San José State University
Department of Urban and Regional Planning
Geog01: Geography of the Natural Environment, Sections 80 and 81

Fall 2021

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 would like 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 Leaning 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 in 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 suffer if you repeatedly fail to address additional questions or concerns that I may have posted 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 would like 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 and that we are often encouraged to use. If you look closely, you might notice something rather odd. 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. This, in my opinion, perfectly exemplifies postmodern decision making. People were paid to design and construct several of these things.

You can take the bench in the photo 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 censorious atmosphere that has taken over 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 any of the other technologies that can, and have, gotten people like you and me in trouble merely for exploring interesting ideas. Instead, **I encourage you to edit the work you do for me and for others, and post it online 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, 'geog01-80' or 'geog01-81', and 'Fall 2021', 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, if it leads to further understanding. If your writing style is average, and you avoid redundancy, and you put in the time expected of you, each homework assignment should probably run at least three pages.

Don't expect an A+ (or even an A) just for being 'correct'. 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, particularly if it hasn't been graded. I may be a few days late with grades on occasion. 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
80% - 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 at http://www.sjsu.edu/gup/syllabusinfo/

About your instructor

I'm just another kid who grew up in New Jersey, in a semi-industrial city near NYC. I went to public schools and held a variety of untrained jobs in various settings, from our downtown single-screen movie theater to the reactor building of a nuclear power plant.

I began working professionally with a two-year degree in electronics engineering, with a team that helped to build and maintain 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 at Brooklyn College, where I took evening courses and earned a master's degree in computer science. While in Brooklyn, I met Cheri. We got married, and after we had a child, we moved to Bethlehem, PA. I worked there for the Physics Department at Lehigh University, later working nearby as a geographic information systems engineer for Lockheed Martin. After a few years we moved again to Minnesota, where I worked in a government facility that processes remote sensing, GIS, and hydrological models to produce geospatial data products online. 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 well-known and highly respected scholars in geography. We moved again to the Bay Area, and I've been at SJSU for nearly 20 years.

Why do I encourage you all to join professional organizations or guilds as students and to participate in whatever online learning opportunities they offer? Why do I encourage you at the very least to put your best work online, within something that employers can easily access, like Portfolium? I can think of plenty of reasons, involving everything from the current state of the world to my own lived experience. For example, while I was working as a technician at Lehigh University, I also took all of the classes needed for a PhD in Computer Science, but we moved to Minnesota before I could make enough progress on a dissertation. Oh well. It didn't really matter that much, since none of that learning was wasted. I was most interested in pattern recognition, simulation, modeling, and visualization, as well as the natural sciences, and I independently developed a software system for remote sensing and GIS that I presented at a conference in Vancouver. I had no financial support. I paid for the travel, lodging and registration myself. A couple of weeks after the conference, I got a call from someone at Lockheed Martin Corporation who'd seen me there and read my paper. They had a GIS project within commuting distance of my home that might interest me. They interviewed me, and they offered me a job as a systems engineer, which I accepted.

https://portfolium.com/garympereira/portfolio

Geog01-80(81), Geography of the Natural Environment, Fall 2021

Please submit your homework responses as Word or pdf files by the due date indicated. Use 10 point font, with 1 ½ line spacing and normal margins. Put on the first page of each submission your name, homework #, geog01-80(81), Fall 2021.

Course Schedule

Week	Due Date	Discussion, Readings, Videos, Assignments
1		Topic: **The nature of the natural sciences** If you haven't already done so, please **Watch:** General notes for my online classes [Gary Pereira] https://youtu.be/_AN8k0Ogwl0 Reminder: check each week for any new **Announcements.** Textbooks often give the false impression that the science contained therein is settled. They are written that way. That doesn't make it true. There is often a great deal more diversity of thought in legitimate science than our textbooks would have you believe. Science also changes faster than you would have imagined. When I first studied physics and astronomy, for example, the cutting edge involved protons, neutrons, electrons, photons, relativity, and quantum theory. Now, in what feels like just a few years, we see serious discussion of quarks and strings, cosmic inflation and multiverses. Our own universe seems to be absolutely dominated by the still utterly unknown nature of dark matter and of dark energy. I'd like to start off by challenging the assumption that the physical sciences are necessarily a materialist project. Much of contemporary science actually has more to do with information than with 'materiality'. In the video below, Sheldrake's descriptions of physics are accurate, and his views remain controversial. There is absolutely nothing wrong with controversy in science or in philosophy. I want you to watch this in order to disabuse you of the notion that the big questions in science have all been answered. They have not. **Watch:** Rupert Sheldrake - The Science Delusion [revolutionloveevolve] https://youtu.be/JKHUaNAxsTg Our ignorance of the world involves not only the very big and the very small. Reality at our own scale remains mysterious. For example, nonlinearities (in the mathematical sense) yield all sorts of weird and wonderful things, and this happens at all scales. Nature itself is almost entirely nonlinear in form and in function. As we begin to look ever more closely at astronomical objects, for example, from stars to galaxies and beyond, they reveal themselves to be as complex in their own way as living things. As we have seen it more closely, the universe itself has revealed to us its own evolution. The universe and everything in it are actually far more intricate at all scales than we realize. In math and science, a nonlinear system, in contrast to a linear system, is a system whose output is not directly proportional to its input due to the interconnections and interdependencies within the systems. **Watch:** Nonlinear Systems Overview https://youtu.be/VSsXxM1Wm2M

