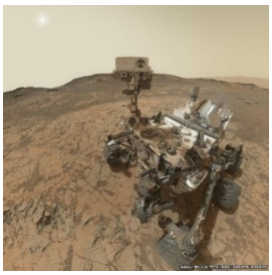
GEOL 124: Evolution of Life and Environment on Planet Earth

This course is for students in the Once and Future Planet (OFP) Carillon Community.

Carillon Communities creates an inspiring and supportive living and learning environment for first year students. Carillon promotes an environment where students develop a sense of belonging and trust that supports their academic success and innovative thought. In Carillon, students consider their own interests and knowledge, and become more active agents in their own education.

Course overview



Ever dream of travelling to Mars? Join the scientific mission of the Mars Science Laboratory "Curiosity" rover in real time to search for signs of ancient life on the red planet, while we explore evidence for the origin and evolution of life on Earth in this I-Series course. Weekly discoveries by the MSL rover on the Martian surface will be discussed and compared with those from Earth's distant past, from the origin of the solar system to the sequential origin of prokaryotic, eukaryotic, and animal life over our planet's first four billion years.

The central question in this I-Series course titled Evolution of Life and Environment on Planet Earth is ***"How did life begin and evolve on Earth?"*** We interrogate this enduring question by exploring the building blocks of life, hypotheses on its origin, geological the fossil evidence for its existence and diversification. We then consider how life has shaped physical environments (and vice versa) over the long run of Earth history. Using these deep-time perspectives and methodologies, we then explore future interactions between life and the environment on Earth and beyond.

The current MSL rover mission is the culmination of decades of Martian speculation and exploration by NASA's Astrobiology Program, which has even deeper roots, with important discoveries by now famous scientists that span nearly 200 years. While the rate of 18th and early 19th century insights were slow and poorly coordinated, technological advances in chemical, biological, and space sciences after WWII have served to hasten the pace of astrobiological research into the origin and evolution of life on our home planet, and the search for life elsewhere in the universe, in part through detailed studies of meteorites and rover explorations of the Martian surface.

A note on I-Series Courses: The I-Series courses are designed to investigate significant issues and inspire innovative ideas. They are intended to fulfill university general education requirements in a creative and contemporary way, and to challenge students to apply diverse intellectual traditions to today's big issues. GEOL 124 accomplishes these goals by bridging traditional divisions between the scientific disciplines of geology, biology, chemistry and physics. It also emphasizes how a perspective of deep time provided by geology principles can be valuable for informing big-picture questions relevant to today.

Signature: _____
Date: _____

GEOL 124: Evolution of Life and Environment on Planet Earth

Instructors

This course is taught by ***Professor Alan J. Kaufman*** of the Geology Department. Over the past 30 years, Kaufman has travelled to the four corners of the ancient Earth to study its environmental and biological evolution. In this course he will take you on a journey to deep time and space, putting discoveries on the Martian surface in context of what we know about the evolution of our own planet through a long geological lens.

Instructor: Prof. Alan J. Kaufman
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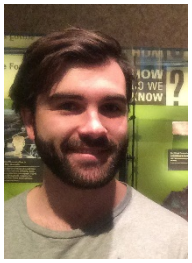
Office: CHEM 0217A
Office Hours: By appointment
Email: kaufman@umd.edu



The Discussion sections for this course are taught by Graduate Teaching Assistant (GTA) ***Ben Farcy***, who leads the discussion on weekly assigned book chapters, and who prepares weekly quizzes related to these readings. The GTA also provides feedback for on-line discussion topics, and attends lectures, field trips, and Curiosity Panels (see below) to evaluate student participation and efforts. The GTA may also be available by appointment to attend occasional Curiosity Panel meetings.

