NASC209 - Physical Geology

Fall Semester 2023
COURSE INFORMATION

Instructor

Dr. Gregory W. Clark	Department of Chemistry and Physics, SCIC112
Office Hours :	3:00 – 3:50 pm, Mondays and Wednesdays, or by appointment.
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Welcome

I am glad that you are taking this course and look forward to helping you along in your journey to understand the science of our planet. Physical geology can be very intuitive at times and at other times not one bit intuitive! But it can nevertheless be fascinating. I hope to serve you well as a guide in learning both what comes easy and what is a bit more of a challenge in the small part of what constitutes physical geology that we will study. If you are observant and fascinated by the world around you, or hope to become more so, applications and manifestations of geology are everywhere! And the more you learn about geology, the more you notice that this is so.

I look forward to meeting with you outside of regular class time to help with any questions you have. I have regular office hours (above), but it's very likely that these won't work for everyone. I am happy to meet at other times. Email me and we will find a time to meet that works. We can also meet over MS Teams if that is more convenient.

The best way to contact me is through email. I will endeavor to respond within 24 hours during the week. On weekends, I will try my best to respond within 48 hours. My phone numbers are also listed above. If you call my office number and I'm not in, feel free to leave a message.

It is my intent that the spaces and times associated with this course are safe for you to feel free to express yourself, comfortably ask questions, and learn as best you can, regardless of background. I welcome diversity of all kinds: gender, sexuality, disability, age, ethnicity, socioeconomic status, race, and culture. I enjoy meeting and getting to know new people! I am always seeking ways to improve the atmosphere and effectiveness of my courses; your suggestions/feedback are encouraged and appreciated.

The Course

Physical Geology is a *Natural World Core* course designed for both non-science and science majors. This course will fulfill three credit hours of the Core *Ways of Knowing: Natural World* requirement for graduation. The course will also fulfill the LARC LA-ENS requirement, **if and only if** one takes a second 100- or 200- level science course in a different discipline (e.g., with course prefix BIOL, CHEM, ENVS, NASC, PHYS). The overall goal of the course is for you to gain an understanding of the role that physical geology, as a scientific process, plays in understanding earth systems by studying its main models and theories. Of course, it will be impossible to cover all of what constitutes physical geology in one semester; we will barely scratch the surface of an exciting, diverse, and active realm of science. By focusing on several major phenomena that have significant impact on our collective culture and on our lives, I hope that you will gain some insight into the underlying scientific process and an appreciation for the complexity of the sciences. Above all, have fun with this course! Question everything about the beautiful and complex universe we live in!

MU Catalog Description: A study of the earth and the changes that it undergoes. Topics include minerals, rocks, weathering, volcanism, glaciation, mountain building, and earthquakes discussed in the context of the theory of plate tectonics. The course has a laboratory component and may include one required field trip. Lab fee. C-4NE. [*Please note that there is no required lab fee for the course this semester*.]

Class Meetings

The *official* listed class meetings are MWF from 10:00 AM - 10:50 PM in SCIC 202. Every few weeks or so, we will also use room SCIC 131 for lab exercises outside our regular class meeting time (see below). During class, we will discuss topics from the text as well as a few supplemental topics. We all benefit from dialogue and discussion of the course material; to facilitate this, we will frequently work in groups (see details below). Class participation is a course

requirement. Reading the appropriate sections of the text and working on homework before class is also required**!** The order of topics and relevant chapters of the text are listed below; I will keep you posted on the current reading assignment each week via the course *Canvas* pages. I will post pdf files of all *PowerPoint* slides for each week under that week's *Module* on *Canvas* after each class. This is an *in-person* class; there will be no remote class options for our class meetings.

It is your responsibility to inform me of any anticipated absences from class meetings or exams. If you miss any class meetings it is your responsibility to contact me to find out if you can make up any missed work, review the posted *PowerPoint* slides (and any other relevant materials posted on *Canvas*), and to get notes from a classmate. I'll be happy to work with you on any missed work if you set up a time to meet with me or come by my office hours. Work done in class can only be made up if you have an excused absence. If you are excused from a class due to academic and/or athletic commitments, please email me beforehand for each missed class; I use those emails to keep track of excused absences. If you miss class for another reason and it is considered an excused absence, please also send me an email to that I can track it.

