

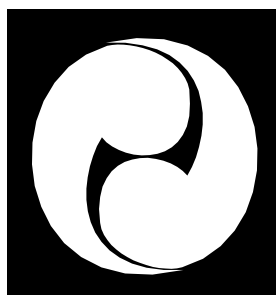
James Madison University

Department of Geology
And Environmental Science

Syllabus - GGEOL 102

<http://csmres.jmu.edu/geollab/Fichter/GS102/index.html>

ENVIRONMENT: EARTH



COURSE	GGEOL 102-4101 LEC 51339
CREDIT HOURS:	03
BUILDING:	Memorial Hall
ROOM:	7370
TIME:	9:00AM 12:00PM MTuWTh
INSTRUCTOR:	Lynn S. Fichter, Professor of Geology
OFFICE:	Memorial Hall, Room No. 7100 E
OFFICE PHONE:	568-6531
E-MAIL:	FICHTELS@JMU.EDU
OFFICE HOURS:	Before and after class. By Appointment, but any time I am in my office, most of the time, you may come by to see me
FINAL EXAM:	Friday of the last week of classes
TEXTS:	☺ Notebook of Lecture Illustrations (JMU Copy Center)

WHY DO I HAVE TO TAKE A GENERAL EDUCATION SCIENCE CLASS?

What does it matter? And who really cares!?! And what possible importance could it have for me and my life?

These are good questions asked in classrooms around the world, and deserve answers. There are two reasons for taking a General Education Science class. The first is about becoming an educated citizen of the world. We live on a very complex world where what happens in one distant corner is almost instantly known about in this corner, and what happens in that corner can seriously affect us. We cannot live self-sufficiently, in isolation, even though there are people who want to, but must contend and struggle in a world with many conflicting view points and agendas, and against nations which often do things and believe things differently from us. Living in a world this complex, making it work, requires wisdom.

Wisdom is knowing what to do with knowledge. That ultimately is what a college education is for - to learn how to intelligently deal with all the masses of information, of conflicting needs and wants in a complex world. It is no longer good enough to rely on explanations which are emotionally satisfying; which just make you feel good but which have no logical basis; it is getting too dangerous for that.

So, where does wisdom come from? It comes from thinking about and trying to solve problems, and debating with people who have different (and perhaps better, perhaps worse) solutions to problems. But wisdom cannot be tied up into a neat package. There is the wisdom of psychology, of history, of philosophy, of science, etc. And there is wisdom that worked last year, but not this.

Being an educated person means knowing something about all these different kinds of wisdom, how to use them, how to defend your ideas against people who abuse them. If your teachers do not try to help you enhance your wisdom they are failing you (they, of course, cannot *give* you wisdom, each must find their own).

So, you are not here to just learn some facts about this Earth we live on, or even why it is important or practical to know something about the Earth. You will learn some of these things of course, but it is secondary. You are required to take a general education science course to learn about scientists, how we think, how we solve problems, and what scientists can and cannot do (and still being doing science) so that you can better understand and evaluate the influence of science in your life.

The **second reason** for taking General Science course about the Earth is more specific. We live on a planet we pretty much take for granted. Because of this, our relationship with the Earth is too overwhelmingly human-centered. Most people treat the Earth like a black box. Things go into it (like garbage), and things come out of it (like water, and energy, and minerals) but most people do not really know, or care, about what goes on in between.

Yet, virtually every day we become more aware of environmental problems: global warming, polluted drinking water, not enough landfills for all our garbage, and the loss of rural landscapes (especially in northern Virginia and its suburbs that now extend as far as Pennsylvania), to mention just a few. We wring our hands over how awful the human species is, doing all these things that pollute the Earth, destroy the Bay, over fish the fish. We know there is something wrong, but most of the time we do not know enough, or have the will, or have the ability (for reasons we will explore) to act more responsibly.

Alternatively, we are immersed in news reports of the destructive power of the Earth. Ever watch Storm Stories on the Weather Channel? You might come to think the Earth is out to get us: hurricanes, tornados, floods, fires, landslides, earth quakes, volcanic eruptions.

We blame the Earth for being what it is and doing what it does, without understanding the why of it. We also have the illusion we might be able to do something about these calamities—without inconveniencing ourselves, of course—diminishing them, make they go away, make ourselves safe.

These perspectives are misguided at best. P.M.A.J Atwater expressed it well while commenting on the December, 2004 Indonesian tsunami.