Graduate Teaching Assistant Ben Farcy
Office: CHEM 1217B
Office Hours: By appointment
Email: bfarcy@umd.edu

The Undergraduate Teaching Assistant (UTA) is a student(s) who has taken this course in previous years, and is available to answer questions about the lecture material, readings, testing, and expectations for team work. The UTA may also be available by appointment to attend occasional Curiosity Panel meeting, and to provide study sessions for midterm tests.

Undergraduate Teaching Assistant Madison Bee
Email: madinicole513@gmail.com

Initials: _____
Date: _____

ELMS website

All written communications in this course should be through the course ELMS website, including the on-time submission of discussions, assignments, reports, evaluations, and the Community Research Project. Use the ELMS mail tool to:

- Ask any course related questions.
- Provide notification of an absence. ***Notification should come as soon as possible before or after the missed class. In the case of religious observances, athletic***

events, or other planned absences, notification must be sent during the schedule adjustment period.

- Arrange a meeting for discussion of 1) academic accommodations for an excused absence, 2) DSS accommodations, or 3) grades and grading policy. ***Issues regarding grading in the Discussion section should initially be raised with the Teaching Assistant, while those related to the Lecture should be discussed with the Instructor.***

Use the ELMS assignments or grades tools to evaluate your points progress in the course related to each of the graded exercises. ***It is particularly important to read through the instructor feedback remarks on <u>formative</u> assignments in order to implement recommended changes in <u>summative</u> assignments.***

ELMS Announcements will be used to communicate upcoming events, including the timing and location of field trips, reminders of due dates for Assignments, and class cancelations due to inclement weather or unforeseen circumstances.

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Required textbooks and technology

We will draw on the book by A.H. Knoll titled *Life on a Young Planet* (Princeton University Press ISBN 0-691-00978-3). This book provides context that will be relevant for the course, but it is not a textbook in the typical sense. This book will be read in conjunction with the Discussion sections, with a weekly quiz related to the reading of specific chapters at the beginning of each section.

For determining GPS coordinates, topography, and bedrock geology during field trips you should download the Google Earth, FreeGPS, and ROCKD apps to your smart phones. You will also use the camera function on your smart phones to take pictures for field report illustrations. Notes related to observations or discussions in the field may also be recorded on your smart phones. It is strongly advised that you wear closed shoes or boots on field trips, rather than sandals or flip flops.

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Learning outcomes

At the completion of an I-Series Course students will be able to:

- Look at complex questions and identify the science in the question and how it impacts and is impacted by political, social, economic, and ethical dimensions
- Understand the limits of scientific knowledge
- Critically evaluate science arguments
- Ask good questions
- Find information using various sources and evaluate the veracity of the information
- Communicate scientific ideas effectively
- Relate science to a personal situation

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Course description and objectives

This course will examine how the Earth formed, how its place in the solar system allowed for life to take hold, and how, once evolved, life shaped or was shaped by Earth's physical environments. In this course we will explore questions from the perspective of geological, biological, chemical, and physical scientists about:

I. Interconnections between biology, climate, and geology in the Earth System: How did Earth's environment change in the past, and how are its components linked today? To address this, we explore the way that things work on our planet. We use simulations and scientific methods to get to the nuts and bolts of issues like the greenhouse effect, the role of ozone in the present as well as in deep time, and how biodiversity can respond to and maybe compensate for some types of changes that would upset the equilibrium state of a planet.

II. How life remodels its environment (our planet): How have the processes of life shaped and how do they continue to shape Earth's environments? Here we examine the consequences of life for the geologic realm. We survey the geologic and geochemical tools used to describe ancient environments, review what the evidence that these tools reveal tells us about how Earth's environments have changed through time, and evaluate hypotheses of the role of living things in these changes. We then apply these insights to investigations of changing present-day environments, use them to propose methods for finding life on other worlds, and consider the potential significance of such discoveries.

III. What life is and what life does: How do we distinguish life from non-life? We examine the basic processes of metabolism - the energy pathways of life, and replication - the transfer of genetic information. Shifting from process to pattern, we ask what the basic subdivisions - the domains of life - are, and how scientists have identified them.