Please note that mobile phone use (including for texting) during class is prohibited unless specifically instructed to use it as a resource – which we will, in fact do (so bring yours to class!); unapproved mobile phone use will affect your class participation grade. I reserve the right to count you as absent in cases of excessive phone use during class. During quizzes and exams, please silence your phone and stow it under your seat or in your backpack, along with your smart watch if you have one. Phone use during quizzes or exams will result in failure of the quiz/exam.

Text and References

The course textbook is **Physical Geology** by Steven Earle & Karla Panchuk (Second Edition, Pearson Education, 2019). This is a free resource (open textbook) and is available at https://opentextbc.ca/physicalgeology2ed/ as a single pdf file or by individual chapters pdf files. Readings for this course will be mostly from the text. Keeping up with the reading assignments is a course requirement. We will not discuss all the reading material in class, but I will assume that you have read it and hope that you will ask me questions about unclear material. As you read through the book, write down questions that you have. Bring this list of questions with you for discussion in class or post them on the course discussion board on *Canvas*. Throughout each chapter of the text are various ***Exercises*** *and* *a*t the end of each chapter are ***Questions for Review*** related to the material. Homework will be assigned on these as well as some additional questions. Be sure you understand the answers to all these that are relevant to the material we cover.

We will also make use of the short publication **Geology of Michigan and the Great Lakes** by Gillespie, Harrison, & Grammer (available on course *Canvas* Module on Course Resources). Several other physical geology texts have been in the Math/Physics Study Room (SCIC 113) to provide different perspectives on the topics we will cover. There are also some other good open textbook resources out there that I have posted on *Canvas* (under Course Resources).

The web is a great place to find fantastic extra resources related to geology. Excellent sources include the *U.S. Geological Survey* website and individual state geological survey websites. There are loads of other great web-based resources out there on the topics we will be covering that you can find by simply searching the web for appropriate terms. I encourage you to use the wealth of web-based resources to help you along as you prepare for class. Post good sources you find on the appropriate *Canvas* Discussion board!

Homework and Quizzes

Homework will be assigned weekly and will help prepare you for class meetings and quizzes. Assignments will be from the end-of-chapter **Questions for Review**, **Exercises**, and from additional questions that I will provide. Homework assignments will be posted on Wednesdays on *Canvas* in each week's *Module*; the assignment will be due at class time the following Monday and will serve as your **Base Group Ticket** (see below). You will have a chance to go over questions about the homework in **Base Groups** (see below). I will only spot check the homework and will post solutions/answers each week. All work in this course should be *legible* (if you want it graded!).

You will likely encounter much new vocabulary in the text. As part of each week's homework assignment, I will post a list of **Key Terms** on *Canvas*, mostly from the readings that you should know (or bring questions about to class). You do not need to turn in definitions of these terms. Yes, spelling counts on quizzes and exams! I strongly recommend the use of flash cards (or a flashcard app like *Quizlet*) for learning **Key Terms**.

We will have quizzes each Monday [except on 16 Oct, which is during Fall Break, and on 20 Nov, the week of Thanksgiving] for a total of twelve quizzes. The format of the quizzes will typically be a combination of short answer, multiple choice, sketches, essay, and/or problems (as will the exams). *Your lowest two quiz scores will be dropped*. There will be **NO** make-up quizzes. If you have an excused absence**,** the missed quiz score will be replaced by the average of your other quizzes for the semester. It is **your responsibility** to check with me as to whether a missed quiz can be counted as excused. It is imperative that you know and understand the weekly list of **Key Terms** - *some will be on each quiz*! You should use them freely as you discuss the course with classmates (and your friends/family!). You will have the opportunity to add bonus points to each quiz with successful **Base Group** work (see below).

⇨ Incidentally, you may occasionally find a calculator useful. One that does scientific notation would be best. It's not a bad idea to bring your calculator (or smart phone version of one) with you to all class meetings, just in case!

Laboratories

We are blessed with a reasonably well-stocked geology collection for a university of our size. Take advantage of this resource! We will have **laboratory** experiences for this course every few weeks, in rooms SCIC 131. The labs will help you gain some practical insight into the course material. **Please do not remove any of the specimens or equipment from the laboratory.** There is no lab fee for this course.

