

**San José State University**  
**Department of Urban and Regional Planning**  
**Geog01-80: Geography of the Natural Environment**

**Spring 2023**



*January 13, 2020*

**Course and Contact Information**

**Instructor:** Gary Pereira

**Office Location:** Online only.

**Telephone:** (510) 825-3506 (**text** please, at least initially)

**Email:** (**Canvas messaging preferred**, or text 510-825-3506 in emergency)  
gary.manuel.pereira@gmail.com

**Office Hours:** Please message me if you need to set up an appointment.

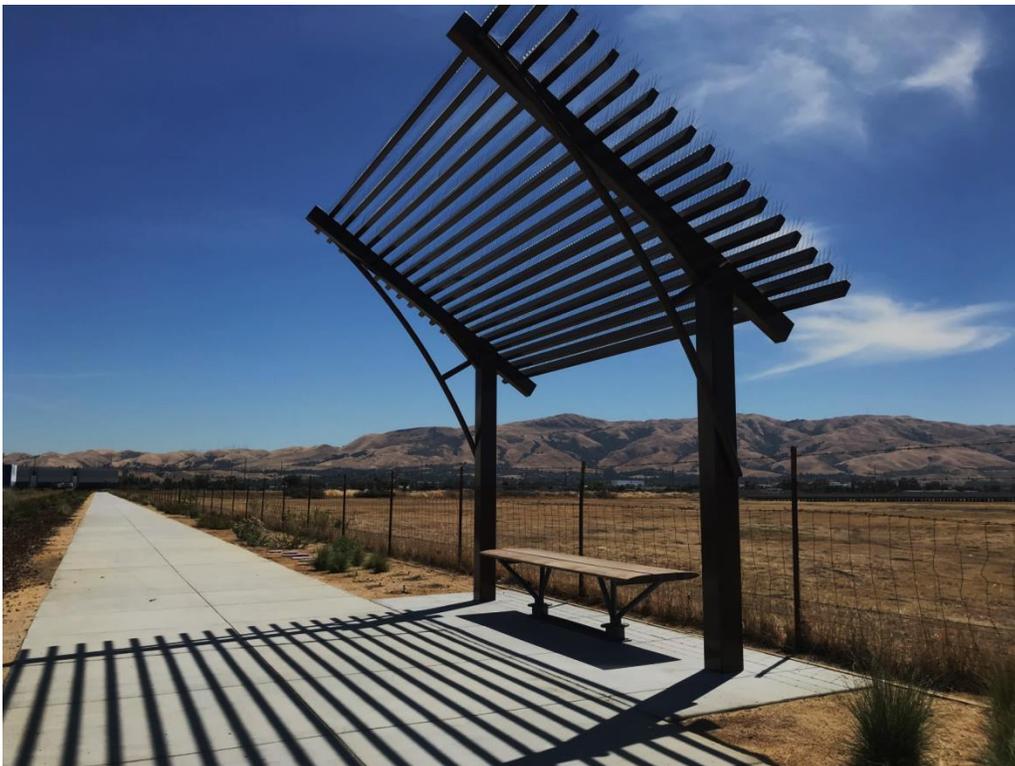
**Class Days/Time:** Weekly homework and announcements as scheduled.

## Course Format

This is an online-only course. Internet connectivity and computer are required. Many of the resources that we will use are from safe, reliable sources on the Internet. The course itself can be accessed through the Canvas Learning Management System course login website, primarily through the **Announcements** and **Assignments** for this class. Additional course materials (including this syllabus) can be found and uploaded from **Files**, as prompted by the schedule. Students are required submit one homework assignment each week, as well as a final evaluation paper. Study material and assignments are listed and described under **Assignments**, but additional requirements or suggestions may be described within the **Announcements**. Please check the Announcements at least once a week, particularly before submitting homework. Your grades may reflect repeated failure to address additional questions or concerns that I may post there.

All homework must be submitted, even if late. Any work that has not been submitted by the end of the semester will receive a zero grade. Repeated lateness should be explained in an independent Canvas message or with a message pinned to the submission itself. Please be aware that messages may be pinned to particular submissions by both the instructor and student. I will try to get to each submission within a week after its due date, although I may sometimes run late. Check your submission for any remarks or instructions I may have pinned there, regardless of whether you have received a grade. Please address any requests for resubmission. If you want to respond to a pinned message, please do so by sending me an independent message within Canvas. I am unlikely to return to any particular submission once it has been graded, unless I've been prompted to do so by you.

The photo below represents (hopefully with a little humor) my impression of some of the systems and applications that have become commonplace in education. If you look closely, you might notice something a little strange. The structure looming over the bench looks it might provide some sort of shade or shelter from the rain, but in fact it does neither, at any time. Nevertheless, spikes had to be inserted on top to keep birds from messing up the bench below. This, in my opinion, perfectly exemplifies some of the confusion surrounding current thinking. People were paid to design and construct several of these things.



The bench in the photo is intended here to represent the parts of Canvas that we will be using: **Announcements**, **Assignments**, and **Files**, communicating as necessary via messaging. The stylish structure looming over it might be taken to represent what I consider some of the less helpful parts of Canvas, as well as most of the published resources that students are often required to buy and use. For this course, I have found that a free online textbook is sufficient to supplement some carefully chosen Internet sources, as well as some of my own material. In my opinion, this strategy results in a more substantive, robust, personal, and direct understanding of the topics described here than even expensive textbooks and their associated resources offer.

What makes a course engaging should be its subject matter, not the structure of the course or the personalities of the instructor or participants. Let's try a simple metaphor. If you're looking for the moon in the night sky, it would certainly be foolish to confuse the finger that someone might be using to point out the moon for you, with the moon itself. The characteristics of the finger are completely unimportant. It just points the way. For the most part, that is what I will be doing for you: pointing the way. As best I can, of course, given what I find to be true and meaningful thus far in my understanding of things. I've kept the structure of this course simple so that we will have more flexibility to follow relevant current events, discoveries, or connections in real time. Therefore, despite the structural simplicity of this course, it is important that you follow the **Announcements** by checking them at least once a week, and to respond in subsequent homework assignments to specific questions that may be posted there.

Remaining within our metaphor, the tendency to confuse some pointing 'finger' with some external object of study can have another unfortunate association. Because we can manipulate our fingers any way we want, we might start to believe that by doing so we can magically affect the object being pointed at. Consider that the opposite might be true. Possibly, at least for educational purposes, we should set aside the implications of our own personal or collective identities and just try to learn about what exists well beyond (or invisibly within) ourselves. We might thus learn to realistically evaluate and adapt to whatever the unknown forces of nature (and of the human heart) might throw our way.

Within **Announcements**, I might make some general observations and offer some general advice regarding earlier homework responses, but I will never identify students by name without prior permission. I further promise on my part to keep any information we exchange via either messages or homework completely private. Nevertheless, you may of course share any such exchanges or documents with anyone at any time.

With Canvas messaging, conversations cannot be easily ignored, misplaced, modified, forged, or shared with others. There are no such assurances with email and other social media platforms, which are as a result often used as tools of manipulation, power, confusion, and disrespect, particularly by people in positions of authority. That is why I would prefer not to use email in my role as educator. Canvas messaging is sufficient. Text my private number, which is listed on page one of this syllabus, if you have an emergency. Being late is not an emergency. If any of your work is late, submit it anyway and pin an explanation to the homework itself, or message me regarding more serious issues.

Given the current state of America's universities, I will not ask you to share your work, your opinions, or even your image with others in the class, or with anyone else who happens to be looking in. I do not want anyone to suffer retaliation for anything expressed in any of my classes. For the foreseeable future, I will never ask students to use zoom, skype, Canvas conversations, or whatever the latest thing happens to be, tools that have gotten innocent people like you and me in a great deal of trouble merely for exploring ideas that someone finds unacceptable.

Instead, I encourage you to refine and edit the work that you do for my courses and for others, and to post it online at your own discretion in a way that is fully under your own control (e.g., via Portfolium).

Please read and view the material at the beginning of each **Assignment**, as well as any new **Announcements**, every week. These locations are where the material that would otherwise be covered in lectures will be located. Homework questions are posed within each **Assignment**. If I pose an additional question for your homework in an **Announcement** and you have not addressed it in your homework, this may be reflected in your grade. I am not obsessive about the quality of your writing, since you have a limited amount of time each week to proofread, but I do appreciate good organization, reasoning, and grammar. **I am looking mostly to see that you have actually accessed and examined the material in question, and that you have put in the time.** If you are uncertain, make adjustments based on the grades and comments you receive. You might want to ask someone to independently read and edit your homework before submission. However, your words and thoughts should be your own. You may quote extensively from material in the assigned or suggested texts or videos, but please provide attribution, by means of notes or references. A URL alone is not enough; provide proper references. The style is unimportant; just be consistent.

The university expects that each student put at least nine hours of work per week into each three-credit course (University Policy S12-3 at <http://www.sjsu.edu/senate/docs/S12-3.pdf>). Your homework assignments and final paper will be evaluated and graded primarily on the degree to which this expectation has been met, based on my impression of your work. The more detailed, organized, and thoughtful your responses are, relative to your classmates, the better your grades will be. You are not graded on the basis of any opinions or conclusions you may express on any issue, even when I might ask you to express one. I am more interested in whether you understand and appreciate the issues themselves. Further details are discussed below under **Course Requirements** and Assignments, in the **Course Schedule**, and in my introductory video.

## Course Description

This course covers the basic sciences that describe the Earth's atmosphere, hydrosphere, biosphere, and lithosphere.

## Course Goals and Learning Outcomes

Upon successful completion of this course, students will be able to use the methods of science and knowledge derived from current scientific inquiry in life or physical science to question existing explanations; demonstrate ways in which science influences and is influenced by complex societies, including political and moral issues; recognize the methods of science, including quantitative, analytical reasoning techniques. The tools and methodologies of the physical geographical sciences, as well as the analytical and algorithmic reasoning techniques, are studied in some detail.

## Textbook

The **Fundamentals of Physical Geography** (2<sup>nd</sup> edition) is a free online textbook with over 300 pages and 400 illustrations, photos and animated graphics. It is the work of two professors from the University of British Columbia Okanagan – Dr. Michael Pidwirny & Scott Jones. Important terms are hyperlinked to a glossary. There are links to study guide pages and additional reading within each chapter. Most importantly, 'weblinks' are provided for each chapter that provide a wealth of well-respected sources of additional data and social media. The textbook is accessible at the following site. **Do not download or use the pdf version suggested on the website or in popup windows.**

<http://www.physicalgeography.net/>

## Additional Readings

Additional readings are required for certain assignments. All of the readings listed in the schedule are preceded by one of the following:

**Read:** take the time to read all or most of the text, keeping in mind any associated homework questions.

**Reference:** contains information that may help to fill out your understanding of key terms and relationships. You may want to use this information to inform your homework responses.

**Recommended reading:** read or keep this handy if the topic interests you, or if you intend to study or write about the topic in greater detail (for example, for the final evaluation paper).

## Videos

Videos are a big part of this course, and much of the homework will be judged on the basis of how closely you consider them in your discussions. If you are accessing each assignment directly through CANVAS **Assignments**, you can watch the videos coming from YouTube embedded directly within CANVAS, but you also have the choice of running each video in a separate browser. Watching videos within separate browsers often provides you with additional textual information, as well as access to the author's channel. You might want to watch videos on a tablet or TV as you write on a laptop. Use whatever method feels comfortable, but make sure you have a large enough screen to clearly see the details (including text) in the videos. You also obviously need sufficient bandwidth, which may change for you over the course of a typical day. Most videos listed in the schedule are preceded by either 'Watch' or 'Examine'. I may also 'Recommend' additional videos that might interest you.

**Watch:** take the time to watch all or most of this video. You may find it helpful to watch key portions repeatedly, taking notes as you watch.

**Examine:** You may watch the video in its entirety if you like it, but there is no immediate need to do so. You might want to scrub through segments and watch only those portions that look particularly interesting or connect to the questions you need to address. Many of these videos have no narration, although they do convey a great deal of information. Some just provide a deeper sense of context. In any case, do NOT just skip over these videos, since they nearly always connect with the homework questions.

**Recommended:** You are not required to either watch or examine this video, but I have found it to be of exceptional value or interest with regard to the topic at hand, so you might want to check it out.

It is important that you have clear audio with easily adjustable volume. The sound processing on some of the videos is binaural, meaning that it simulates the geometry of human hearing. This provides a more realistic, 3D experience than normal stereo processing, particularly if you use earphones.

If you open these videos in a separate browser, you will find that many of them contain or are preceded by ads. Usually, these can be cut short by clicking on 'Skip Ad' at the lower right of the browser, or by clicking on the **X** within the ad itself if it's a popup. YouTube reserves the right to place ads in anything, including my own videos, although I get no monetary benefit. By the way, I do not generally provide tags on my videos, and I do sometimes disable comments. Your views of videos embedded within Canvas are not counted as views by YouTube. As a result, most of my videos get few officially counted views. Feel free to subscribe to any channel that interests you, including my channel, and to share these videos with others. If any of the videos for the course become unavailable over the course of the semester, don't panic. Check the Announcements to see whether I have recognized the issue yet and have provided alternatives. If I have not

addressed it yet, please let me know about it. Otherwise, if time is short, do your best with the resources at hand, and if you're feeling resourceful you may searching for alternatives. In any case, videos disappear from YouTube only rarely.

## Course Requirements and Assignments

### Homework

Fourteen homework assignments should be completed on or before the due dates, as described in the course schedule below. They should all be submitted, even if late. Please submit all files via Canvas; never email them to me. If you are having difficulties, message me through Canvas. If Canvas goes down or if you are having difficulties communicating, just be patient, try again later or the next day, and let me know about it. No penalty, obviously, if you let me know. For each homework assignment, I would prefer that you use 10 (or 12) point font with 1½ line spacing. Put your name, the Assignment number, 'geog01-80, and 'Fall 2022', arranged at the upper right of the first page.

Text, figures, and images copied from documents or screenshots may be embedded within your homework, but these must all include full attribution (not just the URL). In other words, be honest about which words, figures and images are yours, and which are from other sources. You will need to be especially careful if you decide to publish or post your work in an online portfolio. Although it is often helpful to include external material in the form of extended quotes, graphs, and figures, these should be explicitly cited and referenced. They should be there for an important reason, otherwise leave them out. Most of the text in each homework submission should be your own.

Regarding the length in pages or word count expected for each assignment: this depends on the topic, and also on your writing style. **I'm looking for evidence of understanding, substance, and a willingness to sufficiently pursue each point you are making until you've made it properly.** I understand that you only have a few days for each one. It is also perfectly reasonable to be unsure about topics that you are just beginning to understand. The ability and willingness to openly express one's own doubts and uncertainties is a virtue, since it often leads to further understanding. If your writing style is average, if you avoid redundancy, and you put in the time expected of you, each homework assignment should probably run at least three pages. The time and effort you spend on each question may vary, depending on your interest. If you cannot find much to say about one topic, make sure you compensate for that with another one in the same assignment.

