

Mineralogy, GEO 212
Block 4, 2018

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Office hours: By appointment or whenever you catch me in my office.

Textbooks: *Introduction to Optical Mineralogy* by Nesse

*Students must also purchase a hand lens of their own, available at the bookstore.

(NOTE: I will also have several copies of *The Manual of Mineral Science* by Klein in the classroom for your use. This book was required other years, and you will find it extremely helpful for mineral identification. You may also wish to read the relevant chapters to help you understand the course material. However, these books should NOT leave the classroom to ensure everyone has access to them.)

Course meeting times: M–F 9:00–11:00 am and 1:00–3:00 pm.

Course description: This course is an introduction to the external form, external and internal symmetry, physical properties, chemical composition, crystal structure, and crystal chemistry of minerals. We will take a hands-on approach to learn about minerals, using mineral hand-samples, crystal form models, atomic structure models, as well as polarizing microscopes to uncover even the subtlest properties of minerals.

Prerequisites: GEO 111 or GEO 114; CHE 121 HIGHLY recommended but not required

WHY take this course? Minerals are all around you—they make up the rocks in the earth and the soil on the ground. They are in many products you use daily (whether it be toothpaste, cosmetics, etc.); they are used in making foods and beverages; they are used in construction and the manufacture of everyday materials; you wear them (metals, jewelry, etc.); you use them for transportation. Minerals are IN you (your teeth, for example); they are necessary ingredients of life, though they may also cause health problems. They are used to save the environment through environmental cleanup, but they may also be used to cause widespread death and destruction. They are the frameworks in which we live.

The really handy thing about minerals is that they follow certain physical and chemical rules. If you know how a mineral works, then you can figure out how to use it to your advantage. While the actual study of minerals may not be your calling, learning even the basics about minerals will put you a step ahead and will help prepare you for work in whatever field you choose.

Course objectives:

1. Students will understand the chemistry and symmetry rules of mineral structures and will be able to identify unknown minerals based on their physical properties.
2. Students will understand the theory of optical microscopy and will be able to identify unknown minerals based on their optical properties.
3. Students will be able to interpret mineral growth outcomes based on changing variables.
4. Students will be able to interpret mineralogical data and make predictions about the mineral, its structure, characteristics and mineral associations.
5. Students will be aware of different analytical techniques available for the study of minerals as well as the wide, interdisciplinary application of minerals.
6. Students will be introduced to the major rock-forming minerals and will be able to discuss minerals in the context of rocks.

**This course supports the Educational Priorities and Outcomes of Cornell College with emphases on knowledge, inquiry, reasoning, and communication.*

Course information:

Responsibility:

As students at a liberal arts college, you are responsible for your own engagement in the academic conversation. This means being a prepared, active, and respectful participant. This includes reading the syllabus and all the assigned material, but more importantly, this means thinking critically, asking questions, coming to class having formulated your own ideas and responses to the course material, and engaging in dialogue with others. If you do not understand a topic of discussion, an assignment, a grade, or if you have any other questions or concerns, please come and talk with me.

Technology Policy

There may be certain times during class that it would be helpful to use a laptop, tablet, or smart phone. I expect you to use these devices only for class related purposes. If I believe that you are misusing technology, I will issue you a warning—after that I may ask you to leave class and other repercussions may follow.

Late Work:

I will **not** accept late assignments for a grade, but I will look at them for you to make sure you're on the right track. Missed reading questions or quizzes may not be made up without prior approval or evidence of a serious emergency. If you need an extension, please see me before the assignment deadline.

Course Accommodations:

College Policy regarding students with disabilities: Students who need accommodations for learning disabilities must provide documentation from a professional qualified to diagnose learning disabilities. Students requesting services should schedule a meeting with the disabilities services coordinator as early as possible to discuss their needs and develop an individualized accommodation plan. Ideally, this meeting would take place well before the start of classes. The student must notify the instructor of a new course of any accommodations needed within the first three days of the term. Additional information is available at:

http://cornellcollege.edu/academic_affairs/disabilities/.