*“No government can be blamed for the tsunami tragedy,
or cursed for not having done enough to prevent it.*

We are not God.

*We can recognize and work with the Earth’s evolutionary design,
but we cannot stop it –
Nor should we.”*

The purpose of this course is to help us come to understand the Earth, what it is made of, how it works, what its history can tell us about the Earth we live on today, and what it may be like in the future. A secondary purpose is to explore human relationships with the Earth, again historically, today, and in the future.

The problem with most thinking is that Earth environments and man's relationship to those environments are thought of as separate problems. But, the Earth does not have an environmental problem. We humans may have problems with the environment, but the Earth does not. Over 4 billion years of evolutionary history the Earth has seen glaciations that froze the oceans at the equator, to tropical climates so warm even the north and south poles were warm in winter, to widespread desert conditions, to a time when oxygen levels plummeted so low 96% of species went extinct because they could not breathe. The Earth does not care what we do—it has seen it all, and survived it all. But, for our own sakes we sure need to care—if we only knew how.

We are not nearly as tough, or as clever as we think we are. In fact, most people are quite ignorant of this planet and how it works. And most people are quite ignorant of how we as a species works. History is littered with civilization after civilization that at the very peak of their power, crashed and burned. Crashed and burned because they were ignorant of their environment, and pushed it way past its limits, and did not seem to be able to do anything about it, just as we are doing now.

What civilization needs to learn from geology is that we cannot impose short-term thinking on long-term problems, or adopt policies that do not recognize the Earth is embedded in ongoing evolutionary change. Geologic understanding is an antidote to the fragmented and piecemeal thinking that is characteristic of most human decision making and the provincialism of narrow specialist centered thinking about the environment, our relationship with Earth, and about the importance of human civilization.

Text and Other Readings

I have not ordered a formal text book for this class. There are plenty of geology books available, but most of them are useful for only a fraction of the topics I cover, and do not help at all for the other things. So, because most traditional text books are marginally useful I do not require you to spend the money on one.

There is a required LECTURE NOTEBOOKS for the class, purchased from the JMU copy center. You will not get through the class without it. Bring it to class every day. This is the former edition, and I am making changes, but many of the handouts are still needed.

Studying and Getting Through the Course Painlessly

(Well, relatively painlessly) and Doing Well

My main interest is helping you learn about how scientists think about and work to understand the Earth, and the environment. Some times you may get the impression I am trying to turn you into scientists, but I am not. Learning about scientists, how we think, how we solve problems, and what is and is not science, is an important part of your education, even if you have no intention of doing science, or even don't like science. But, what we have to learn is difficult enough without you having to jump through unnecessary hoops. Some strategies for getting through.

1. **Power Point Presentations:** Geology is a very visual subject. Sometimes you just have to see it. So, I have put the entire course with all the illustrations into Power Point presentations and make these available at the course web site as pdf files. These files tend to be large and in the past some have not been able to download them. Ask if you have problems.
2. **Use the Power Points as study guides.** When I make up a test I go through the power points slide by slide, reminding myself of what we discussed and emphasized, and compose questions from that. My tests follow the order and logic of the power points almost exactly. There is a story and logic to everything we study, and if you get in the rhythm of the stories and logic it will all flow more smoothly.
3. **Take good notes.** Because there is no formal text, good note taking is essential. It is very hard to miss classes and get through the class well. Find a good partner whose academic abilities you trust to exchange notes with if you do have to miss class.
4. **Create a Study group.** Perhaps the most efficacious thing you can do. Find 1, or 2, or 3 people to study with. Go through the power points together, and talk about the logic of the ideas as they develop. Try to explain to each other what you know; saying it out loud sets it in your mind, and if you misunderstand something your partners will quickly correct it so you do not learn it wrong.
5. **Sample tests at course web site:** <http://www.jmu.edu/geology/GS102/> Tests are multiple choice/true-false, but the format is probably unlike any test you have taken. So, I have put sample tests on the course web site to let you see the format before you take them. They will also give you some insight on how to study and prepare.

The Importance of Minerals and Rocks

The study of the earth is the study of minerals and rocks, and the first third is all about minerals and rocks. Aside from living things, the entire earth is composed of minerals and rocks, and everything takes place in the presence of, through, or because of minerals and rocks. We talk a lot about minerals and rocks.

But this class does not have a laboratory, and that is an enormous disadvantage since most of you are not familiar with minerals and rocks. To you, they begin largely as disembodied names, which I refer to over and over all semester, expecting you to understand what I am talking about. I know it is difficult to do, but you need to make an effort to get to know these rocks beyond the level of isolated, unconnected words.

