

## OEB/EPS 56

# The History and Evolution of Life on Earth

### Course instructors

- **Nadja Drabon**, Earth and Planetary Sciences – [ndrabon@fas.harvard.edu](mailto:ndrabon@fas.harvard.edu)
- **Javier Ortega-Hernández**, Organismic and Evolutionary Biology – [jortegahernandez@fas.harvard.edu](mailto:jortegahernandez@fas.harvard.edu)

### Teaching Fellows:

- **Lucy Wilson**, Organismic and Evolutionary Biology – [lucy\\_wilson@g.harvard.edu](mailto:lucy_wilson@g.harvard.edu)
- **Emily Stoll**, Earth and Planetary Sciences – [estoll@fas.harvard.edu](mailto:estoll@fas.harvard.edu)

### Preceptor:

- **Chloe Anderson**, Earth and Planetary Sciences – [chloeanderson@fas.harvard.edu](mailto:chloeanderson@fas.harvard.edu)

### Meeting

Lectures - Monday and Wednesdays 10:30-11:45am

Laboratory practical – Wednesday 3:00-5:45pm.

### Description

Within our solar system, Earth is distinguished as the planet with life. Living organisms are complex entities that originated from planetary processes, have been sustained by the same processes for approximately four billion years, and have fundamentally affected the functioning and composition of the Earth's surface and atmosphere. In this course we will investigate the ways that Earth and Life interact with each other in deep time, focusing on the biogeochemical cycles of major elements, and the interplay between complex organisms and their ever-changing environment. Throughout the course you will obtain key knowledge and practical skills that will allow you to interpret the fascinating history of Life captured in the rock record, and how living organisms have built the world as we know it today.

### Grading system:

30% mid-term  
20% weekly lab assignments  
20% student presentations  
30% final exam

**Reading:** Reading assignments are provided for each lecture. These will primarily be from the course text, but will also include a moderate number of other, accessible articles.

**Participation:** Students are expected to attend synchronous bi-weekly meetings and the lab section. Further, students will be expected to schedule a brief, 15 minute “get to know you” meeting with one of the course instructors within the first 2 weeks of class. In class participation is always welcomed.

**Class norms:** Lectures and practical sessions will take place in-person. In the need of self-isolation, the course instructors will accommodate a remote viewing of the lecture via Zoom. It is important to contact the course instructors immediately if self-isolation is needed to make preparation for a remote delivery in a timely manner.

### Prerequisites

Any of the following classes: EPS 10, 21, EPS 22, OEB 10, or permission from the instructor.

## OEB/EPS 56

### The History and Evolution of Life on Earth

**Academic support:** Please don't hesitate to reach out to any member of the teaching team with any concerns or difficulties that you're experiencing. We hope to help with the transition to in person learning however we can! Additional resources are available through Harvard's Academic Resource Center: <https://academicresourcecenter.harvard.edu/college-students> which offers individual consultations, workshops, and tutoring services. Any student needing academic adjustments or accommodations is requested to present a letter from the Accessible Education Office (AEO) and speak with the professor by the end of the second week of the term. All discussions will remain confidential, although the AEO may be consulted to discuss appropriate implementation.

**Spring fieldtrip to Utah:** The course will include an *optional national fieldtrip* to visit Paleozoic and Mesozoic fossil localities in the state of Utah, Western USA. The fieldtrip will take place during Spring break, specifically from March 10<sup>th</sup> to 16<sup>th</sup> 2024. All costs associated with the fieldtrip will be covered by the organizing departments, but students are required to bring appropriate clothing and personal items. We will circulate more instructions and recommendations about the fieldtrip during a dedicated briefing session on Week 8. Please get in touch with the course instructors, teaching fellows or preceptor if you have any questions or might require any accommodations during the fieldtrip.

**Student presentations:** Students will have time to prepare oral presentations on Week 10 after the Spring fieldtrip, which will be delivered during Week 10. We expect a total of four to six presentations depending on class size, half on each class day for Week 10, and they will require students to work in small groups (3 to 4 individuals) to provide a more in-depth overview of a specific topic related to the course. We will provide more details about the topics, objectives and format of student presentations during the course.

**Statement of Artificial Intelligence use:** The course is designed to provide active learning and engage students with material directly. Although the course instructors do not actively discourage the use of Artificial Intelligence (AI) resources as potential tools that might aid studying sessions or summarizing course material outside of class, the use of such AI resources during graded examinations is strictly prohibited.