Each of your submissions is graded relative to those of your classmates in the current and former semesters. I often look through each week's submissions repeatedly before deciding on grades. I may offer comments or advice in Canvas for each assignment. Check back on each assignment a week or more after the deadline for any comments that I may have tagged to it, even if it hasn't been graded. If you would like to begin or continue a conversation about an assignment, please do so with an independent Canvas message. I encourage you all to go back and expand and polish up some of your most interesting essays and **publish them online**, in Portfolium at a minimum. In my opinion, the work you are doing for this class and others should be used in support of your professional career. Please read 'About your instructor', below.

### Announcements

Please check the **Announcements** tab every week. Discussions of homework results and expectations, current events, and other issues of interest to this class will be posted there. Additional homework questions may also be posted, due more than a week after posting.

## Final Evaluation

Instead of a comprehensive exam, I want you to write a thoughtful essay as described below in the Course Schedule.

## Grading Information

Fourteen homework assignments and the Final Exam should be completed on or before the due dates, as described in the Course Schedule below. They must all be completed by the end of semester. Please submit these responses as either Word or pdf files via Canvas.

## Determination of Grades

Homework assignments (6.5% each) x 14	91%
Final Evaluation	9%
<b>Total</b>	<b>100%</b>

98% and above	A+
94% - 97.9%	A
90% - 93.9%	A-
87% - 89.9%	B+
84% - 86.9%	B
81% - 83.9%	B-
77% - 79.9%	C+
74% - 76.9%	C
70% - 73.9%	C-
67% - 69.9%	D+
64% - 66.9%	D
60% - 63.9%	D-
<b>below 60%</b>	<b>F</b>

## University Policies

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at <http://www.sjsu.edu/senate/docs/S12-3.pdf>.

Note that “All students have the right, within a reasonable time, to know their academic scores, to reWatch their grade-dependent work, and to be provided with explanations for the determination of their course grades.” See University Policy F13-1 at <http://www.sjsu.edu/senate/docs/F13-1.pdf> for more details.

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs’ [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>

## About the instructor



I grew up in a semi-industrial town in New Jersey, near NYC. I went to public schools and held several untrained jobs in various settings, from our single-screen downtown movie theater to the reactor building of an active nuclear power plant. I began working professionally with a two-year degree in electronics engineering, on a team of about a dozen technicians that built and maintained the data acquisition and instrument control system for Princeton's tokamak reactor 'TFTR', the largest and most complex nuclear fusion experiment in the world at the time. After six years at Princeton and the reactor's successful completion, I worked as an electronics technician for the science departments of Brooklyn College in NYC, where I took evening courses and earned a master's degree in computer science. While in Brooklyn, I met Cheri, we married and had a child. We moved to Bethlehem, PA, where I worked as a technician for the Physics Department at Lehigh University, later as a geographic information systems engineer for Lockheed Martin. After a few years we moved to Minnesota, where I worked at a NOAA facility called NOHRSC, which processes remote sensing, GIS, and hydrological models to produce online data products. I earned a PhD in Geography at the University of Minnesota, where I did tropical fire research, taught physical geography, and met and worked with some of the most well-known and highly respected scholars in geography and related fields. We finally moved to the Bay Area, and I've been at SJSU for nearly 20 years.

I encourage all students to participate in professional organizations or guilds and to make use of any truly meaningful learning opportunities or certifications that are being offered, at least until you are settled into a career path. Learn a few extra skills. Even if you don't end up using them all, you will have demonstrated to yourself and to others that you remain capable of learning. I've worked for business, government, and education, and everywhere the intentions and capabilities of individual people are the key to the success or failure of any given project. Before anyone serious hires you, they will probably want to know more about you than what your degree and GPA or even an interview or two may provide. I encourage you to revise and publish your best work (in whatever medium you use, but certainly including your most engaging text), within a setting that potential employers or collaborators can easily access, like Portfolium. Here's a little story to show what might happen if you just let people know what you're capable of doing. I worked for a few years as a technician for Lehigh University, where I also took the classes that I needed for a PhD in Computer Science. We moved away before I could make much progress on a dissertation, but I'd been working independently on something. Based largely on what I'd learned at Brooklyn and Lehigh, I developed a system in software that performed some novel analyses and visualizations (at the time) in remote sensing and GIS. I presented a paper explaining its function at an international conference in Vancouver. I paid for the membership, registration, flights, hotel, and everything myself. A couple of weeks later, I got a call from someone at Lockheed Martin Corporation who'd been to the conference and had read my paper. He described a position at a cutting edge GIS project within commuting distance of my home. They interviewed me and offered me a job as a systems engineer, which I accepted.

<https://portfolium.com/garympereira/portfolio>

# Geog01-80, Geography of the Natural Environment, Spring 2023

Please submit your homework responses as Word or pdf files by the due date indicated. Use 10 point font, with 1 ½ line spacing and normal margins. Put on the first page of each submission your name, homework #, geog01-80, Spring 2023.

## Course Schedule

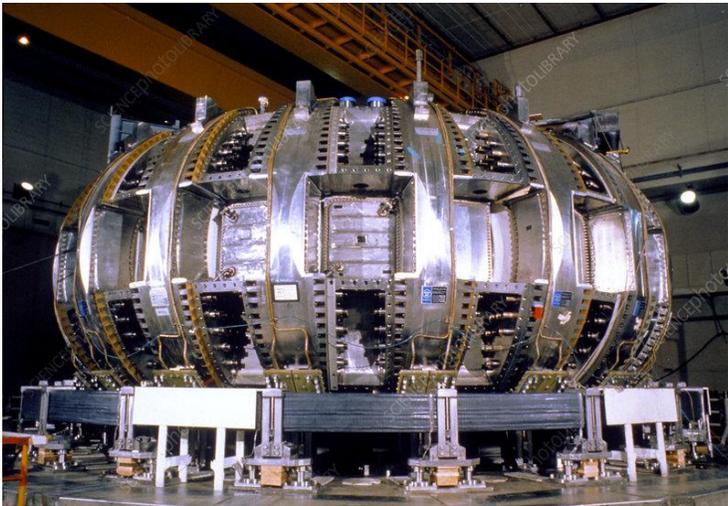
Week	Due Date	Discussion, Readings, Videos, Assignments
1		<p>If you haven't already done so, please  <b>Watch:</b> General notes for my online classes [Gary Pereira]  <a href="https://youtu.be/_AN8k0OgwI0">https://youtu.be/_AN8k0OgwI0</a></p> <p><b>Topic 1: Science v scientism</b></p> <p>Since this course includes aspects of the physical, biological, and social sciences, we should probably begin by recognizing and discussing the nature and practice of science in the modern world. If you've read the syllabus or watched the introductory video, you already will know that I don't expect anyone to agree with any of my views. I am expressing them upfront this week for your potential benefit, at least in helping you understand why I ask the questions that I do. If any of these views are intolerable to you, be advised that the last day to drop this course without penalty is <b>February 6<sup>th</sup></b>.</p> <p>1. It seems increasingly likely that the COVID-19 virus was engineered. It may even have been created as part of a 'gain of function' viral enhancement program that was encouraged and at least partially funded by US scientists and administrators, and ultimately by American taxpayers. One of the most troubling aspects of the COVID-19 pandemic is the lack of genuine interest by our own political, managerial, scientific, and media elite in determining the origin of this virus, or in making any genuine effort to prevent it from ever happening again. This suggests that the same thing could happen again, and quite soon, for similar reasons, possibly involving pathogens that may already have been developed and that happen to lie dormant (for the time being) in a freezer somewhere in the world. We are being encouraged by the medical/ pharmaceutical industry to prepare for 'the next pandemic' and for a lifetime of synthetic vaccines and treatments for a potentially endless sequence of emerging pathogens. Is this state of affairs now expected to become routine? If so, why? The continuing dull-witted disinterest in these fundamental issues of survival by people who should know better indicates to me that most of the people involved in managing things in this nation and elsewhere would rather look the other way than jeopardize their own comfortable lives and careers, even at the potential cost of many more deaths. Instead, they attack their fellow citizens for political and cultural wrongthink. Many would have done quite well for themselves working for Joseph Stalin, who reputedly said that a single death may be tragic, but a million deaths are a mere statistic.</p> <p>2. Although both the mitigation of global warming and adaptation to regional and global climate change require a great deal of serious work, discussion, and decision making, it has become increasingly clear that these topics have been dominated in recent years by non-expert authoritarians, catastrophists, and social engineers in education, educational administration, and science administration, most of whom seem to have come to define science on the basis of irrelevant and often nonsensical psychological and cultural concerns. This lack of respect for the competencies and educational requirements that exist within the sciences themselves has already resulted in the marginalization and cancellation of many of our most helpful courses of instruction and in the silencing of many of our most qualified voices, just when we need them most. Given how inconsistently and coercively authorities here and around the</p>

