Geology 112: Surface Earth Dynamics

When and How We Will Meet

MWF	11:00 – 11:50	Class Meetings, Paino Lecture Hall, Beneski Building
Tu	8:00 – 10:00	Lab A Meetings with Anna, Beneski 211
	1:00 – 3:00	Lab B Meetings with Nick, Beneski 211

Instructor Information

Nick Holschuh (he/him/his), nholschuh@amherst.edu
Office Hours: Mondays, 4-5 pm and Thursday, 4-5 pm in Beneski 311

Anna Martini (she/her/hers), ammartini@amherst.edu
Office Hours: Monday, 2-3 pm and Thursday, 10-11 am in Beneski 203

What is this course about?

This semester you will learn to think about the planet as a system of interconnected components. Our focus is on the Earth's surface, which includes the atmosphere, ocean, continents, inland water systems, and glaciers. However, many surface processes are linked to processes deep within the Earth, so you will learn about that interior activity as well. There are four main conceptual themes that will guide us in our study of the Earth system:

- ***Energy*** - you'll learn how internal and external energy sources fuel the geological, biological, and chemical activity on the planet, with a particular focus on the climate system
- ***Matter*** - you'll learn how rocks, minerals, and elements are cycled through the earth system in interlocking systems
- ***Time*** - energy and matter cycle through the earth in processes that operate on a tremendous range of time scales, and you'll learn to think about time in new ways
- ***Landscape*** - you'll learn how geologists use understanding of earth system processes to interpret the landscapes we inhabit, using the area around Amherst as a case study

Textbooks and Other Readings

All readings for the course will be posted as PDFs through Moodle. They will include excerpts from several textbooks, as well as articles from popular and professional literature.

- *The Earth System (ES)* by Kump, Kasting, and Crane
- *Earth: Portrait of a Planet (EPP)* by Marshak
- *How to Build a Habitable Planet (HBHP)* by Langmuir and Broecker
- Popular science articles from *The New York Times*, *EOS* (the monthly magazine of the American Geophysical Union), and other sources

Weekly Workflow

We have tried to build in a regular rhythm to the weeks so that you can know what to expect and plan your efforts for what makes the most sense for you. While there may be some exceptions, you should expect each week to have these components:

Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Attend class	Attend lab Turn in lab assignment if not completed last week	Attend class		Attend class Turn in weekly assignment - homework or journal

Semester Plan

There are five content areas in the course, each lasting 2-4 weeks (the semester is 13 weeks long). The general content areas are:

1. **Earth System Science.** We will build up the skills we need to analyze the Earth system quantitatively, including elements of physics, chemistry and biology. We will learn how the solid Earth - core, mantle, and crust - interacts with the surface Earth - hydrosphere, atmosphere, biosphere. Central to our understanding will be consideration of how energy and matter cycle on these planetary scales.

2. **The Climate System.** Next, we will turn our attention to the processes that modulate the planet's climate. You'll learn how interconnected planetary systems redistribute the sun's energy over a wide range of time scales. You will learn how carbon is cycled by organisms, the ocean, and the lithosphere.

3. **Climate and Time.** In this section of the course, we will think about runaway global climate change deep in Earth's history. We will think about how positive feedbacks in the systems discussed in unit 2 resulted in conditions at Earth's surface that would be unrecognizable to modern society. In this unit, we focus on the Neoproterozoic and Cenozoic.

4. **Modifying the Landscape**. During this unit, we will consider the processes that act to reshape the landscape, examining them using both experimental evidence in the lab and examples from around the globe.

5. **Synthesis using the Connecticut River Valley.** Finally, we will synthesize all the concepts we have learned to understand the history of the Connecticut River Valley. We will evaluate how it records more recent global climate change, and examine the history of mountain building, glacial advance and retreat, river discharge, and coastal activity using features accessible from campus.

Field Trips

Once the weather warms up (likely after spring break), some of our labs will be spent on field trips around the area to make observations and collect other data. Even more than in the classroom, we need an environment of mutual respect and trust in the field, to make sure that it is a place we can all learn and our safety is preserved. Do not hesitate to talk to us if you feel unsafe in the field for any reason.

We also have an optional all-day field trip to Plum Island, MA on 04/22. This is an awesome trip with great opportunities to study and observe many of the coastal and glacial geological features we study in the third unit of the course. Rain date is TBD.

What skills will you gain in this course?

Beyond acquiring a knowledge base about the Earth system, you will also work to develop several skills and attitudes that will serve you throughout your life, regardless of whether you continue studying and working in geoscience. There are three main areas that you will strengthen through your participation the course:

Quantitative skills - One of the wonderful things about all branches of scientific inquiry is the capacity to make quantitative predictions about how the world works. We want to help you see how elements of math can be applied to geology. You probably already know the math you will need (we're really talking about algebra, maybe trigonometry, and a bit of precalculus here). What you don't know yet is how to use it to solve real-world problems about the Earth. That is a big skill you will work on, and we will coach you through it and provide the support you need. Gaining the confidence to apply your quantitative tools to new and unfamiliar situations is something you can carry with you forever.

Observational skills - Another great aspect of geoscience is the premium we place on making observations. To some extent, all science requires making observations, but in this class we will work together to see the world through a new lens. During the first half of the semester, your observational skills will be honed using pre-existing datasets or exercises we can do on campus. When the weather improves, you will have opportunities to develop your observational powers in the region – labs will take you out into the Connecticut River Valley to interpret our local landscape. These observational skills, developed both in the lab and in the field, will serve you well throughout your life.