Week	Due Date	Discussion, Readings, Videos, Assignments
		1. Complexity and fractals There are so many interesting tools and methodologies in science that we could mention in the context of this course, but I thought we'd start with a kind of mathematics that lends itself quite well to the geometry of natural forms: fractals. **Watch:** Fractals [Systems Innovation] https://youtu.be/NrH3RZ2me6Y **Watch:** Fractals in Pictures [Systems Innovation] https://youtu.be/PcWl8h6-rXg In the video below, as you look down on the Earth from above, ask yourself, other than the horizon line, is there anything that is NOT fractal? **Examine:** The Blue Pearl III [Sean Doran] https://youtu.be/FYOH_54XEJY 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 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 can come out of 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. The 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. Nevertheless, we shall explore it next week. **Examine:** Sapphires - Mandelbrot Fractal Zoom [Maths Town] https://youtu.be/8cgp2WNNKmQ Fractal mathematics is used to model and visualize many three-dimensional natural and artificial forms. One software package for generating such forms is called 'Mandelbulb'. If you search on that term in YouTube, you'll get results like the following. They demonstrate that it is not particularly difficult to generate biological or geological forms using fractal geometry. **Examine** any of the following three videos: [3D FRACTAL] Emergence [Julius Horshuis] https://youtu.be/G8qZvzv5ABg Mandelbulb 3D Animation [Russ McClay] https://youtu.be/VGpnuTJhv1U Virtual nature (fractal world) [San Base] https://youtu.be/79SqIC2bNcM

Week	Due Date	Discussion, Readings, Videos, Assignments
		Topic 2: **Scale and pattern** You will notice that many fractal patterns are to some degree scale-independent. That is, they may persist or repeat themselves in slightly different forms at different scales. Natural branching patterns are often like this. I've been thinking about relationships between scales for some time. The following is not required reading by any means, but you may find it interesting: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1538-4632.2002.tb01073.x My first success in creative computer science was with pattern recognition. Patterns can be detected, examined, or formed at any scale and in any abstract 'space' of any dimension, within a computer. We don't need to be able to visualize multidimensional spaces in order to work with them. This ability to work with patterns forms the basis of much of AI, neural networks, etc. **Watch:** The Science of Patterns [Systems Innovation] https://youtu.be/kh6KMW8J3RQ Combining the ideas of pattern and scale, of space and time, we can better appreciate the patterns that emerge from natural phenomena. In the following videos, I look at lichens and terracettes, which grow over long periods of time, and bird song, which forms patters over very short periods of time. In both cases, the scales of activity fall to some extent outside of direct human perception. **Recommended:** Pattern formation in Nature 2: lichens and terracettes [Gary Pereira] https://youtu.be/AZ14PyiqM28 **Recommended:** Pattern formation in Nature 3: bird song [Gary Pereira] https://youtu.be/UvGue54F4lk
	08/25/21	**Homework 1:** 1. What makes a system nonlinear? How is a nonlinear system different from a linear one? 2. Fractal mathematics can be used to describe forms in space and events in time that operate over a range of scales. What is a fractal? What sort of natural forms have fractal characteristics? 3. 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		Reminder: check each week for any new **Announcements.** Topic: **Emergence** **Watch:** Emergence [Systems Innovation] https://youtu.be/QItTWZc7hKs **Watch:** Synergies [Systems Innovation] https://youtu.be/rsn5EQoAhUc