There will be a one half-day field trip during this course that will constitute one of our labs, most likely on a Thursday. You will be excused from your other classes for this trip. The field trip will likely consist of sites in southern Wabash County of geologic interest, unless the class, as a whole, agrees to another option (I'm happy for us all to go to Lake Superior, Alaska, Hawaii, *etc.*, if everyone in the class wants to – and you can pay your way!).

Free Points!

Minute Papers: Occasionally, we will take some time to write one or two lines each on two questions:

1. What is the most important/interesting thing you have learned since the last "minute paper?"
2. What are some questions you have about the material covered?

For each minute paper that you hand in, you will receive one point (*Minute Paper Points*) which will be added to the total of your homework/classwork scores at the semester's end. You must be present to hand in a minute paper.

Current News Article: You may upload a pdf of or web link to a **current** (within the past week) newspaper, news site, or popular magazine article (*e.g.,* New York Times, CNN, Time, Newsweek, *etc.*; online versions are acceptable) relating to geology to earn *Minute Paper Points* that are added to your homework/classwork score (general WWW sources and scientific journals are excluded from this offer!). The article should be posted on the *Current News Articles* discussion board on *Canvas.* To the earn points, the story must be on an event that was not previously posted by another student. On occasion, quizzes may refer to these articles - be sure to check out the discussion board every Monday morning. [Limit one article per student per week; six for the entire semester!]

Examinations and Grading

We will have one **midterm examination** on Friday, 13 Oct, and a **cumulative final examination** on Friday, 15 Dec, 8:00 - 9:50 am. Please note that cell phone use during quizzes or exams will result in failure of the quiz/exam. All grades will be posted on Canvas; please let me know if you would like to discuss, or notice any issues with, posted grades. The breakdown for the course grade will be as follows:

Quizzes	35%
Checked/Graded Homework	5%
Classwork, Class Participation, Group Work	15%
Laboratory Work (including field trip if we do one)	10%
Midterm Exam	15%
Final Exam	20%

Important Dates for this Course

M, 28 Aug 2023	Class meetings begin
R, 13 Oct 2023	Midterm Exam
M, 13 Nov 2023	Last day to convert to P/NP or withdraw with a W for a course
F, 08 Dec 2023	Last class meeting
F, 15 Dec 2023	Final Exam, 8:00 - 9:50 am.

Academic Integrity

Academic dishonesty in any form is a serious offense. It is your responsibility to know what constitutes academic dishonesty. If you are not sure what constitutes plagiarism, please ask me for clarification before you turn in the assignment. Academic integrity policies can be found in The Source Handbook and are linked here: http://www.manchester.edu/syllabi_information. Academic dishonesty includes, but is not limited to, cheating on exams or quizzes; submitting another's work as your own, in whole or in part (*note that this also includes copying homework answers from the back of the textbook*); unauthorized collaboration; failing to correctly cite any sources used; and falsifying documentation including fabrication of sources. Fabrication of sources includes insufficient, inaccurate, or manufactured citations for materials that cannot be traced back to any source. Fabrication of sources is often an indication that AI was used to generate the material. All written and oral assignments must be your original work and may not be submitted concurrently with another class without specific written permission of both instructors. Using AI for some portion of an assignment may be acceptable as directed by the instructor as part of a specific assignment. However, material submitted as your own which was created using AI that is not properly cited constitutes plagiarism.

Academic dishonesty, including plagiarism, in any form will not be tolerated and will result in the forfeiture of the work involved with no opportunity to make up that work. Please note that bringing course materials of another student from a previous offering of this course to class or lab and/or copying its contents is not permitted and will be treated as plagiarism. Although you are **expected** to work together on homework and to discuss the material from this class, any work you hand in should be an expression of **your own understanding** of the material, *unless* an assignment is specifically given to a group. Copying and turning in the work of a classmate is plagiarism. Plagiarized work will receive zero credit for the assignment and will result in an academic dishonesty report being filed with the Office of Academic and Student Affairs; a repeat plagiarism offense will result in course failure.

Additional Syllabus Information

Important syllabi information (on academic integrity, student disability and reasonable accommodations, medical emergency/evacuation assistance, sexual misconduct reporting requirements, Spartan Success and course feedback) may be found on the Canvas course navigation bar, under "syllabi information" or via this link (https://www.manchester.edu/docs/default-source/academics/syllabus_information.pdf).