IV. How has Earth changed over time and how is it changing now: We wrap up by examining how we human beings act as biological agents to change our Earth. We frame this in the context of long and short term climate change, and examine how a systems perspective is essential in understanding the issues we face as one of life's species and that other species faced in more ancient worlds.

At the end of this course participants should:

- Be aware of and able to address common misunderstandings about the nature, language, and limits of science, and to enable students to identify the deeper issues in and critically scrutinize scientific information in popular media.
- Be able to read and evaluate geologic findings reported in the popular science literature (the news, magazines, and books).
- Use observations and reasoning from geology, biology, and chemistry to reconstruct the conditions for some or Earth's earliest environments.
- Foster and enhance team work and activities in support of presentations, scientific investigations, and the term paper required for the course.

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Date: _____

Grading

Given the emphasis on participation, team work, field activities, and the *Curiosity Panels* in this freshman course, ***the grading scheme is balanced in order to accurately reflect your time and efforts***. Exactly 1000 points are possible in this course, and are subdivided into formative and summative activities. Formal testing represents **200 points**, with the remaining **800 points** related to student engagement in the course, including Participation (**200 points**), Reports (**150 points**), Curiosity Panels (**200 points**), and the Community Research Project (**250 points**), which serves as the final course assessment.

Mid-semester grades will be calculated in the second week of October based on tests and reports completed to that date, as well as a generalized estimate of individual student participation. Students will meet with the faculty to discuss past and current efforts (both individual and team work), and course corrections (if necessary) projected to the end of the semester.

Participation: The Participation portion of the grade is divided equally between the Lecture and Discussion sections. In the Lecture, Participation reflects student engagement with lecturer and peers in the classroom and the field (**50** points) over the course of the semester along with student input and faculty feedback on ELMS submissions, including:

- reading and signing syllabus (**5 points**: due **8/31**)
- submitting portrait and biography (**5 points**: due **9/5**)
- one-on-one meeting with faculty (**10 points**: due **9/7**)
- commentary in two ELMS discussion strings (**5 points** each: due **9/12, 10/26**)
- evaluation of four *in-class* Curiosity Panel presentations (**5 points each**: due **10/3, 10/24, 11/9, 12/5**)

Curiosity Panel evaluations will include your objective scoring of the style (individual) and substance (group) of each presentation, ***except*** for the presentation by your own panel. In addition, you will be prompted to provide a question that came to your mind related to the presented material. ***Scoring must provide a relative ranking of all of the speaker's styles or the substance of the group's presentation for full credit.***

In the Discussion sections, Participation reflects engagement with GTA in the classroom (**50 points**) over the course of the semester, and 10 laboratory quizzes based on pre-assigned weekly readings (**5 points each**: see Discussion section dates in **Calendar** below).

Reports: The Reports portion of the grade include well written 2-5 page documents using a prescribed format, including:

1. name, date, course, and instructor in the header
2. unique title related to the specific activity
3. objective of the activity
4. methods (including use of cell phone apps)
5. observations (including photographs, sketches, descriptions, and/or tables all with informative captions)
6. conclusions (including relevance of activity to the course material)

Reports are due ***one week*** after the activities are completed; feedback provided by the instructor in formative reports should be read and considered carefully. Faculty comments and suggestions on these should then be integrated into revisions representing the summative reports, and re-submitted.