Week	Due Date	Discussion, Readings, Videos, Assignments
		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. The evolution of the elements in the periodic table is far more involved than you may think. The vast majority appeared hundreds of millions or billions of years after the Big Bang: **Recommended:** Where do atoms come from? [Sabine Hossenfelder] https://youtu.be/yszguz5uAW4 The significance of nonlinear phenomena (that is, most things) cannot be determined by addition and subtraction alone. Imagine bumping into a wall at 1 mile per hour. No big deal. Now imagine doing that fifty times in a row. It would be kind of silly but still, no big deal. Now imagine bumping into the wall just once, but moving at fifty miles per hour. Obviously, a very different result from doing it fifty times at 1 mph. A great deal of what happens in the real world is not simply the result of additive processes. The sorts of events that carry the most significance (possibly the only real significance) are often very those rare events that are strung out along the long tail of the powerfulness v frequency distribution. These are the events that actually change lives, nations, and civilizations. **Watch:** Long Tail Distributions [Systems Innovation] https://youtu.be/vIp1kY0H0yw Throughout the semester, it will be helpful to keep in mind that important 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 ever notice within an entire lifetime. The pandemic that we are going through now is a perfect illustration of 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 would typically find on a common ruler. So ten thousand individual virus particles can be lined up between those millimeter marks. Square that number: a hundred million could cover a square millimeter of surface with a single layer. Now think about the surface area of human lung tissue, which is the target. The alveolar surface area of a pair of human lungs varies from 50 to 75 square meters. That huge surface area is possible in such compact volume because (as we've seen last week) lungs like many things in nature are fractal, terminating in hundreds of millions of alveoli for gas exchange. You can imagine the sorts of battles that are being fought at molecular scales upon the vast terrain (from the virus's point of view) of available human lung tissue within a single human being. Now think about the spread of that virus to hundreds of millions, potentially billions of humans everywhere on earth. The point is, don't judge the potential power of any agent of change by its size or by our current awareness of its potentialities. Very few people were warning anyone about this sort of thing happening. 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'. https://en.wikipedia.org/wiki/Antifragile

Week	Due Date	Discussion, Readings, Videos, Assignments
	09/01/21	**Homework 2:** 1. Describe the concepts of emergence and synergies, and try to illustrate them in the context of the natural sciences with a few examples. 2. 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. 3. 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?
3		Reminder: check each week for any new **Announcements.** Topic: **Networks** 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 the, 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. **Watch:** Network Paradigm [Systems Innovation] https://youtu.be/9XEvXNrc-dg **Watch:** Network Theory Overview [Systems Innovation] https://youtu.be/qFcuovfgPTc **Watch:** Network Diffusion & Contagion [Systems Innovation] https://youtu.be/bTXUJQhEqL0 **Watch:** Network Robustness & Resilience [Systems Innovation] https://youtu.be/_ztNkmDg0mw The following lecture by Dirk Helbing provides a glimpse into what current network research is like. **Recommended:** How Networks Can Change Everything for Better or for Worse [Computational Social

Week	Due Date	Discussion, Readings, Videos, Assignments
		Science ETH] https://youtu.be/PWx91zUnBVU **09/08/21** **Homework 3:** 1. What is a paradigm? What are some of the key features of the network paradigm? 2. Describe in some detail at least two examples of diffusion and contagion acting on natural or human-created networks. 3. What are network robustness and resilience? Describe some of the characteristics or practices that are more likely to result in resilient networks?
4		Reminder: check each week for any new **Announcements.** Topic: **Energy and the Sun-Earth system** The following video is the best and most complete visual description of the motions of the Sun-Earth system I've found online. 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). **Watch:** Earth's motion around the Sun, not as simple as I thought [Aryan Navabi] https://youtu.be/82p-DYgGFjI **Watch:** A guide to the energy of the Earth https://youtu.be/fHztd6k5ZXY Access online the text **Fundamentals of Physical Geography** http://www.physicalgeography.net/ (I DO NOT suggest that you download the pdf version, as suggested by the website or popup). CHAPTER 6: Energy and Matter 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. **09/15/21** **Homework 4:** 1. Describe some internal and external sources of energy for the Earth. Chapter 6 Essay Questions 3, 4, 5, 6, 7, 9 , 12:

Week	Due Date	Discussion, Readings, Videos, Assignments
		6.3. How do the three mechanisms of conduction, convection and radiation move energy from one place to another? 6.4. Outline the three laws of thermodynamics. 6.5. What is radiation? How is it created? What factors determine its quantity and quality? 6.6. Define the Stefan-Boltzmann Law. What does it describe? 6.7. Define Wien's Law. What does it describe? 6.9. How does the Sun create the energy that drives most systems on the Earth? 6.12. How does angle of incidence control the intensity of solar radiation received at the Earth's surface?
5		Reminder: check each week for any new **Announcements.** Topic: **Coronal Mass Ejections** We will now spend a week on a topic that most physical geography textbooks won't even mention. You will soon see why I have included it here. This is the freedom we get in not following some publisher's script. Solar superstorms and coronal mass ejections 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. https://en.wikipedia.org/wiki/Coronal_mass_ejection The only reason the first video below is included is to get you thinking about the dynamical complexity of the sun, and how its changes might directly influence us. **Examine:** The Sun in 4K - Viewed By NASA's Solar Dynamics Observatory [Space Videos] https://youtu.be/eTylYEBSmrI **Watch:** The Carrington Event - A Short Documentary [Fascinating Horror] https://youtu.be/C9tfx6rfAIo **Watch:** How Solar Storms Could Knock Out Our Power Grid [NOVA PBS Official] https://youtu.be/7nkC8SXzHls **Watch:** The Grid vs. The Next Big Solar Storm [Real Engineering] https://youtu.be/LLO9WxVO9s8 **Watch:** What If a Massive Solar Storm Hit the Earth? [What If] https://youtu.be/q2kDvrs2VEs About a year before COVID-19 made its appearance, I had decided to start including discussions of epidemic and pandemic diseases in some of my courses. I've always asked my physical geography students to consider the consequences of a large earthquake. Now, partly because I have been asking