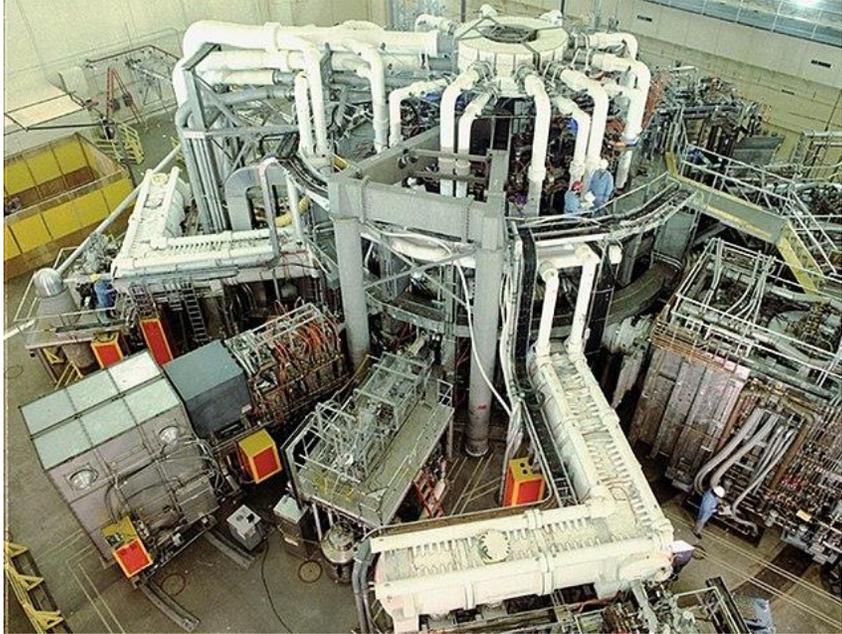
Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>world have responded to the current pandemic, as well as many, many, many other things, it seems to me highly doubtful that our current crop of ‘leaders’, ‘deciders’, and ‘influencers’ will ever understand the interconnections between climate, energy, agriculture, economy, etc., even to the degree that you will understand at least some of these connections upon completion of this introductory course. In my view, our current political, managerial, educational, and scientific elite are just not qualified to plan and decide anything on our behalf. Most of them couldn’t run a grocery store. The wisdom required to overcome or at least competently recognize our environmental and social difficulties will not come from our leadership class, but from the intelligence residing within each of us.</p> <p>Let’s think about the different meanings that have been assigned to the word ‘science’. Two stand out. On the one hand, science has been defined as the application of a set of approaches to understanding reality, and on the other hand it is used to represent the body of knowledge that presumably resulted from the application of such approaches. It’s not hard to see the paradox at the heart of this duality. Excessive or exclusive reliance on any body of knowledge, even one that has been accumulated ‘scientifically’, is fundamentally contrary to the methods that were presumably used to discover that very knowledge. It is unfortunate that one word carries these often contradictory meanings. The confusions and tensions that result from this conflation are real. The struggle between the proponents of acceptable accumulated truth, and attempts by others to falsify any portion of it in search of some greater or more reliable truth, is an ancient one.</p> <p>Science as an <b>approach</b> to understanding reality must always include a willingness to be proven wrong. But representatives of science as a body of knowledge and the institutions of science in particular are often unwilling to be proven wrong, or even to be second guessed. As a result, science is experiencing a number of crises at all levels, including a lack of successful replication and an explosion of unjustified or barely justified claims and counterclaims. Established publications favor established incumbent or fashionable opinions and topics, and funding is increasingly based on an ever-changing set of irrelevant political and cultural concerns. The tools, methods, skill sets, and good-natured disagreements that everyone knows lies at the heart of healthy science are ignored and set aside as unqualified people in positions of authority think and believe their own opinions and impressions fully represent what we all should think and believe. Which they most certainly do not.</p> <p>Our often unjustified trust in the institutions of accumulated knowledge is not new. Consider the story of Galileo’s telescope; or rather, the story of two of Galileo’s contemporaries, men who became famous throughout history for one thing and one thing only: their refusal to even look through it. Galileo did not invent the telescope, but he improved its design and demonstrated its usefulness for port and military operations via visual communication. When Galileo began building telescopes at higher magnifications specifically to view the night sky, and when he described what he saw, people were astonished. If you haven’t viewed the night sky through a telescope yet, you really should try it sometime. Even with a relatively inexpensive telescope, it is easy to see the three dimensional contours of mountains and craters on the moon, particularly near the current limb of illumination, and on clear nights (and far away from the ‘light pollution’ of the city) you can see the moons of Jupiter and the rings of Saturn. By watching Jupiter over time, Galileo was the first to see that these moons orbited that distant planet, just as our moon orbits us.</p> <p>But for formally educated people of Galileo’s time, and particularly for university educators, this was disturbing news. The contradiction between what they had assumed must be true based on accumulated knowledge (all presumably scientifically or rationally derived), and what any common, uneducated person could see by just looking through an eyepiece, led to some rather famous examples of self-delusion and stupidity. Two stand out.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>Cesare Cremonini was a friend and colleague of Galileo at the University of Padua. When Galileo announced that he had seen mountains on the Moon, Cremonini and others denounced the claim and refused to look through the telescope. The evidence refuting Aristotle's theory that the Moon was a perfect sphere would have made his position as Professor of Aristotelian Philosophy at the University untenable. In other words, people would no longer believe and respect everything he said, and this made Cremonini sad. Many seemingly complex and difficult but entirely false academic arguments that students are often recruited into joining actually come down to such simple-minded self-righteousness, even in our own time.</p> <p>Giulio Libri was a Professor of Aristotelian Philosophy at Pisa, and he was an open opponent of Galileo. Libri was particularly vehement in his denunciation of the telescope, which he considered to be a parlor trick, refusing to look. When Libri died, Galileo commented of him that "never having wanted to see Moons of Jupiter on Earth, perhaps he'll see them on the way to heaven."</p> <p>To us, Galileo represents science, and Cremonini and Libri represent anti-scientific views, but this is not what it seemed like to them at the time. To them, Cremonini and Libri represented the scientific consensus. Now consider (for question 1) the following quotations from George Orwell's essay "What Is Science?" that was published in the London Tribune on October 26<sup>th</sup>, 1945. In Orwell's view we can all see that many non-scientists also keep rationality and objectivity, and even a willingness to be proven wrong, as their guideposts in their lives, even if they have nothing to do with the science of their time. On the other hand, scientists have often shown themselves to be unreliable practitioners of the scientific approach to knowledge and to life. One obvious example of this, according to Orwell, involves the history of scientific nationalism. The full essay can be found online in pdf form, if you are interested.</p> <p style="padding-left: 40px;">"This confusion of meaning, which is partly deliberate, has in it a great danger. Implied in the demand for more scientific education is the claim that if one has been scientifically trained one's approach to all subjects will be more intelligent than if one had had no such training. A scientist's political opinions, it is assumed, his opinions on sociological questions, on morals, on philosophy, perhaps even on the arts, will be more valuable than those of a layman. The world, in other words, would be a better place if the scientists were in control of it. But a 'scientist', as we have just seen, means in practice a specialist in one of the exact sciences. It follows that a chemist or a physicist, as such, is politically more intelligent than a poet or a lawyer, as such... But is it really true that a 'scientist', in this narrower sense, is any likelier than other people to approach non-scientific problems in an objective way? There is not much reason for thinking so. Take one simple test — the ability to withstand nationalism."</p> <p style="padding-left: 40px;">"Clearly, scientific education ought to mean the implanting of a rational, skeptical, experimental habit of mind. It ought to mean acquiring a method — a method that can be used on any problem that one meets, and not simply piling up a lot of facts. Put it in those words, and the apologist of scientific education will usually agree. Press him further, ask him to particularize, and somehow it always turns out that scientific education means more attention to the sciences, in other words — more facts. The idea that science means a way of looking at the world, and not simply a body of knowledge, is in practice strongly resisted. I think sheer professional jealousy is part of the reason for this. For if science is simply a method or an attitude, so that anyone whose thought-processes are sufficiently rational can in some sense be described as a scientist — what then becomes of the enormous prestige now enjoyed by the chemist, the physicist, etc.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p style="text-align: center;">and his claim to be somehow wiser than the rest of us?”</p> <p>Textbooks often give the impression that the scientific body of knowledge contained within is relatively complete and settled. But as I said in the syllabus for this course, we need to distinguish the finger that is being used to point at some object of study, from the object itself. The tendency for educators and publishers to write with self-assurance is often misleading. There is often a great deal more legitimate diversity of thought on even the most basic questions that you might find in the different fields of science than most textbooks would have us believe. That does not mean that anything can be valid. Mathematical representations, for example, are often essential to understanding, and they cannot simply be replaced by words. And texts that accurately represent scientific realities cannot be replaced by other texts just because those other texts seem to ‘feel’ right to someone. The practice of science requires rigorous understanding of what already exists within a given discipline, and this cannot be replaced by an active imagination alone. It always requires a lot of hard work.</p> <p>The perpetual presence of human ignorance with regard to what the universe may throw our way should not surprise us. Evolution may be a universal property of nature that guarantees the emergence of novel forms and functions (not necessarily biological) whose interactions with what already exists had never been predefined anywhere, or anytime; and what emerges from these interactions may also be entirely new. If this emergent property of nature is real, it has its potential down side. It guarantees that potentially troublesome forms or events that no one could have ever predicted will eventually appear. We may manage to avoid similar situations in the future, and that’s good. Nevertheless some entirely new, unanticipated situation will always eventually arise. If this property of nature is real, then even the most advanced future AI system, encompassing all of science, could still not possibly anticipate everything that will happen, including processes and events that, for good or ill, affect our future survival. I think that this is indeed a universal property of nature, as demonstrated in various domains by the uncertainty principle, by quantum indeterminacy, by deterministic chaos, by the Incompleteness Theorems of Kurt Gödel, and by the undecidability results of Turing and others in the domain of computation. We will briefly discuss deterministic chaos two weeks from now.</p> <p>I caution you not to take the preceding discussion as an endorsement of the sort of social reform of science with which educators are currently enthralled, based on belief systems that intentionally upend everything without justification. We can all see this for example with regard to human biology and the social sciences, but these so-called reforms are now penetrating the physical sciences and mathematics as well. It is my view that what has been taking place over the past decade is a cultural revolution that is far more sinister in its global implications than the cultural revolutions of the affluent West in the 1960s, the childish, destructive, self-righteous revolutions that educators seem so intent on romanticizing and imitating. We are for example being told to ‘decolonize the curriculum’, but I’m afraid the people who are telling us this have no self-awareness. If they had any self-awareness, they would realize that they are the real colonizers, since they are asking the world, which has contributed in a truly distributed way over many hundreds of years to the disciplines in question, to see things in the same superficial, artificial, delusional, and ultimately destructive ways they see them. In the face of real issues related to climate, food, energy, economics, disasters, wars, and political instability, most of the world cannot afford to delude itself as cheaply and as self-righteously as we in the affluent West seem to have managed to delude ourselves about such things.</p> <p>I’ve always had to earn my own wages, even while going to school. Professionally, my background is embedded in the sciences, in a variety of capacities. I have worked for example in a nuclear fission electrical generation plant, within an international nuclear fusion energy program, and in a federal remote sensing hydrological agency, as a technician, programmer, systems engineer, and staff scientist.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>Only after more than twenty-five years of often challenging work did I return full-time to school, further develop and publish my own research, and begin teaching. My nearly lifelong dependence on work is certainly not unusual, but it is unusual among university professors and instructors. Even as a student, but certainly upon graduation, you will begin to acquire work experiences for which many of your teachers and administrators have no real appreciation, and about which they have no useful advice to offer. Please keep that in mind the next time you're tempted to be harsh to an outsider like me. The advantage of being an outsider is, I've been outside.</p> <p><b>Topic 2: Developments in nuclear fusion</b></p> <p>As an addendum to the previous discussion, I'd like to introduce a topic that might not be covered in any other course you may be taking, but which young people should know something about. Science has been a depressing topic of late, what with COVID-19 and all. And perhaps out of fear, many people increasingly seem to have fallen under the spell of a variety of 'I am the science' charlatans. But for now, let's look at some positive developments. Positive developments often take a long time to unravel, so they seldom make the news, but they should be part of your science education.</p> <p>In week 2, we will discuss a few topics that underpin the entire semester, and in week 3 we will look at the Earth's relationship with the Sun. Nearly all of the energy powering life on Earth is ultimately derived from the nuclear fusion processes occurring within the Sun. If we could create similar processes here on Earth, huge amounts of energy could be released through the use of a few very light, relatively safe and rather abundant substances. This presents an enormous set of engineering challenges. But many of these challenges have already been met, or they soon will be.</p> <p>The developmental costs of the technology might mean that fusion energy will probably not be cheap or plentiful at first, but if it scales up, it could go a long way toward reducing atmospheric carbon and solving our climate and energy supply issues. The golden age of fusion energy research may be approaching. We've recently seen news from the Lawrence Livermore Lab with laser-induced fusion. We will concentrate here on the more likely pathway to power generation, magnetic confinement.</p> <p><b>Watch:</b> Nuclear Fusion 3.0: Real World Electricity is Coming [Electric Future]  <a href="https://youtu.be/4GJtGpvE1sQ">https://youtu.be/4GJtGpvE1sQ</a></p> <p><b>Watch:</b> Why Private Billions Are Flowing Into Fusion [Bloomberg Quick Takes]  <a href="https://youtu.be/Dp6W7g9no0w">https://youtu.be/Dp6W7g9no0w</a></p> <p>Helion is an interesting company with a unique approach. What is most exciting to me is the way electricity is stored in capacitor banks between strokes of the 'engine', with the excess charge that is hopefully created by the fusion reaction bled off directly for immediate use. There is no need to convert heat or radiation into electricity; it is produced directly. This is real futuristic steampunk! Can you imagine working for this company?</p> <p><b>Watch:</b> A New Way to Achieve Nuclear Fusion: Helion [Real Engineering]  <a href="https://youtu.be/bDXXWQxK38">https://youtu.be/bDXXWQxK38</a></p> <p>There's some redundancy among the following recommended videos, but each one shows something different, particularly with regard to the history of magnetic confinement, so I didn't want to remove anything of potential interest. You might want to think about fusion for your final paper.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p><b>Recommended:</b> Nuclear Fusion Breakthrough Rewrites Laws of Physics  <a href="https://youtu.be/G27M0eRTRZE">https://youtu.be/G27M0eRTRZE</a></p> <p><b>Recommended:</b> Major breakthrough on nuclear fusion energy - BBC News  <a href="https://youtu.be/0fYiNVRmOA4">https://youtu.be/0fYiNVRmOA4</a></p> <p><b>Recommended:</b> Scientists New Nuclear Fusion Breakthrough Changes Everything! [Tech Space]  <a href="https://youtu.be/fqBD8Cs4oWQ">https://youtu.be/fqBD8Cs4oWQ</a></p> <p><b>Recommended:</b> We Went Inside the Largest Nuclear Fusion Reactor [The B1M]  <a href="https://youtu.be/4BkOUOK0XzM">https://youtu.be/4BkOUOK0XzM</a></p> <p><b>Recommended</b> (beginning at minute 1:10): Wendelstein 7-X fusion device [Max Planck Institute]  <a href="https://youtu.be/51Hji5NfkdA">https://youtu.be/51Hji5NfkdA</a></p> <p><b>Focus topic: Memories of the Tokamak Fusion Test Reactor (TFTR)</b></p> <p>Science is a cooperative endeavor, often involving many non-scientists. I was fortunate to have been in the right place, at the right time, and with the right qualifications to have been hired onto a team of about a dozen electronics technicians that helped to build, install, and maintain the instrumentation for the largest, most elaborate nuclear fusion device in the world at the time. The Tokamak Fusion Test Reactor was built on the grounds of the Princeton Plasma Physics Laboratory, adjacent to woods and cornfields just outside Princeton, New Jersey. Construction on TFTR began in 1980, and initial operations began in 1982. TFTR remained in use until 1997. It was dismantled in September 2002. My favorite memories of the tokamak were formed during the early stages of construction, when the vacuum vessel was still visible. It was made of stainless steel, it was doughnut-shaped (a torus), and it was huge. The internal diameter of the vacuum vessel itself, within the body of the torus, was eight feet. Technicians could open it up and easily work on it from within.</p>  <p>Soon, however, the tokamak disappeared within a maze of instrumentation, magnets, and cryogenics.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p data-bbox="354 174 1479 380">TFTR was the largest, most elaborate nuclear fusion device of its kind at the time. It was intended to test a simple idea, whether confining a cloud of hydrogen isotopes within a ‘tokamak’ a torus-shaped vacuum vessel, heating it with microwaves and squeezing it magnetically could ignite fusion reactions to the point of ‘break even’ energy generation. The name ‘tokamak’ sounds Russian because it is. The idea was originally proposed by the Soviet physicist and human rights campaigner, Andrei Sakharov. His story, by the way, is a fascinating one.</p>  <p data-bbox="354 1161 1479 1717">I was member of a group of electrical and electronics engineers and technicians that was called ‘Central Instrumentation Control and Data Acquisition’ (CICADA). Most of the time, we worked in our own labs and in the computer and control rooms downstairs. This was in a building a few hundred feet away from the building that actually contained the tokamak device. The buildings were connected through an underground tunnel through which we walked. Within this tunnel, we installed the fiber optic lines that were used to communication with the device. Optical fiber rather than electrical wire was used to communicate with the tokamak primarily in order to keep the control and computer rooms electrically isolated from the pulsed high voltages and currents around the device itself. The electricity required to power the device could not be drawn directly from the electrical grid. Two absolutely massive dynamos were slowly spun up to high speed like tops on vertical axes in huge cylindrical pits in yet another building, and the current required by the tokamak could then be drawn off suddenly from these dynamos. As they experienced the resulting breaking action, the dynamos would scream, and the images on CRT screens nearby would bend for a few seconds. No one was allowed near the device while it was in operation, and I was assigned to install and maintain the card readers and cameras that made sure of that. Through this task, I got to know the head of security, an old gentleman who had flown missions over the Himalayas to China during WWII. But that’s another story.</p> <p data-bbox="354 1759 1479 1892">Since a great deal of fabrication was required at the component level (with lots of soldering iron action), particular technicians were assigned to work closely with particular engineers. I was assigned to work with an absolutely brilliant engineer, Jane Montague, who was just a few years older than me, on some of the project’s most critically important systems. For example, we built a complex master clock that</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	02/01/23	<p>synchronized a whole suite of operations involving instrumentation control and data acquisition. All of these operations occurred within just a few seconds, and most in under a second, which was about how long stable plasma conditions could be maintained at the time. Since this master clock had to perform operations with microsecond precision, it had to be built with fast, ultrareliable components and an extremely fast internal clock. Digital devices operate in discrete steps, and in real world applications they had to be timed precisely and responsively. All of the observational data resulting from the operation of the tokamak was processed and stored on large frame computers in a separate computer room, but these computers were not sufficiently isolated from outside influences to do the work required of our master clock, as well as many, many other real-time specialized functions.</p> <p>Jane would first meet with physicists and other engineers in order to determine what the requirements were. She would then design circuits with the most reliable military-grade TTL logic devices that were available at the time, and I would construct them on circuit boards, which would then be plugged into crates to connect them to other customized circuits, displays, computers, and peripherals. I decided on how the components would be arranged on a board, and I soldered them individually to wires and other components. Jane and I might sit for hours, testing and modifying our circuits with the aid of logic analyzers and oscilloscopes. Meanwhile, other teams would be doing the same thing. It was challenging work involving invention, innovation, and craftsmanship on a scale that few people outside of such endeavors get to witness.</p> <p>The following is a promotional video from 1989 about the Plasma Physics Lab and the Tokamak Fusion Test Reactor (TFTR), with footage of the interior, machines, and scientists at work.</p> <p><b>Recommended:</b> Plasma Physics Lab and the Tokamak Fusion Test Reactor, 1989 [princetoncampuslife] <a href="https://youtu.be/TamkP8QrZak">https://youtu.be/TamkP8QrZak</a></p> <p><b>Recommended:</b> The Princeton Plasma Physics Laboratory [WebsEdge Science, Feb 28, 2014] <a href="https://youtu.be/b8iH1930p2s">https://youtu.be/b8iH1930p2s</a></p> <p><b>Homework 1:</b></p> <p>1. Please download the file named <b>jme-2022-108449.full.pdf</b> from Files, in Canvas. Alternatively, it can be found at the following URL: <a href="https://jme.bmj.com/content/early/2022/12/05/jme-2022-108449">https://jme.bmj.com/content/early/2022/12/05/jme-2022-108449</a> Describe in some detail the conclusions of the authors. The Conclusion of the paper begins at the bottom of page 10, and it is two paragraphs long. Cite the paper as follows:</p> <p>Bardosh K, Krug A, Jamrozik E et al. “COVID-19 vaccine boosters for young adults: a risk benefit assessment and ethical analysis of mandate policies at universities”. Journal of Medical Ethics Published Online First: 05 December 2022. doi: 10.1136/jme-2022-108449</p> <p>2. Based on the quotations provided above, do you think that Orwell’s essay “What Is Science?” might still describe our general perception of science and its institutions? This essay was written only a couple of months after the atomic bombings of Japan, and after the US and USSR had both recruited German weapons scientists with the Nazi defeat.</p> <p>3. Discuss the prospects for energy generation using magnetic confinement nuclear fusion.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
