COURSE INFORMATION

Earth Science Today: Geos 170, King 218

Instructor: Dr. Russ Colson, x5832, rm 201 King, Office hrs: 8-9, 10-11 MWF, 9-11 TH
colson@mnstate.edu, web.mnstate.edu/colson/;
Department: Anthropology and Earth Science, King 103, 218-477-4217

Course Description: Geos 170 (LASC 3) Earth Science Today (3cr), Taught Spring and Fall
A survey of the components of Earth Science needed for teacher licensure in Minnesota, including aspects of physical geology, historical geology, astronomy, and meteorology. Particular emphasis is placed on critical evaluation of evidence, how we know things in science, what the implications are for our society, and on actual investigation. Topics include volcanoes and earthquakes, the influence of chemical change on natural resources and environment, plate tectonics, planetary science, phases of the Moon, stories told by rocks of the Earth, how weather features form and move, and Earth's climate.

Text: **Required Text:** http://web.mnstate.edu/colson/est/est.htm
Reference Text: The Foundations of Earth Science by Lutgens and Tarbuck (Prentice Hall).

Conceptual Framework (for education majors):

Knowledgeable: Students will learn the basic concepts of the four branches of earth science, but more importantly, they will learn HOW WE LEARN things about the earth. The course focuses on the process of science more than the information of science.

Reflective: Students will consider the philosophical aspects earth science and the implications for our understanding of ourselves, our planet, and our past.

Humanistic: Students will consider the implications of human actions on our planet, and the effects of our planet on us, including how natural resources have helped shape human societies.

Creative: Creativity is at the core of what science is, in our reach into the darkness of ignorance to construct new ideas and new understanding. Earth Science differs from other sciences in that it focuses on scientific storytelling. Students will participate in the STORY TELLING of Earth Science, and will learn how science is more about creating understanding than it is about memorizing an understanding that someone else has created.

Objectives:

Louis Agassiz, after whom former Lake Agassiz in our region was named, believed that science is not something that can possibly be learned from a book. He believed that science is something you do, not something you know. He once said "The book of nature is always open". It is there, in the book of nature, that we can learn what science is about.

I want to give you a feel for what science is all about. Sometimes it seems like science is about a lot of facts and information. But actually, to a scientist and also to the little-kid-explorer in all of us, science is about discovering things and figuring out what they mean.

Consequently, although this course covers the core aspects of Earth science required for Elementary Education licensure in Minnesota, it is for the most part focused on *How we know things*, and *how we think scientifically*, not on what we know. You should be concerned with how your thinking about science is changing, not on how many facts you are learning (although, hopefully, you will feel we cover some facts too!).

Earth Science Today is a topical survey of Earth Science focusing on

Thinking scientifically and understanding what experiment and observation reveal about the universe.
Doing Earth Science (experimentation and observation)
Understanding the implications of and evidence for the key concepts in Earth Science

This Course counts as a **LASC goal Area 3 with Lab**. As such, it addresses 1) understanding of concepts, principles, and investigative methods of Earth Science, 2) gathering of observational and experimental data, analysis and interpretation of data, reporting of results, and 3) understanding of societal issues from a natural sciences perspective. In addition, this course builds on critical thinking skills in the process of engaging in science reasoning problems (to a significant extent), and on oral and written communication skills (to a lesser extent). Some of the lab and lecture activities require simple math and algebra, and thus build on math skills as well.

Instruction Strategies: I will expect you to come to class having already read and understood the material so we can use more class time to consider questions and comments, engage in discussion, and do labs. However, after past experience with the 'flipped classroom' I will also do some lecturing.

In my lectures, I present basic knowledge to some extent, but more importantly I give you an example of how earth scientists approach problems and solving problems in science. Don't just write down the 'answer', but rather take notes on how approach getting to that answer. You should pay particular attention to demonstrations and thought puzzles used during lecture and think about what they mean. *Labs* will give you an opportunity to practice thinking through application of concepts and to learn to recognize important rocks, fossils, or geological structures. Labs are done in groups so that you get practice discussing and explaining your thinking and can benefit from classmates ideas. Small group or class *discussions* offer opportunities for you to explore their thinking and understanding, and to practice organizing that understanding to present to others.

Course Requirements:
Five exams: Four Exams during the term plus a Final exam. Participation in lab activities (you will work in groups and turn in lab assignments as a group). Flipped-classroom questions and pop-quizzes. Participation in class and group discussions. Participation in Class Field Trip. Dates for exams and field trips are included on the schedule. An on-your-own course review activity.

Evaluation Standards:
Four exams (covering the four topics of earth science) = 50% of your grade (your lowest exam score will be discarded). Each test is graded on a perfect curve, meaning that the average grade is forced to be 'C', with a normal distribution of other grades. Each exam tests both for your knowledge of information [60% of each exam], and your ability to reason and apply that knowledge to new situations [40%])

Final Exam = 20%. You will have the questions for the final early in the term, and can work on them at your leisure, although when you come to the final, it will be closed book and closed note. The questions are challenging, and intended to be more like a homework exercise than a traditional "test", giving you a chance to work through hard earth science problems on your own.