Week	Due Date	Discussion, Readings, Videos, Assignments
		people to think more about the networks in our lives, and partly because it is of direct relevance to a discussion of the Sun-Earth system, I want you to think deeply about the consequences of a Carrington-like CME occurring now. In 1859, the world population was about 1.3 billion. It is now nearly 8 billion. In 1859, the only potentially sensitive electrical circuits in existence were simple telegraphs, and the videos describe some of the strange things that happened with them. There's an old movie called "The Day the Earth Stood Still" (I prefer the original) wherein a star man and his robot temporarily disable all electrical circuits, making every device, including automobiles, inoperable. He did this in order to make a point. In the developed parts of the world, and even in the developing world, nearly everything we need and do is dependent on the continuous reliability of electronic circuits. If these circuits were to be made permanently or even temporarily inoperable by a CME, as described in the videos, then everything would come to a screeching halt. Communications, light power, water, everything. Even the off-grid stuff. And when the CME passes, don't expect things to be turned back on. Many critical components and nodes, including satellites, will likely be damaged permanently and may take years to replace. What comes about socially and politically around the world is anybody's guess, but it is not likely to be good. Unlike an earthquake or flood, this would be a global event. Some very bad things are likely to happen, in my opinion. We really need to think about protecting ourselves from this sort of event, which is far more likely than we might think.
	09/22/21	**Homework 5:** 1. Write an essay describing 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 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. I want you to write this in such a way that it can stand on its own, independently of the homework. Hopefully some of you might publish it or otherwise share it with others. I doubt that many people have ever heard of this, or if they had, that they'd given it much thought.
`		Reminder: check each week for any new **Announcements.** Topic: **The Atmosphere** **Watch:** Water Vapor Fuels Hurricane https://ca.pbslearningmedia.org/resource/nves.sci.earth.hurricane/water-vapor-fuels-hurricanes/ **Watch:** NOVA: Earth From Space | Monitoring Earth's Water Vapor https://ca.pbslearningmedia.org/resource/nves.sci.earth.vapor/monitoring-earths-water-vapor **Watch:** Careers In Atmospheric Science [NCAR Earth Observing Laboratory https://youtu.be/Fk-uqrXkkG8

Week	Due Date	Discussion, Readings, Videos, Assignments
	09/29/21	Access the text **Fundamentals of Physical Geography** http://www.physicalgeography.net/fundamentals/contents.html CHAPTER 7: Introduction to the Atmosphere **Homework 6:** 1. What is the primary function of the Aqua satellite? How does it monitor the production of water vapor? 2. What is a geostationary orbit? Why do you think it would be useful to have a satellite remain in orbit over one point on Earth? Why do scientists combine data from multiple satellites in geostationary orbit? 3. Explain how topography, latitude, and other factors combine to change the impact of water vapor regionally, as described in the video. 4. Describe the sort of careers in atmospheric science from in the video that you find most interesting. Chapter 7 Essay Questions 3, 4, 5, 6, 7 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? 7.4. How is the incoming shortwave solar radiation from the Sun modified by the atmosphere and the Earth's surface? 7.5. Describe the difference between the following two terms: heat and temperature. 7.10. What is a hurricane? Where, when and why does it form? How is global warming likely to influence hurricane intensity and frequency? 7.13. Discuss the formation and characteristics of the various types of thunderstorms (see also the videos).
7		Reminder: check each week for any new **Announcements.** Topic: **The Hydrosphere** **Watch:** The Water Cycle [National Science Foundation] https://youtu.be/al-do-HGuIk **Watch:** Is the world's fresh water supply running out? [PBS NewsHour] https://youtu.be/iVcTQdOJMMw **Recommended:** Inside Story - What can be done to stop global water scarcity? [Al Jazeera English] https://youtu.be/JIlBBWSQMds **Watch:** Water Resource Management