One lesson, Nature, let me learn of thee. ❧ *Matthew Arnold*

Every now and then things become clear. ❧ *Jane Siberry*

The Book of Nature is written in mathematical characters. ❧ *Galileo Galilei*

What more can we require? Nothing but time. ❧ *James Hutton*

Course Topics

The four major ideas that we will focus on are: the *rock cycle*, *plate tectonics*, *surface processes* and *geological resources*. The topics we will discuss include, but are not limited to, material from the sections of the text given in the table. Please keep in mind that this outline is somewhat tentative and may evolve a bit as the term progresses.

Week	1st class of week		Topics	Readings: chapters from textbook	Quizzes & Exams
1	28 Aug		Science, modeling earth, plate tectonics, the Great Lakes!	1	Syllabus quiz
2†	04 Sep		Geologic time and dating, rock cycle, atoms, minerals	1	Q01
3†	11 Sep		Minerals: bonding, properties, families, non-silicates, silicates	2	Q02
4	18 Sep		More with minerals	2	Q03
5	25 Sep		Igneous rocks	3	Q04
6	02 Oct		Volcanism	4	Q05
7	09 Oct		Weathering	5	Q06
7		13 Oct	**Midterm Exam**		Exam I
8		16 Oct	Fall Break		Break!
8	18 Oct		Weathering; Sedimentary rocks	6	*No Quiz!*
9	23 Oct		Sedimentary rocks	6	Q07
10	30 Oct		Metamorphism & metamorphic rocks	7	Q08
11	06 Nov		Hydrologic cycle, Glaciation	13.1, 16	Q09
12	13 Nov		Glaciation	16	Q10
13	20 Nov		Streams	13	
13			Thanksgiving Break: 22 and 24 Nov!		Break!
14	27 Nov		Groundwater	14	Q11
15	04 Dec		The Great Lakes		Q12
16	15 Dec		**Final Exam** (8:00 – 9:50 am)		Exam II

† Camp Mack Day Possible = Camp Mack Day will be on one of the following dates: 5 - 7 or 12 - 14 Sept. Actual date will be announced at 5:00 am on the day of the event. Classes between 8 am – 3 pm will be canceled. Go to Camp Mack!!

We will likely also discuss other topics here and there, as they are useful for and relevant to an understanding of the material that we are investigating. Additional resources may be posted on *Canvas* for some of these topics. Examples include basics of topographic maps, the mid-continental rift system, the formation of the Great Lakes, and Great Lakes resources. These will serve to help focus the course more locally than does our textbook which often has a focus on Western Canada.

Course Objectives and Outcomes

The overall goal of the course is for you to understand (and appreciate!) the essential aspects of physical geology listed among the Course Topics. By the end of this course, you will be able to:

1. Understand that the process of science is based on reproducible observations, and the testing/analysis of hypotheses informed by observations.
2. Articulate the physical and chemical processes that continue to be active on Earth and how they result in observable geologic phenomena.
3. Apply the theory of plate tectonics and our knowledge of Earth's structure to all the dynamic processes of physical geology that we discuss.
4. Understand the structure and properties of materials from which the Earth is made.
5. Identify common mineral and rock samples by their properties and apply this knowledge to samples you will encounter in everyday life.
6. Give reasonable explanations of how common rocks from each of the three rock families were formed.
7. Identify and give plausible explanations as to how common, observable surface features were formed.
8. Demonstrate an understanding of the role of water in geologic processes and observable surface features.
9. Describe the geologic history and resources of Indiana and the Great Lakes region.
10. Make connections between human society and geology.

GROUP WORK

Informal Group Work

Often, we will work on questions and problems during class in pairs; we will utilize the following procedure:

1. **Formulate** your own answer to the question/problem.
2. **Share** your answer with your partner.
3. **Listen** carefully to partner's answer. Don't change your mind unless persuaded by logic or information to do so.
4. **Create** a new answer, as a pair, that is superior to or incorporates each member's initial answer by synthesis, critical analysis, and cooperation.

Formal Group Work

We will occasionally work in the context of **Formal Groups** formed for specific tasks (*e.g.*, laboratory work). All members are expected to participate actively, work to maintain effective working relationships with other participants, assist classmates, express their ideas, not change their minds unless persuaded by logic or information to do so, and indicate agreement with the group's work, in writing. You will get more information on these groups as they form!

