

San José State University
Department of Urban and Regional Planning
Geog01: Geography of the Natural Environment, Sections 1 and 2
Spring 2022



January 13, 2020

Course and Contact Information

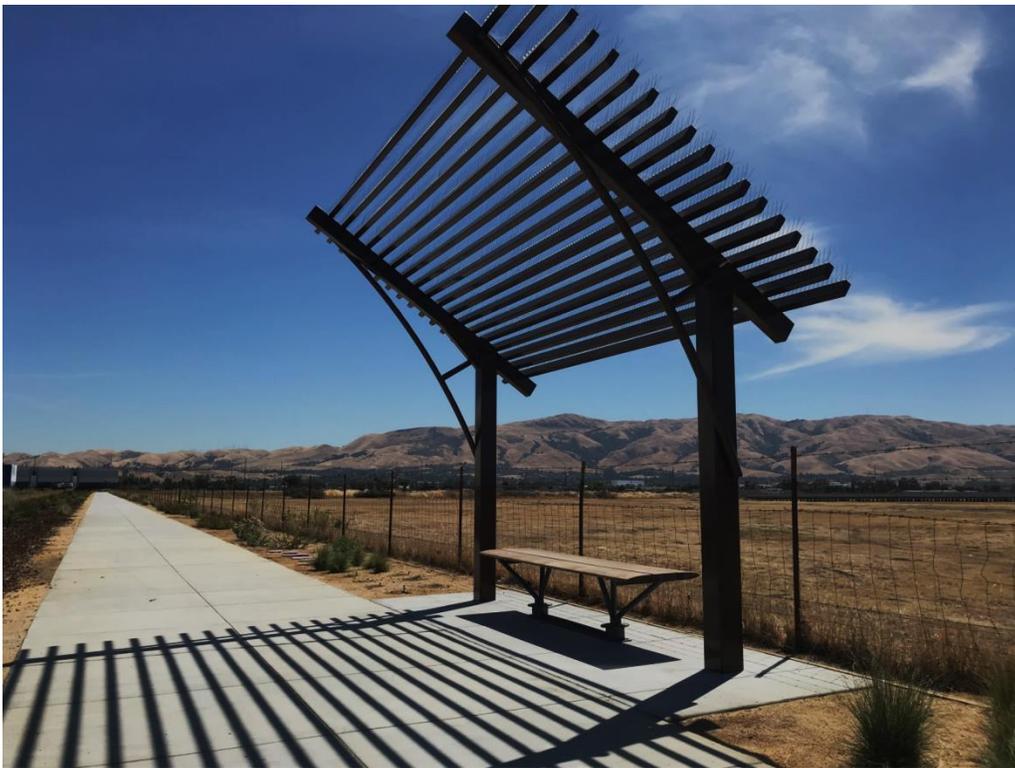
Instructor:	Gary Pereira
Office Location:	Online only.
Telephone:	(510) 825-3506 (text please, at least initially)
Email:	(Canvas messaging preferred , or text 510-825-3506 in emergency) gary.manuel.pereira@gmail.com
Office Hours:	Please message me if you need to set up an appointment.
Class Days/Time:	Weekly homework and announcements as scheduled.
GE/SJSU Studies Category:	Area B1

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 a Canvas message or with a comment pinned to the submission itself. Please be aware that comments 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 comments I may have pinned there, regardless of whether you have received a grade, and address any pressing concerns expressed there. If you want to respond to a pinned comment, please do so by sending me an independent message within Canvas, since I am unlikely to return to that 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 postmodern 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 its instructor or participants. Let’s stretch another metaphor. If you’re looking for the moon, don’t confuse the finger that someone might be using to point out the moon, with the moon itself. The finger is unimportant. It just points the way. For the most part, that is what I will be doing for you: pointing the way. I kept the structure of this course simple so that we will have more flexibility to follow current events, discoveries, or connections whenever they might come up in real time. Therefore, despite the 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.

To stretch the metaphor just a bit, 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. By simply ignoring ourselves for once and just learning about what lies entirely beyond, we can 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 for 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

This course is approved for General Education Core Physical Science area, B1. Upon successful completion of this course, students will be able to:

- 1: use the methods of science and knowledge derived from current scientific inquiry in life or physical science to question existing explanations. Evidence-based learning and discovery form the basis of scientific inquiry. The focus of this class is therefore on evidence, rather than belief. Challenges to existing explanations are approached through examination of evidence.
- 2: demonstrate ways in which science influences and is influenced by complex societies, including political and moral issues. The goal of achieving relative independence of the natural sciences from social belief systems is recognized, as is the influence of such belief systems on the process of achieving that goal. The influence of the resulting comprehension of natural systems on human societies is emphasized throughout the course, particularly with regard to natural disasters like earthquakes, as well as the complex impact of climate change on social systems.
- 3: 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. Students shall understand how knowledge is achieved and improved on an ongoing basis.

Textbook

The **Fundamentals of Physical Geography** (2nd 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 the pdf version suggested on the website or in popup windows.

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

Additional Readings

Additional readings are required for certain assignments. These files are available from Canvas, under **Files**:

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 the video in its entirety, or at least most of it. 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.