Week	Due Date	Discussion, Readings, Videos, Assignments
	10/06/21	https://youtu.be/odngssDFMrU Take a look at our closest reservoir, the Calaveras: **Examine:** Calaveras Reservoir [Gary Pereira] https://youtu.be/_EqehbxjfUk And of course, there is the Three Gorges Dam, and the Yangtze River… **Recommended:** The Three Gorges Dam [Gary Pereira] https://youtu.be/pPKV_GTI4gk **Recommended:** The Three Gorges [Gary Pereira] https://youtu.be/yQ7lrqE_bKU **Homework 7:** 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. Why was the new Calaveras Reservoir Dam designed to safely hold up to four times as much water as it is currently holding, other than for seismic reasons? (see video) Access the text **Fundamentals of Physical Geography** http://www.physicalgeography.net/fundamentals/contents.html CHAPTER 8: Introduction to the Hydrosphere Essay Questions 1, 3, 4, 7, 10, 12 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	**10/13/21**	Reminder: check each week for any new **Announcements.** Topic: **Climate** Climate is obviously an issue of central concern, and it is important to understand that it involves far more than just the atmosphere. The oceans, the cryosphere (ice), and the continents all influence climate. The other thing to understand is that 'climate' is a concept that applies at a wide variety of scales. The microclimate of a farm or of a city or park is a real thing that can be influenced both positively and negatively. Using Remote Sensing, I've investigated the microclimates of growing cities like Shanghai, Beijing, and Houston. The Chinese have in fact been doing a great deal to make their urban microclimates more pleasant and resistant to the urban heat island effect. More on this perhaps in an Announcement. **Watch:** NOVA: Extreme Ice | Ice-Core Record of Climate https://ca.pbslearningmedia.org/resource/nvei.sci.earth.climate/ice-core-record-of-climate/ **Watch:** NASA | The Ocean: A Driving Force for Weather and Climate https://youtu.be/6vgvTeuoDWY **Watch:** What is a Climate Model? https://youtu.be/bkcrH9tYv8g **Recommended:** Climate Refugees: Nations under threat [CBS News] https://youtu.be/4MXoUbsswHY **Recommended:** Fleeing climate change — the real environmental disaster [DW Documentary] https://youtu.be/cl4Uv9_7KJE **Recommended:** Changing Climate, Moving People: A film on climate stress related migration [TERI] https://youtu.be/NjYR3LohMM0 **Homework 8:** 1. What is an ice core? Why is it useful? 3. What precisely is the relationship between greenhouse gases, global temperatures, and sea level? 4. Why are the oceans a driving force for weather and climate? 5. How do climate models work? Chapter 7 Essay Questions 15, 21 7.15. What factors are responsible for the altered micro-climate of urban areas? 7.21. Why do urban areas have more energy available for the creation of sensible heat than rural areas?

Week	Due Date	Discussion, Readings, Videos, Assignments
9		Reminder: check each week for any new **Announcements.** Topic 1: **Mathematics** Much of the universe at all scales seems to be fractal in nature, and mathematics itself seems to be fractal in its development over time. Most of us have the wrong impression about math because we usually progress in our formal education through some point in a linear sequence involving arithmetic, geometry, algebra, trigonometry, calculus, etc. But that's not the way it is. Newton and Leibnitz independently discovered the differential calculus, and at the time they described in very different ways, each using the symbology springing freely from their own imaginations. These days, calculus is presented a certain way, but its ultimate source within the individual human mind is ignored. The diversity in the development of mathematics mirrored the diversity in the development of language. For example, all sorts of number systems have been used by humans to understand the natural cycles of time that we experience and must understand and predict in order to plant and harvest crops; or to establish terms of ownership and trade; or in order to build dwellings and establish boundaries, etc. Different (although often ultimately equivalent) systems of geometry and of logic developed wherever human beings had managed to establish conditions conducive to their discovery and use. We tend to narrow down to a few systems and topics that we use in our ordinary lives, but these represent a very tiny fraction of the huge diversity of mathematics that are out there, and that actually routinely enter into our scientific and technological work. For example, take the imaginary number *i*, the square root of -1. You may know that it can be useful in solving certain kinds of equations. But it turns out to do much more than that. It is actually necessary in order to represent the quantum world, and therefore all of reality, at its most fundamental level. Read the following article if you are interested: Imaginary Numbers May Be Essential for Describing Reality [Quanta Magazine] https://www.quantamagazine.org/imaginary-numbers-may-be-essential-for-describing-reality-20210303/ I've studied and used some unusual but surprisingly helpful kinds of mathematics, including so-called fuzzy logics and other forms of approximate reasoning; multidimensional pattern recognition; various decision making algorithms (a topic that really requires much more scrutiny that it has received); set theory; the Incompleteness Theorems; I can't remember them all. But rather than study and explore (or at least show some appreciation for) all of the beautiful branches of pure and applied mathematics that have developed over the years, our academic establishment seems intent on corralling selected strands, together with all of science, technology, and engineering, within yet another one of their clever little acronyms. In case you haven't noticed, they're always very proud of their acronyms. But to me, "STEM" represents a conceptual ghetto into which administrators and manipulators throw all of those (potentially money-making) activities that they don't really understand or appreciate. I've always disliked the term, particularly since it always seems to have come up in the context of 'how can we get some of that STEM money?'… Topic 2: **Remote Sensing** Some of the most important technologies currently used to understand and monitor the Earth's atmosphere, oceans, polar regions, forests, cropland, urban areas, etc., fall under the heading of Remote Sensing. Much of my professional background is in Remote Sensing. In 2002, I decided to turn down four other tenure-track offers in order to come to SJSU, largely because SJSU already had a Remote Sensing program in the catalog (geog181 and geog182) upon which I could build. That is precisely what

