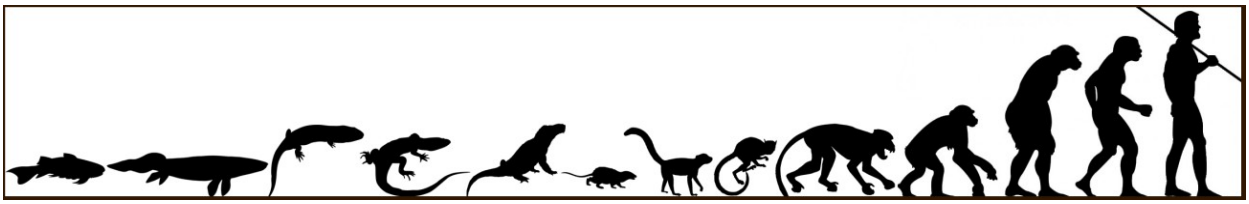
Geology 134: Evolution and Extinction



Instructor:
Daniel Segessenman (dsegesse@gmu.edu); **Classroom**: Exploratory Hall 1309, **Office**: Exploratory Hall Rm. 3420, **Office Hours**: Tuesdays 9-11 AM & Thursdays 1-3 PM, **Textbook**: None; we will have readings/videos that I will provide via Canvas

Credit Hours: Three in-person lectures per week (~50 minutes each) plus time required outside of class to complete readings, quizzes, tests, and other assignments constitutes **3 credit hours**. 'In-class' time will be ~3 hours per week with the lectures. Weekly 'out-of-class time' will be ~3 hours maximum per week between the quizzes and readings. However, it will likely take you less than 3 hours to complete the weekly out of class assignments.

Mason Core: Geology 134 belongs to the Natural Science category of Exploration Courses in the Mason Core (https://masoncore.gmu.edu/). As such, this course has been designed to address the following learning outcomes:

- Understand how scientific inquiry is based on investigation of evidence from the natural world, and that scientific knowledge and understanding:
a) evolves based on new evidence
b) differs from (but is not necessarily superior to) personal and cultural beliefs

- Recognize the scope and limits of science

- Recognize and articulate the relationship between the natural sciences and society and the application of science to societal challenges (e.g., health, conservation, sustainability, energy, natural disasters, etc.)

- Evaluate scientific information (e.g., distinguish primary and secondary sources, assess credibility and validity of information)

- Participate in scientific inquiry and communicate the elements of the process, including:
a) Making careful and systematic observations
b) Developing and testing a hypothesis
c) Analyzing evidence
d) Interpreting results

Lecture Time: **9:30 – 10:20 AM MWF**; **Lectures will be in Room 1309 in Exploratory Hall** during this time for lecture content. PDFs of slides will also be uploaded to their respective module on Canvas for ease of access and review. A portion of the weekly online quizzes (every weekend) will be from that week's lecture material.

Weekly Readings/Media: There will be weekly readings and assignments, which may include watching select videos. These will be clearly indicated each week through Canvas and in the lecture. A portion of the weekly online quizzes will be on material from the readings/media for that week. Many readings will be from the textbook from this class. Any readings outside of the textbook will be provided on Canvas.

Course Overview: I will work to provide you with the best learning experience that I can using the tools that are available to me. It is important to remember that the more effort you put into this course, the more you will get out of it. You will get the most out of this course by being present for lecture, completing the weekly content, and asking any questions you may have during lecture, on the Canvas discussion board, in-person during office hours, or by emailing me.

What to expect each week for this course:

1) **Day 1 (Wednesday, January 21st 10:30-11:20 AM) will be our first lecture**. Following that, we will meet from 10:30-11:20 AM Monday, Wednesday, and Friday. Lecture slides will also be uploaded as PDF files for ease of access and review.

2) As part of Monday's normal lecture at 10:30 AM, I will address 'Gots and Nots' from the previous week (common content questions) which will be collected after each lecture. This system will be explained in more detail in class.

3) There will be one weekly online quiz (1 attempt), which will ask questions based on the weekly reading and lecture content. Quizzes are timed (30 minutes) and will be 15-20 multiple choice questions. They are open-book, open-note. Online quizzes will open Friday after lecture and close Monday before lecture. See schedule for exact details. Quizzes will be found on the GEOL 134 Canvas page under modules or assignments.