If you open YouTube 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** if it's a popup. There are never ads on my own videos, and I get no monetary benefit from YouTube. I do not often provide tags, and I do often disable comments. In addition, embedded Canvas views are not counted as views by YouTube. As a result, most of my videos get few views. However, you may share my videos with anyone at any time. YouTube, along with most other social media, is becoming increasingly censorious, and this is a problem, but it remains the principle depository of educational videos, so we will continue to use it.

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, 'geog01-01' or 'geog01-02', and 'Spring 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.

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.

I don't believe in having students review one another's work, but I do encourage you to make your best work available to the world, on your own terms. That is what **Portfolium** and similar online services are for. I advise you all to polish up and recombine some of the work you do for this class and others, create some graphical, illustrative material, and put it online. Portfolium is designed to be a one-stop shop for potential partners, employers, and clients who want to get an idea of just how bright you might be. You all should create and begin populating your own accounts, which you can constantly revise and over which you have total control. It's free.

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%
Total	100%

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-
below 60%	F

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 University's tokamak reactor 'TFTR', the largest 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 of my students to participate in professional organizations or guilds and to make use of any truly meaningful online 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>

Geog01-01(02), Geography of the Natural Environment, Spring 2022

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 #, geog01-01(02), Spring 2022.

Course Schedule

Week	Due Date	Discussion, Readings, Videos, Assignments
1		<p>If you haven't already done so, please Watch: General notes for my online classes [Gary Pereira] https://youtu.be/_AN8k0OgwI0</p> <p>Topic 1: Science v scientism</p> <p>Given our recent global history, a background course like this should probably begin with a discussion of the meaning of the word 'science'. We need to recognize in particular the difference between science as a set of approaches to understanding reality, and science as a body of knowledge that presumably results from the application of such approaches. There is a paradox at the heart of this duality. An over-reliance on any body of knowledge, even one that has been accumulated scientifically, is fundamentally contrary to many of the approaches that may have been used to discover that knowledge to begin with. It is therefore unfortunate that the same word, 'science', has this double meaning. The tension and confusion that results has been discussed since at least the dawn of the technological age, but the struggle between accumulated 'truth' and the scientific goal of always trying to falsify such claims is an ancient one. Science as an approach to understanding must always include a willingness to be proven wrong. But representatives of science as a body of knowledge are often unwilling to be proven wrong. Science is currently experiencing a replication crisis, leading to unjustified claims by some, distrust of such claims by others, and politicization. The tools and methods of science are set aside as various people in positions of authority begin to insist on everyone's acceptance of their own opinions and impressions. My impression is that we are experiencing this now with regard to the covid-19 virus, for example, but 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 who became famous throughout history for one thing, and one thing only: their refusal to look through it.</p> <p>Galileo did not invent the telescope, but he improved its design and demonstrated its usefulness for port operations and visual communications. When Galileo began building telescopes specifically designed to view the night sky at a higher power, 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 (but 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 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>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 26th, 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 short essay can be easily 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. and his claim to be somehow wiser than the rest of us?"</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<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 between the finger that is being used to point at some object of study, and the object itself. The tendency for educators and publishing houses 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. Similarly, you may have noticed that people whom our leadership and news media assure us represent the very best expertise in science (as a body of knowledge), have recently shown themselves be distrustful of the methods of science and to have been largely ignorant of how best to deal with novel things nature might throw our way (e.g., the appearance and nature of a sequence of covid-19 variants). Experts have disagreed on any number of important things related to this pandemic. Nevertheless, some claim to represent all of science, politicizing what is essentially a difficult biological issue that needs to be worked through with some degree of humility.</p> <p>The perpetual presence of human ignorance with regard to what the universe may throw our way should not surprise us. Over the following two weeks, we will explore topics that show why evolution may actually be a universal property of nature, which guarantees the emergence of novel forms and functions. This sort of universal evolution guarantees the appearance of entirely new things (not necessarily biological) whose interactions with what already exists had never been predefined anywhere, or anytime. If this property of nature is real, and I believe it is, it's a wonderful thing that actually supports many peoples' religious and philosophical beliefs, but it also guarantees the periodic appearance of potentially troublesome events that no person or algorithm had ever previously experienced or predicted. We may eventually understand what happened and 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 affect our future survival. I think that this is indeed a universal property of nature, for reasons that have been expressed as physical nonlinearity and deterministic chaos, mathematically within the Incompleteness Theorems of Kurt Gödel, and by Turing and others in the domain of computation.