Week	Due Date	Discussion, Readings, Videos, Assignments
		I did for several years. I developed over fifty lab exercises that were used to teach students how to use state of the art software (ERDAS Imagine, IDRISI, etc.) for practical applications that they may be called upon to perform in the workplace. A dozen or more graduate students used what they had learned in my class in their thesis work. A number of Masters Theses included substantive work with Remote Sensing. You will notice from the following library link that this trend ended by 2014. https://scholarworks.sjsu.edu/geog_grad/ Among a number of senseless decisions that began around that time, the Department of Geography repeatedly and without warning cancelled my Remote Sensing classes, geog181 and geog182, at the beginning of the semesters for which they were scheduled, several semesters in a row. Any students who were interested in a quantitative education geared toward the development of skills and eventual employment soon left the program, and the department was itself eliminated several years due to general incompetence and low student enrollment. Remote Sensing remains an exciting and accessible field of study, particularly when used in models.Take a look at the simulation below, from Michelle Fong's thesis of 2011: **Watch:** movie1 https://youtu.be/Zr7qOvs35H0 This video portrays a dynamical agent-based simulation of an invasive crab species that could potentially inhabit San Francisco Bay. The simulated crabs move around in search of food or spawning grounds, depending on their age. Each one is born and eventually dies. The environment is formed from remote sensing data regarding water temperature, sediment, chlorophyll content, etc., which changes each month. The simulation cycles repeatedly through a typical year. This is quite a sophisticated model, into which Michelle and I put a great deal of work, ignored unfortunately by everyone at the time. But her thesis is there and available for download, and I encourage everyone to read it and the other fine theses that were generated by the now-gone Department of Geography. https://scholarworks.sjsu.edu/etd_theses/4089/ **Watch:** What is Remote Sensing? https://youtu.be/xIsUP1Ds5Pg **Watch:** How Does LiDAR Remote Sensing Work? Light Detection and Ranging https://youtu.be/EYbhNSUnIdU **Watch:** Satellite Remote Sensing for Environmental Protection https://youtu.be/aKfsh2NAuR8
	10/20/21	**Homework 9:** 1. What is remote sensing? What types of remote sensing instruments have been developed to monitor the Earth? What sorts of things do they measure? 2. How Does LiDAR Remote Sensing Work? 3. Describe some of the ways satellites are being used for environmental protection..

Week	Due Date	Discussion, Readings, Videos, Assignments
10		Reminder: check each week for any new **Announcements.** Topic: **The Biosphere** 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 for the planet. **Watch:** Plants Affect the Atmosphere https://ca.pbslearningmedia.org/resource/nves.sci.earth.atmosphere/plants-affect-the-atmosphere/ **Watch:** NOVA: Earth From Space | Lightning Produces Nitrates https://ca.pbslearningmedia.org/resource/nves.sci.earth.nitrate/lightning-produces-nitrates/ 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. **Read** CHAPTER 9: Introduction to the Biosphere 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.
	10/27/21	**Homework 10:** 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?

