affiliation is required and, also, does not count towards the minimum pagination.

Your research project must use a *minimum* of 5 references from the primary literature (i.e., peer reviewed journals). Paper topics can include any item of interest to you (i.e., why do scientists think that dinosaurs were inertial homeotherms, and what did they used to think? How do we figure out color in fossil animals? What were different brachiopod shapes useful for? Are birds dinosaurs, and why or why not? What did ammonites eat, and how do we know? What are the competing explanations for the Permo-Triassic Mass Extinction event?).

Feel free to come up with your own ideas, as well! This is an opportunity for you to explore some aspect of Paleontology that you find interesting. You will be graded on accuracy, clarity of expression and communication of your ideas, in both oral and written presentations, and on whether or not you followed technical instructions. There will be separate grading rubrics for the oral and written parts of the assignment. And, of course, plagiarism will result in a zero on your paper, and will be reported to the Dean of Students and Department Chair.
The following is the time schedule for this academic term.

- 11 October — Friday — topic choice due to me for review; we will meet individually to explore how you intend to approach the topic. If it is too broadly constrained or too narrowly focused, you may be asked to develop another paper topic. You must have your topic approved by the Instructor.
- 18 October — Friday — Class meeting with Science Librarian, Olin @ 9:00 am
- 4 November — Monday — annotated bibliography due
- 18-20 November — Monday/Wednesday — Seminar Presentations (graded; see rubric below; NOTE: peers also rate the presentation according to the rubric, and the grade is assigned on a 40:60 [student : instructor] division).
- 26 November — Tuesday — Draft papers due (graded exercise; see rubric below)
- 2 December — Monday — Reviewed papers returned

· No later than 16 December — Monday — Upload of revised papers (graded; see rubric below)

The term project will count 25% toward the final course grade using the following breakdown: Oral Presentation = 10%, Essay draft = 5%, Revised draft = 10%. Grading will be based on a set of rubrics attached to this handout. Needless to say: all of your work must be original; the use of Wikipedia, Conservapedia, or any website is strictly prohibited; any evidence of plagiarism will not be tolerates. I repeat, evidence of any transgression will result in a severe penalty.

MORPHOMETRICS & SYSTEMATICS LABORATORY

PART 1 Wednesday, 16 October 2013

Any organism, fossils included, can be distinguished descriptively (subjective) and quantitatively (objective). The first attempts at classifying organisms was based solely upon the former, while an early attempt to quantitatively describe the mechanism of shape and shape change was published by D'Arcy Thompson (1917). Some authors have come to rely on quantitative means in the description of natural form; other authors have combined the two approaches in their delimitation of species (along with supplemental data on the molecular level).

The species (or morphospecies) is the basic unit of paleontology, but because fossil species can't be defined as biological species, several questions arise:

· What characteristic features are used to define species?

· How much variation can be accommodated in a sample suite before a new species is recognized or separated?

· How can data be manipulated and displayed to demonstrate population variance?

You will select a genus from the following suite of fossil collections and address these questions using morphological and morphometric approaches. These are used routinely to describe species within a genus.

Mucrospirifer brachiopod (Devonian)	*Kingena* brachiopods (Cretaceous)	*Scapanorhynchus* teeth (Cretaceous)
Turritelid gastropods (Miocene)	Irregular echinoid (Pliocene)	

· Once you have identified the features preserved on your samples (consulting your textbook, The Treatise on Invertebrate Paleontology, and other references), describe the features, and detail their characteristics. ***This is the qualitative (morphological) approach***.

· ***Using the qualitative characters you believe separate "species,"*** divide (if possible) your collection into those individual groups. These form your "hypothesis" of how many species exist in your collection. Don't forget to account for taphonomic overprinting that may have effected your organisms post burial. How many species do you there you have in your collection? Propose a hypothesis.