I bring rocks to class, and show them to you, and keep them around so you can look at them if you want. But in addition are a series of web sites with numerous pictures and descriptions of minerals, rocks, and tectonic concepts that are valuable study aid. But if you do not work to make the rocks behind the names real in some sense, and connected with each other, then the course is more difficult.

<http://csmres.jmu.edu/geollab/Fichter/Fichter/websites.html>

ATTENDANCE, GRADING, EXAMS, AND STUDY GUIDES

ATTENDANCE

I do not keep track of attendance. I assume you will show up and if you do not I expect you to accept full responsibility for making up missed material.

I strongly encourage you to come to every class, however. The knowledge and skills are cumulative through the semester, and much of it is not in the text book. Former students tell me my lectures are full enough that they just could not afford to miss. I don't know about that; I just do my thing.

But it is likely that once you fall behind, or miss some important subject required later in the semester, you will have great difficulty catching up. I can guarantee that you will use in the last week of class knowledge you learned not only on the first day, but on most every day through the semester.

MAKE-UP TESTS

Sometimes there are legitimate reasons for having to miss a test, and take it on another day. But if this becomes necessary I would like you to tell me as soon as possible, and make arrangements to take the test at another time.

But if you have missed a test, and are unable to make it up in a timely manner, I will probably give you a different test from the one the rest of the class takes, and they may be more demanding than the original test.

GRADING:

There are four lecture exams, the fourth and last being the final. Grading is based upon the following schedule.

Lecture Test # 1: Complex Evolutionary Systems	25 %
Lecture Test # 1: The Rock Cycle: Part One	25 %
Lecture Test # 2: The Rock Cycle: Part Two	25 %
Final Exam: The Earth as a System	<u>25 %</u>
	100%

TEST GRADING - Tests are computer graded using Scantron cards. Test scores are sent to you via e-mail.

The scores sent by e-mail are Not your grades. The computer center provides two scores, a raw score and a percent score. I ignore the percent score. The raw scores are the basis for the curve where I convert the raw score into a percent scale; 90-100 = A, etc. I run a curve on the scores and send you via e-mail your raw score and the curve ranges. The actual curve I bring to class, or you may come see it in my office (233 Miller). You have to compare your raw score with the curve to determine your final test grade.

FINAL GRADES - Final grades are based on the percent scale, with plus and minus grades distributed as follows:

94-100 = A	87- 89 = B+	77- 79 = C+	67-69 = D+
90- 93 = A -	84- 86 = B	74- 76 = C	60-66 = D
	80- 83 = B -	70- 73 = C -	NO D- GRADES EXIST

GRADE CURVING - Because my tests always contain more than 100 points they have to be curved to get them all down to a 100% basis. This is done test by test. Because each test is curved individually, final grades are not curved.

EXAMS...

Exams are scantron computer graded with True/False and Multiple Choice questions. But the questions I ask even on True-False/Multiple Choice tests are typically not the Memorize ⇒ Regurgitate type.

I am interested in processes, in understanding why things are the way they are, and how they came to be. I teach my classes to explore these processes, and as much as possible I test to explore these ideas.

Interpretations of illustrations, diagrams and charts are a common part of my tests. We use lots of them in class, and virtually any of them can appear on a test. You are expected to be able to read and interpret any diagram, and answer questions that ask you to analyze what is going on and make your choices based on that analysis.

Schedule Based on Last Time Course Was Taught

I am always revising courses, and this one will be no exception. Most of the time revisions are minor and do not change the flow of the course. The schedule below may change, but if it does so significantly I will let you know.

			<i>Subjects Explored</i>
Week One	Day One Monday 5/18	Hour 1	PP-1 The Earth and Solar System are Born Classical Science Framework: Assumptions of Classical Science
		Hour 2	Assumptions of modern science; entropy and equilibrium
		Hour 3	Chaos Theory - <i>why the Earth does not behave as an equilibrium system: Xnext and the logistic system</i>
	Day Two Tuesday 5/19	Hour 1	PP-2 How do things evolve? PP-3 The Earth is an open system, and it evolves.
		Hour 2	PP-4 Rock Forming Minerals
		Hour 3	PP-5 Igneous Rocks: Bowen's Reaction Series
	Day Three Wednesday 5/20	Hour 1	PP-5 Igneous rocks
		Hour 2	PP-5 Igneous Rocck PP-6 Lava/Volcanoes
		Hour 3	PP-6 Lava/Volcanoes/Intrusives
	Day Four Thursday 5/21	Hour 1	PP-7 Fractionating Evolution of Igneous Rocks
		Hour 2	PP-8 Sedimentary Rock Origin and Classification
		Hour 3	PP-8 Sedimentary Rock Origin and Classification
Week Two	Day Five Monday 5/25		MEMORIAL DAY - CLASS DO NOT MEET