Week	Due Date	Discussion, Readings, Videos, Assignments
11		Reminder: check each week for any new **Announcements.** Topic 1: **Ecosystems** Again, 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). **Watch:** Ecosystems [Systems Innovation] https://youtu.be/H-RPVJaojo8 Topic 2: **Pandemics** It will be helpful to keep in mind that important agents of change exist at every scale, as we discussed in week two. These agents of change 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 ever notice within an entire lifetime. The pandemic that we are going through now is a perfect illustration of 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 would typically find on a common ruler. So ten thousand individual virus particles can be lined up between those millimeter marks. Square that number: a hundred million could cover a square millimeter of surface with a single layer. Now think about the surface area of human lung tissue, which is the target. The alveolar surface area of a pair of human lungs varies from 50 to 75 square meters. That huge surface area is possible in such compact volume because (as we've seen last week) lungs like many things in nature are fractal, terminating in hundreds of millions of alveoli for gas exchange. You can imagine the sorts of battles that are being fought at molecular scales upon the vast terrain (from the virus's point of view) of available human lung tissue within a single human being. Now think about the spread of that virus to hundreds of millions, potentially billions of humans everywhere on earth. The point is, don't judge the potential power of any agent of change by its size or by our current awareness of its potentialities. **Watch:** How Pandemics Spread [TED-Ed] https://youtu.be/UG8YbNbdaco **Watch:** Why are outbreaks of infectious diseases on the rise? [DW News] https://youtu.be/4J1AqK0ayTE The following articles may be helpful in addressing question 3: How deforestation helps deadly viruses jump from animals to humans https://theconversation.com/how-deforestation-helps-deadly-viruses-jump-from-animals-to-humans-139645 How Climate Change Is Contributing to Skyrocketing Rates of Infectious Disease [ProPublica] https://www.propublica.org/article/climate-infectious-diseases

Week	Due Date	Discussion, Readings, Videos, Assignments
	11/03/21	**Homework 11:** 1. What are some of the characteristics of ecosystems? How does it differ from a community? What are some of its important components? (see video and text) 2. Briefly discuss how viral pandemics might form. 3. Why are deforestation and climate change concerning with regard to the rise of infectious disease? Chapter 9 Essay Questions 2, 3, 4,5, 9, 10, 11, 14 9.2. Compare and contrast the function and structure of the grazing and detritus food chain. 9.4. Evolution describes the process by which species come to possess adaptations. In an essay, describe how evolution works through natural selection, spatial isolation, and gene mutation. 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. 9.9. What are some of the major components of ecosystems? How are these components related to each other? 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. 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.
12		Reminder: check each week for any new **Announcements.** Topic: **The Lithosphere** Recently, I took a trip to a massive volcano called Changbaishan, or Changbai Mountain, also known as Mount Paektu. Changbaishan is located on the border between China and North Korea. It last erupted, with tremendous force, about a thousand years ago. The scars remain, and within them have arisen some of the most unique and magical ecosystems in northeast Asia. Anyone who grew up with Lord of the Rings or Harry Potter would love this place. 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.

Week	Due Date	Discussion, Readings, Videos, Assignments
		Examine: 1442 Steps to Heaven Lake [Gary Pereira] https://youtu.be/TsnoFuC4zrw **Recommended:** Valley Float Stone Forest of Changbai Mountain [Gary Pereira] https://youtu.be/_HSdtL-AQyM **Recommended:** Jinjiang River Canyon [Gary Pereira] https://youtu.be/l_JWAZkvNQk **Recommended:** Natural History Museum of Changbaishan [Gary Pereira] https://youtu.be/Un6ig2Z9lIY 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. **Watch:** Why China's Largest Volcano Is So Unusual [Deep Dive] https://youtu.be/3C2HVOB-g5s **Access via CANVAS (Files):** StayingSafeWhereTheEarthShakes_BayArea.pdf PuttingDownRootsInEarthquakeCountry_BayArea.pdf **Access:** CHAPTER 10: Introduction to the Lithosphere
	11/10/21	**Homework 12:** 1. Describe the process of plate tectonics between the Pacific and East Asia. Why is Changbai Mountain (Mount Paektu) so unusual, in a geological sense? What is the role of water? 2. 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. In other words, I want to know more than just what you would do for yourself during and immediately after the earthquake. I also want to know about long-term planning, and about the long-term aftermath. Assume that the earthquake has caused casualties, and that people around you are in need of first aid, at the very least. Assume that gas lines are ruptured, that electricity is off, and that communications via cell phone is unreliable. Assume that you have the ability to move and do things. You may be at work, or school, at home or on the streets. You may fictionalize your account, with specifics, or you may write in the manner of the USGS documents. This essay should take at least a couple of pages. Chapter 10 Essay Questions 14, 17, 25, 28, 32, 33 10.14. What is a volcano? Where and why do they form? Describe the five different types of volcanoes. 10.17. Outline the various processes of physical, chemical, or biological weathering. 10.25. How do glaciers influence the surface configuration of the Earth by way of erosion and deposition?