2		<p data-bbox="345 212 586 247"><b>Topic 1: Fractals</b></p> <p data-bbox="345 289 1463 422">This week, we will have a taste of what is being discovered regarding ways of representing and understanding the sorts of structures and processes that are directly relevant to each of the topics we will cover. Unfortunately, our educational system has not kept up with these developments, and our textbooks seldom mention them.</p> <p data-bbox="345 464 922 531"><b>Watch:</b> Could our universe be fractal? [Chillheimer]  <a data-bbox="345 499 695 531" href="https://youtu.be/tN_eNQFcv5E">https://youtu.be/tN_eNQFcv5E</a></p> <p data-bbox="345 569 1474 877">As an example of the sort of complexity that can come out of a relatively simple nonlinear relationship, consider the Mandelbrot Set, which can be generated by using a very simple iterative equation. As you zoom in towards some point along the boundary of converging solutions to that equation on the complex number plane, it reveals itself with infinite complexity, as shown in the video below. Notice that the fractal patterns that come out of this pure mathematics often appear to be more biological and crystalline than utterly abstract. The forms you can see emerging from the background and dissolving into the foreground as we zoom in are emerging from the calculations as they are performed. This concept of ‘emergence’ seems to be of fundamental significance within both the mathematical and observable world, although it is difficult to formalize in mere words.</p> <p data-bbox="345 919 1036 987"><b>Examine:</b> Sapphires - Mandelbrot Fractal Zoom [Maths Town]  <a data-bbox="345 955 722 987" href="https://youtu.be/8cgp2WNNKmQ">https://youtu.be/8cgp2WNNKmQ</a></p> <p data-bbox="345 1024 1419 1056">Here’s a zoom into the tip of the needle along the main axis. Things get interesting quickly, though.</p> <p data-bbox="345 1094 997 1161"><b>The Hardest Trip - Mandelbrot Fractal Zoom [Maths Town]</b>  <a data-bbox="345 1129 717 1161" href="https://youtu.be/LhOSM6uCWxk">https://youtu.be/LhOSM6uCWxk</a></p> <p data-bbox="345 1199 1468 1371">Fractal mathematics is used to model and visualize many three-dimensional natural and artificial forms. One software package for generating such forms is called ‘Mandelbulb’. If you search on that term in YouTube, you’ll get results like the following three videos. They demonstrate that it is not particularly difficult to generate biological or geological forms using fractal geometry. While these are imaginary, it is not hard to see such methods being used to accurately represent natural structures.</p> <p data-bbox="345 1409 850 1476"><b>Recommended:</b> Emergence [Julius Horshuis]  <a data-bbox="345 1444 698 1476" href="https://youtu.be/G8qZvzv5ABg">https://youtu.be/G8qZvzv5ABg</a></p> <p data-bbox="345 1514 997 1581"><b>Recommended:</b> Mandelbulb 3D Animation [Russ McClay]  <a data-bbox="345 1549 698 1581" href="https://youtu.be/VGpnuTJhv1U">https://youtu.be/VGpnuTJhv1U</a></p> <p data-bbox="345 1619 980 1686"><b>Recommended:</b> Virtual nature (fractal world ) [San Base]  <a data-bbox="345 1654 698 1686" href="https://youtu.be/79SqIC2bNcM">https://youtu.be/79SqIC2bNcM</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p><b>Topic 2: Scale and pattern</b></p> <p><b>Watch:</b> The Science of Patterns [Systems Innovation]  <a href="https://youtu.be/kh6KMW8J3RQ">https://youtu.be/kh6KMW8J3RQ</a></p> <p>Many fractal patterns are ‘self-similar’ at different scales. Patterns might persist or repeat themselves, perhaps in modified form, as you zoom in and out. Natural branching patterns in particular are often like this. The sorts of patterns that running water makes in the sand at your feet are very similar to the patterns that they might form at the landscape scale. It has been possible to examine hydrological patterns and design large scale structures in the landscape by using small scale models of water storage and flow. And as we’ll discuss next week, human lungs have a huge internal surface area precisely because of their branching fractal geometry. I’ve often thought about relationships between different scales of space and time. The following paper of mine is not required reading, but you may find it interesting:</p> <p><b>Recommended reading:</b> A Typology of Spatial and Temporal Scale Relations [Gary Pereira]  <a href="https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1538-4632.2002.tb01073.x">https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1538-4632.2002.tb01073.x</a></p> <p>The ability to work with patterns forms the basis of much of AI, neural networks, etc. The following is an example of some work that I was doing with agent-based models and the patterns they form.</p> <p><b>Recommended:</b> Functional diversity in geospatial domains (1) [Gary Pereira]  <a href="https://youtu.be/rEb9XZyMsBQ">https://youtu.be/rEb9XZyMsBQ</a></p> <p>You can download my paper on this from the following site:  <b>Recommended:</b> <a href="https://portfolium.com/entry/investigating-the-effects-of-functional-diversity">https://portfolium.com/entry/investigating-the-effects-of-functional-diversity</a></p> <p>The following locally shot videos of mine involve lichens and terracettes that form spatial patterns over long periods of time, and bird songs, which form temporal patterns over very short periods of time.</p> <p><b>Recommended:</b> Pattern formation in Nature 2: lichens and terracettes [Gary Pereira]  <a href="https://youtu.be/AZ14PyiqM28">https://youtu.be/AZ14PyiqM28</a></p> <p><b>Recommended:</b> Pattern formation in Nature 3: bird song [Gary Pereira]  <a href="https://youtu.be/UvGue54F4Ik">https://youtu.be/UvGue54F4Ik</a></p> <p><b>Topic 3: Emergence</b></p> <p>‘Emergence’ is one of a set of several key ideas that encompass contemporary theories of complexity, as applied to the physical world. Evolutionary theory in biology has discovered many illuminating processes and principles that have proven to be useful in explaining the appearance of new forms and processes at biological, ecological, and social scales. Indeed, the evolutionary history of the universe itself is the central topic of cosmology. The appearance of each of the elements in the periodic table is the result of a kind of cosmic evolution. Most of the elements with which we are familiar first appeared hundreds of millions or even billions of years after the Big Bang, having been generated from fusion processes within earlier generations of stars, or from collisions between neutron stars or even black holes. We are, quite literally, made of stardust.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p><b>Watch:</b> Emergence [Systems Innovation]  <a href="https://youtu.be/QItTWZc7hKs">https://youtu.be/QItTWZc7hKs</a></p> <p><b>Watch:</b> Synergies [Systems Innovation]  <a href="https://youtu.be/rsn5EQoAhUc">https://youtu.be/rsn5EQoAhUc</a></p> <p><b>Recommended:</b> Tom McLeish - Is Emergence Fundamental? [Closer to Truth]  <a href="https://youtu.be/GXCvOXUhBUk">https://youtu.be/GXCvOXUhBUk</a></p> <p><b>Topic 4: Nonlinearity</b></p> <p>The significance of nonlinear phenomena (that is to say, most things) cannot be determined by simple additive or multiplicative reasoning. Imagine bumping into a wall at 1 mile per hour. No big deal. Now imagine doing that same bump 10 times in a row. It would be kind of OCD but still, no big deal. Now imagine running straight into the wall just once, at 10 miles per hour. Obviously, a very different result from bumping into it 10 times at 1 mph. Also much greater than what you would get at 1 mph and just multiplying that insignificant effect by 10. At 20 or 30 mph, it could easily result in death. In order to translate velocity into significance, you would need to at least raise it to some power, rather than just multiply it by some value. That is the basis of nonlinearity. The events that often carry the most significance, possibly the only real significance, are often extremely powerful, carrying everything they interact with into qualitatively uncharted terrain. These are the sorts of events that actually change lives, nations, and civilizations.</p> <p><b>Watch:</b> Long Tail Distributions [Systems Innovation]  <a href="https://youtu.be/vIp1kY0H0yw">https://youtu.be/vIp1kY0H0yw</a></p> <p>Agents of change exist at every scale. They can be far smaller or far larger than anything we as human beings can directly perceive. They can occur far more quickly than we could ever have time to respond to, and they can happen far more slowly than we might even notice. The pandemic that we are going through now illustrates this point. Each COVID-19 virus particle is approximately 50–200 nanometers in diameter. Let’s say 100 nanometers, typically. That’s four orders of magnitude smaller than a millimeter, which is the finest mark that you might find on a common ruler. Ten thousand individual virus particles can be lined up between each of those millimeter marks. Roughly a hundred million particles could cover a square millimeter of surface. Now compare that to the surface area of a pair of human lungs, which is the primary target of most variants of this particular virus. The alveolar surface area of a pair of human lungs is enormous, somewhere between 50 and 75 square meters! It is possible for Nature to fit such an enormous surface area into such a compact volume because lungs exemplify a fractal branching pattern, terminating in hundreds of millions of alveoli for gas exchange. If a hundred million virus particles can cover a square millimeter, and there are fifty square meters of surface available, you can imagine the sorts of battles that are being fought within the vast terrain (from the virus’s point of view) available within a single human being. Now think about the spread of that virus to billions of people. The potential power of anything cannot be determined merely by its size or by our current awareness of its potentialities. This is one of the things that nonlinearity implies. Next week, we will look at how nonlinearity can lead to ‘chaos’, which has a very different meaning in science than it does in common usage.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	<b>02/08/23</b>	<p><b>Topic 5: Antifragility</b></p> <p>Usually the discussion of solution to our collective vulnerability to powerful events strung out along the tails of event distributions (events like pandemics, floods, earthquakes, etc.) revolves around terms like ‘resilience’ and ‘robustness’. However, an argument can be made (through simple observation of nature) that some other principle better characterizes the opposite of fragility: something that people have known about for a long time, but which Nassim Taleb recently termed ‘antifragility’.</p> <p><b>Recommended:</b> <a href="https://en.wikipedia.org/wiki/Antifragile">https://en.wikipedia.org/wiki/Antifragile</a></p> <p><b>Watch:</b> Nassim Nicholas Taleb explains Antifragile [Penguin Books UK] <a href="https://youtu.be/tZonEaP5ts4">https://youtu.be/tZonEaP5ts4</a></p> <p><b>Homework 2:</b></p> <p>Reminder: check each week for any new Announcements.</p> <ol style="list-style-type: none"> <li>1. How are patterns defined by the Systems Innovation video? How might patterns be defined in time as well as space? Give me some examples.</li> <li>2. Describe the concepts of emergence and synergies, and try to illustrate them in the context of the natural sciences with a few examples.</li> <li>3. What are long-tailed statistical distributions? How might events following a power-law or long-tailed distribution make assumptions of long-term normality nonsensical? In other words, are common statistical terms always meaningful? For example, can the mean of a power-law distribution ever be determined? This is an important point, given the fact that many natural distributions do indeed have very long tails.</li> <li>4. What is antifragility? Try to explain how it can be seen as different from resilience or robustness. Why might you think this concept is important in an era of climate change and pandemics?</li> </ol>
<b>3</b>		<p><b>Topic 1: Deterministic chaos</b></p> <p>Now for a topic that is actually central to any understanding of Earth systems, indeed of most complex systems. The popular use of the word ‘chaos’ is not what we will be talking about, so for most of you an accurate understanding of this topic may require you to actually try to ignore its popular definition, which is difficult. The science of chaos is actually far more interesting and engaging than our common use of the term would imply.</p> <p><b>Watch:</b> Nonlinear Dynamics &amp; Chaos [Systems Innovation] <a href="https://youtu.be/qz6gXyFzV9A">https://youtu.be/qz6gXyFzV9A</a></p> <p>Keep in mind that the illustrative portrayal of chaotic systems is by means of the ‘trajectory’ the system follows through time, in terms of any important variables. Time is not represented explicitly, but only</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>through the trace of the trajectory the system follows in terms of the values these variables take at each time step. Three (or more) variables are required, resulting in a 3D trace that can be rotated for different perspectives on the action. While the video above does a good job of explaining the fundamentals, it seems to imply that deterministic chaos occurs primarily in simple systems. It does not discuss actual chaos in nature or in complex systems or networks. All of these are in fact real, common, and of particular importance for this course.</p> <p>For example, consider the Lorenz attractor. This is the shape described by the trajectory of a point in three-dimensional ‘space’ of three variables, as described by a set of simple equations. Notice that through much of the trajectory, the path of the point is fairly predictable. Although the pathways never repeat perfectly, they are aligned like the rings of Saturn. But in certain regions, the paths can diverge wildly from nearly the same coordinate, moving in this example between the two distinct lobes (looking conveniently like the wings of a butterfly: just a coincidence). Check out the other attractors that the author programed with the same sorts of qualities. One thing to keep in mind about deterministic chaos: it is often fairly predictably, and it stays within certain bounds (the attractor), but it is also magnificently unpredictable at other points, and certainly unpredictable over the long term. That is fundamentally why weather prediction is limited.</p> <p><b>Watch:</b> Are there other Chaotic Attractors? [Orfeas Liossatos]  <a href="https://youtu.be/idpOunnpKTo">https://youtu.be/idpOunnpKTo</a></p> <p>We do not study chaos in order only to understand some of the limits of our knowledge and predictive abilities, but also to potentially overcome some of those limits. Thus titles of books in business and lifestyle on the topic of overcoming or controlling chaos. I’ve looked through some of these books, and most seem to be speculative, with little or no basis in the science of chaos. However, there is already scientific and engineering progress in not only understanding chaos, but in controlling it. This progress has huge implications for the climatic and ecological systems we will be studying here.</p> <p><b>Watch:</b> How Chaos Control Is Changing The World [Sabine Hossenfelder]  <a href="https://youtu.be/q1-cwamhwag">https://youtu.be/q1-cwamhwag</a></p> <p><b>Topic 2: The Milankovitch cycles</b></p> <p>This first video below is the best and most complete visual description of the motions of the Sun-Earth system that I’ve been able to find. It includes visual explanations of the seasons, different ways of measuring the length of a year, and changes in tilt and wobbles with periods of tens or hundreds of thousands of years (the Milankovitch cycles) that largely guide our global climate. I recommend that you watch it repeatedly to get a sense of the complexity of this motion.</p> <p><b>Watch:</b> Earth's motion around the Sun, not as simple as I thought [Aryan Navabi]  <a href="https://youtu.be/82p-DYgGFjI">https://youtu.be/82p-DYgGFjI</a></p> <p>The long-term variations in the Earth-Sun relationship are largely, but not solely, responsible for long-term changes to the Earth’s climate. These variations must be understood in order to understand the Earth’s climate, but they should not be used to excuse inaction with regard to anthropogenic climate change,</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	<b>02/15/23</b>	<p><b>Watch:</b> What Milankovitch Cycles Will Do To Earth [Astrum]  <a href="https://youtu.be/01aFP88qfQs">https://youtu.be/01aFP88qfQs</a></p> <p>How Ice Ages Happen: The Milankovitch Cycles [It's Just Astronomical!]  <a href="https://youtu.be/iA788usYNWA">https://youtu.be/iA788usYNWA</a></p> <p><b>Watch:</b> The Milankovitch Cycle Timeline: Where are we now?  <a href="https://youtu.be/eB3DJtQZVsw">https://youtu.be/eB3DJtQZVsw</a></p> <p><b>Topic 3: Energy and the Sun-Earth system</b></p> <p>Now that we've covered what I consider to be some of the necessary background, we can begin discussing the traditional topics of a class in physical geography. Energy is the basis for all activity and change, and it is connected intimately to the Earth-Sun dynamics we just covered.</p> <p><b>Watch:</b> A guide to the energy of the Earth  <a href="https://youtu.be/fHztd6k5ZXY">https://youtu.be/fHztd6k5ZXY</a></p> <p><b>Reference:</b> Fundamentals of Physical Geography CHAPTER 6: Energy and Matter  <a href="http://www.physicalgeography.net/">http://www.physicalgeography.net/</a></p> <p><b>Homework 3:</b></p> <p>Reminder: check each week for any new Announcements.</p> <ol style="list-style-type: none"> <li>1. Can a system that is fully deterministic, also be chaotic? What does deterministic chaos imply about the limits of prediction? Why?</li> <li>2. Discuss how deterministic chaos might be controlled, as described by physicist Sabine Hossenfelder.</li> <li>3. Describe the Milankovitch cycles and their influence on the Earth's climate.</li> </ol> <p><b>(In accessing the textbook, please ignore the ads. Do not download the pdf version suggested by the website or popup. Just access the online version.)</b></p> <p>Access online the text <b>Fundamentals of Physical Geography</b>  CHAPTER 6: Energy and Matter  <a href="http://www.physicalgeography.net/fundamentals/chapter6.html">http://www.physicalgeography.net/fundamentals/chapter6.html</a></p> <p>Each chapter of the online text <b>Fundamentals of Physical Geography</b> includes a Study Guide page. At the bottom of each Study Guide page is a list of Essay Questions. Responses to questions from the book may be partially copied and pasted from the text, but most of the writing should be your own. Take your answers, at least in part, from the section of that chapter that discusses the topic at hand. Do not take them from the summary of the chapter. Use your own words most of the time, and incorporate what you learn from the videos.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>Chapter 6 Essay Questions 3, 5, 6, 7, 9, 12:</p> <p>6.3. How do conduction, convection and radiation move energy from one place to another?</p> <p>6.6. Define the Stefan-Boltzmann Law, including each term expressed in the equation. What does it describe?</p> <p>6.7. Define Wien's Law, including each term expressed in the equation. What does it describe?</p> <p>6.12. How does angle of incidence control the intensity of solar radiation received at the Earth's surface?</p>