	Day Six Tuesday 5/26	Hour 1	PP-9 Follow the Energy: <i>power laws and natural (and not so natural) disasters</i>
		Hour 2	PP-10 Sedimentary Environments
		Hour 3	PP-11 Metamorphism
	Day Seven Wednesday 5/27	Hour 1	PP-11 Metamorphism END TEST UNIT ONE: The Geological Earth
		Hour 2	PP-12 Earth's first billion years: origins of everything
		Hour 3	PP-13 Archaean crustal evolution: <i>where continents came from</i>
	Day Eight Thursday 5/28	Hour 1	PP-14 Supercontinent cycles: <i>restless, restless, restless Earth</i>
		Hour 2	PP-15 Wilson Cycles: <i>opening and closing of ocean basins, why are mountains found on Earth where they are found?</i>
		Hour 3	PP-15 Wilson Cycle
Week Three	Day Nine Monday 6/1	Hour 1	TEST NUMBER ONE: The Geological Earth (scheduled to convenience of class)
		Hour 2	PP-16 Modern Earth Tectonics: <i>where are the safe places to live; and where is there hazard?</i>
		Hour 3	PP-16 Modern Earth Tectonics
	Day Ten Tuesday 6/2	Hour 1	PP-17 Atmospheric Evolution: <i>the air has not been safe to breath through large spans of Earth history</i>
		Hour 2	PP-18 Biogeochemical Cycling
		Hour 3	PP-18 Biogeochemical Cycling
	Day Eleven Wednesday 6/3	Hour 1	PP-19 It's the System ! <i>Why you can't run, and you can't hide, and there really is no completely safe place on the planet</i>
		Hour 2	PP-19 It's the System !
		Hour 3	PP-20 Gaia Theory (introduction): <i>Why everything is connected with everything else, and everything is dependent on everything else</i>
	Day Twelve Thursday 6/4	Hour 1	PP-20 Gaia Theory (Daisyworlds) END TEST UNIT TWO: The Evolutionary E
		Hour 2	PP-21 Environmental Changes: Glaciations in Earth History
		Hour 3	PP-22 Environmental Change: Sea Level changes <i>during the Phanerozoic (past 540 my) Up and down, up and down, up and down; or, drown and dry out, drown and dry out, drown and dry out.</i>
Week Four	Day Thirteen Monday 6/15	Hour 1	TEST TWO: The Evolutionary Earth (test scheduled to convenience of class)

	Hour 2	PP-23 Environmental Change: Extinctions <i>99.9% of all the life that has lived on this planet is extinct; what makes us think the human species will be any different?</i>
	Hour 3	PP-23 Environmental Change: Extinctions PP-24 Attractors and bistable behavior: <i>why do so many systems oscillate between two states (like breathing in, breathing out) and how does that affect environmental change (because the Earth breathes too)</i>
Day Fourteen Tuesday 6/16	Hour 1	PP-24 Attractors and bistable behavior:
	Hour 2	PP-25 Climate and Environment
	Hour 3	PP-26 65 Million Years of Climate Change: <i>what we need is perspective; everything is not always about us, the human species and our petty little problems</i>
Day Fourteen Wednesday 6/17	Hour 1	PP-27 Recent Ice Ages <i>10,000 years ago New York was under an ice sheet, and Virginia was tundra</i>
	Hour 2	PP-28 The Human System
	Hour 3	PP-29 The Great Wave <i>large scale economic patterns in human history and what that tells us about the history of human civilization</i>
Day Fifteen Thursday 6/18	Hour 1	PP-29 The Great Wave PP-30- Climate and Humans
	Hour 2	PP-30 How Changing Earth Environments have affected the History of Human Civilization
	Hour 3	PP-31 Case Studies: Humans and the Environment: <i>how to be prepared for major changes; countries that have succeeded, those that have failed, and how they differ</i>
Day Sixteen Friday 6/19		FINAL EXAM: The Earth Does Not Have an Environmental Problem; Humans may have environmental problems, but the Earth does not. Friday, during class time.