4) I will not be making study guides for the unit tests; the lecture notes and weekly quizzes are the best study material!

5) The Final will be on Wednesday May 6th from 10:30 AM to 1:15 PM in our normal classroom (Exploratory Hall 1309). I will schedule a review between our last class on the Final.

Grading: If you listen to and take notes during lecture, attend reviews, and complete the readings, quizzes, and assignments, good grades will follow! Here is a breakdown of grade weights for your final grade:

Assignment	Weight	Notes
Weekly Quizzes, Assignments, Attendance	55.00%	online, out-of-class/in-class, multiple choice
Test (Unit 1)	10.00%	multiple choice + short answer, unit 1 only
Test (Unit 2)	10.00%	multiple choice + short answer, unit 2 focus
Test (Unit 3)	10.00%	multiple choice + short answer, unit 3 focus
Test (Unit 4); Final	15.00%	multiple choice + short answer, cumulative
TOTAL	**100.00%**	**-**

Grades are expected to be on the following scale:
A+ 100-97%, **A** 96-93%, **A-** 92-90%, **B+** 89-87%, **B** 86-83%, **B-** 82-80%, **C+** 78-77%, **C** 76-73%, **C-** 72-70%, **D** 69-66%, **F** <= 65%

Late Work Policy: If you need an assignment extension or cannot complete an assignment (for example a quiz or test) on time due to illness, logistics issues, necessary travel, or otherwise, let me know as soon as you can. This should be done before-hand, if possible, otherwise I cannot guarantee that you will be able to make up assignments after they are due. I can be flexible, though communication will be of the utmost importance.

Course Learning Objectives: This course will cover a wide range of content detailing the scientific theory of evolution, processes that drive evolution and extinction, and the role that geological processes and physical environments play in shaping life on Earth. We will explore the relationships between how organisms and environments have influenced each other in the past and how they continue to do so today. The complete content of this course can be split into four overarching units: 1) The theory of evolution: what is it and how was it developed?; 2) The driving mechanisms of evolution and extinction; 3) Constructing a habitable Earth and the origins of life; and 4) The history of animal life on Earth, up to the evolution of our ancestors and the modern day. By the end of this course, we will have covered the following overarching topics within the 4 units mentioned above:

Unit 1) Theory of evolution origins and description

- Fundamentals of scientific process
- Foundation of scientific inquiry and how it differs from other inquiry methods
- How to have a scientific perspective and practice open-mindedness
- Historical origins of the study of nature and development of the theory of evolution
- Process of natural selection
- Different types of selection and how they result in changes to organisms over time

Unit 2) Genetic (intrinsic) and environmental (extrinsic) drivers of evolution

- Mendelian genetics and simple gene expression
- Central Dogma of biology and define key molecular components of it as a process
- Key mechanisms of gene expression and regulation during organism development
- Meaning of morphological and genetic similarities/differences between organisms
- Modes of speciation and extinction
- How environment/ecology influences species development
- Modern examples of evolutionary process and rate

Unit 3) Physical construction of a habitable planet and origins of life on Earth

- Nature of the fossil record and its general properties as an archive for evolutionary change of organisms
- Geologic time scale, how it is divided, and how geologists can tell the timing and rates of Earth and evolutionary change
- Geologic time periods names and some important dates in Earth's earliest geologic history
- Origins of Earth as a planet and the chemical elements/processes that sort and concentrate them during solar system formation
- Factors that regulate planetary atmosphere, why Earth's atmosphere is anomalous compared to other planets', and how this relates to life and environment
- Hypotheses of how life started on Earth
- Fossil record of early life on Earth (1st 3+ billion years)

Unit 4) The history of animal life on Earth

- Origins of animal life as we know it and the separation between the ancient eons of Earth from the modern eon; the Phanerozoic (last 539 million years)
- 'Big picture' trends in macroevolution and patterns of evolution in the last 539 million years of Earth history
- Basis for the recognition of mass extinctions of Earth history and how this relates to the modern day
- General feedbacks of how changing environments have changed organisms on local/global scales and how organisms have shaped their local/global environments
- Basic steps in the history of the evolution of our own species, *Homo sapiens*
- How paleontologists, biologists, ecologists, and climate scientists work together to use the past and present to predict the future

Summary Course Goals: By the end of the course, we will have covered the process of the scientific method, how evolution relates to your day-to-day life, and how it affects humanity in the past, present, and in the future. I want you to be able to start to see in your mind's eye the complex network of actions and reactions that have shaped life for the last ***4 billion years*** of Earth history and how that contributes to you as an individual, to the rest of our species, and to all life on Earth today.