Week	Due Date	Discussion, Readings, Videos, Assignments
		10.28. How does beach drift and longshore drift move sediment along coastlines? 10.32. Describe some of the landforms common to environments influenced by eolian processes. 10.33. Describe some the important characteristics of soil.
13		Reminder: check each week for any new **Announcements.** Topic: **Uranium, thorium, and plutonium** Again, a topic that Is seldom covered in a course like this, but should. Both political parties in the US support increased use of nuclear energy, as do most of the rest of the world's leaders. Given that, I think there should be at least a little discussion, and some education around these substances. **Watch:** Thorium and the Future of Nuclear Energy [PBS Space Time] https://youtu.be/ElulEJruhRQ **Watch:** Could Advanced Nuclear Power Replace Fossil Fuels? [Journe https://youtu.be/eg613DFBR8s **Watch:** Small Modular Reactors. Are they now unavoidable? [Just Have a Think] https://youtu.be/yofGtxEgpI8 **Watch:** Understanding the accident of Fukushima Daiichi [IRSN] https://youtu.be/YBNFvZ6Vr2U **Watch:** Fukushima's ghost towns https://youtu.be/xKfnsYzQWjw 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). Those years left me with some lasting memories, some of which I'll briefly mention here. In the late 1970's, I was hired to fill out a work team from Rhode Island at the Oyster Creek Nuclear Generating Station, in Forked River, New Jersey: https://en.wikipedia.org/wiki/Oyster_Creek_Nuclear_Generating_Station 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 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. These fuel rods are described in detail in the [How It's Made] videos below. 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 challenged by states, for many reactors the rods remain is sealed casks somewhere on the grounds.

Week	Due Date	Discussion, Readings, Videos, Assignments
	11/17/21	**Watch:** What If You Fell Into a Spent Nuclear Fuel Pool? [What If] https://youtu.be/mM-5DhIhYmQ 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. Since I was the lowest man on the totem pole (and admittedly totally untrained), that was my job. The plant that I worked in is now shut down, but when I was there, 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 disposable clothing that is used in semiconductor clean rooms today, but in a nuclear reactor these clothes were there for the opposite reason: to keep contaminants away from your clothing and body. At the time, there was one guard near the entrance to the room above the reactor, sitting at a desk, with a handgun. There seemed to be no additional armed security at the time. It was in the 1970's; things were very different pre-9/11. 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. I had absorbed some radioactive iodine in my few weeks on the job. I learned later that if had taken iodine supplements prior to working there, my thyroid would have been pre-saturated and may not have absorbed any on the job. Iodine pills had been distributed throughout the US during the Cold War in the event of a nuclear strike. **Homework 13:** 1. Describe some of the prospects for the nuclear power industry 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 wisdom of 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?
14	**11/24/21**	**Thanksgiving Holiday**
15		Reminder: check each week for any new **Announcements.** **Topic:** The Oceans Finally, I'd like you to think about one of the key components of the Earth system that I often find missing from physical geography textbooks: the oceans. More specifically, the recent discovery of resources on the seabed and the development of technologies to exploit those resources.

Week	Due Date	Discussion, Readings, Videos, Assignments
		Countries bordered by oceans often claim an exclusive economic zone that extends far out to sea. Many of these waters are disputed among various nations (e.g., the South China Sea). Fissures along plate boundaries and hotspots in the deep ocean bring minerals up from deep beneath the crust. Many islands and seamounts associated with such processes have abundant minerals in their seabed. Unknown forms of life, that we have barely begun to understand, exist in these environments as well. **Watch:** Nutrients from Deep-Sea Vents https://ca.pbslearningmedia.org/resource/nves.sci.earth.hydro/nutrients-from-deep-sea-vents/ **Watch:** The Next Frontier in Mining: Deep Sea Exploitation in the Pacific https://youtu.be/PuEXmFQEJpw The following entries may be helpful in addressing question 3: https://en.wikipedia.org/wiki/Deep_sea_mining https://www.nature.com/articles/d41586-019-02242-y https://en.wikipedia.org/wiki/International_Seabed_Authority https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea **Watch** or examine some of the following additional discussions: TechKnow - Deep sea gold rush [Al Jazeera English] https://youtu.be/s1b4xVTAKcI Mining the Deep Sea [Massachusetts Institute of Technology (MIT)] https://youtu.be/MWvCtF1itQM Deep Sea Mining: Searching for the Next Mineral Boom [Roundtable] https://youtu.be/-UPjsuuyvD4 Seabed Mining in the Deep Sea [University of California Television (UCTV)] https://youtu.be/ePm3Wbw2tyc Introduction to the International Seabed Authority and Seabed Mining part 1 [dyaguilfoyle] https://youtu.be/Tlumf1ivuPg
	12/01/21	**Homework 14:** 1. What is a hydrothermal vent? 2. Describe the process by which hydrothermal vents produce nutrient-rich water. 3. Discuss the status and prospects f deep-sea mining. What (if anything) is being done to regulate the exploitation of the seabed for minerals? Discuss the history and significance of national claims of exclusive rights over offshore resources.

Week	Due Date	Discussion, Readings, Videos, Assignments
16	**12/10/21**	**Final Evaluation:** 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 citations. 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 lengthen it with unnecessary repetition. I expect all of you to produce a paper that you can publish online without further editing.