HYPOTHESIS : There are _____taxa in my collection based on the following characteristics:

_____

Next, develop a morphometric data set that can be used to mathematically describe each fossil population that you suspect are separate species (or not). ***This is the quantitative (numerical) approach.***

What to measure? Once you've become familiar with your organism, the selection of parameters to be measured becomes self-evident (almost). In most cases, parameters will include (1) straight-line measurements (e.g., shell length); (2) an angle (e.g., apical angle); or (3) the number of a particular

feature (e.g., number of ribs). Additional parameters can be generated by the development of ratios between two or more of the measurements (e.g., length:width ratio — a crude measure of shell shape).

How do you minimize operator error? Once you've determined what you want to measure, there is always the possibility that your measurements will vary from reality. This may be a function of the equipment (sensitive to changes in temperature) or operator (recall what you've learned with the class measurements of skulls). Therefore, it is essential to reduce error to the minimum.

- Reducing error can be done by multiple measurements of the same parameter for each sample in the population.
- Measurements should be done by the primary investigator on separate occasions (one or more days apart), with compensation for equipment error.
- Then, each set of measurements should be analyzed and tested to see if significantly different statistical measures are calculated for each of the data sets.
- If statistically significant errors are found between data sets, you should determine the reasons behind the error before continuing with data collection.

Citation

Thompson, D'Arcy W., 1917, On growth and form: Cambridge University Press, Cambridge, 793 p.

MORPHOMETRICS & SYSTEMATICS LABORATORY**: DATA ANALYSIS**

Friday 18 October 2013

Univariate data are typically depicted as a histogram that provides a clear visual presentation of the recorded values throughout the range of the variable measured. It is important to determine whether or not the form of the histogram is biased by either poor sampling or closure. Poor sampling, mainly caused by small sample size or bias to large (or small) specimens, may result in a bimodal distribution of the data. Closure, on the other hand, occurs when there is an upper limit on a particular variable (the maximum number of segments in a trilobite). The shape of the resultant histogram is a function of growth rates, recruitment rates (the number of individuals that colonized and/or coexisted within a particular area), and mortality rates (when an organism reaches a specific size and/or age, it dies).

From these empirical data (descriptive and quantitative), you are to determine if there is one, two, three or more species represented in your assemblage. You also should determine the range in taphonomic variation within your population.

When you have completed your analysis, you are to write a short report (1000 word maximum) in which you:

- Detail the morphological variation in your sample population,
- Present the results of your data, and
- Interpret your data.

Other things that you may want to consider in your report include:

- What is the growth strategy of the genus and how did you determine it?
- Does your fossil organism display isometric or allometric growth?
- Is it possible to demonstrate this relationship graphically from your data?
- How can you test this interpretation?

Some Basic Descriptive Statistics that can be found in many spreadsheet (@) functions (**check your spreadsheet for the appropriate @ function or statistical function; Excel uses the = sign to indicate a mathematical function**) and/or statistical packages. Consult the Excel tutorial handout for help.

DETAILS ON AVAILABLE STATISTICAL PROGRAMS ARE PROVIDED TO THE STUDENT, BUT OMITTED IN THIS HANDOUT TO SAVE SPACE.

A report on your analysis is due on Monday, 21 October. Your report should include:

- Title page
- Abstract (250 words)
- Introduction to the problem, organism studied, and hypothesis tested (number of species identified using qualitative assessment)
- Methodologies for both qualitative and quantitative analysis
- Results including qualitative evaluation and quantitative assessment with supporting data graphs
- Discussion
- Conclusions
- Citations (if used)

The report will be critiqued, evaluated, and returned for revision upon which the grade for this assignment will be based.