4		<p><b>Topic 1: Networks</b></p> <p>Networks and grids, regardless of the domain, almost always generate emergent properties. The most spectacular, from our point of view, may be the human brain and nervous system. But living things of all kinds form networks, from micron to planetary scales. And seemingly delicate networks of matter and energy are being found even on universal scales.</p> <p>Many scientific and mathematical insights have emerged recently with regard to the evolution, structure, and behavior of networks. Unfortunately, most of us are taught very little about them, unless we take a specialized course as part of a computer science, math, or engineering curriculum. If you search for 'networks' in YouTube, nearly everything you get is about computers and communications. You are better off searching for 'network theory' or 'graph theory'. Even then, there is usually not sufficient exploration of how these ideas apply to the real world. Nevertheless, the Systems Innovation channel provides a set of introductory videos on networks.</p> <p><b>Watch:</b> Network Theory Overview [Systems Innovation]  <a href="https://youtu.be/qFcuovfgPTc">https://youtu.be/qFcuovfgPTc</a></p> <p><b>Watch:</b> Network Paradigm [Systems Innovation]  <a href="https://youtu.be/9XEvXNrc-dg">https://youtu.be/9XEvXNrc-dg</a></p> <p><b>Watch:</b> Network Robustness &amp; Resilience [Systems Innovation]  <a href="https://youtu.be/_ztNkmDg0mw">https://youtu.be/_ztNkmDg0mw</a></p> <p><b>Recommended:</b> Network Diffusion &amp; Contagion [Systems Innovation]  <a href="https://youtu.be/bTXUJQhEqL0">https://youtu.be/bTXUJQhEqL0</a></p> <p><b>Recommended:</b> How Networks Can Change Everything [Computational Social Science ETH]  <a href="https://youtu.be/PWx91zUnBVU">https://youtu.be/PWx91zUnBVU</a></p> <p>Now, in anticipation of our next topic, I want you to think about the networks that keep society from falling apart. Networks of electrical energy, water, natural gas, information, commerce, etc.</p> <p><b>Watch:</b> How Long Would Society Last During a Total Grid Collapse? [Practical Engineering]  <a href="https://youtu.be/OpC4fH3mEk">https://youtu.be/OpC4fH3mEk</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p><b>Topic 2: Coronal Mass Ejections</b></p> <p>Barnhardt: <i>Tell me, Hilda, does all this frighten you? Does it make you feel insecure?</i>  Hilda: <i>Yes sir, it certainly does.</i>  Barnhardt: <i>That's good, Hilda; I'm glad.</i></p> <p>(from “The Day the Earth Stood Still”, 1951)</p> <p>This week’s topic is one that physical geography textbooks seldom mention. But coronal mass ejections (CMEs) and their potential impact on civilization are in fact the perfect topic to connect last week’s discussion of our relationship to the Sun, with the importance of networks in our lives.</p> <p><b>Reference:</b> <a href="https://en.wikipedia.org/wiki/Coronal_mass_ejection">https://en.wikipedia.org/wiki/Coronal_mass_ejection</a></p> <p><b>Watch:</b> The Carrington Event - A Short Documentary [Fascinating Horror]  <a href="https://youtu.be/C9tfx6rfAIo">https://youtu.be/C9tfx6rfAIo</a></p> <p><b>Watch:</b> How Solar Storms Could Knock Out Our Power Grid [NOVA PBS Official]  <a href="https://youtu.be/7nkC8SXzHls">https://youtu.be/7nkC8SXzHls</a></p> <p><b>Watch:</b> The Grid vs. The Next Big Solar Storm [Real Engineering]  <a href="https://youtu.be/LLO9WxVO9s8">https://youtu.be/LLO9WxVO9s8</a></p> <p><b>Watch:</b> What If a Massive Solar Storm Hit the Earth? [What If]  <a href="https://youtu.be/q2kDvrs2VEs">https://youtu.be/q2kDvrs2VEs</a></p> <p>About a year before COVID-19 made its appearance, I had begun to discuss epidemics and pandemics in some of my courses, including this one. On the other hand, I’d always also asked students in this course to consider the consequences of a large earthquake, which we have thankfully not yet experienced yet. So hopefully I’m a poor oracle of disaster.</p> <p>But I want you to think about the consequences of a Carrington-like CME occurring now. Think about how very different the world is now, and how vulnerable we have become to electronic damage to our survival systems. In 1859, the world population was about 1.3 billion; it is now almost 8 billion. In 1859, the only electrical circuits in existence were telegraphs. Now, nearly every source of life support for urban dwellers in developed nations, at least, may depend on sensitive electronic circuits and devices.</p> <p>In “The Day the Earth Stood Still” (1951), a visitor from space pressed his demands by temporarily disabling all electrical circuits on Earth. All devices requiring electricity, including vehicles, become temporarily inoperable. A severe CME would be very different. Some of its effects might pass with the event itself, but a great deal of permanent damage requiring time-consuming repair and replacement would be inevitable. In wonder, would our governing bodies, which seem increasingly to live on the Internet, survive even a partial disconnection? Unlike an earthquake or flood, this would be a global event.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	02/22/23	<p><b>Homework 4:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. What are some of the key features of the network paradigm?</li> <li>2. What are network robustness and resilience? Describe some of the characteristics or practices that are more likely to result in resilient networks.</li> <li>3. If we sustained a direct hit from a powerful Coronal Mass Ejection, what do you think might happen immediately? What might happen over time? What do you think could be done, given the globalized, networked nature of the world we live in, to reduce and overcome the impact of such an event?</li> </ol>
5		<p><b>Topic 1: The Atmosphere</b></p> <p>A thin shell of gases, the atmosphere of the Earth is perfectly suited for life. Indeed, it's current composition is due in large part to the presence of life on Earth.</p> <p><b>Reference:</b> Fundamentals of Physical Geography CHAPTER 7:  <a href="http://www.physicalgeography.net/">http://www.physicalgeography.net/</a></p> <p><b>Watch:</b> Water Vapor Fuels Hurricane  <a href="https://ca.pbslearningmedia.org/resource/nves.sci.earth.hurricane/water-vapor-fuels-hurricanes/">https://ca.pbslearningmedia.org/resource/nves.sci.earth.hurricane/water-vapor-fuels-hurricanes/</a></p> <p><b>Watch:</b> NOVA: Earth From Space   Monitoring Earth's Water Vapor  <a href="https://ca.pbslearningmedia.org/resource/nves.sci.earth.vapor/monitoring-earths-water-vapor">https://ca.pbslearningmedia.org/resource/nves.sci.earth.vapor/monitoring-earths-water-vapor</a></p> <p><b>Watch:</b> Careers In Atmospheric Science [NCAR Earth Observing Laboratory]  <a href="https://youtu.be/Fk-uqrXkkG8">https://youtu.be/Fk-uqrXkkG8</a></p> <p><b>Topic 2: Remote sensing and dynamic modeling</b></p> <p><b>Watch:</b> What is Remote Sensing?  <a href="https://youtu.be/xIsUP1Ds5Pg">https://youtu.be/xIsUP1Ds5Pg</a></p> <p><b>Watch</b> at least one of the following three videos:</p> <p>Satellite Remote Sensing for Environmental Protection  <a href="https://youtu.be/aKfsh2NAuR8">https://youtu.be/aKfsh2NAuR8</a></p> <p>What NASA Knows from Decades of Earth Observations [NASA Scientific Visualization Studio]  <a href="https://youtu.be/dzmktmXUZag">https://youtu.be/dzmktmXUZag</a></p> <p>How can earth observations help predict next pandemics? [NASA Scientific Visualization Studio]  <a href="https://youtu.be/01OkR1Q-2KY">https://youtu.be/01OkR1Q-2KY</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>A number of Masters Theses in Geography included substantive work with remote sensing from our lab. Here are a few:</p> <p><b>Recommended:</b> Examining the relationship between snow cover and reservoir storage in the American River basin, by Karen McGillis-Moskaluk  <a href="https://scholarworks.sjsu.edu/etd_theses/4291/">https://scholarworks.sjsu.edu/etd_theses/4291/</a></p> <p><b>Recommended:</b> Landsat image classification using fuzzy sets rule base theory, by Avivit Shani  <a href="https://scholarworks.sjsu.edu/etd_theses/2978/">https://scholarworks.sjsu.edu/etd_theses/2978/</a></p> <p><b>Recommended:</b> Comparison of two classification methods for vegetation mapping in Palau, by Julie K. Andersen  <a href="https://scholarworks.sjsu.edu/etd_theses/2938/">https://scholarworks.sjsu.edu/etd_theses/2938/</a></p> <p><b>Recommended:</b> Tea bush health determination and yield estimation, by Tapasi Barman  <a href="https://scholarworks.sjsu.edu/etd_theses/3514/">https://scholarworks.sjsu.edu/etd_theses/3514/</a></p> <p><b>Recommended:</b> Effects of Water Conservation on Evapotranspiration in Las Vegas, Nevada, by Joseph Belli  <a href="https://scholarworks.sjsu.edu/etd_theses/3911/">https://scholarworks.sjsu.edu/etd_theses/3911/</a></p> <p><b>Recommended:</b> Creating an Agent-based Model to Examine Spatial Behavior of <i>Eriocheir Sinensis</i>, by Michelle Fong  <a href="https://scholarworks.sjsu.edu/etd_theses/4089/">https://scholarworks.sjsu.edu/etd_theses/4089/</a></p> <p>We will discuss climate models next week, but models are also used in the earth and social sciences, to describe and forecast actual conditions. The data gathered via remote sensing is clearly important for all such modeling, in helping us to design and calibrate the model, provide initial conditions, and interpret results. One interesting class of models that we've done some work with are based on the representation of mobile, autonomous agents interacting in changing environments. Take for example Michelle Fong's 2011 Masters' thesis:</p> <p><b>Reference:</b> Creating an Agent-based Model to Examine Spatial Behavior of <i>Eriocheir Sinensis</i>  <a href="https://scholarworks.sjsu.edu/etd_theses/4089/">https://scholarworks.sjsu.edu/etd_theses/4089/</a></p> <p><b>Watch:</b> An agent-based model of <i>Eriocheir Sinensis</i>  <a href="https://youtu.be/Zr7qOvs35H0">https://youtu.be/Zr7qOvs35H0</a></p> <p>The low resolution of my video makes it difficult to read the graphs, but you should get the idea. The general operation is clear, and the process is not difficult to understand. The video portrays a dynamical agent-based simulation of an invasive crab species in San Francisco Bay. At each time step of the simulation, each simulated crab moves around in search of food or spawning grounds, depending on its age. Adult and juveniles are indicated in the model by black and red dots, respectively. Each simulated crab is born and interacts with its environment, moving in response to a local sense of conditions. If it meets those conditions and survives, it may reproduce, and all eventually die. The age of each natural death and other variables in the system are chosen randomly from normal distributions based on observations of real data. The simulated environment is a space-filling grid of values derived from remotely sensed or directly recorded data regarding water temperature, sediment content, chlorophyll</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/01/23	<p>content, etc. These values change throughout the entire year each month, based on the corresponding month's typical values. These values were derived from twelve Landsat data scenes spanning a typical year. Each simulation cycles repeatedly through this typical year. Due to an intentionally introduced degree of randomness, each simulation is different. Many simulations can be run in batches and their statistics compiled for meta-analysis. You can imagine how the data and techniques involved in this sort of model may be applied to a wide variety of settings, using human beings for example as mobile agents.</p> <p>The Complexity Explorer channel has a series of connected videos on agent-based modeling, including descriptions of NetLogo, the system that Michelle and I used. They also have additional series on NetLogo itself, dynamical systems and chaos, the origins of life, machine learning, etc. The source of this channel, the Santa Fe Institute, has long been at the forefront of complexity research.</p> <p><b>Watch:</b> Agent-Based Modeling: An Initial Exploration [Complexity Explorer]  <a href="https://youtu.be/Z8Wf1vF_xgQ">https://youtu.be/Z8Wf1vF_xgQ</a></p> <p><b>Recommended:</b> Agent-Based Modeling: What is Agent-Based Modeling? [Complexity Explorer]  <a href="https://youtu.be/FVmQbfsOkGc">https://youtu.be/FVmQbfsOkGc</a></p> <p><b>Homework 5:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. What is the primary function of the Aqua satellite? How does it monitor the production of water vapor?</li> <li>2. Describe the sort of careers in atmospheric science from in the video that you find most interesting.</li> <li>3. What is remote sensing? Describe what you've learned from at least one of the three additional remote sensing videos.</li> <li>4. What is agent-based modeling?</li> </ol> <p><b>(In accessing the textbook, please ignore the ads. Do not download the pdf version suggested by the website or popup. Just access the online version.)</b></p> <p>Access the text <b>Fundamentals of Physical Geography</b>  <a href="http://www.physicalgeography.net/fundamentals/contents.html">http://www.physicalgeography.net/fundamentals/contents.html</a></p> <p>Chapter 7 Essay Questions 4, 10, 13</p> <p>7.4. How is the incoming shortwave solar radiation from the Sun modified by the atmosphere and the Earth's surface?</p> <p>7.10. What is a hurricane? Where, when and why does it form? How is global warming likely to influence hurricane intensity and frequency?</p> <p>7.13. Discuss the formation and characteristics of the various types of thunderstorms (see also the videos).</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
6		<p><b>Topic: The Hydrosphere</b></p> <p><b>Reference:</b> Fundamentals of Physical Geography CHAPTER 8: Introduction to the Hydrosphere  <a href="http://www.physicalgeography.net/fundamentals/chapter8.html">http://www.physicalgeography.net/fundamentals/chapter8.html</a></p> <p>I worked for a couple of years at National Operational Hydrologic Remote Sensing Center (NOHRSC) (<a href="https://www.nohrsc.noaa.gov">https://www.nohrsc.noaa.gov</a>) which is NOAA’s “source for snow information” and other hydrological data products and models. Every winter day, several satellite datasets are downloaded to this facility and analyzed, and by evening a variety of maps and graphs are generated and uploaded onto the Internet for use by regional hydrological agencies, businesses, and others to inform their own work and decisions. One important variable that has to be mapped and used to forecast springtime flooding is called Snow Water Equivalent (SWE), which gauges the volume of liquid water that would result from melting a given area of snow cover. This can be checked manually on the ground at various points using automated ‘snow pillows’ and other devices, but it can also be checked from above. NOAA pilots run low altitude flight-lines over snow with instruments that estimate SWE by measuring the degree to which the natural radioactivity of the ground beneath is dampened, or attenuated. These NOAA Corps pilots travel all over the world gathering data and assisting researchers; one in our office had once overwintered at the South Pole.</p> <p><b>Watch:</b> The Water Cycle [National Science Foundation]  <a href="https://youtu.be/al-do-HGulk">https://youtu.be/al-do-HGulk</a></p> <p><b>Watch:</b> Is the world’s fresh water supply running out? [PBS NewsHour]  <a href="https://youtu.be/iVcTQdOJMMw">https://youtu.be/iVcTQdOJMMw</a></p> <p><b>Recommended:</b> Inside Story - What can be done to stop global water scarcity? [Al Jazeera English]  <a href="https://youtu.be/JIIBBWSQMds">https://youtu.be/JIIBBWSQMds</a></p> <p><b>Watch:</b> Calaveras Reservoir [Gary Pereira]  <a href="https://youtu.be/EqehbxjfUk">https://youtu.be/EqehbxjfUk</a></p> <p><b>Reference:</b>  <a href="https://www.sanjoseca.gov/your-government/environment/water-utilities/drinking-water/water-supply">https://www.sanjoseca.gov/your-government/environment/water-utilities/drinking-water/water-supply</a></p> <p><b>Reference:</b>  <a href="https://www.kqed.org/news/11886536/bay-area-do-you-know-where-your-water-comes-from-2">https://www.kqed.org/news/11886536/bay-area-do-you-know-where-your-water-comes-from-2</a></p> <p><b>Reference:</b> <a href="https://bawsca.org/water">https://bawsca.org/water</a></p> <p>Remotely sensed earth surface data, as it changes through time, can illuminate hydrological relationships, like that between snow cover and reservoir storage, certainly an important one for California’s future water needs.</p> <p><b>Recommended:</b> Examining the relationship between snow cover and reservoir storage in the American River basin, by Karen McGillis-Moskaluk  <a href="https://scholarworks.sjsu.edu/etd_theses/4291/">https://scholarworks.sjsu.edu/etd_theses/4291/</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p><b>Focus topic: Urban rivers and streams</b></p> <p>I wanted to present you with some of the street videos that I flood my global geography course with, because I think it's important to connect some of these broader issues with daily life. In the United States, many urban rivers, and in particular the smaller streams, are often hidden and fenced off. They are made to be inaccessible to law-abiding people. As a result, these potentially fun places are often poorly maintained and both physically and socially dangerous.</p> <p>Japanese urban rivers and streams are often channelized, as are many of ours. The streams themselves are often inaccessible, and the channels are deep, in order to accommodate flooding. Nevertheless, Japanese urban streams and the neighborhoods around them can be very attractive. Some of them are particularly popular during cherry blossom (sakura) season. Examine the following videos with question 3 in mind.</p> <p><b>Examine:</b> Rainy night Sakura cherry at Tokyo Meguro River [Ramblac]  <a href="https://youtu.be/wuXmlyS3pVw">https://youtu.be/wuXmlyS3pVw</a></p> <p><b>Examine:</b> (begin at minute 28) Night Sakura of Mama river in Ichikawa city [Ramblac]  <a href="https://youtu.be/KONsMZiXsH4">https://youtu.be/KONsMZiXsH4</a></p> <p>When I was a graduate student at the University of Minnesota in Minneapolis, several of my classmates had come from Korea just to study there in the Geography doctoral program. They were all interested in designing cities with nature in mind. One resulting dissertation for example concerned the creation of greenbelts around and within Korean cities. I'm sure that the subsequent appearance of parks and greenbelts around Seoul and other cities in Korea was at least partly due to their personal efforts.</p> <p><b>Watch:</b> How a City Demolished a Freeway to Restore an Ancient River System [Leaf of life Films]  <a href="https://youtu.be/-I5qMDCcvTI">https://youtu.be/-I5qMDCcvTI</a></p> <p><b>Examine</b> at least one of the following three videos from South Korea:</p> <p>Cheonggyecheon and surrounding scenery at sunset [Bau Walk]  <a href="https://youtu.be/YNEymTSjpYA">https://youtu.be/YNEymTSjpYA</a></p> <p>Cheonggyecheon in the Evening (Sep.2021) [4K Korea]  <a href="https://youtu.be/LqEnkG5LY9k">https://youtu.be/LqEnkG5LY9k</a></p> <p>Peaceful evening walk in Seoul, Danghyun Stream [Walk Together]  <a href="https://youtu.be/H61dOkJfEW0">https://youtu.be/H61dOkJfEW0</a></p> <p>In my over thirty years of travel to China, I've seen significant transformations in the quality and health of urban waterways. Here is just one example.</p> <p><b>Examine:</b> The waterfront of Liangma River at night, Beijing, China [Beijing Walking]  <a href="https://youtu.be/gJCJQwGi5MU">https://youtu.be/gJCJQwGi5MU</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/08/23	<p><b>Homework 6:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. Is the world's fresh water supply running out? Try to be geographically specific.</li> <li>2. What is an aquifer? What is the current state of aquifers around the world?</li> <li>3. Where does our local water come from? Why do you think the new Calaveras Reservoir Dam was designed to hold up to four times as much water as it is currently holding?</li> <li>4. What are your impressions of the Japanese, Korean, and Chinese stream videos? Do they look like neighborhoods where you might be comfortable living? Discuss the benefits of the Cheonggyecheon River restoration. How do these scenes compare with urban streams with which you may be familiar, or perhaps may have ignored until now?</li> </ol> <p><b>(In accessing the textbook, please ignore the ads. Do not download the pdf version suggested by the website or popup. Just access the online version.)</b></p> <p>Access the text <b>Fundamentals of Physical Geography</b>  CHAPTER 8: Introduction to the Hydrosphere  <a href="http://www.physicalgeography.net/fundamentals/chapter8.html">http://www.physicalgeography.net/fundamentals/chapter8.html</a></p> <p>Essay Questions Chapter 8: 1, 3, 4, 7, 10</p> <ol style="list-style-type: none"> <li>8.1. What is streamflow? How can it be expressed in a mathematical model? Describe the effect of an intense 1 hour storm on streamflow over 24 hours using a hydrograph.</li> <li>8.3. Discuss the movement of water into soils. How and why does infiltration vary with time?</li> <li>8.4. Why does runoff occur?</li> <li>8.7. Describe the mathematical equation used to model stream discharge.</li> <li>8.10. What is potential evapotranspiration and how does it differ from actual evapotranspiration? What factors control the rate at which water leaves the Earth's surface by way of evaporation and transpiration?</li> </ol>