Base Groups

Most weeks, we will have Base Group meetings. You will be assigned to a Base Group and remain with the same Base Group for the term. Ideally, your Base Group that will provide you with additional support, encouragement, and assistance needed to make academic progress. Base Groups personalize the work required and the course learning experience. You should be sure to exchange phone numbers and schedules with your base group members as you may wish to meet or chat outside of class. All members are expected to participate actively in class discussions, work to maintain effective working relationships with other participants, complete all assignments, assist classmates in completing their assignments and express their ideas. Think critically; interact cordially!

In your base group meetings, you should:

- ☛ Congratulate each other on survival since the last meeting and check if anyone is under any undue stress.
- ☞ Check to see if members have completed their homework or need help/assistance doing so. Ensure that each member gets answers to his/her specific questions! Ensure that all group members understand the homework.
- ☛ Complete the Base Group WorkSheet (BGWS).

In order to facilitate this, I suggest the following procedure (we will deviate from this on occasion!):

1. Quickly make a list of homework questions needing the most attention.
2. For each of these questions and for the questions on the BGWS, one group member is the explainer (explains their answer) and the other members are accuracy checkers (check the explanation for accuracy).
3. Rotate these roles for each question/problem so that each member does an equal amount of explaining.
4. If there is disagreement on an answer, discuss until a consensus is reached. Concentrate on parts of the homework and BGWS where there is confusion or misunderstanding. If you cannot agree on an answer, find the section of the book where the issue is discussed and note the page number(s) and/or call me over for help.

If all members of your Base Group achieve a quiz score of 80% or above, a bonus point will be added to the quiz score of each member. The same holds for the Midterm and Final exams, but with a 70% cut-off.

Base Group meetings are **NOT** intended to be times for beginning or copying homework. You must show up with your homework completed, except, perhaps, for a few questions/problems with which you are having difficulty. During Base Group meetings, your homework should be out and visible so that I and your partners can see it. If you are completely lost on an assignment, you should seek me out before the work is due (stop by my office or send me an email). Your competed homework will serve as your ***Base Group Ticket***, which allows you to receive credit for the Base Group Worksheet. Bring a hard copy to each class! I will monitor and grade you on your Base Group participation. Those who do not abide by Base Group expectations will not receive Base Group participation credit. If you are having problems with one of your Base Group members (not contributing, no homework, *etc.)* please let that person know that their behavior is not acceptable. If problems persist, please inform me.

A Simplified Summary of Mineral and Rock Classification

[*We will focus on much of this for the first half of the semester*]

Minerals – Common groups

- Silicates (most common group); *e.g.,* quartz, feldspars, micas, hornblende
  Isolated tetrahedra, single chains, double chains, continuous sheets, 3D framework
- Carbonates; *e.g.,* calcite, dolomite
- Oxides; *e.g.,* hematite, magnetite, corundum, ice
- Sulfides; *e.g.,* galena, pyrite, sphalerite, chalcopyrite
- Sulfates; *e.g.,* gypsum, barite,
- Halides; *e.g.,* halite, fluorite
- Native Elements; *e.g.,* gold, copper, diamond, sulfur, graphite, silver, platinum

Minerals – Common properties: Color, luster, hardness, streak, cleavage/fracture, crystal form, density, taste, reaction with acid, luminescence, smell, interaction with light (optical properties)

Rocks - Rocks are made of minerals!

- **Igneous** : classified on basis of texture & composition

  Intrusive = Phaneritic ► Felsic: granite; Intermediate: diorite; Mafic: gabbro
  Extrusive = Aphanitic ► Felsic: rhyolite; Intermediate: andesite; Mafic: basalt

  Glasses > scoria, pumice, obsidian
  Pyroclastic > tuff, volcanic breccia

- **Sedimentary** : classified on basis of type of source material

  Detrital
  Gravels > conglomerate, breccia
  Sands > sandstone; arkose; graywacke
  Muds > shale; mudstone

  Chemical (inorganic) ► limestone; dolostone; chert; rock salt; rock gypsum
  Biochemical (organic) ► limestone; chert; coal

- **Metamorphic** : classified on basis of texture, grain size, & composition
  Foliated ► slate; phyllite; schist; gneiss; migmatite
  Non-foliated ►marble; quartzite; greenstone; hornfels; anthracite