- model solar system (*formative* **10 points**/*summative* **20 points**: due **9/5**, **9/14**)
- UMD campus geology (*formative* **10 points**/*summative* **20 points**: due **9/26**, **10/5**)
- Bobcat Hill (**30 points**: due **10/5**)
- Smithsonian Institution (**30 points**: due **11/16**)
- UMD geochemistry laboratory (**30** points: due **11/28**)

Curiosity Panels (**200 points**): The Curiosity Panels consist of teams of students focused on some aspect of Martian exploration by current and past rovers and probes, including: i) Getting to Mars, ii) Past Missions to Mars, iii) Geology of Mars, iv) The Mars Science Laboratory, v) Search for Water on Mars, and vi) Search for Life on Mars. All students in each group are expected to participate in the development of the panel presentation (background research, construction of the PowerPoint or Prezi, and review) although only one or two of the students will present the material during each of the four panels. Group work will require ten scheduled meetings held in an Easton Hall lounge, study room, or dorm room. Chair(s) (generally the individual(s) who will give the presentation) will be assigned for each of the four panels, and a scribe assigned for each meeting. At each meeting, the group and individual tasks for participants related to each of the presentation will be discussed. The role of the scribe is to take attendance and notes of the meeting and complete a report submitted to the course faculty within three days of the meeting. Groups may also work together in course-related research projects in the laboratory or the field or studying for exams.

Grades for the Curiosity Panels are based on both group and individual efforts on four different presentations throughout the semester. For the group, the four panel presentations combined are worth **150 points**. This reflects:

1. ten separate team meetings in Easton Hall (or elsewhere on campus)
2. procurement and assessment of material required for each presentation
3. preparation, practice, and revision of each presentation based on team assessment
4. submission of electronic materials two hours prior to the *in-class* presentations
5. substance and organization of the presentations as evaluated by faculty and peers

The remaining **50 points** of the **Curiosity Panel** overall grade is for individual efforts within the team. These reflect:

- signing Curiosity Panel team contract (**5 points**: due **9/19**)
- attendance and engagement in Easton Hall (or elsewhere) team meetings (**10 points**)
- submission of two ***detailed*** scribe reports within three days of the panel meetings (**5 points each**)
- style of the individual *in-class* presentation as evaluated by faculty and peers (**15 points**)
- anonymous and ***objective*** evaluation of other team members as outlined in the Curiosity Panel team contract (**10 points**: due **12/7**)

Community Research Project: The Community Research Project (CRP), which is worth **250 points** will include various *formative* and *summative* activities throughout the semester, including:

- two week diet survey report (**30 points**: due **9/21**)

- hypotheses for individual and community hair samples (**10 points**: due **10/10**)
- calculations of ranges, averages, and standard deviations of populations (**10 points**: due **11/30**)
- Community Research Project term paper (**200 points:** due **12/13**)

The term paper will be a maximum of 15 pages in length (double spaced 12 point Times New Roman text) with illustrations (no larger than ¼ of a page each) and references. Graded sections in the term paper include:

- File name, header and title (**5**)
- Introduction (**20**)
- Hypothesis (**15**)
- Methods (**20**)
- Results (**30**)
- Illustrations and captions (**20**)
- Discussion (**30**)
- Conclusion (**30**)
- Citations (**10**)
- Style (**20**)

Final grades for the course are based on:

A+	98.1-100% (981-1000 points)
A	92.0-98.0% (920-980 points)
A-	90.0-91.9% (900-919 points)
B+	88.1-89.9% (881-899 points)
B	82.0-88.0% (820-880 points)
B-	80.0-81.9% (800-819 points)
C+	78.1-79.9% (781-799 points)
C	72.0-78.0% (720-780 points)
C-	70.0-71.9% (700-719 points)
D+	68.1-69.9% (681-699 points)
D	62.0-68.0% (620-680 points)
D-	60.0-61.9% (600-619 points)
F	<60% (<600 points)

Initials: _____
Date: _____

Course Related Policies: http://www.ugst.umd.edu/courserelatedpolicies.html

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like academic integrity, student and instructor conduct, accessibility and accommodations, attendance and excused absences, grades and appeals, copyright and intellectual property

Please read and become familiar with these policies.

Academic Accommodations: If you have a documented disability, you should contact Accessibility Disability Support Services in 0126 Shoemaker Hall. Each semester students with documented disabilities should apply to ADS for accommodation request forms which you can provide to your professors as proof of your eligibility for accommodations. The rules for eligibility and the types of accommodations a student may request can be reviewed on the ADS web site at https://www.counseling.umd.edu/ads/.