</p> <p>Topic 2: Complexity and fractals</p> <p>Over the next two weeks, in preparation for a course that spans the physical and biological sciences, we'll discuss some of the ideas that are being used to tie these physical and biological sciences together. While not a complete survey, this short introduction will give you a better picture than our textbooks provide. Textbooks often begin with a description of the so-called 'systems' view of the world, involving flow diagrams with sources and reservoirs of energy, materials, and information. The basic concepts of systems theory, 'feedback' for example, remain important, but over the last thirty years mathematicians, computer scientists, and many domain scientists have been developing and using tools derived from far more comprehensive theories of complexity. In my view, a selection of videos and documents provide a more accurate and comprehensive education in the basics of how scientists conceptualize and model the world than domain-specific textbooks provide. If any of the following ideas interest you, it is easy to find detailed published documents. In fact, for the Final Evaluation paper, whatever your chosen topic may be, I expect you to find documents online. The applicability of the ideas that we will be presenting here to domains of your professional life (including those far from geography, or from science) should become clear the more you study them. One thing you can do to further expand</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>your understanding is to watch the full suite of videos offered by the Systems Innovation channel that are like those selections listed below.</p> <p>To be clear, one underappreciated aspect of scientific approaches to understanding is the power derived from admitting to our own ignorance, even with regard to our supposedly fully confirmed beliefs or assumptions. It is easy to accept that the universe at the largest and tiniest scales remains mysterious. But in fact, our collective ignorance of the world involves not only the very big and the very small. Much of what happens at even our own scales of existence and perception remains mysterious, including many of the topics contained within this course. In particular, we will explore why so-called nonlinearities (in the mathematical sense) yield all sorts of weird and wonderful things happening at all scales. As we look more closely at astronomical objects, for example, from stars to galaxies and beyond, they reveal themselves to be as intricate and complex in their own way as living things appear to be, to us. The more deeply we manage to look, the more the visible universe reveals its own evolution. And yet the two most significant facets of the universe itself, dark matter and dark energy, remain shrouded in mystery.</p> <p>Watch: Nonlinear Systems Overview [Systems Innovation] https://youtu.be/VsSxM1Wm2M</p> <p>Watch: Fractals [Systems Innovation] https://youtu.be/NrH3RZ2me6Y</p> <p>Watch: Fractals in Pictures [Systems Innovation] https://youtu.be/PcW18h6-rXg</p> <p>Keep in mind that fractal mathematics can describe fractal forms, but also fractal patterns in time and in terms of other non-spatial characteristics. I'll be asking you to 'Examine' a few more selected videos this week, but you needn't to examine them very closely. They are here in order to stir your imagination. If anything appeals to you, check out the YouTube channel indicated in brackets. In the first video below, as you look down on the Earth from above, ask yourself, other than the horizon line, is there anything in the picture that is <i>not</i> fractal in form?</p> <p>Examine: The Blue Pearl III [Sean Doran] https://youtu.be/FYOH_54XEJY</p> <p>As an example of the sort of fractal complexity that can come out of a relatively simple nonlinear relationship, consider the Mandelbrot Set, which is generated in code by 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>Examine: Sapphires - Mandelbrot Fractal Zoom [Maths Town] https://youtu.be/8cgp2WNNKmQ</p> <p>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</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	02/02/22	<p>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. I wonder, has the gaming world caught up to what fractal mathematics can provide? You can find many more by searching YouTube for Mandelbulb, which you can learn how to use yourself (certainly a selling point if you want to be a game programmer).</p> <p>Examine any of the following three videos.</p> <p>Emergence [Julius Horshuis] https://youtu.be/G8qZvzv5ABg</p> <p>Mandelbulb 3D Animation [Russ McClay] https://youtu.be/VGpnuTJhv1U</p> <p>Virtual nature (fractal world) [San Base] https://youtu.be/79SqIC2bNcM</p> <p>Homework 1:</p> <ol style="list-style-type: none"> 1. Based on the quotations provided above, do you think that Orwell's essay "What Is Science?" might still describe our perception of science and our relationship to its institutions? Keep in mind that 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. In a couple of weeks, we will briefly discuss a film from 1951 called "The Day the Earth Stood Still", in which Professor Bernhardt and a visitor from space named Klaatu portray the 'wise scientists' whose rationalist view of the world is forced upon the world in order to save it from itself. But do science and its institutions need reform? 2. What makes a system nonlinear? How is a nonlinear system different from a linear one? 3. Fractal mathematics can be used to describe forms in space and events in time that operate over a range of scales. What makes a form or process fractal? Describe a few natural forms with fractal characteristics.
2		<p>Reminder: check each week for any new Announcements.</p> <p>Topic 1: Scale and pattern</p> <p>You may have noticed from last week's videos that many fractal patterns are 'self-similar' at different scales. That is, patterns might persist or repeat themselves, perhaps in modified form, at vastly different scales. 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>Recommended: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1538-4632.2002.tb01073.x</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<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>Examine: Demonstrating the effects of functional diversity in geospatial domains (1) [Gary Pereira] https://youtu.be/rEb9XZyMsBQ</p> <p>Watch: The Science of Patterns [Systems Innovation] https://youtu.be/kh6KMW8J3RQ</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 patterns over very short periods of time.</p> <p>Watch at least one of the following two videos:</p> <p>Pattern formation in Nature 2: lichens and terracettes [Gary Pereira] https://youtu.be/AZ14PyiqM28</p> <p>Pattern formation in Nature 3: bird song [Gary Pereira] https://youtu.be/UvGue54F4lk</p> <p>Topic 2: Emergence</p> <p>Watch: Emergence [Systems Innovation] https://youtu.be/QtTWZc7hKs</p> <p>Watch: Synergies [Systems Innovation] https://youtu.be/rsn5EQoAhUc</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 also discovered many illuminating processes and principles that have proven to be useful at ecological and social scales. Indeed, the evolutionary history of the universe itself is the central topic of cosmology. For example, the appearance 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 within earlier generations of stars.</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. 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 might 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>

Week	Due Date	Discussion, Readings, Videos, Assignments
	02/09/22	<p>Watch: Long Tail Distributions [Systems Innovation] https://youtu.be/vIp1kY0H0yw</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 SARS-CoV-2 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.</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>Recommended: https://en.wikipedia.org/wiki/Antifragile</p> <p>Watch: Nassim Nicholas Taleb explains Antifragile [Penguin Books UK] https://youtu.be/tZonEaP5ts4</p> <p>Homework 2:</p> <ol style="list-style-type: none"> 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. 2. Describe the concepts of emergence and synergies, and try to illustrate them in the context of the natural sciences with a few examples. 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. 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?