Week	Due Date	Discussion, Readings, Videos, Assignments
7		<p><b>Topic: Climate</b></p> <p>Climate involves far more than just the atmosphere. The oceans, the cryosphere, and the continents all have a huge influence on the world’s climate. Climate can be measured and defined over a wide variety of scales. The microclimate of a forest, a farm, a city, or of a park within a city is real and measurable, and it can be influenced both by any number of factors, many of which we have some control over.</p> <p>The paleoclimate record, found in Antarctic ice as well as many other sources, makes it clear that the Earth’s climate has experienced many wide and often rather sudden shifts, as its oceans, ice, land, and biogeochemistry have responded in complex ways to subtle shifts in the Earth-Sun system due to the Milankovitch cycles. But during our most recent climatic period, the Holocene, the world’s climate has been remarkably stable. Coincidentally, human civilization blossomed. We should try to keep in mind that nearly everything we have accomplished as a species has occurred under an unusual stable climate regime. Even without our influence, the Holocene will come to an end. Under unintended human influence we cannot be sure of what lies ahead, although rather abrupt changes are inevitable. The Earth’s climate system is permeated with deterministic chaos (discussed earlier), and long term prediction may be fundamentally impossible. Nevertheless, we should keep in mind that biological organisms, ecosystems, and humankind in particular have shown a remarkable ability to adapt to radical environmental change, a characteristic attributable in part at least to the antifragility we looked at earlier. Humankind has the additional proven ability to shape and control aspects of the physical environment to an extraordinary degree. Despite the challenges, as understanding increases, we may find that the Earth’s climate is controllable, to some degree, in possibly subtle ways that we still haven’t discovered.</p> <p><b>Watch:</b> NOVA: Extreme Ice   Ice-Core Record of Climate  <a href="https://youtu.be/93H41LKWA6o">https://youtu.be/93H41LKWA6o</a></p> <p><b>Examine:</b> NASA   The Ocean: A Driving Force for Weather and Climate [Top Documentary Films]  <a href="https://youtu.be/6vgvTeuoDWY">https://youtu.be/6vgvTeuoDWY</a></p> <p><b>Watch:</b> What is a Climate Model?  <a href="https://youtu.be/bkcrH9tYv8g">https://youtu.be/bkcrH9tYv8g</a></p> <p><b>Watch:</b> An Atmospheric River from an Earth System Model [NASA Scientific Visualization Studio]  <a href="https://youtu.be/w3rtYM0HtIM">https://youtu.be/w3rtYM0HtIM</a></p> <p><b>Watch:</b> How Whales Change Climate [Sustainable Human]  <a href="https://youtu.be/M18HxXve3CM">https://youtu.be/M18HxXve3CM</a></p> <p>Regardless of the relative validity of the various assessments and projections of the state of the global climate system, the importance of global, regional, and local climates and their associated systems to human well-being should be self-evident. The associations of climate with the rise and the fall of past civilizations are undeniable. There is abundant historical evidence, from all parts of the inhabited world, of people having had to struggle with changing climates. No divorce from nature is ever possible. We can probably expect this relationship to continue and to grow more difficult in the near future. Let’s consider the idea that the climate is approaching a global tipping point that may challenge or even extinguish civilization. This is a popular claim, and it should be taken seriously. For more than ten years,</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	<b>03/15/23</b>	<p>I've been assigning readings and lectures from researchers themselves regarding tipping points in the Earth's climate, ecosystems, and biogeochemistry. For this course, I've pared it down to one lecture. Please watch it carefully. Regardless of how much you already know or manage to understand, I'm sure that you will learn something important. Hopefully, you can help others to deepen and broaden their understanding as well.</p> <p><b>Watch:</b> Early Warning of Climate Tipping Points [Understanding Climate Change]  <a href="https://youtu.be/5yTJZzQzdYI">https://youtu.be/5yTJZzQzdYI</a></p> <p><b>Reference:</b> Here's a pdf of the slides from the lecture.  <a href="http://www.to.isac.cnr.it/aosta/LecturesSeminars/Lenton_3.pdf">http://www.to.isac.cnr.it/aosta/LecturesSeminars/Lenton_3.pdf</a></p> <p>Here is the latest news from one of the most troubling potential sources of sudden sea level change. You will find that ice shelf dynamics are, like many things, complex and difficult to assess, but that the trend may be one of accelerating sea levels in the near future. Think about this if you are even in the market for a house near an ocean or bay.</p> <p><b>Watch:</b> Antarctica latest research: Doomsday Glacier ice shelf gone in 5 years [Just Have a Think]  <a href="https://youtu.be/49NPdyUEos8">https://youtu.be/49NPdyUEos8</a></p> <p>Tipping points exist at all scales, even in everyday life. But it can be difficult to extrapolate the idea to much longer time scales. Sea level rise is one of those topics. People will generally assume that a slow rise in sea level might be something relatively easy to adapt to, since it is likely to occur relatively slowly. But specific readjustments can in fact be quite rapid, due to tipping points in glacial dynamics. And even if the average change is slow, the effects can be quite sudden, as when they are triggered by a storm. New York City and adjacent coastal regions discovered this with Superstorm Sandy. Many such events, while not directly attributed to some global change, exemplify the sort of 'flickering' that may occur as a tipping point is being approached.</p> <p><b>Homework 7:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. What is an ice core? Why is it useful?</li> <li>2. Why are the oceans a driving force for weather and climate?</li> <li>3. How do climate models work?</li> <li>4. How are atmospheric rivers formed?</li> <li>5. How do whales affect the global climate?</li> <li>6. Summarize main points of the lecture on 'Early Warning of Climate Tipping Points'.</li> <li>7. What can be inferred about global sea levels from observations of Antarctic ice shelves?</li> </ol>