Academic Integrity Statement: Unit tests (three) and the Final will be given in-class during the normal lecture time. For the weekly online quizzes, I encourage you to connect with other students to work together and discuss. The unit tests and the Final will be solo assignments. It is expected you will do your own work for these assessments. Note that using AI products to complete your work such as (but not limited to) ChatGPT, Grok, Gemini, etc., does not count as doing your own work. Here are links to George Mason University's policies on Academic Integrity:

GMU Office of Academic Integrity Honor Code: https://oai.gmu.edu/full-honor-code-document/

GMU Policy on Responsible Use of Computing: https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/

GMU Code of Student Conduct: https://studentconduct.gmu.edu/wp-content/uploads/2022/08/GMU-Code-of-Student-Conduct-2022-23.pdf

Diversity of Views and Opinions: By virtue of course content, human origins, futures, and many other societally relevant topics are addressed, both explicitly and implicitly. At no point will the purposeful and disrespectful marginalization of any individual, or their beliefs, be tolerated. Respectful disagreement, and dialogue focused on those disagreements, is encouraged. **Disagreement does not constitute disrespect**. It is imperative that the distinction between scientific inquiry and other human pursuits be understood and maintained. A key learning objective of this course is to distinguish between different modes of investigation, to appreciate their strengths, weaknesses, compatibilities, and differences so that we can appreciate how all have contributed to our current understanding of our world.

Disabilities: Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit https://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500.
Email: ods@gmu.edu | Phone: (703) 993-2474

Campus Resources for Personal Support:

• https://learningservices.gmu.edu/campus-resources/

Title IX: Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Non-Confidential Employee," and must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-993-3686 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance or support measures from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu.

Course Weekly Rhythm:

<table>
<tr><th></th><th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th><th>Saturday</th><th>Sunday</th></tr>
<tr><td rowspan="2">Lecture</td><td>Old Quiz closes 9 AM; Lecture 10:30-11:20 AM</td><td>-</td><td>Lecture 10:30-11:20 AM</td><td>-</td><td>Lecture 10:30-11:20 AM; New Quiz Opens 11:20 AM</td><td>-</td><td>-</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="3">Complete Weekly Online Quiz</td></tr>
<tr><td rowspan="3">Contact</td><td>Meetings by appointment</td><td>Instructor Office Hours 9 AM – 11 AM</td><td>Meetings by appointment</td><td>Instructor Office Hours 1 PM - 3 PM</td><td>Meetings by appointment</td><td>-</td><td>-</td></tr>
<tr><td colspan="5">Complete Weekly Reading/Assignment (Weekly Online Quiz will have questions on this reading/assignment)</td><td>-</td><td>-</td></tr>
<tr><td colspan="5">Email, Canvas Message (faster)</td><td colspan="2">Email Response only (slower)</td></tr>
</table>

Spriggina floundersi – One of the earliest fossil animals (~570-550 million years old). Flinders Ranges, Southern Australia

Detailed Schedule: On the following (last) page is a tentative detailed schedule for the semester. This schedule may change through the semester. If it does, it will be updated.