Week	Due Date	Discussion, Readings, Videos, Assignments
3		<p>Reminder: check each week for any new Announcements.</p> <p>Topic 1: Networks</p> <p>Nearly everything of significance that has been happening lately seems to be related to the existence of networks in both the natural human worlds. A great many scientific and mathematical insights have been gained about networks in general, and many of these could be used beneficially, if we knew more about them. Unfortunately, most of us are taught very little in a formal sense about networks, unless we take a specialized course on the topic as part of a computer science, math, or engineering curriculum. Even then, there is usually not sufficient exploration of how networks work in the real world. There's also a great deal of superficial nonsense out there. The Systems Innovation channel, which you watched earlier, provides a set of introductory videos on networks, a few of which you need to watch. We will soon see how relevant this topic will be as we examine pandemics for example or the effects of a coronal mass injection from the Sun on communications networks worldwide. Following are the first two and the last two videos in the Systems Innovation playlist for networks. There are many others in between, and for a more complete picture you can watch them as well.</p> <p>Watch: Network Paradigm [Systems Innovation] https://youtu.be/9XEvXNrc-dg</p> <p>Watch: Network Theory Overview [Systems Innovation] https://youtu.be/qFcuovfgPTc</p> <p>Watch: Network Diffusion & Contagion [Systems Innovation] https://youtu.be/bTXUJQhEqL0</p> <p>Watch: Network Robustness & Resilience [Systems Innovation] https://youtu.be/_ztNkmDg0mw</p> <p>The following lecture provides a glimpse into what current network research is like.</p> <p>Recommended: How Networks Can Change Everything [Computational Social Science ETH] https://youtu.be/PWx91zUnBVU</p> <p>Topic 2: Deterministic chaos</p> <p>The last topic of a general nature I think you should keep in mind involves chaotic dynamics. The popular use of the word 'chaos' is not what we are talking about, so for many of you an accurate understanding of this topic may require you to differentiate between its popular and formal definition. The science of chaos is actually far more interesting and engaging than our common use of the term would imply.</p> <p>Watch: Nonlinear Dynamics & Chaos [Systems Innovation] https://youtu.be/qz6gXyFzV9A</p> <p>While this video does a good job of explaining the fundamentals, it seems to imply that deterministic chaos occurs primarily in simple systems. They do 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>