Week	Due Date	Discussion, Readings, Videos, Assignments
8		<p><b>Topic 1: Addressing climate change</b></p> <p>Proposals for addressing climate change follow two principle threads. There are proposals for the <b>mitigation</b> of global warming, principally through the reduction of carbon dioxide and methane emissions into the atmosphere and by increasing absorption of these gases into some kind of long term storage. There are also many proposals for <b>adaptation</b> to climate change, whatever that implies, from local to global scales.</p> <p>Most of us would agree that rational, self-consistent, open-minded, adaptive, long-term thinking could help to create a future in which human beings and as many other species as possible continue to live in healthy ways, without the sorts of regional catastrophic histories that we have as a species experienced many times in the past. But catastrophism grabs attention, and it grabs minds. It's in our movies and TV shows. It's certainly in our politics. It has taken the stage, and less hysterical voices are being ignored. I would advise you to be careful about what you might be expected to believe to be true, and whom you are expected to support. There are many voices calling for greater control and coercion. Speeches and proclamations within organizations like the United Nations and World Economic Forum are being cited as their justification.</p> <p>Objectively, socialism has never provided guaranteed 'solutions' to environmental problems. Most industrialized and/or collectivized socialist regimes of the 20<sup>th</sup> century were notoriously damaging to the environment at local, regional, and even global scales, at least to the same extent as pro-capitalist regimes. Regardless of how people treated one another throughout history, it was nearly always man against nature.</p> <p>There are other ways of going about creating that successful and optimistic future for everyone to which most of our leadership claim to aspire. I'd like you to consider the idea that the wisdom and common sense required to overcome our difficulties need not come from some centralized leadership. It will come from the distributed intelligence represented by all of us. How many times have you or someone you know have been concerned about something but were ignored because of your low status in the social hierarchy? And then it turns out you were right, but you continued to be ignored? How much better might things be if ideas were considered on their merits, rather than on the person who claims to have said it first?</p> <p>There is so much wasted human intelligence and creativity out there. That's the real energy crisis. Being human is not easy, even under the best circumstances. As much of the world sheds itself of extreme poverty and disease, and as people become aware of one another's work through increased global communication, we will hopefully see local success duplicated under similar circumstances around the world. But expecting people to accept coercive tactics in the name of a greater good only destroys and wastes that individualized and group creativity that naturally arises in human societies. In short, the currently fashionable call to accept a socialist future in the name of solving the climate crisis is false and destructive. In my humble opinion of course.</p> <p><b>Watch:</b> The Way We Talk About Climate Change Isn't Helpful   Chris Jordan [Sustainable Human]  <a href="https://youtu.be/4CaCsZKECB8">https://youtu.be/4CaCsZKECB8</a></p> <p>Regardless of how you feel about the issues, I want you to be aware of a YouTube channel called 'Just Have a Think', one of the few places to find discussion of new technologies and techniques that may turn out to be very helpful in addressing climate change. Always educational, and particularly helpful to</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>people at the beginning of their careers.</p> <p><b>Watch:</b> How to capture 2 billion tons of CO2 AND fix our oceans [Just Have a Think]  <a href="https://youtu.be/zr6CYS9ie5E">https://youtu.be/zr6CYS9ie5E</a></p> <p>Topic 2: <b>Climate types</b></p> <p><b>Reference: Fundamentals of Physical Geography</b>  CHAPTER 7: Introduction to the Atmosphere, Section v, Climate Classification and Climatic Regions of the World. In accessing the textbook, please ignore the ads. Do not download the pdf version suggested by the website or popup. Just access the online version. Sorry about that)  <a href="http://www.physicalgeography.net/fundamentals/7v.html">http://www.physicalgeography.net/fundamentals/7v.html</a></p> <p>I'm only listing this chapter of the textbook as a reference because, although its discussion is excellent, its categorization of climate and biome types are different from the following videos, which I prefer you watch and use in your response to question 2 (which I expect to be substantive).</p> <p><b>Watch:</b> Secrets of World Climate Course – Introduction [Geodiode]  <a href="https://youtu.be/Y5NcKTFb3ck">https://youtu.be/Y5NcKTFb3ck</a></p> <p><b>Watch at least seven of the following twelve videos:</b></p> <p>Tropical Rainforest Climate [Geodiode]  <a href="https://youtu.be/wq0asIXcW7w">https://youtu.be/wq0asIXcW7w</a></p> <p>Tropical Savannah Climate and Tropical Monsoon Climate [Geodiode]  <a href="http://youtu.be/tqpA9tswQxM">http://youtu.be/tqpA9tswQxM</a></p> <p>Subtropical Highland Climate [Geodiode]  <a href="http://youtu.be/3vzP0kWm-AQ">http://youtu.be/3vzP0kWm-AQ</a></p> <p>Hot Desert Climate [Geodiode]  <a href="https://youtu.be/itnYTE-3u-o">https://youtu.be/itnYTE-3u-o</a></p> <p>Humid Subtropical Climate [Geodiode]  <a href="https://youtu.be/FHj71X_k8h0">https://youtu.be/FHj71X_k8h0</a></p> <p>Mediterranean Climate [Geodiode]  <a href="https://youtu.be/uk9Fyw2Okyw">https://youtu.be/uk9Fyw2Okyw</a></p> <p>Oceanic Climate [Geodiode]  <a href="https://youtu.be/vlNybvaGPpg">https://youtu.be/vlNybvaGPpg</a></p> <p>Cool Desert Climate [Geodiode]  <a href="https://youtu.be/kSzuXA7oQ68">https://youtu.be/kSzuXA7oQ68</a></p> <p>Continental Climate [Geodiode]  <a href="https://youtu.be/IE1Z5PtkzXQ">https://youtu.be/IE1Z5PtkzXQ</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/22/23	<p>Subarctic Climate [Geodiode]  <a href="https://youtu.be/PtavJ3Tt9XE">https://youtu.be/PtavJ3Tt9XE</a></p> <p>Tundra Climate [Geodiode]  <a href="https://youtu.be/pNxcY4Ru3gs">https://youtu.be/pNxcY4Ru3gs</a></p> <p>Icecap Climate [Geodiode]  <a href="https://youtu.be/pRZgNGXmOoO">https://youtu.be/pRZgNGXmOoO</a></p> <p><b>Homework 8:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <p>1. How does the [Just Have a Think] video propose we capture 2 billion tons of CO2 AND fix our oceans?</p> <p>2. Discuss the specific characteristics of seven distinct climate types of your choice, based on the categorizations of the videos you chose to watch. Show me that you've watched them. Which two or three types do you find yourself most drawn to? Since there are only two questions this week, I expect you to put significant effort into this one.</p>
9	03/29/23	<b>Spring break</b>
10		<p>Topic: <b>The Biosphere</b></p> <p><b>Reference:</b> Fundamentals of Physical Geography CHAPTER 9: Introduction to the Biosphere  <a href="http://www.physicalgeography.net/fundamentals/chapter9.html">http://www.physicalgeography.net/fundamentals/chapter9.html</a></p> <p><b>Watch:</b> Plants Affect the Atmosphere  <a href="https://ca.pbslearningmedia.org/resource/nves.sci.earth.atmosphere/plants-affect-the-atmosphere/">https://ca.pbslearningmedia.org/resource/nves.sci.earth.atmosphere/plants-affect-the-atmosphere/</a></p> <p><b>Watch:</b> NOVA: Earth From Space   Lightning Produces Nitrates  <a href="https://ca.pbslearningmedia.org/resource/nves.sci.earth.nitrate/lightning-produces-nitrates/">https://ca.pbslearningmedia.org/resource/nves.sci.earth.nitrate/lightning-produces-nitrates/</a></p> <p>Besides a source of energy and water, life depends on the presence of a few other elements, particularly nitrogen. Most living things cannot get this nitrogen directly from the air; they get it indirectly from specialized microbes, as well as from lightning. Another direct link between the biosphere and the atmosphere that most of us are unaware of. Most life on Earth gets its energy from the sun, either directly or indirectly, via an evolved set of processes called photosynthesis and respiration. Carbon dioxide is required, and water and oxygen are released, globally, on a massive scale. Living things therefore are key determinants of just how much carbon is in the atmosphere, and so they are largely responsible for the sort of climate that has evolved on this planet. In order to fully understand climate, we have to understand life. We can change the direction that the world climate takes in the future, one way or another, depending on how well we understand and treat living things.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/05/23	<p><b>Homework 9:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. What primary components of Earth’s atmosphere do plants modify through photosynthesis and respiration?</li> <li>2. Describe the processes of photosynthesis and respiration. How do they relate to one another?</li> <li>3. How have plants contributed to making Earth a habitable planet?</li> <li>4. Why does the Amazon rainforest have such a dramatic impact on the atmosphere?</li> <li>5. On average, how many lightning strikes occur on Earth each second?</li> <li>6. How does lightning produce nitrate?</li> <li>7. Why is nitrate important for living things?</li> <li>8. How does nitrate produced in clouds end up in human bodies?</li> </ol>
11		<p>Topic: <b>Biomes and ecosystems</b></p> <p>I’m only listing the textbook as a reference for the first topic because its categorization of biome types are different from the following videos, which I prefer you watch and use in your response to question 1 (which I expect to be substantive).</p> <p><b>Reference:</b> Access online the text <b>Fundamentals of Physical Geography</b> CHAPTER 9: Introduction to the Biosphere, section (k). Characteristics of the Earth's Terrestrial Biomes <a href="http://www.physicalgeography.net/fundamentals/9k.html">http://www.physicalgeography.net/fundamentals/9k.html</a></p> <p><b>Watch:</b> Biomes - The Living Landscapes of Earth, Introduction To Biomes Of The World [Geodiode] <a href="https://youtu.be/o_AfNcjIOgU">https://youtu.be/o_AfNcjIOgU</a></p> <p><b>Watch any five</b> of the following 11 videos:</p> <p>Tropical Rainforest [Geodiode] <a href="https://youtu.be/E6WdEyt93vA">https://youtu.be/E6WdEyt93vA</a></p> <p>Savannah [Geodiode] <a href="https://youtu.be/Mle5gmEpYys">https://youtu.be/Mle5gmEpYys</a></p> <p>Shrubland or Scrub [Geodiode] <a href="https://youtu.be/wcYWS-5iUcc">https://youtu.be/wcYWS-5iUcc</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/12/23	<p>Desert [Geodiode]  <a href="https://youtu.be/TSx1wP18hRE">https://youtu.be/TSx1wP18hRE</a></p> <p>Grasslands [Geodiode]  <a href="https://youtu.be/Yy191KVBNP0">https://youtu.be/Yy191KVBNP0</a></p> <p>Temperate Forests [Geodiode]  <a href="https://youtu.be/K8i0K0pZlCM">https://youtu.be/K8i0K0pZlCM</a></p> <p>Boreal Forest or Taiga [Geodiode]  <a href="https://youtu.be/OUmHWrf8MnY">https://youtu.be/OUmHWrf8MnY</a></p> <p>Tundra and Ice [Geodiode]  <a href="https://youtu.be/II15uUa1on0">https://youtu.be/II15uUa1on0</a></p> <p>Highlands [Geodiode]  <a href="https://youtu.be/UYFZA_aljbY">https://youtu.be/UYFZA_aljbY</a></p> <p>Wetlands [Geodiode]  <a href="https://youtu.be/4bRgUShrC1w">https://youtu.be/4bRgUShrC1w</a></p> <p>Shallow Seas [Geodiode]  <a href="https://youtu.be/atY1szpyeMs">https://youtu.be/atY1szpyeMs</a></p> <p><b>Watch:</b> Ecosystems [Systems Innovation]  <a href="https://youtu.be/H-RPVJaoj08">https://youtu.be/H-RPVJaoj08</a></p> <p><b>Watch:</b> How Wolves Change Rivers [Sustainable Human]  <a href="https://youtu.be/W88Sact1kws">https://youtu.be/W88Sact1kws</a></p> <p><b>Watch:</b> Top 5 Inspirational Animal Conservation Stories [BBC Earth]  <a href="https://youtu.be/zQZndqa2bIw">https://youtu.be/zQZndqa2bIw</a></p> <p><b>Recommended:</b> Modern day wildlife conservation   Nick Bubb [TEDx Talks]  <a href="https://youtu.be/BTzm6RKmaXs">https://youtu.be/BTzm6RKmaXs</a></p> <p><b>Homework 10:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. Discuss the characteristics of five distinct biomes types, based primarily on what you've learned from the videos.</li> <li>2. What are some of the characteristics of ecosystems, according to the Systems Innovation video? How does an ecosystem differ from a community?</li> <li>3. How do wolves change rivers?</li> </ol>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>4. What is your favorite ‘inspirational animal conservation story’ from the video?</p> <p>Chapter 9 Essay Questions 2, 4, 5, 11</p> <p>9.2. Compare and contrast the function and structure of the grazing and detritus food chain.</p> <p>9.4. Describe how evolution works through natural selection, spatial isolation, and gene mutation.</p> <p>9.5. Explain in detail how energy moves through the grazing food chain and the detritus food chain. Also, discuss how these food chains are related to each other and are necessary for the cycling of nutrients in an ecosystem.</p> <p>9.11. Discuss the term dispersal. Include in your answer an explanation of why organisms want to disperse, and how organisms accomplish this life-cycle strategy.</p>
12		<p><b>Topic: The Lithosphere</b></p> <p><b>Reference:</b> StayingSafeWhereTheEarthShakes_BayArea.pdf</p> <p><b>Reference:</b> PuttingDownRootsInEarthquakeCountry_BayArea.pdf</p> <p><b>Watch:</b> Geologists explain why Tasmania is different [ABC Science]  <a href="https://youtu.be/f_Hcyfv5rU">https://youtu.be/f_Hcyfv5rU</a></p> <p>In discussing the lithosphere, it might be more instructive to look closely at a particular place whose characteristics illustrate nearly all of the elements of plate tectonics, than to take a typically textbook approach. I want you to watch the following [Deep Dive] video closely, since it’s packed with information. Hopefully, you will get a more realistic idea of how many features of the solid Earth <b>and</b> ocean work together as a system.</p> <p><b>Watch:</b> Why China's Largest Volcano Is So Unusual [Deep Dive]  <a href="https://youtu.be/3C2HVOB-g5s">https://youtu.be/3C2HVOB-g5s</a></p> <p>I recently took a trip to the topic of the Deep Dive video: Changbaishan, or Changbai Mountain, also known in Korea as Mount Paektu. Changbaishan is located on the border between China and North Korea. This massive volcano last erupted, with tremendous force, about a thousand years ago. The scars remain, and within them have arisen some of the most unique ecosystems in northeast Asia.</p> <p><b>Recommended:</b> 1442 Steps to Heaven Lake [Gary Pereira]  <a href="https://youtu.be/TsnoFuC4zrw">https://youtu.be/TsnoFuC4zrw</a></p> <p><b>Watch:</b> Will the Cascadia Earthquake be the Worst Disaster North America’s Ever Seen? [PBS Terra]  <a href="https://youtu.be/76b_WGzCI54">https://youtu.be/76b_WGzCI54</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/19/23	<p><b>Homework 11:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. How does Tasmania illustrate the concept of continental drift?</li> <li>2. Describe the process of plate tectonics between the Pacific and East Asia. Why is Changbai Mountain (Mount Paektu) so unusual, in a geological sense? What does this show about the role of water in plate tectonics?</li> <li>3. What are the characteristics of the Cascadia fault line, and why might an earthquake there be extremely deadly?</li> <li>4. Retrieve from Files and read through the two documents, “<b>StayingSafeWhereTheEarthShakes_BayArea</b>” and “<b>PuttingDownRootsInEarthquakeCountry_BayArea</b>”.</li> </ol> <p>In an essay, describe steps that should be taken before, during, and after a major destructive earthquake, from the perspective of you as a family member and/or neighbor, public servant, health care worker, business officer, planner, etc. in order to reduce suffering and loss. Assume that people around you may be in need of aid. Assume that gas lines, electricity, and communications have been disrupted. You may be at work, or school, at home or on the streets when it hits. You may fictionalize your account, with specifics, or you may write in a more straightforward manner.</p> <p>Chapter 10 Essay Questions 17, 33</p> <p>10.17. Outline the various processes of physical, chemical, or biological weathering.</p> <p>10.33. Describe some the important characteristics of soil.</p>
13		<p><b>Topic: The Oceans</b></p> <p>Another topic that is often strangely missing from physical geography textbooks is the oceans. We can’t cover very much in one week, but I do want to cover the recent discovery of resources on the seabed, the development of technologies to exploit those resources, and what this implies for international relations and ocean ecosystems. Fissures along plate boundaries and near hotspots bring valuable minerals up from deep beneath the crust. Many islands and seamounts associated with such processes have thereby accumulated abundant minerals in their seabed. Associated with these environments are some of the most fascinating and vulnerable ecosystems on earth. Unknown forms of life, that we have barely begun to understand, exist within environments that we may soon begin using large machines to dredge up.</p> <p><b>Watch:</b> Nutrients from Deep-Sea Vents  <a href="https://ca.pbslearningmedia.org/resource/nves.sci.earth.hydro/nutrients-from-deep-sea-vents/">https://ca.pbslearningmedia.org/resource/nves.sci.earth.hydro/nutrients-from-deep-sea-vents/</a></p> <p><b>Watch:</b> The Next Frontier in Mining: Deep Sea Exploitation in the Pacific  <a href="https://youtu.be/PuEXmFQeJpw">https://youtu.be/PuEXmFQeJpw</a></p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/26/23	<p><b>Reference:</b> <a href="https://en.wikipedia.org/wiki/Deep_sea_mining">https://en.wikipedia.org/wiki/Deep_sea_mining</a></p> <p><b>Reference:</b> <a href="https://www.nature.com/articles/d41586-019-02242-y">https://www.nature.com/articles/d41586-019-02242-y</a></p> <p><b>Reference:</b> <a href="https://en.wikipedia.org/wiki/International_Seabed_Authority">https://en.wikipedia.org/wiki/International_Seabed_Authority</a></p> <p><b>Reference:</b> <a href="https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea">https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea</a></p> <p><b>Recommended:</b> Deep sea gold rush [Al Jazeera English] <a href="https://youtu.be/s1b4xVTAKcI">https://youtu.be/s1b4xVTAKcI</a></p> <p><b>Recommended:</b> Mining the Deep Sea [Massachusetts Institute of Technology (MIT)] <a href="https://youtu.be/MWvCtF1itQM">https://youtu.be/MWvCtF1itQM</a></p> <p><b>Recommended:</b> Deep Sea Mining: Searching for the Next Mineral Boom [Roundtable] <a href="https://youtu.be/-UPjsuuyvD4">https://youtu.be/-UPjsuuyvD4</a></p> <p><b>Recommended:</b> Seabed Mining in the Deep Sea [University of California Television (UCTV)] <a href="https://youtu.be/ePm3Wbw2tyc">https://youtu.be/ePm3Wbw2tyc</a></p> <p><b>Recommended:</b> Introduction to the International Seabed Authority and Seabed Mining [dyaguilfoyle] <a href="https://youtu.be/Tlumf1ivuPg">https://youtu.be/Tlumf1ivuPg</a></p> <p><b>Homework 12:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. What is a hydrothermal vent? Describe how hydrothermal vents produce nutrient-rich water.</li> <li>2. Discuss the status and prospects of deep-sea mining. What (if anything) is being done or should be done to regulate the exploitation of the seabed for minerals? Discuss the history and significance of national claims of exclusive rights over offshore resources.</li> </ol>
14		<p><b>Topic: Uranium, thorium, and plutonium</b></p> <p>Our last two weeks are devoted once again to topics that are seldom covered in a course in physical geography, but should be. Minerals and metals in the lithosphere are responsible for the presence of human civilization, and this continues to be true. Fossil fuels remain important, but we shall concentrate on what comes next. Improvements in energy storage are required in order to fully utilize technologies like solar and wind. Nuclear reactors are offered as a way around such difficulties, since they are designed to operate continuously. Both approaches are likely to be pursued with increasing intensity in the near future.</p> <p>Nuclear technologies yield power without directly generating atmospheric carbon, although the mining and refining of uranium and the building and decommissioning of reactors remains carbon-intensive. The</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>biggest concern remains the toxic nature of the fuel, partly because of the nuclear power and weapons industries' often ignored history of mistakes, disasters, and near-disasters, and partly because of its vulnerability to terroristic intentions. New reactor designs claim to address some of these issues. I'll leave these things for you to consider. Whatever ends up happening with uranium, plutonium, and thorium, it will probably play out in your lifetimes.</p> <p><b>Watch:</b> Thorium and the Future of Nuclear Energy [PBS Space Time]  <a href="https://youtu.be/ElulEJruhRQ">https://youtu.be/ElulEJruhRQ</a></p> <p><b>Watch:</b> Could Advanced Nuclear Power Replace Fossil Fuels? [Journey]  <a href="https://youtu.be/eg613DFBR8s">https://youtu.be/eg613DFBR8s</a></p> <p><b>Watch:</b> Small Modular Reactors. Are they now unavoidable? [Just Have a Think]  <a href="https://youtu.be/yofGtxEgpI8">https://youtu.be/yofGtxEgpI8</a></p> <p>I'm probably one of the few people who worked as a technician on projects in both a commercial Nuclear Fission reactor and an advanced Nuclear Fusion project (many engineers and physicists must have worked in both domains, but I just played a minor role). I was hired to fill out a work team at the Oyster Creek Nuclear Generating Station, in Forked River, New Jersey:</p>  <p><a href="https://en.wikipedia.org/wiki/Oyster_Creek_Nuclear_Generating_Station">https://en.wikipedia.org/wiki/Oyster_Creek_Nuclear_Generating_Station</a></p> <p>The reactor was in the cube-shaped building in the center of the picture. The upper portion with the cladding around it is one large room, with the reactor embedded in the center and pools full of water to either side. Above on girders, a large industrial crane can lift the lid off the reactor, and remove the 'spent' fuel rods. The crane immediately lowers each rod into one of the refrigerated pools, where it continues to emit heat (and more dangerous forms of radiation) for many years. They are left there at least until they are sufficiently cooled. After the spent rods are removed, the crane can reload the reactor with new rods. The problem then was (and this continues to be a problem for the nuclear industry), where to then put the spent fuel (and any other contaminated material) more permanently. Since there is no reprocessing industry in the US, and since federal storage proposals are being challenged by states, the rods from such reactors often remain in sealed casks somewhere on the grounds.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	05/03/23	<p><b>Recommended:</b> What If You Fell Into a Spent Nuclear Fuel Pool? [What If]  <a href="https://youtu.be/mM-5DhIhYmQ">https://youtu.be/mM-5DhIhYmQ</a></p> <p>Our team worked in that big room above the operating reactor. Our job was to rearrange brackets that had been installed on the floor of the pool in order to accommodate a higher density of fuel rods. Even in the 1970s, storage had become a problem. The technology we used was very basic: wrenches on long poles handled by technicians at the edge of the pool, as guided by other technicians with binoculars to screw and unscrew brackets that were deep underwater. You would not otherwise want to get anywhere near that water. Anything coming out of the pool would need to be wiped down with acetone to reduce their potential toxicity. That was my job.</p> <p>The plant that I worked in is now shut down, but when I was there in the 1970s, it was in full operation. The room was physically hot, regardless of the season, as the result of its proximity to the reactor itself. The disposable outer clothing and booties that we wore were similar in style and effectiveness to the gear used in semiconductor manufacturing clean rooms today, but in a nuclear reactor they were required to keep contaminants away from your personal clothing and body. At the time, there was only one guard with a handgun at the entrance to the room above the reactor. The place made me uneasy, and I didn't stay long. When I left the plant for the last time, I was given a full body scan in a trailer that the NRC kept on site. They discovered that I had absorbed some radioactive iodine in my few weeks on the job. If I had taken iodine supplements prior to working there, my thyroid might not have absorbed any of the bad stuff. In fact, as part of its civil defense plan, the federal government had distributed iodine pills throughout the US during the Cold War in anticipation of a potential nuclear attack.</p> <p>Having asked students for several years now about this recent disaster, I remain unsurprised at how little discussion has taken place in the classroom or on the news. I have to give the Japanese reporters at NHK credit for having dug so deeply into the causes and consequences of placing nuclear reactors with fatal design flaws on one of the most seismically active coastlines in the world.</p> <p><b>Watch:</b> Understanding the accident of Fukushima Daiichi [IRSN]  <a href="https://youtu.be/YBNFvZ6Vr2U">https://youtu.be/YBNFvZ6Vr2U</a></p> <p><b>Watch:</b> Fukushima's ghost towns  <a href="https://youtu.be/xKfnsYzQWjw">https://youtu.be/xKfnsYzQWjw</a></p> <p><b>Homework 13:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <ol style="list-style-type: none"> <li>1. Describe some of the prospects for nuclear power around the world. Be region-specific if you can. What are some of the differences between traditional reactor designs and fuels and current generation designs, including 'small nuclear reactors' and those that use thorium? Since there are only two questions this week, I expect a substantive response here.</li> <li>2. Describe the circumstances leading up to the Fukushima Daiichi disaster. You might begin with the decision to site nuclear plants on Japan's eastern shore. What precisely is the situation now? Why did Japan decide to go so strongly with nuclear energy? Has anything changed?</li> </ol>

