

THE WAGNER FREE INSTITUTE OF SCIENCE

Winter 2018
BIOLOGICAL SCIENCES/PALEONTOLOGY SERIES
Macroevolution and the History of Life
Professor Jason Downs

This course is co-sponsored by the **University of Pennsylvania Museum of Archaeology and Anthropology**, located at 33rd and Spruce Streets, Philadelphia. The entrance for the course is at the east end of the building.

8 Saturdays from January 27 – March 17, 2018

LECTURES ARE HELD FROM 10:30 AM TO NOON

Course Description

“Nothing in biology makes sense except in the light of evolution.” –Theodosius Dobzhansky

An understanding of evolution allows us to see the connections that unify all organisms that have ever lived on Earth. The study of evolution occurs at all scales of space and time. You can compare the ratios of gene variants in a population from one generation to the next, or reconstruct the pattern of change in a globally-distributed lineage across hundreds of millions of years. This course will view evolution from the grandest perspectives. The way that groups of organisms, species, groups of species, and entire lineages change over time is impossible to understand by simply scaling up microevolutionary process. Our focus in the course will be on macroevolutionary process and patterns in the history of life. Our ability to protect biological diversity in the modern world is aided by our understanding of this history and the agents of macroevolution that helped to shape it.

Note: The topics of the lectures were not covered by last spring’s course, ‘Evolution: Process and Pattern.’ If you attended that course, this will serve as a fitting companion course. If you did not, it will be a very welcoming place to begin your studies of the science.

Course Schedule

1. Saturday, January 27, 2018 – Introduction to macroevolution; Evolution of development

This lecture will introduce the course and present the evolutionary field of “evo-devo.” Development refers to bodily change within the lifetime of a single organism. Development itself evolves and understanding these processes is essential to understanding the origin of diversity.

2. Saturday, February 3, 2018 – Population genetics; Evolution of continuously varying traits

In this lecture, we will study the evolution of continuously varying traits (e.g., shades of color, sizes of bodies and body parts, among others). Many genes are involved in the evolution of such traits. We will examine how we determine the heritability of such traits and how they will respond to natural selection.

3. Saturday, February 10, 2018 - Natural selection of groups and species

Natural selection acts upon all scales of biology including groups of individuals and species. This lecture will explain what is meant by group or species fitness and why species selection is impossible to understand from the selection of individual traits.

4. Saturday, February 17, 2018 - Biogeography

Biogeography is the study of how geographic distributions of species change over time. Biogeographic data may be used to correlate geological formations across space or to reconstruct the origins, migrations, expansions, contractions, and extinction of species.

5. Saturday, February 24, 2018 – Extinction and radiation

Extinction is a necessary part of the history of a species or a more inclusive lineage. We will discuss how extinction is studied and look at Earth's mass extinctions. Mass extinctions present opportunity for the radiation of new forms to fill the void. We will look at how modern diversity is ultimately the product of past extinctions.

6. Saturday, March 3, 2018 – The origin of life

It is a remarkable assumption that all of life on Earth is descended from a single original organism and that all living things are therefore related to one another. This lecture will address the origin of the life and the context in which it occurred. We will learn that there was a moment in Earth's history when the origin of life was possible and that time has likely passed.

7. Saturday, March 10, 2018 – From water to land: The terrestrialization of life

The Devonian Period is a time of major biological advances into Earth's terrestrial geography. Plants, arthropods, and vertebrates participate in this shift to land and all diversify in the new space. Professor Downs will share his recent research on the fin to limb transition in vertebrates.

8. Saturday, March 17, 2018 – Major transitions in vertebrate locomotion

This class will examine at least three major transitions in vertebrate locomotion: the origin of flight in birds and in bats and the origin of secondary aquaticism in cetaceans (whales and dolphins). It will incorporate recent research on fossils representing key intermediate forms.

Saturday, March 24, 2018 – make-up class (if needed)

Recommended Readings

Evolution. Douglas J. Futuyma. Sinauer Associates, Third Edition, 2005. ISBN 978 1605351155.

Endless Forms Most Beautiful: The New Science of Evo Devo. Sean B. Carroll. W. W. Norton & Company, 2005. ISBN 978 0393060164.

Dr. Jason Downs is Assistant Professor of Biology at Delaware Valley University. He is also a Research Associate at the Academy of Natural Sciences in the Vertebrate Paleontology Group, where he has done active research since 2006. He was one of the team members who discovered the Tiktaalik roseae, a specimen that shed new light on the vertebrate transition to land. Dr. Downs has been teaching for the Wagner since 2012.