Name:	GE 251 — Presentation Rubric		
Topic:			Total Score —
Content (5%)			
Topic Unannounced — Audience has no idea what is to be covered	Vaguely describes the topic of the lecture		Clearly explains the topic of the lecture
0	3		5
Completeness of Topic Discussion (25%)			
One or more points omitted	Majority of points not treated in detail	Majority of points treated in some depth	Thoroughly explained all points
6	9	12	15
Presentation Timing (5%)			
Presentation <11 minute minimum	Presentation timing 11-12 minutes		Presentation timing >12 minute maximum
6	10		6
Professionalism of Presentation (20%)			
Inarticulate and confusing, audience has difficulty hearing lecture. Incorrect pronunciation of terms.	Presentation not clear, thoughts do not flow logically, audience not engaged. Incorrect pronunciation of terms.	Articulate and clearly organized; pronunciation of most words correct. Audience not particularly engaged.	Presentation well organized, interest level of the audience is maintained.
5	10	15	20
Visual Aids (15%)			
Poor, distracts audience and are hard to read.	Most add nothing to presentation; act as	Not well developed, engaging, or	Visual aids enhance presentation, are pertinent and utilized in

	window dressing only. Misspellings and/or grammatical errors.	utilized in the lecture; few misspellings and/or grammatical errors.	the lecture. No misspellings or grammatical errors.
5	9	11	15
Eye Contact (10%)			
Does not attempt to look at audience, reads only notes or PowerPoint slides.	Focuses attention on one particular part of the audience, does not scan class.	Occasionally looks at someone or some groups during talk.	Constantly looks at audience, does not rely on notes or PowerPoint to discuss points.
2	4.5	7	10
Vocal Skills and Enthusiasm (10%)			
Shows absolutely no interest in topic.	Demonstrates some negativity towards subject presented.	Occasionally shows positive impressions about the subject.	Demonstrates strong positive feelings about the topic during entire presentation.
0	7	11	15
Subject Knowledge (10%)			
Does not have competent understanding of subject; unable to answer questions	Uncomfortable with information, answers are at a rudimentary level of understanding	Confident with answers to the questions, but unable to elaborate in detail	Demonstrates full knowledge (more than required) by answering questions with explanation and elaboration
3	5	7	10

Term Paper Evaluation Rubric Name:					
				Draft (26 Nov)	**Final Term Paper**
ABSTRACT (250 word maximum; 10%)					
Absence or incomplete reason for essay; incomplete results presentation; no attempt at broader project significance	Incomplete statement of problem/hypothesis; results section not synthetic; some attempt to indicate significance	Comprehensive problem statement; succinct presentation of results; significance to broader question provided		3%	7%
2	6	10			
INTRODUCTION (20%)					
Problem statement absent or incomplete; cursory background of problem addressed; little insight into purpose of study	Cursory statement of problem; satisfactory discussion on problem background, but minimal depth; statement of project purpose present	In depth demonstration of background information; well developed statement of problem; reason for study clearly stated with implications		5%	15%
6	13	20			
RESULTS (20 %)					
Fossil group or topic under discussion is not made clear to the reader; very generalized patterns identified without spatial or temporal context; a limited use of available literature	Fossil group or topic is clear but errors about these are present; patterns in the data are confusing; may be some problems with the way in which temporal and spatial patterns are ordered or presented	The fossil group or topic and their pertinent features are made clear to the reader; data patterns are presented logically both in time and space; there is little confusion imparted to the reader		5%	15%
6	13	20			
DISCUSSION (30%)					
No attempt at synthesis of literature; few relevant comparative studies used; little or no insight into the application of data	Confusing or illogical order of presentation; incorporation and use of minimum pertinent comparative literature; some attempt at application of results to project	Logical presentation of synthesis; patterns identified and compared to appropriate literature base; broader application of project results addressed		5%	25%
10	20	30			
CITATIONS (10%)					
Several text citations are missing in the references; SEPM format not followed	1-2 text and/or literature citations are missing; a few format errors exist	All citations present; format problems exist	All citations present; formatting correct	3%	7%
4	6	8	10		
FIGURES (10%)					
Poorly developed or missing; absence of captions or captions uninformative	All necessary figures are present; captions terse and uninformative; figures of moderate quality	All figures well developed and necessary; high quality; captions sufficient and informative		3%	7%
4	7	10			
TOTALS					