Week	Due Date	Discussion, Readings, Videos, Assignments
	02/16/22	<p>For example, consider one of the most famous examples: 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 programmed with the same sorts of qualities. One thing to keep in mind about deterministic chaos: it is often fairly predictable, 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>Watch: Are there other Chaotic Attractors? [Orfeas Liossatos] https://youtu.be/idpOunnpKTo</p> <p>Homework 3:</p> <ol style="list-style-type: none"> 1. What is a paradigm? What are some of the key features of the network paradigm? 2. Describe at least two examples of diffusion and contagion acting on natural or human-created networks (from the third video above). 3. What are network robustness and resilience? Describe some of the characteristics or practices that are more likely to result in resilient networks? 4. Can a system that is fully deterministic, also be chaotic? What does this imply about the limits of prediction?
4		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: Energy and the Sun-Earth system</p> <p>This video is the best and most complete visual description of the motions of the Sun-Earth system 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.</p> <p>Watch: Earth's motion around the Sun, not as simple as I thought [Aryan Navabi] https://youtu.be/82p-DYgGFjI</p> <p>Watch: A guide to the energy of the Earth https://youtu.be/fHztd6k5ZXY</p> <p>Access online the text Fundamentals of Physical Geography http://www.physicalgeography.net/ (I suggest that you do not download the pdf version, as suggested by the website or popup, but just access the online version.)</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	02/23/22	<p>CHAPTER 6: Energy and Matter</p> <p>Each chapter of the online text Fundamentals of Physical Geography 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> <p>Homework 4:</p> <p>1. Describe the internal and external sources of energy for the Earth, based on the second video.</p> <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>6.5. What is radiation? How is it created? What factors determine its quantity and quality?</p> <p>6.6. Define the Stefan-Boltzmann Law. What does it describe?</p> <p>6.7. Define Wien's Law. What does it describe?</p> <p>6.9. How does the Sun create the energy that drives most systems on the Earth?</p> <p>6.12. How does angle of incidence control the intensity of solar radiation received at the Earth's surface?</p>
5		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: Coronal Mass Ejections</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> (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 the previous two weeks: our relationship to the Sun, and the importance of networks in our lives. Here's an overview:</p> <p>Recommended: https://en.wikipedia.org/wiki/Coronal_mass_ejection</p> <p>The first video below is intended to get you thinking about the dynamical complexity of the sun, and how its changes might directly influence us.</p> <p>Examine: The Sun in 4K - Viewed By NASA's Solar Dynamics Observatory [Space Videos] https://youtu.be/eTyIYEBSmrI</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/02/22	<p>Watch: The Carrington Event - A Short Documentary [Fascinating Horror] https://youtu.be/C9tfx6rfAlo</p> <p>Watch: How Solar Storms Could Knock Out Our Power Grid [NOVA PBS Official] https://youtu.be/7nkC8SXzHls</p> <p>Watch: The Grid vs. The Next Big Solar Storm [Real Engineering] https://youtu.be/LLO9WxVO9s8</p> <p>Watch: What If a Massive Solar Storm Hit the Earth? [What If] https://youtu.be/q2kDvrs2VEs</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. I'd always also asked students in this course to consider the consequences of a large earthquake, which we have thankfully not yet experienced. So hopefully I'm a poor oracle of disaster.</p> <p>But partly because I have been asking all of my students to think more about the changing role of networks in our lives, and partly because of last week's discussion of the Sun-Earth system, 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 damage in systems of survival. In 1859, the world population was about 1.3 billion; it is now almost 8 billion. In 1859, the only potentially sensitive circuits in existence were telegraphs, and the videos describe some of the strange things that happened to them. 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" (the original version), a visitor from space presses his demands by temporarily disabling all electrical circuits on Earth. All devices requiring electricity, including vehicles, became inoperable. A severe CME would be different. Many 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> <p>Homework 5:</p> <p>1. Describe the nature of Coronal Mass Ejections, and try to estimate, based on the videos or websites you visited, how much time the Earth might have to prepare for an event if astronomers discovered that one was brewing, and how much time we'd have if one actually occurs and is on a collision course with the Earth. If we sustained a direct hit, what is likely to happen immediately? What, in your view, is likely to happen over time? Might agrarians or hunter-gatherers or others disconnected from the world economy cope better with the consequences? What might be done, given the inescapably globalized nature of the world we live in, to reduce and overcome the impact of such an event? Think for example about the video on network robustness and resilience from two weeks ago.</p> <p>Since you have only one topic for discussion this week, I expect a substantive essay. Write something in such a way that might interest and inform others. This is the sort of topic that we probably should all know more about, as we become ever more embedded into this networked world.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
6		<p>Reminder: check each week for any new Announcements.</p> <p>Topic 1: Sensing and modeling</p> <p>Watch: What is Remote Sensing? https://youtu.be/xIsUP1Ds5Pg</p> <p>Watch at least one of the following three videos:</p> <p>Satellite Remote Sensing for Environmental Protection https://youtu.be/aKfsh2NAuR8</p> <p>What NASA Knows from Decades of Earth Observations [NASA Scientific Visualization Studio] https://youtu.be/dzmktmXUZag</p> <p>How can earth observations help predict next pandemics? [NASA Scientific Visualization Studio] https://youtu.be/01OkR1Q-2KY</p> <p>Some of the most important technologies currently used to understand and monitor the Earth, including its atmosphere, oceans, polar regions, forests, cropland, urban areas, etc., ‘remote sensing’. Much of my professional work and research is in remote sensing. I decided to come to SJSU in 2002 largely because it had remote sensing courses in the catalog (geog181 and geog182) upon which I could build. That is precisely what I did for several years, developing over fifty lab exercises using state of the art software for practical applications that professionals in the earth and social scientists, business and urban planners, and related disciplines may be called upon to perform in the workplace. A number of Masters Theses included substantive work with remote sensing in our lab.</p> <p>Recommended: https://scholarworks.sjsu.edu/geog_grad/</p> <p>Let’s take a look at Michelle Fong’s Masters’ thesis of 2011.</p> <p>Recommended: Creating an Agent-based Model to Examine Spatial Behavior of <i>Eriocheir Sinensis</i> https://scholarworks.sjsu.edu/etd_theses/4089/</p> <p>Watch: An agent-based model of <i>Eriocheir Sinensis</i> https://youtu.be/Zr7qOvs35H0</p> <p>The low resolution of the video (my fault) makes the graphs difficult to read, but you should get the idea. This is the system described in. But 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 content, etc. These values change throughout the entire bay</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/09/22	<p>each month, based on the corresponding month's typical values derived from twelve Landsat TM data scenes spanning a typical year. Each simulation cycles repeatedly through this typical year.</p> <p>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>Watch: Agent-Based Modeling: An Initial Exploration [Complexity Explorer] https://youtu.be/Z8Wf1vF_xgQ</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>Recommended: Agent-Based Modeling: What is Agent-Based Modeling? [Complexity Explorer] https://youtu.be/FVmQbfsOkGc</p> <p>Topic 2: The Atmosphere</p> <p>Watch: Water Vapor Fuels Hurricane https://ca.pbslearningmedia.org/resource/nves.sci.earth.hurricane/water-vapor-fuels-hurricanes/</p> <p>Watch: NOVA: Earth From Space Monitoring Earth's Water Vapor https://ca.pbslearningmedia.org/resource/nves.sci.earth.vapor/monitoring-earths-water-vapor</p> <p>Watch: Careers In Atmospheric Science [NCAR Earth Observing Laboratory] https://youtu.be/Fk-uqrXkkG8</p> <p>Access the text Fundamentals of Physical Geography http://www.physicalgeography.net/fundamentals/contents.html</p> <p>Homework 6:</p> <ol style="list-style-type: none"> 1. What is remote sensing? Describe what you've learned from at least one of the three additional remote sensing videos. 2. What agent-based modeling? How does it work? Find some example of how agent-based models may help us to understand behavior. 3. What is the primary function of the Aqua satellite? How does it monitor the production of water vapor? 4. Describe the sort of careers in atmospheric science from in the video that you find most interesting.