Group Lab reports and 3-hour field trip = 25%

On-your-own computer review lab= 5%

This comes to 100%. You can also get extra credit points through attendance. I will keep track of your attendance, and you get extra credit assigned as follows: 10pnts on regular exams - days missed. (if you miss more than 10 days, you don't go negative, it just stays at 0). 10 days corresponds to 25% of class periods, excluding exams. If you miss more than that FOR ANY REASON, there is no extra credit for attendance. Yes, you may have a very good excuse for missing, but you can't get extra credit for something you didn't do, even if you had good reason for not doing it.

The grading scale for the class is as follows:
A= >90%
B= 78-90%

C= 64-77%
D= 50-64%

I do not award pluses and minus (because students have in the past preferred no pluses or minuses).

Average grades on the first four tests are forced to be 'C', but grades on the final exam, labs, and reports can be higher than that, and usually are. Typically, the average GPA for the class is typical for introductory science classes at the university (2.2-2.6).

Course Outline:

Introduction
I. Physical Geology
II. Historical Geology
III. Astronomy and Planets
IV. Weather and Climate

Other: Course Schedule is attached.

Attendance Policy: Because this class involves daily thought puzzles, demonstrations, discussions, labs, and other activities that are not 'testable' in the traditional sense, attendance is very important. There is no way to make up for missing these classroom activities since they are unique to the in-class experience and not something you can do on your own. Good attendance does not mean that you make it to half the classes. Good attendance means you miss only two or three classes at most.

Many of the labs cannot be made up because there is no possible 'on your own' activity that is equivalent in any meaningful way. To accommodate this reality of life, I discard your lowest lab score. However, missing more than one lab will affect your grade.

If you miss an exam, you must reschedule and try to make up the missed exam within 3 days.

Academic Honesty: Don't cheat, don't plagiarize, don't have someone else do your work. It MAY help your grade slightly if you don't get caught, but it gradually turns you into a hapless buffoon who knows nothing. I *assume* that you are honest and conscientious and are here at MSUM because you really want to learn.

Special Accommodations: If you have, or think you may have, a disability (e.g. mental health, attentional, learning, chronic health, sensory or physical) please contact Accessibility Resources (AR) at (218) 477-4318 (V) or (800)627.3529 (MRS/TTY) to schedule an appointment for an intake. Additional information is available on the AR website: http://www.mnstate.edu/accessibility. If you are registered with the AR and have a current Accommodation Letter, please schedule an appointment to visit with me, during my office hours, to discuss implementation of your accommodations.

If you are in need of tutoring for this class the Academic Assistant Program can help. Stop by the Academic Support Center located in Flora-Frick Hall 154 and pick up a Tutor Request Form. Tutors are available on a first come, first serve basis, however, if we do not have tutors available we will locate one for you. For more information on MSUM's tutoring program check out our website at http://www.mnstate.edu/asc/.

Schedule for Earth Science Today, Fall 2017

Dr. Russ Colson, King 218, colson@mnstate.edu

Readings: read appropriate chapters in web text and reference text.

Introduction

Aug 21 (I will be on a field trip with other students for this class so please read the syllabus. The air pressure demo will be posted on D2L)

- Structure of class, syllabus, expectations, philosophy, open door policy
- Air pressure demo and thought puzzle

Historical Geology

Aug 23, 25: Reading Historical Geology, Topic 1: Geological time and life of the past, reading stories in rocks and fossils. **Read about Igneous, Metamorphic, Sedimentary rocks**

Rock Cycle, Rocks and the stories they tell, Basin-lake-sediment simulation activity, Q/A, Rock Rummy, reading our own rock stories, brain storming environments.

Aug 28: **Lab:** Identification of rocks and reading their stories

Aug 30: Reading Historical Geology, Topic 1: Geological time and life of the past, reading stories in rocks and fossils. **Read about Fossils**

Ecosystems and fossils, Example stories from fossils, Q/A, Creating an imaginary alien world--diverse, abundant? Discussion of where fossils are found and what it means.

Sept 1: **Lab:** Classification and identification of invertebrate fossils

Sept 6: Reading Historical Geology, Topic 2: Stratigraphy, plate tectonics, and geological change. **Read about Stratigraphy**.

Brief overview of concepts, Q/A, Go through stratigraphy thought puzzle, Local geology

Sept 8: Reading Historical Geology, Topic 2: Stratigraphy, plate tectonics, and geological change. **Read about Plate Tectonics (including Q/A**).

Recap Earth structure, plate boundaries. Q/A. Group discussion of key concepts of theory

Sept 11: Field Trip--local Climate change and Historical Geology--we will board bus at 2PM, back by 4PM (fee $10).