Academic Honesty:

College Policy: Cornell College expects all members of the Cornell community to act with academic integrity. An important aspect of academic integrity is respecting the work of others. A student is expected to explicitly acknowledge ideas, claims, observations, or data of others, unless generally known. When a piece of work is submitted for credit, a student is asserting that the submission is their work unless the citation of another specific source is included. If there is no appropriate acknowledgement of sources, whether intended or not, this may constitute a violation of the College's requirement for honesty in academic work and may be treated as a case of academic dishonesty. The procedures regarding how the College deals with cases of academic dishonesty appear in The Compass, our student handbook, under the heading "Academic Policies – Honesty in Academic Work."

Cheating, plagiarism, and other forms of academic dishonesty will not be tolerated. Any student in this course who is involved in academic dishonesty (portraying another person's work or ideas as their own, submitting the same or similar papers in more than one course without permission from the course instructors, facilitating plagiarism, etc.) will not earn credit for the relevant assignments, may be formally charged with academic dishonesty, and may receive an F in the course.

15-Day Drop:

To drop on the 15th day, you may have no more than 2 *excused* absences; you must have completed all your work, and you must have participated in class. I reserve the right to decide which excuses are valid and to determine whether you have been participating actively in class.

Additional Resources Available to You:

To get the most out of this course, I recommend you use all the resources available to you. This includes me, Science Librarian Amy Gullen, quantitative reasoning consultant Jessica Johannigmeier, and writing consultant Jennifer Haigh. The library has a fairly well-rounded assortment of geological books and journals, and what cannot be found there can be found online through the library's electronic resources website. Please ask for assistance!

Graded Work:

You will complete several different types of assignments in this course, including problem sets, scientific readings and reading questions, hands-on labs, mineral identification, and a block-long mineral growth lab with lab write-up and oral presentation. Assignments will generally be turned in on Moodle; assignments turned in on Moodle will receive comments through Moodle.

Grading:

I use the following general scale but reserve the right to use my discretion and your class attendance/participation record.

A 100–95; A- 94–90; B+ 89–85; B 84–80; B- 79–75; C+ 74–70; C 69–65; C- 64–60; D 59–55; D- 54–50; F <50

25% Homeworks and labs

15% Crystal growth lab

10% Mineral display assignment

10% Mineral quizzes

20% Daily content quizzes

20% Final exam

Homeworks and Labs:

As is true for any subject, mineralogy is easier to learn when you have lots of practice. Therefore, I will try to give you sufficient assignments to help you learn the material. Note that labs will usually be due at lab time (1 pm) two days later. We will read a substantial number of scientific (peer-reviewed) journal articles covering a wide range of topics—of course, they will all be about minerals and will provide review or practice for material just learned in class. Each student is responsible for reading every article and answering the questions on Moodle before morning class the next day—these reading questions will not be graded but will count toward the Homeworks and Labs portion of your course grade. Each student is also responsible for leading one article discussion and writing a 2-page article summary for that article.

Crystal growth lab:

You will design your own mineral growth experiment and run the experiment for the length of the block. More information will be given about this project, which serves as a full-block mineralogy review. This will entail a project proposal, setting up and running the experiment, collecting data and observations, and a final, detailed write-up with interpretation of the data.

Mineral Display:

More will be said about this in class—you will, as a class, be putting together a mineral exhibit for public display here on campus. In doing so, you will not only learn more about minerals but you will also learn about curatorship, which is an important part of teaching the public about minerals.

Mineral Quizzes:

There will be three mineral quizzes (Monday afternoons of weeks 2, 3, & 4). It is up to you to learn the minerals on your own time. Each week, I will put out a new set of minerals for you to identify and learn. I will tell you which of the mineral formulas you should also memorize. Make sure you check your answers with me by **Friday morning before class!** I realize this is pure memorization, and I also realize there are a lot of minerals and their formulas can be complex. However, these are important rock-forming minerals that you will discuss over and over again in your geological (even environmental or archeological) career. You will need to know these—no time better than the present. Note: I typically offer prizes for the highest grades on mineral quizzes.

Content quizzes and exams:

You will have daily or semi-daily content quizzes at the start of morning class to encourage you to study regularly throughout the block. These quizzes will take place of a midterm exam grade. The course will end with a final exam on the last Wednesday of the block. The final will be cumulative and will include practical portions (from the labs, such as symmetry blocks and microscopes). Neither the daily quizzes nor the final exam will include mineral hand sample identification (unless I tell you otherwise).