					WOQ = Weekly Online Quiz *WDQ = Weekly Discussion Question*
Day	**Date**	**Topic**	**Reading/Assignment**	**Week**	**Quizzes**
W	21-Jan	Course Introduction: What is evolution? What is extinction?	-	1	-
F	23-Jan	Development of Scientific Inquiry	-	-	-
M	26-Jan	Scientific Method & Process Today	Reading 1	2	-
W	28-Jan	Meaning of Fossils	Reading 1	-	-
F	30-Jan	Birth of Modern Geology	Reading 1	-	WOQ1 Open
M	2-Feb	Animal Classification	Reading 2	3	WOQ1 Due
W	4-Feb	Population and Extinction	Reading 2	-	-
F	6-Feb	Darwin, Wallace, the Beagle, and Evolution	Reading 2	-	WOQ2 Open
M	9-Feb	Natural Selection & Selection Types	Reading 3	4	WOQ2 Due
W	11-Feb	Natural Selection & Selection Types (cont.) + Common Ancestry	Reading 3	-	-
F	13-Feb	***Unit 1 Test***	Reading 3	-	-
M	16-Feb	The Mystery of Heritability	Reading 4	5	WDQ1 Open
W	18-Feb	The Central Dogma of Biology	Reading 4	-	-
F	20-Feb	Gene expression, regulation, & mutation	Reading 4	-	WOQ3 Open
M	23-Feb	HOX genes & morphogenetic mutation	Reading 5	6	WOQ3, WDQ1 Due; WDQ2 Open
W	25-Feb	Evolutionary Rates: how fast can it happen?	Reading 5	-	-
F	27-Feb	Reproductive Isolation	Reading 5	-	WOQ4 Opens
M	2-Mar	Modern observations of evolution	Reading 6	7	WOQ4, WDQ2 Due; WDQ3 Open
W	4-Mar	Biogeography	Reading 6	-	-
F	6-Mar	***Unit 2 Test***	Reading 6	-	-
MWF	9-13 Mar	**NO LECTURE, READING, OR QUIZ, SPRING BREAK!**	-	-	WDQ3 Due (Monday)
M	16-Mar	Building a Geologic Timescale & Earth's Age	Reading 7	8	WDQ4 Open
W	18-Mar	Life, the Universe, and Everything	Reading 7	-	-
F	20-Mar	Building Earth I: Heavy Construction	Reading 7	-	WOQ5 Open
M	23-Mar	Building Earth II: A Livable Earth	Reading 8	9	WOQ5, WDQ4 Due; WDQ5 Open
W	25-Mar	Building Earth III: Origins of Life on Earth	Reading 8	-	-
F	27-Mar	*No Lecture; Research Travel for Instructor*	Reading 8	-	WOQ6 Open
M	30-Mar	Precambrian Earth, Rusting Oceans, and Oxygenation, oh my!	Reading 9	10	WOQ6, WDQ5 Due; WDQ6 Open
W	1-Apr	The 'Boring' Billion and Snowball Earth	Reading 9	-	-
F	3-Apr	Dawn of Animals in the 'Garden of Ediacara'	Reading 9	-	-
M	6-Apr	***Unit 3 Test***	Reading 10	11	WDQ6 Due; WDQ7 Open
W	8-Apr	Cambrian Radiation and Revolutions	Reading 10	-	-
F	10-Apr	The Early-Mid Paleozoic: Life grows a spine… and jaws	Reading 10	-	WOQ7 Open
M	13-Apr	Paleozoic cont. - Life, uhhh, Finds a Way (on to land)	Reading 11	12	WOQ7, WDQ7 Due; WDQ8 Open
W	15-Apr	Welcome to Mesozoic Park! (Rise of the Dinosaurs)	Reading 11	-	-
F	17-Apr	The Lost World of the Dinosaurs	Reading 11	-	WOQ8 Open
M	20-Apr	Spoilers: Dinosaur extinction, survivors, & how it happened	Reading 12	13	WOQ8, WDQ8 Due, WDQ9 Open
W	22-Apr	Welcome to Cenozoic Park! (after the dinosaurs)	Reading 12	-	-
F	24-Apr	Human Ancestry in the Cenozoic	Reading 12	-	WOQ9 Open
M	27-Apr	Extinction	Reading 13	14	WOQ9, WDQ9 Due; WDQ10 Open
W	29-Apr	Lessons from the Past	Reading 13	-	-
F	1-May	Using the Past to Predict the Future	Reading 13	-	WOQ10 Open
M	4-May	Course Conclusion	-	15	WOQ10, WDQ10, Extra Credit Due
W	6-May	***FINAL (10:30 AM-1:15 PM)***	None	-	-