**Academic integrity:** Course attendees agree to adhere to the Harvard College Honor Code as outlined below (more information at <https://honor.fas.harvard.edu/honor-code>):

*Members of the Harvard College community commit themselves to producing academic work of integrity – that is, work that adheres to the scholarly and intellectual standards of accurate attribution of sources, appropriate collection and use of data, and transparent acknowledgement of the contribution of others to their ideas, discoveries, interpretations, and conclusions. Cheating on exams or problem sets, plagiarizing or misrepresenting the ideas or language of someone else as one's own, falsifying data, or any other instance of academic dishonesty violates the standards of our community, as well as the standards of the wider world of learning and affairs.*

## OEB/EPS 56

### The History and Evolution of Life on Earth

#### Lecture and Lab schedule

<b>Week 1 – Welcome to the history and evolution of life on Earth</b>
<b>Session 1. M Jan 22:</b> Introduction to course, the language of stratigraphy and the fossil record (JOH)
<b>Session 2. W Jan 24:</b> How to tell time – introduction to basic geology (ND)
<b>No Lab this week</b>

<b>Week 2 – A brief introduction to planet Earth</b>
<b>Session 3. M Jan 29:</b> Sediments: the book of Earth's History (ND)
<b>Session 4. W Feb 31:</b> The Hadean Eon: making Earth habitable (ND)
<b>LAB 1: The rock cycle, sedimentary rocks, and depositional environments</b>

<b>Week 3 – Origin and early evolution of the first life forms</b>
<b>Session 5. M Feb 5:</b> The Archean Eon: conditions for an early biosphere (ND)
<b>Session 6. W Feb 7:</b> Life during the Archean and the Great Oxidation Event (ND)
<b>LAB 2: The Carbon cycle</b>

<b>Week 4 – The rise of complex Life</b>
<b>Session 7. M Feb 12:</b> Life during the Proterozoic (JOH)
<b>Session 8. W Feb 14:</b> Neoproterozoic Snowball Earths (ND)
<b>LAB 3: The nature of fossils and fossilization</b>

# OEB/EPS 56

## The History and Evolution of Life on Earth

<b>Week 5 – Invention of the modern biosphere Part 1</b>
<b>W Feb 19 President's Day, no class</b>
<b>Session 9. W Feb 21:</b> The Ediacaran Period and the dawn of animals (JOH)
<b>Review session for Midterm Exam</b>

<b>Week 6 – Invention of the modern biosphere Part 2</b>
<b>Session 10. M Feb 26:</b> The Cambrian Explosion and the origin of the Phanerozoic biosphere (JOH)
<b>W Feb 28 Midterm Exam</b>
<b>No lab this week</b>

<b>Week 7 – Invention of the modern biosphere Part 3</b>
<b>Session 11. W Mar 4:</b> The Great Ordovician Biodiversification Event (JOH)
<b>Session 12. M Mar 6:</b> Silurian reefs and the Devonian Nekton Revolution (JOH)
<b>Pre-fieldtrip briefing session</b>

<b>Week 8 – Sedimentological and paleontological evidence in the field</b>
<b>Fieldtrip – March 10<sup>th</sup> to 16<sup>th</sup> (Utah, Western USA)</b>

<b>Week 9 – Preparation for student presentations</b>
<b>M March 18: No class – preparation for student presentations</b>
<b>W March 20: No class – preparation for student presentations</b>
<b>No lab this week</b>

## OEB/EPS 56

### The History and Evolution of Life on Earth

<b>Week 10 – Select topics in sedimentology and paleontology</b>
<b>Session 13. M March 25:</b> Student presentations (groups 1 to 3)
<b>Session 14. W March 27:</b> Student presentations (groups 4 to 6)
<b>LAB 4: Stromatolites and microfossils – the fossil record of early life</b>

<b>Week 11 – Life on land and the Great Dying</b>
<b>Session 15. M April 1:</b> Terrestrialization and the evolution of life on land (JOH)
<b>Session 16. W April 3:</b> The Permian Mass Extinction (ND)
<b>LAB 5: Paleozoic life in the sea and land</b>

<b>Week 12 – Life during the Age of Reptiles</b>
<b>Session 17. M April 8:</b> The Mesozoic Marine Revolution (JOH)
<b>Session 18. W April 10:</b> Terrestrial evolution during the Mesozoic (JOH)
<b>LAB 6: Mesozoic life in the sea and land</b>

<b>Week 14 – The demise of dinosaurs and the rise of mammals</b>
<b>Session 19. M April 15:</b> The end-Cretaceous Mass Extinction (ND)
<b>Session 20. W April 17:</b> Life during the Cenozoic (JOH)
<b>LAB 7: Cenozoic life in the sea and land</b>

## **OEB/EPS 56**

### **The History and Evolution of Life on Earth**

<b>Week 15 – Life during the Ice Ages</b>
<b>Session 21. M April 22:</b> Life during the Ice Ages (ND, JOH)
<b>Session 22. W April 24:</b> Evolution and climate change during the Anthropocene (ND, JOH)
<b>LAB 8: Reconstructing past climates</b>

<b>Final Exam (May 2024, date TBC)</b>
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