Personal values - The subject of our course is nothing less than the planet that sustains us, and shapes the way we life. This affords us a remarkable opportunity to think deeply about how our personal values are informed by our scientific understanding of Earth processes. Throughout the semester you will reflect on real world examples of how the geological systems we study intersect with issues that matter in the social and political realms. You will attempt to integrate your developing scientific knowledge, skills, and awareness through writing about a place on the planet that holds meaning for you. We hope that you will feel like you can bring your whole self to this class, and making these connections between science and your personal experiences and values may be one of the most important components of your learning.

How Will You Demonstrate Your Learning?

Throughout the semester, you will have opportunities to practice the skills you are learning, and to demonstrate your progress to us. These are "formative" and "summative" assessments, respectively. It is important for you to have both - we all need practice as we learn new information and techniques, and we all need moments when we pull it all together and see what we can do with what we've learned.

Formative Assessments (60%). These will be the bulk of the work you do and form the bulk of your grade. Our goal is to provide the resources and support you need to get 100% on every assignment – when you find the ideas that underpin any of these assignments challenging, we encourage you to turn to your peers or to us, so that by the time you turn them in, you're confident you've got it .

- **Labs (35%).** Your lab activity each week is designed to expose you to something new about geoscience. You will work in small groups for most labs. We will offer you feedback so that you can feel confident in what you got right, and learn from what you didn't.

- **Homework (quantitative - 15%).** Each Friday you will turn in an assignment. These will alternate between homework problems and journal entries (described below). The homework problems are designed to allow you to engage with the course content on a deeper and more sustained level than what is possible in the in-class exercises.

- **Homework (reflective – 10%).** The journal entries are personal reflections on the course material and its connection to your life and the society we live in. These will be graded largely on completion, but their content will be useful in formulating your final essay.

Summative Assessments (40%). These will take up less of your time all together, and they are less frequent. They are opportunities for you to see what you have learned and what you still need to work on.

- **Synthesis assessments (30%).** Three times during the semester, you will pull together what you have been learning in an assessment completed during the lab period. These give you a chance to see how you are progressing, and for us to see how we can help teach you better. The questions on these assessments will be similar to the kinds of things you have practiced in class, in lab, and on homework problems. These assessments will take place at the end of units 2, 3, and 5.

- **Final reflective essay (10%).** As the final exercise in this class, we will ask you to synthesize ideas across your reflective homework and the course content, to explore and evaluate your relationship with the landscape. This is meant to be partially a report on the role of climate and Earth surface processes in shaping a place you care about, and partially a reflection on how you this class has changed the way you think about Earth's surface generally.

Attendance Policy. We expect you to attend all classes and labs whenever you are able - everyone's learning is enhanced by being together. If you must miss a class for emergency, illness, or other health reasons, please be in touch with both Nick and Anna. Unfortunately, field trips cannot be made up.

Late Policy. Please let us know in advance if there are circumstances that interfere with getting your work turned in – we tend to be very flexible if you submit a request more than 48 hours ahead of the deadline. To request a late submission without penalty, please use this form. Otherwise, everyone gets two automatic late passes, each good for a 48 hour extension, no questions asked. Work that is turned in late without talking to us and without using a pass will lose 10% for every 24 hours late.

To ensure that late homework is received, and your grade is updated, we require that you submit late assignments using this form. It can be very difficult to keep track of late assignments, so we do this to standardize the process. This is both to ensure that you get the credit you deserve for the assignment, and make the process easier for us.

Intellectual Responsibility

Science is a collaborative endeavor, and we want you to develop the skills that make collaboration successful. An essential part of collaboration is acknowledgement, and we provide these guidelines for you to follow.

Formative assessments. You may work with a partner on any formative assessment. (In fact, often you will be required to do so.) Among other things, working together can mean talking about ideas, asking questions, and comparing thought processes. The work you turn in must represent your own understanding of the questions.

Summative assessments. Submitted work for summative assessment must be done alone, with all work generated by you.

Classroom culture

We continuously strive to be inclusive in our teaching and learning. We believe everyone can be successful in geology. Whether you come to the course with a lot of STEM experience or very little, we will meet you where you are and support you as you develop as a scientist. Taking risks, asking questions, and making mistakes are all important parts of the learning process.

We all have a shared responsibility to facilitate a welcoming, accessible, and inclusive environment, in and out of the classroom, online and in person. Our classroom welcomes people from all social or cultural backgrounds and identities. We are committed to listening deeply, and staying engaged and curious in other's perspectives, even during challenging conversations. We invite you to explore the resources available at Unlearning Racism in Geoscience (URGE) to learn more about the ongoing anti-racism work in our department and across the geoscience community.

Accessibility Services

Students seeking general disability services and/or accommodations should contact Accessibility Services. You can reach them via email at accessibility@amherst.edu, or via phone at 413-542-2337. Once you have your accommodations in place, we will be glad to meet with you privately during office hours or at another agreed upon time to discuss the best implementation of your accommodations. For more information, please visit their website.

GUAC (Geologists Underrepresented at Amherst College)

GUAC describes itself as "a student run organization established to create a safe space for underrepresented students in the geosciences...includ[ing]: POC, LGBTQ, disabled students, women..." Its goal is to be a safe space & serve as a bridge between underrepresented students and faculty in the department in order to diversify and create change within Amherst College's geology department and eventually the geosciences as a whole. GUAC meets several times each semester. Be on the lookout for announcements over email and in the Daily Mammoth. GUAC is lead by Isabelle Caban '23.

TGIRx (Thank Goodness it's Rocks)

Every Friday, the Geology Department hosts a meeting of students and faculty where we can get together as a community. Often we will hear an informal talk from a student - about their research, a summer geo experience, or any of a number of geology-related topics. Other times we will hear from an outside speaker (possibly an alum) about career pathways, diversity in geoscience, or other issues that are valuable for us all to think about and discuss. This is a great community-building tradition, and we invite you to join us every week. Look for an email from one of the faculty about the schedule, and then put it on your calendar!