Religious Observances: The University System of Maryland policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period.

Academic Integrity: The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

To further exhibit your commitment to academic integrity, remember to write out the Honor Pledge on all examinations and assignments: **"I pledge on my honor that I have not given or received any unauthorized assistance on this examination (or assignment)."**

Course Evaluation: CourseEvalUM Fall 2017: Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations for fall semester courses in early December. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. Registered students are able to see course evaluation results for the student items, and then only if 70% or more of the students enrolled in that course section participated in the evaluation. Student access to course evaluation results is via ELMS; choose Course Eval from the sidebar on the left edge of the screen.

Initials: _____
Date: _____

Calendar for EVOLUTION OF LIFE AND ENVIRONMENT ON PLANET EARTH
Fall semester 2017

Date		Lecture (*Activity*)
Aug.	29	Landing on Mars: An Introduction to the Solar System **(*Solar System Model*)**
	30	Discussion (Research Port, UMD Resources, and Field Reports)
	31	Back to the Future: Understanding Deep Time ***(Community Research Project)***
Sept.	5	Electromagnetic Radiation and the Big Bang
	6	Discussion (Chapter 1: In the Beginning?)
	7	Synthesis of the Elements and the Solar System ***(Meteorite Collection)***
	12	Life's Signature in Ancient Rocks ***(Rock du Jour)***
	13	Discussion (Chapter 3: Life's Signature in Ancient Rocks)
	14	Formation and Circulation of the Solid Earth
	19	***(Campus Field Trip)***
	20	Discussion (Chapter 4: The Earliest Glimmers of Life)
	21	The Mobile Earth: Continental Drift and Plate Tectonics
	26	(***Midterm Exam I)***
	27	Discussion (Chapter 2: The Tree of Life)
	28	***(Bobcat Hill)***
Oct.	3	(***Curiosity Panel I)***
	4	Discussion (Chapter 5: The Emergence of Life)
	5	Environments of the Primordial Earth
	10	Hypotheses on the Origin of Life
	11	Discussion (Chapter 6: The Oxygen Revolution)
	12	Life without Oxygen: The Microbial World of the Archean
	17	The Base of the Food Chain: Photosynthesis Writ Large
	18	Discussion (Chapter 7: The Cyanobacteria, Life's Microbial Heroes)
	19	Take a Deep Breath: Respiration and the Origin of Eukaryotes
	24	(***Curiosity Panel II***)
	25	Discussion (Chapter 8: The Origins of Eukaryotic Cells)
	26	The Great Oxidation Event
	31	***Midterm Exam II***
Nov.	1	Discussion (Chapter 9: Fossils of Early Eukaryotes)
	2	Snowball Earth Hypothesis: Global Glaciation
	7	The Origin of Animals
	8	Discussion (Chapter 10: Animals Take the Stage)
	9	(***Curiosity Panel III***)
	11	***(Saturday) Field Trip to the Smithsonian Museum***
	14	The Cambrian Explosion
	15	Discussion (Chapter 11: Cambrian Redux)
	16	Scientific writing: The distillation of the scientific experience
	21	***Geochemical Laboratory Tour: Chemistry Building***
	22	***Thanksgiving (no discussion section)***
	23	***Thanksgiving (no lecture)***
	28	Data analysis: ranges, averages, and standard deviations
	29	Discussion (Chapter 12: Dynamic Earth, Permissive Ecology)
	30	Illustrations and figures

Dec. 5 (***Curiosity Panel IV***)
6 Discussion (The Community Research Project)
7 The Community Research Project

Term paper due by COB on Wednesday, December 13th

I have checked the calendar against my schedule and informed the faculty of any dates that conflict with pre-arranged events both on and off campus.

Initials: _____
Date: _____