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>Chapter 7 Essay Questions 3, 4, 5, 10, 13</p> <p>7.3. Why is ozone important for life on Earth? Where is it found and how is it formed? How is human activity influencing this important atmospheric gas?</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>7.5. Describe the difference between the following two terms: heat and temperature.</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>
7		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: The Hydrosphere</p> <p>I worked for a couple of years for the National Operational Hydrologic Remote Sensing Center (NOHRSC) (https://www.nohrsc.noaa.gov) 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', or 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>Fresh water is likely to become an increasingly contentious issue worldwide, as water availability and distribution is inevitably tied to issues of food production, industry, and social justice.</p> <p>Watch: The Water Cycle [National Science Foundation] https://youtu.be/al-do-HGulk</p> <p>Watch: Is the world's fresh water supply running out? [PBS NewsHour] https://youtu.be/iVcTQdOJMMw</p> <p>Recommended: Inside Story - What can be done to stop global water scarcity? [Al Jazeera English] https://youtu.be/JIIBBWSQMds</p> <p>Watch: Water Resource Management https://youtu.be/odngssDFMrU</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/16/22	<p>Take a look at our closest reservoir, the Calaveras:</p> <p>Watch: Calaveras Reservoir [Gary Pereira] https://youtu.be/EqehbxjfUk</p> <p>Recommended: The Three Gorges Dam [Gary Pereira] https://youtu.be/pPKV GTI4gk</p> <p>Recommended: The Three Gorges [Gary Pereira] https://youtu.be/yQ7lrqE_bKU</p> <p>Homework 7:</p> <ol style="list-style-type: none"> 1. Is the world's fresh water supply running out? Try to be geographically specific. 2. What is an aquifer? What is the current state of aquifers around the world? 3. Describe some of the tasks involved in water resources management. 4. 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? <p>Access the text Fundamentals of Physical Geography http://www.physicalgeography.net/fundamentals/contents.html</p> <p>Essay Questions 1, 3, 4, 7, 10, 12</p> <ol style="list-style-type: none"> 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. 8.3. Discuss the movement of water into soils. How and why does infiltration vary with time? 8.4. Why does runoff occur? 8.7. Describe the mathematical equation used to model stream discharge. 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? 8.12. Explain how relative humidity is measured.

Week	Due Date	Discussion, Readings, Videos, Assignments
8		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: Climate</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>Watch: NOVA: Extreme Ice Ice-Core Record of Climate https://ca.pbslearningmedia.org/resource/nvei.sci.earth.climate/ice-core-record-of-climate/</p> <p>Watch: NASA The Ocean: A Driving Force for Weather and Climate https://youtu.be/6vgvTeuoDWY</p> <p>Watch: What is a Climate Model? https://youtu.be/bkcrH9tYv8g</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.</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, 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>

