Syllabus

GEL298: Foundations of Geo/Paleobiology

COURSE DESCRIPTION: This course will introduce students to core concepts in paleobiology and geobiology. The class provides graduate students with a common set of terminology, background, and foundational scientific literature. It illustrates the diversity of research in geo/paleobiology. The course also focuses on professionalization skills including: how to formulate testable hypotheses, generate and evaluate data, and effective scientific communication.

MEETING TIME: Tu/Th 2:30 p.m. – 4:00 p.m.

INSTRUCTOR: Dr. David Gold

OFFICE HOURS: By appointment

EMAIL: please send emails through CANVAS. If you do not receive a response in 24 hours, please send a follow-up message.

GRADING: Students will be graded on their participation in three areas: discussion, writing, and speaking. Each discussion will be led by one graduate student. The student will be graded on their ability to lead and foster discussion, and other students will be graded on their preparedness to engage the text. There will also be one writing assignment, worked on throughout the class, and a 10-minute presentation the final week. The writing and speaking assignments will be workshopped through the quarter, so the Dr. Gold can work with any student having difficulties.

SCHEDULE:

Lecture 1 (Th): What is Geo/Paleobiology? What is science?

Lecture 2 (Tu): Foundational thinkers: Charles Lyell and Charles Darwin

Discussion (**David Gold**): *The Logic of Scientific Discovery* by Karl Popper, Chpt.1. *Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective* by Donna Harroway.

Lecture 3 (Th): The taxonomy of fossils.Variation exists between fossils • Biological sources of variation: ontogeny, population biology, evolution • Species concepts and modes of speciation.

Writing workshop: developing a hypothesis.

Lecture 4 (Tu): Principles of molecular biology. DNA, RNA, and proteins • Homologous genes and conserved protein domains • Lateral versus horizontal inheritance of genes

Discussion (**Noemie Sierra**): The Origin of Species by Natural Selection. Chpt 4,9,10. Charles Darwin

Lecture 5 (Th): Molecular phylogenetics. Cladistics • Phylogenetics/Phylogenomics • The current hypothesis for the tree of life, noting which clades do and do not have good fossil records • Genes and species can have distinct evolutionary histories (gene trees versus species trees) • Molecular clock reconstruction • Ancestral state reconstruction

Writing workshop: Mapping an argument

Lecture 6 (Tu): When are where fossils occur. Biostratigraphy • Plate tectonics • Biogeography • Dispersal and vicariance over large and small spatial scales

Discussion (**TBD**): Phylogenetics reading(s)

Lecture 7 (Th): Biases in the fossil record. Biomineralization • Taphonomy • Impact of sedimentation and erosion • Historical biases regarding where people look for fossils

Writing workshop: Drafting abstracts

Lecture 8 (Tu): Macroevolution • Testing for "adaptive" radiations • Rates of evolution • Rates of extinctions • Speciation and extinction models

Discussion (**Daniel Kramer**): Biomineralization reading(s)

Lecture 9 (Th): On growth and form. Functional morphology • Adaptation (natural selection) versus constraint (common ancestry) • Biomechanics • Evo-devo and heterochrony.

Writing workshop: Literature review

Lecture 10 (Tu): Paleoecology. Organism-environment interactions over short and long timescales • Niche partitioning • Energy flow through communities • Biotic and abiotic interactions • Macroevolutionary trends driven by ecological interactions.

Discussion (**Steven Mendonca**): Functional morphology reading(s)

Lecture 12 (Th): Conservation paleoecology. Principles of conservation biology • Testing patterns of fossil community change through extinction events • Defining the Anthropocene

Discussion (**Ben Faulkner**): Evolutionary developmental biology reading(s)

Lecture 13 (Tu): Paleobiogeochemistry I. Stable isotopes • Clumped isotopes • Raman spectroscopy • Biotic and abiotic processes that impact isotope ratios.

Discussion (**Hannah Kempf**): Conservation paleoecology reading(s)

Lecture 14 (Th): Paleobiogeochemistry II. Molecular fossils • Ancient DNA and proteins • Lipid biomarkers

Writing workshop: Evaluating background sections.

Lecture 15 (Tu): Microbiology I. A survey if microbial diversity. • The holobiont concept • The role of microbes in development and homeostasis of multicellular organisms

Discussion (**Audrey Miller**): Isotope geochemistry reading(s)

Lecture 16 (Th): Microbiology II. Microbial regulation of energy fluxes and geochemical cycling • The role of microbes in taphonomy

Lecture workshop: how to give a good talk

Lecture 17 (Tu): Metagenomics: Reconstructing microbial communities • Identifying microbial metabolisms

Discussion (**Tessa Browne**): Microbiology reading(s)

Lecture 18 (Th): Earth/Life Interactions: Elements through deep time (silica, oxygen, carbon, etc.) • The role of organisms in nutrient cycling, ocean mixing, and bioturbation

Lecture 19: Justice and Ethics in Geosciences: Fossil dispossession, the public image of paleontologists, diversity.

Discussion (**Belyn Grant**): Justice and ethics reading(s)

Lecture 20: Presentations