SAN DIEGO STATE UNIVERSITY
GEOL 221 Mineralogy and Mineral Optics
Course Syllabus

Instructor: Professor David L. Kimbrough
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Lecture: MW 1000-1050 CSL 425, Lab: MW 1400-1640 CSL 425
Office: GMCS-229A; Office hours: MW 1100-1200; T 1115-1215; by appointment
TA: Cheryl Johnson GMCS-133 Office hours TBD

Course Prerequisite: Credit or concurrent registration in OCEAN 100 or GEOL 100 and 101 or GEOL 104 and 101; Geol 200; high school chemistry & trigonometry or credit or concurrent registration in college chemistry and trigonometry.


Other required materials: Hand lens; calculator

Classroom management: Attendance is crucial. Please let me know if you’re going to be absent for any reason. Be on time for class, don’t participate in excessive side-chatter or cause disruptions during class. Always respond to the instructor, the Teaching Assistant, and your fellow students in a respectful and civil manner. Cheating or plagiarism is not tolerated. It’s easy to spot and constitutes serious academic misconduct.

Helpful hints to make Mineralogy easier and more fun!
- Review and know your introductory material: You need full knowledge of the rocks and minerals material from your Introductory Geology course as well as introductory chemistry; the elements and the periodic chart.
- Attend class: Studies show that the most valuable time commitment by students in a course is the time actually spent in the classroom. Class time is the most important determinant of student success and yields the greatest improvement in student learning outcomes. Information is covered in class that is not in the textbook, and parts of the book are hard to understand. You must let me know ahead of time if you have to miss class, otherwise you cannot make up points from quizzes and other class activities due to absence. Reading assignments should be completed prior to the class period. Bring your questions to class.
- Lecture & Lab: There will be lecture material during lab time and lab activities during lecture on a regular basis. Lecture and lab assignments reinforce one another and aid in comprehension. Exam questions will closely parallel material presented in class. Be there!
- Three-ring binder: Get a binder to hold and keep all your labs and handouts organized.
- Blackboard: Course materials including the syllabus are available on the Blackboard course website. Refer to it regularly for materials and assignments.
- TA and Professor: If you have questions, take advantage of the T.A. and the Professor. Feel free to make an appointment to see the professor, the TA or come during office hours.

Why Mineralogy?: Minerals are the basic ingredients of the solid earth (and terrestrial planets) and knowledge of mineralogy is basic to understanding topics in diverse disciplines in the geosciences including economic geology, environmental sciences, petrology, sedimentology, structural geology, geochemistry, and geophysics. Since minerals are naturally occurring crystalline compounds, chemistry is a prerequisite.
A primary objective of this course is to develop a broad overview of the minerals that form the earth - their nature, origin and evolution. Chemical composition and physical conditions dictate the formation and stability of minerals in and on the earth. As different minerals grow, the physical arrangements of atoms result in various forms of symmetry. The science of crystal symmetry is "crystallography". We will explore the fundamental principles of crystallography and crystal-chemistry. These principles govern and describe the architecture of minerals at the atomic level and are responsible for their properties and stabilities. We will study the nature of the dominant minerals that make up the bulk of the earth. We will learn the methods to identify minerals in hand specimens and using X-ray diffraction, as well as the use of the electron microprobe for the determination of mineral compositions.

A major part of the course is devoted to mineral optics in preparation for the study of rocks in thin section (i.e. petrography) using a polarizing light microscope. Topics to be covered include familiarization with the microscope, the elementary principles of crystal optics, the immersion method, isotropic, uniaxial, and biaxial optics, and the study of minerals in thin section. By the end of the semester students should be able to readily identify the major rock-forming minerals in thin section. This provides a foundation for study of igneous, metamorphic and sedimentary rocks.

After taking this course, you should be able to:

- Explain the importance of minerals to society and to the study of the Earth
- Explain how minerals are used to decipher Earth's geologic history and evolution
- Recognize common rock-forming minerals in hand specimens
- Summarize the properties that allow a material to be classified as a mineral
- Describe the linkage between macroscopic properties and a mineral's internal structure
- Describe the basic principles that govern the structures of ionic materials.
- Explain the basic principles of crystallography and symmetry and their relationship to physical properties of minerals
- Know the structures and compositions of the most common rock forming minerals
- Predict the stability of different minerals under different conditions of pressure and temperature in terms of the competition between internal energy, entropy and volume
- Operate a petrographic microscope; recognize and measure optical properties of minerals; identify basic rock forming minerals in thin section
- Interpret X-ray diffraction (XRD) data and identify minerals on the basis of their structure
- Explain the basics of electron microprobe X-ray spectroscopic methods to determine mineral compositions

Grades
Your grade for the class will be based on:

a) Exams - two midterm exams and a comprehensive final exam (60%)
b) Weekly lab assignments & lab practical exam (20%)
c) Homework/fieldtrip assignments & quizzes (15%)
d) class participation (5%)

Assignments must be turned in on time to get full credit.
**Fieldtrip information**

Field trips are an essential part of the geologic learning process that help develop conceptual skills for solving geologic problems, and fieldtrips are therefore a required part of this class. Understanding the modes of formation of rocks & minerals and their relationship to one another in the context of landscape evolution and the extended geologic history of a region is at the core of the geological sciences. The most successful geologists are in general those with the strongest field skills, which explains the strong field emphasis of the SDSU program as well as just about every other top program across the country. The purpose of each field trip including instructional outlines will be provided to you separately prior to each trip.

Your safety and health on field trips is a primary concern. You must have proper clothing and shoes and eye protection, and provide sun protection, water and food or snacks for yourself. Additional details including necessary geology field gear will be provided separately. Emergency contact information should someone need to contact you while you are on a trip: (Department Office: (619)594-5586 or SDSU public safety: (619)594-1991)
**Lab Schedule**

Week 1  
Introduction to rock forming minerals in hand sample

Week 2  
Physical properties of minerals in hand specimen  
Hand specimen identification of common rock forming minerals

Week 3  
Hand specimen identification of common rock forming minerals  
Crystal Chemistry – bonding, coordination, structure, compositional variations

Week 4  
Crystal Chemistry – emphasis on silicates

Week 5  
Crystallography – symmetry elements

Week 6  
Crystallography – crystal systems

Week 7  
X-Ray Diffraction Techniques (XRD)

Week 8  
X-Ray Diffraction Techniques (XRD)  
Introduction to Scanning Electron Microscopy & X-Ray Fluorescence (XRF) spectra

Week 9  
The Polarizing Microscope: General feature, types, optical system, parts, precaution and adjustments, orthoscopy and conoscopy.

Week 10  

Week 11  
Mineral Preparations for Microscopic Study: Types of preparation, material used, cutting and polishing.

Week 12  
Optical Mineralogy in Ordinary light: ( 3 lectures)  
Color, Shape, Form, Cleavage, Fracture, Inclusions, Index of refraction.

Week 13  
Optical Mineralogy in Plane Polarized light: Double refraction, Polaroid and Nicol Prism, Pleochroism, Ordinary and Extraordinary rays, Isotropic and anisotropic minerals,

Week 14  
Optical Mineralogy in Crossed-polarized light: Interference of waves, Extinction, Interference colors, Anomalous interference colors, Twinning, Zoning, Exsolution, Accessory plates, elongation

Week 15  
Conoscopic Microscopy: Indicatrix, Types of interference figures, Uniaxial minerals, Biaxial minerals, Optic sign, 2-V angles, Optical orientation, dispersion of biaxial minerals.

Kimbrough GEOL 221 Fall 2010