Week	Due Date	Discussion, Readings, Videos, Assignments
	03/23/22	<p>Watch: Early Warning of Climate Tipping Points [Understanding Climate Change] https://youtu.be/5yTJZzQzdYI</p> <p>Here's a pdf of the slides from the lecture. http://www.to.isac.cnr.it/aosta/LecturesSeminars/Lenton_3.pdf</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>Watch: Antarctica latest research: Doomsday Glacier ice shelf gone in 5 years [Just Have a Think] https://youtu.be/49NPdyUEos8</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>Homework 8:</p> <ol style="list-style-type: none"> 1. What is an ice core? Why is it useful? 2. Why are the oceans a driving force for weather and climate? 3. How do climate models work? 4. Summarize what you learned from the lecture on 'Early Warning of Climate Tipping Points'. 5. What is the latest news from observations of Antarctic ice shelves?
9		Spring Recess
10		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: The Biosphere</p> <p>In this course, we cannot go very deeply into biology or ecology, but we shall touch on a few key ideas. This week we will concentrate on the material sources of life, and the material significance of life. I'll keep it brief, for those of you recovering from Spring Break.</p> <p>Watch: Plants Affect the Atmosphere https://ca.pbslearningmedia.org/resource/nves.sci.earth.atmosphere/plants-affect-the-atmosphere/</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/06/22	<p>Watch: NOVA: Earth From Space Lightning Produces Nitrates https://ca.pbslearningmedia.org/resource/nves.sci.earth.nitrate/lightning-produces-nitrates/</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> <p>Homework 9:</p> <ol style="list-style-type: none"> 1. What primary components of Earth’s atmosphere do plants modify through photosynthesis and respiration? 2. Describe the processes of photosynthesis and respiration. How do they relate to one another? 3. How have plants contributed to making Earth a habitable planet? 4. Why does the Amazon rainforest have such a dramatic impact on the atmosphere? 5. On average, how many lightning strikes occur on Earth each second? 6. How does lightning produce nitrate? 7. Why is nitrate important for living things? 8. How does nitrate produced in clouds end up in human bodies?
11		<p>Reminder: check each week for any new Announcements.</p> <p>Topic 1: Ecosystems</p> <p>We shall not go too deeply into the science of ecology, except through the textbook, and the following video (part of a series; if you’re interested, check out the Systems Innovation channel).</p> <p>Watch: Ecosystems [Systems Innovation] https://youtu.be/H-RPVJaojo8</p> <p>Ecological resources are often discussed in terms of the ‘ecosystem services’ that offer benefits to human societies.</p> <p>Recommended: Ecosystem services [California Academy of Sciences] https://youtu.be/BCH1Gre3Mg0</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/13/22	<p>It is often with regard to ecological resources that individual human beings have a powerful personal influence. Through the actions of specific people, entire species have escaped extinction thus far. Careers acting on behalf of wildlife and naturally diverse ecosystems may be some of the most challenging, time-critical, but personally fulfilling domains of natural resource management that we have seen and will continue to see in the near future. Even part-time volunteer work can be quite meaningful.</p> <p>Watch: Top 5 Inspirational Animal Conservation Stories [BBC Earth] https://youtu.be/zQZndqa2bIw</p> <p>Recommended: Modern day wildlife conservation Nick Bubb [TEDx Talks] https://youtu.be/BTzm6RKmaXs</p> <p>Topic 2: Infectious diseases</p> <p>Without commenting on the specifics of the covid-19 virus and its origins, I thought it might be helpful to take a broad look at the general issue and how it connects with population and environment.</p> <p>Watch: How Pandemics Spread [TED-Ed] https://youtu.be/UG8YbNbdaco</p> <p>Watch: Why are outbreaks of infectious diseases on the rise? [DW News] https://youtu.be/4J1AqK0ayTE</p> <p>Recommended: How deforestation helps deadly viruses jump from animals to humans https://theconversation.com/how-deforestation-helps-deadly-viruses-jump-from-animals-to-humans-139645</p> <p>Recommended: How Climate Change Is Contributing to Infectious Disease [ProPublica] https://www.propublica.org/article/climate-infectious-diseases</p> <p>Homework 10:</p> <ol style="list-style-type: none"> 1. What are some of the characteristics of ecosystems? How does an ecosystem differ from a community? 2. What is your favorite ‘inspirational animal conservation story’ from the video? 3. Briefly discuss how viral pandemics might form. 4. Are infectious diseases on the rise? If so, why? <p>Chapter 9 Essay Questions 2, 4, 5, 9, 11, 14</p> <p>9.2. Compare and contrast the function and structure of the grazing and detritus food chain.</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<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>9.9. What are some of the major components of ecosystems? How are these components related to each other?</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> <p>9.14. Compare and contrast the characteristics (climate, plant types, animal life, soil types, etc.) of the following biomes: Tundra, Temperate Deciduous Forest, Desert, and Tropical Rainforest.</p>
12		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: The Lithosphere</p> <p>In discussing the lithosphere, I thought we could look closely at a place whose characteristics illustrate nearly all of the elements of plate tectonics. This way, you will get a better idea of how many features of the solid Earth and ocean work together as a system. That is expressed quite well in the Deep Dive video below. If you watch that video closely, you will understand more than you would from reading all of Chapter 10 in the textbook, which I also recommend you take a good look at.</p> <p>First, let me tell you a little about the place at the center of the Deep Dive video. I recently took a trip there, a place called 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>The border between China and North Korea border runs right through the mountain's crater lake, which is the site of the Korean people's origin myth. Kim Jong Un has visited the lake several times, as have several Chinese leaders. If you look at a map (or watch the beginning of the first video below) you'll notice that the China/DPRK border was intentionally diverted to allow Korean access to and dominion over at least part of this lake. Unfortunately, the North Korean people do not seem to have been given such access. But despite the fact that getting there is still difficult, many South Koreans who travel to China continue to visit from Chinese access points.