Sept 13: Class discussion of what theory is, what evidence is, examples of evidence for Plate Tectonics, **Lab:** Plate tectonic activity

Sept 15: **Test 1: Historical Geology**

Physical Geology

Sept 18: Reading Physical Geology, Topic 1: Physical Catastrophes: Earthquakes, volcanoes, and Earth's structure, what's inside the Earth? **Read about energy**

Very brief recap of energy, Q/A, Brainstorm in groups about how energy moves, sources of energy, go through several examples of how energy moves, source of energy, including a demo.

Sept 20: Reading Physical Geology, Topic 1: Physical Catastrophes: Earthquakes, volcanoes, and Earth's structure, what's inside the Earth? **Read about volcanos**

Demo with gas pressure, coke in syringe, discussion of what it means. Q/A What is a volcano, ccomparison to baking soda and vinegar volcano, what makes a volcano, where lava comes from, where volcanos are likely or not.

Sept 22, 25: Reading Physical Geology, Topic 1: Physical Catastrophes: Earthquakes, volcanoes, and Earth's structure, what's inside the Earth? Read about Earthquakes and Earth's interior

Q/A about Earthquakes, how we predict them, Where does energy come from? "Hearing" into the Earth's interior**. Lab**: locating an Earthquake.

Sept 27: **Lab**: "hearing" into the Earth.

Sept 29, Oct 2: Reading Physical Geology, Topic 2: Natural resources, chemical processes, What is the Earth made of?

Recap of key ideas of partitioning and mass balance in chemical differentiation, Q/A, Go through Gramma's Well puzzle, go through example of measuring partitioning and how to calculate, Group and class discussion of situations where partitioning effects life, (fresh water aquarium, circulation in oceans, ore formation, Jack Daniels chile, etc)

Note: I expect to be on a field trip for another class on Sept 29, so there will be an online lab/activity to work through.

Oct 4: **Lab:** partitioning of pollutants between sediment and water

Oct 6: Reading , review parts of last reading emphasizing physical separation and oil accumulation

Recap story of oil formation, including time scales involved, Go through puzzle of where to drill for oil, talk about fracking, Class discussion on different forms of energy, Q/A

Oct 9: Introduction to geological maps: **Lab:** Finding where to drill for oil

Oct 11: **Test 2: Physical Geology**

Astronomy and Planetary Science

Oct 13, Reading Astronomy and Planets, Topic 1: Objects in the sky, how they move, and how we learn of them

Group brainstorming: relative distance of objects in our sky based on superposition which people thousands of years ago could figure out, Recap of Parallax, Q/A,

Oct 16: **Lab**: Parallax, measuring the distance to the stars

Oct 18: **Lab**: Visit to Planetarium

Oct 20: Reading Review sections of previous reading dealing with Phases of the Moon Game and activity on phases of the Moon,

Oct 23: Reading: Review sections on Seasons from previous reading

Q/A on Seasons and phases of the Moon, **Lab:** Seasons model set up contest

Oct 25, 27 Reading: Astronomy and Planets Topic 2: Planets and how they change
Q/A, Example puzzle of type of planet based on density, Example puzzle of age of a surface--what does "age" mean in this case? List of 5 process that change planets: Come up with features you have seen on Earth or the Moon, what type of process formed it? What are common aspects of features formed by different processes?

Oct 30 **Lab**: Crater size prediction

Nov 1: Begin the "on your own" computer review activity

Nov 3: **Test 3 Astronomy and Planetary Science**

Meteorology

Nov 6, 8 Reading Weather and Climate, Topic 1: Weather, Winds, and Rain, **read the section on Where does wind come from?**
Recap ideas of pressure gradient, coriolis, veering and backing winds. Q/A. Puzzles about where low would be with different wind directions. Puzzles given isobars, which direction is wind in and where is strongest winds. **Lab**. Weather Journal : Over a period of 2 weeks, record wind direction, barometric pressure, and T as specific times and dates, being sure to get some of your own observations of clouds and wind and to take note of how things change as a low approaches and/or as front passes. Draw maps at different times to show how and why things changed.

Nov 13, 15: Reading Weather and Climate, Topic 1: Weather, Winds, and Rain, **read the section on Where does rain come from**?
Recap of concepts of RH, graphing puzzle with water vapor in air, condensation, adiabatic cooling, what causes air to rise. Q/A. Puzzles with RH, cloud height, humidity in winter, etc. Predictions about climate--where will we get the most rain? Where most deserts? Discussion--What causes storms? When cold and warm air meet? (true or false? why?) When high and low P meet (true or false? Why?)

Nov 17: **Lab**: bean and cup activity, how much water can air hold?

Nov 20, 27 Read Weather and Climate, Topic 2: Climate, ice ages, and global warming
recap greenhouse warming, feedback loops, Q/A. Discussion of how climate is different from weather and what climate change means. Understanding Milankovitch cycles. Ice ages.

Nov 29 Class debate/discussion on climate change and national policy—this will be a civil scientific discussion not a polarized political one.

Dec 1: **Test 4 Meteorology and Climate**

Dec 4: review for final and grades to-date.

Final exam: Dec 13, 2PM