Course schedule:

The following is a tentative course schedule—I may change the order of, add or cull subject material depending on course progress. We will follow a spiral learning model in this course, where we continually go back and revisit the major areas of Mineralogy, each time learning additional information and adding depth. Spiral learning is an effective way to learn and retain new material, as we will discuss in class. Unless otherwise noted, assignments are due the next morning by 8:30 am. For full details, see Moodle.

Week 1:

Monday, November 26

9 am — What is a mineral? Crystal chemistry I: elements & coordination

1 pm — Crystallography I: crystal systems

Assignments — *HW1* Mineral-in-the-News; Dyar Preface & Chapter 1; Mineral ID (due 11/30)

Tuesday, November 27

9 am — Physical properties

1 pm — Optical mineralogy I: intro to microscopes; *Lab 1* Plane light microscopy (due 11/29)

Assignments — Articles 1–3 (2 & 3 are merely to skim for overall impressions)

Wednesday, November 28

9 am — Crystal chemistry II: the atom, chemical bonding, coordination

1 pm — *Lab 2* Ball & stick models (due 12/3)

Assignment — Article 4

Thursday, November 29

9 am — Mineral growth basics; Introduce *Lab 3* Mineral growth lab

1 pm — Experiments with light; Optical mineralogy II: isotropic minerals

8 pm — *Lab 3* proposal due on Moodle

Assignment — *Lab 3* proposal (due 8 pm)

Friday, November 30

9 am — *Lab 4* Cross-polars microscopy (due 12/5)

1 pm — Introduce *HW2* Mineral display; set up *Lab 3*

Assignment — *HW3* Mineral analysis presentation; Articles 5, 6

Week 2:

Monday, December 3

9 am — Crystallography II: symmetry operators; *Lab 5* Wood block models (due 12/5)

1 pm — **Mineral quiz #1**; *Lab 5* Wood block models, continued

Assignment — Article 7; Mineral ID (due 12/7)

Tuesday, December 4

9 am — Crystal chemistry III: atomic substitution

1 pm — *HW4* Structural Formulas

Assignment — *HW4* Structural Formulas (due 12/6)

Wednesday, December 5

9 am — Lab day

1 pm — Lab day

8 pm — *Lab 3* intro, background, methods sections due on Moodle

Assignment — *HW4* Structural Formulas; Article 8

Thursday, December 6

9 am — Crystallography III: 3-D; *Lab 6* SHAPE (due 12/10)

1 pm — *Lab 6* SHAPE, continued

8 pm — *HW2* proposal due on Moodle

Assignment — Article 9

Friday, December 7

9 am — Optical mineralogy III: uniaxial minerals

1 pm — *Lab 7* Uniaxial minerals (due 12/11)

Assignment — Article 10

Week 3:

Monday, December 10

9 am — Crystal chemistry IV: color in minerals

1 pm — **Mineral quiz #2**; Continue *Lab 7*

Assignment — Article 11; Mineral ID (due 12/14)

Tuesday, December 11

9 am — Optical mineralogy IV: biaxial minerals

1 pm — *Lab 8* Biaxial minerals (due 12/13)

8 pm — *Lab 3* full draft due on Moodle

Assignment — Finish *Lab 3* draft (due 8 pm)

Wednesday, December 12

9 am — Lab Day and individual conferences

1 pm — Lab Day and individual conferences

Assignment — Article 12

Thursday, December 13

9 am — Systematic mineralogy I: silicate minerals

1 pm — Systematic mineralogy, continued

Assignment — Revise *Lab 3* write-up; *Lab 3* presentation

Friday, December 14

9 am — ***Lab 3* Mineral growth presentations**

1 pm — TBA

8 pm — *Lab 3* revision due on Moodle

Assignment — Article 13

Week 4:

Monday, December 12

9 am — Minerals in the context of rocks

1 pm — **Mineral quiz #3**; Minerals in rocks, cont.

Assignment — Finalize text for mineral display

Tuesday, December 13

9 am — Put up mineral display

1 pm — Put up mineral display

Wednesday, December 14

9 am — **Final exam**