</p> <p>Watch: 1442 Steps to Heaven Lake [Gary Pereira] https://youtu.be/TsnoFuC4zrw</p> <p>Recommended: Valley Float Stone Forest of Changbai Mountain [Gary Pereira] https://youtu.be/HSDtL-AQyM</p> <p>Recommended: Jinjiang River Canyon [Gary Pereira] https://youtu.be/l_JWAZkvNQk</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/20/22	<p>I wanted you to get a good understanding of lithospheric processes and how they connect with hydrological, geochemical and biological processes through the following excellent explanation. Opening this video in a separate browser gives you access to all reference URLs and papers. Try to watch it carefully, and put everything you can into addressing question 1.</p> <p>Watch: Why China's Largest Volcano Is So Unusual [Deep Dive] https://youtu.be/3C2HVOB-g5s</p> <p>Access via CANVAS (Files): StayingSafeWhereTheEarthShakes_BayArea.pdf PuttingDownRootsInEarthquakeCountry_BayArea.pdf</p> <p>Homework 11:</p> <p>1. Describe in detail the process of plate tectonics between the Pacific and East Asia. Why is Changbai Mountain (Mount Paektu) so unusual, in a geological sense? What is the role of water in plate tectonics?</p> <p>2. Retrieve from Files and read the two documents, “StayingSafeWhereTheEarthShakes_BayArea” and “PuttingDownRootsInEarthquakeCountry_BayArea”. 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, 28, 33</p> <p>10.17. Outline the various processes of physical, chemical, or biological weathering.</p> <p>10.28. How does beach drift and longshore drift move sediment along coastlines?</p> <p>10.33. Describe some the important characteristics of soil.</p>
13		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: The Oceans</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>Watch: Nutrients from Deep-Sea Vents https://ca.pbslearningmedia.org/resource/nves.sci.earth.hydro/nutrients-from-deep-sea-vents/</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	04/27/22	<p>Watch: The Next Frontier in Mining: Deep Sea Exploitation in the Pacific https://youtu.be/PuEXmFQEJpw</p> <p>Recommended: https://en.wikipedia.org/wiki/Deep_sea_mining</p> <p>Recommended: https://www.nature.com/articles/d41586-019-02242-y</p> <p>Recommended: https://en.wikipedia.org/wiki/International_Seabed_Authority</p> <p>Recommended: https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea</p> <p>Recommended: Deep sea gold rush [Al Jazeera English] https://youtu.be/s1b4xVTAKcI</p> <p>Recommended: Mining the Deep Sea [Massachusetts Institute of Technology (MIT)] https://youtu.be/MWvCtF1itQM</p> <p>Recommended: Deep Sea Mining: Searching for the Next Mineral Boom [Roundtable] https://youtu.be/-UPjsuuyvD4</p> <p>Recommended: Seabed Mining in the Deep Sea [University of California Television (UCTV)] https://youtu.be/ePm3Wbw2tyc</p> <p>Recommended: Introduction to the International Seabed Authority and Seabed Mining [dyaguilfoyle] https://youtu.be/Tlumf1ivuPg</p> <p>Homework 12:</p> <ol style="list-style-type: none"> 1. What is a hydrothermal vent? Describe how hydrothermal vents produce nutrient-rich water. 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.
14		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: Uranium, thorium, and plutonium</p> <p>Our last two weeks are devoted once again to topics that are seldom covered in a course in physical geography, but should. 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 biggest concern remains the toxic nature of the fuel, partly because of the nuclear power and weapons</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
		<p>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>Watch: Thorium and the Future of Nuclear Energy [PBS Space Time] https://youtu.be/ElulEJruhRQ</p> <p>Watch: Could Advanced Nuclear Power Replace Fossil Fuels? [Journey] https://youtu.be/eg613DFBR8s</p> <p>Watch: Small Modular Reactors. Are they now unavoidable? [Just Have a Think] https://youtu.be/yofGtxEgpl8</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>https://en.wikipedia.org/wiki/Oyster_Creek_Nuclear_Generating_Station</p> <p>The reactor is in the cube-shaped building in the center of this picture: https://en.wikipedia.org/wiki/File:Oyster_Creek_Nuclear_Generating_Station_-_1998.jpg</p> <p>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> <p>Recommended: What If You Fell Into a Spent Nuclear Fuel Pool? [What If] https://youtu.be/mM-5DhIhYmQ</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</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	05/04/22	<p>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>Watch: Understanding the accident of Fukushima Daiichi [IRSN] https://youtu.be/YBNFvZ6Vr2U</p> <p>Watch: Fukushima's ghost towns https://youtu.be/xKfnsYzQWjw</p> <p>Homework 13:</p> <ol style="list-style-type: none"> 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? 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?
15		<p>Reminder: check each week for any new Announcements.</p> <p>Topic: Lithium, cobalt, and rare earths</p> <p>We continue our discussion of energy resources with a couple of minerals that will soon play an increasing role. We may soon begin exchanging lithium batteries as routinely as pumping gasoline. 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 depending on intermittent solar and wind energy sources. The demand for these resources is therefore anticipated to outgrow the demand 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. Most of the demand for lithium and cobalt comes from manufacturers of batteries like those that power electronic devices and (increasingly) automobiles.</p> <p>Watch: Companies race to mine lithium, a battery essential [PBS NewsHour] https://youtu.be/su_UC9ZCD-0</p> <p>Watch: Here's Where the Juice That Powers Batteries Comes From [Bloomberg Quicktakes] https://youtu.be/50rXYrFCQMw</p> <p>Watch: Lithium Recycling FINALLY goes global! [Just Have a Think]</p>

Week	Due Date	Discussion, Readings, Videos, Assignments
	05/11/22	<p>https://youtu.be/mbkhXAP1EQE</p> <p>Cobalt seems to be the more problematic substance, in human and environmental terms.</p> <p>Watch: Whose Wealth? Cobalt from Congo [SOMO Researcher] https://youtu.be/37iLD41vfdI</p> <p>Watch: How do we solve the Cobalt problem? [Just Have a Think] https://youtu.be/-WOOZYILyXI</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>Watch: How These Rare-Earth Elements Could Change Our Future [Spark] https://youtu.be/88jpgxSRVZU</p> <p>Recommended: How the US plans on rivaling China in the production of critical earths [CNBC] https://youtu.be/CW4TnJDIQUw</p> <p>Recommended: Impact of Materials on Society- Rare Earth Elements [Materials Research Society] https://youtu.be/C-b1NacN3IY</p> <p>Homework 14:</p> <ol style="list-style-type: none"> 1. Describe the mining and processing of lithium, its uses, and opportunities for recycling. 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? 3. What are rare earth elements used for? Where are they found? Are there likely to be undiscovered deposits? Which nations are most involved in increasing the production of rare earth minerals?
16	05/20/22	<p>Final Evaluation:</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>