Week	Due Date	Discussion, Readings, Videos, Assignments
15	05/10/23	<p><b>Topic: Lithium, cobalt, and rare earths</b></p> <p>We continue our discussion of energy resources with a couple of minerals that are playing an increasing role in energy production. Lithium, cobalt, and the so-called rare earths are critical ingredients for batteries in cars, homes, and electronic devices, and they may soon begin to provide large capacity storage for utility companies that are increasingly dealing with the intermittency of solar and wind energy sources. The demand for these resources is therefore anticipated to outgrow that for pretty much any other resources, over the short to near term future. And much of this is being mined from some of the poorest, most insecure places on Earth.</p> <p><b>Watch:</b> Companies race to mine lithium, a battery essential [PBS NewsHour]  <a href="https://youtu.be/su_UC9ZCD-0">https://youtu.be/su_UC9ZCD-0</a></p> <p><b>Watch:</b> Here's Where the Juice That Powers Batteries Comes From [Bloomberg Quicktakes]  <a href="https://youtu.be/50rXYrFCQMw">https://youtu.be/50rXYrFCQMw</a></p> <p><b>Watch:</b> Lithium Recycling FINALLY goes global! [Just Have a Think]  <a href="https://youtu.be/mbkhXAP1EQE">https://youtu.be/mbkhXAP1EQE</a></p> <p>Cobalt seems to be the more problematic substance, in human and environmental terms.</p> <p><b>Watch:</b> Whose Wealth? Cobalt from Congo [SOMO Researcher]  <a href="https://youtu.be/37iLD41vfdI">https://youtu.be/37iLD41vfdI</a></p> <p><b>Watch:</b> How do we solve the Cobalt problem? [Just Have a Think]  <a href="https://youtu.be/-WOOZYILyXI">https://youtu.be/-WOOZYILyXI</a></p> <p>Rare earths have unique electromagnetic properties. There are several of them, but they are usually found in the same deposits, which are found at various locations, including the sea floor, which we'll be looking at in a couple of weeks.</p> <p><b>Watch:</b> How These Rare-Earth Elements Could Change Our Future [Spark]  <a href="https://youtu.be/88jpgxSRVZU">https://youtu.be/88jpgxSRVZU</a></p> <p><b>Recommended:</b> How the US plans on rivaling China in the production of critical earths [CNBC]  <a href="https://youtu.be/CW4TnJDIQUw">https://youtu.be/CW4TnJDIQUw</a></p> <p><b>Recommended:</b> Impact of Materials on Society- Rare Earth Elements [Materials Research Society]  <a href="https://youtu.be/C-b1NacN3IY">https://youtu.be/C-b1NacN3IY</a></p> <p><b>Homework 14:</b></p> <p>Reminder: check each week for any new <b>Announcements</b>.</p> <p>1. Describe the mining and processing of lithium, its uses, and opportunities for recycling.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>2. What are some of the current social and environmental issues associated with the mining of cobalt? According to the narrator of the 'Just Have a Think' video, is the cobalt problem bring solved?</p> <p>3. Why are rare earth elements important? Where are they found? Are there likely to be undiscovered deposits? Which nations are most involved in increasing the production of rare earth minerals?</p>
16	05/22/23	<p><b>Final Evaluation:</b></p> <p>Choose one of the topics we've covered and write a thoughtful term paper. This will serve as your final evaluation. Provide at least four full citations (not just URLs). It doesn't matter what format you use, so long as you are consistent. I suggest that you choose a serious topic that is aligned with your interests or career plans. The resulting paper's text should be at least four pages long, easily more. Use the same font and spacing as for the homework, please. You may also include graphics and extended quotations, if you provide citations. I encourage you to produce some of your own graphics if you are so inclined. You will find these to be useful if you upload your work to Portfolium. There is no upper limit to the length of the paper, but please don't artificially lengthen it with unnecessary repetition. I expect all of you to produce a paper that you can publish online without further editing.</p>