Proposed Syllabus

GEO 595: Mineralogy for Science Teachers

Instructor:
Dr. David R. Lageson, Professor of Geology, MSU
lageson@montana.edu
Office: 108 Traphagen Hall

Master of Science in Science Education
Montana State University
P.O. Box 172805
Bozeman, MT 59717-2805
Tel: (406) 994-5679
Fax: (406) 994-5575
E-mail: msse@montana.edu
Location: 451 Reid Hall
Course credits: 1

Course goals:
“Probably the biggest problem with mineralogy is your expectation that the main thing you will learn is how to identify minerals. You probably think that mineralogy is really only useful to identify minerals and, in turn, rocks. This could not be further from the truth.” (Dyar et al., 2008, Mineralogy and Optical Mineralogy: Mineralogical Society of America, p. xii)

This course covers fundamental chemical concepts used in mineralogy, including (but not limited to):

- a) Crystallography and crystal chemistry
- b) Physical properties of minerals as related to their crystal structures and chemistry
- c) Anion classification and naming of minerals
- d) Gemstones versus everyday minerals (i.e., what makes a gemstone special?)
- e) Identification of minerals in hand specimen (lab work)
- f) Identification of minerals in rocks (lab work)
- g) Brief introduction to thin-section analysis and various analytical techniques of mineral analysis

Learning outcomes:
At the end of the course, students will be able to:

- a) Understand the broader importance of minerals to society, both historically and in the present day
- b) Understand the basic concepts of mineral chemistry (structure of atoms, elements, ions, ionic sizes and coordination number, atomic bonding, anion groups, silica-oxygen tetrahedra linking, phase rule, mineral phase diagrams, isotopes, etc.)
- c) Be able to identify 10-15 common, rock-forming minerals based on physical properties such as color, streak, luster, hardness, crystal habit, fracture and cleavage, reaction to acid, etc.
- d) Understand the basic physics of how light is used in the identification and analysis of minerals (i.e., brief introduction to the transmitted/reflected light petrographic microscope)
- e) Understand the use of minerals and isotopes in geochronology and tectonics, by tracking pressure and temperature changes of mineral phases through time and space (i.e., deformation-pressure-temp-time diagrams, or DPT-t); the tectonic evolution of the Himalaya and Karakoram Ranges over the past 50 Ma will be used as a case study

Major topics covered:

- a) Overview of minerals and their importance to society (uses and applications of minerals throughout human history)
- b) History of mineralogy as a branch of the geosciences
- c) What is a mineral?
- d) The origin of mineral-forming elements (Big Bang nucleosynthesis, stellar nucleosynthesis, supernovae explosions)
e) Crystal chemistry (structure of atoms; ions, atomic bonds, ionic sizes)
f) Crystallography (symmetry; isometric system; tetragonal system; orthorhombic system; hexagonal system; monoclinic system; triclinic system)
g) Mineral classification schemes
h) Introduction to the rock-forming silicate minerals (silica polymorphs, feldspars, layered silicates amphiboles, pyroxenes, etc.)
i) Introduction to non-silicate minerals
j) The “Big Ten” minerals (quartz, orthoclase, albite, anorthite, muscovite, biotitie, amphibole, pyroxene, olivine, calcite)
k) Environments of mineral formation in the Earth’s crust
l) Hand sample identification using mineral properties (color and streak; luster; hardness; fracture and cleavage; crystal form and habit; twinning; specific gravity; reaction to acid; etc.)
m) Introduction to optical mineralogy and the use of the petrographic microscope (wave theory of light; optical classes; Snell’s Law [reflection & refraction]; hands-on introduction to the “pet-scope”)
n) Mineral evolution on Earth over the past 4.5 Ga (Hazen et al., 2008, Mineral Evolution: American Mineralogist, vol. 93, p. 1693-1720)
o) Tectonic history of the Himalaya-Karakoram Ranges as revealed by the evolution of various metamorphic and igneous mineral phases, as well as isotope geochronology

Grading:
- 20 pts ⇒ Mineral ID quiz
- 50 pts ⇒ Quiz at the end of the day over lecture material (following a study break of one hour)
- 30 pts ⇒ Written report on “your home state’s mineral, or your birth mineral, or your favorite mineral”
  - Format = PDF
  - Page minimum = 2
  - Calibri (body) 12-point font
  - 1.15 spacing
  - References cited at the end (1.0 spacing; 10-point font size)
  - Make sure the following is at the TOP of your report (on page 1):
    - Name, date, course title/number, TITLE OF YOUR PAPER
  - Email to: lageson@montana.edu
  - Due date: TBD

Grading scale:
A (94-100%); A- (90-93%); B+ (87-89%); B (84-86%); B- (80-83%); C+ (77-79%); C (74-76%); C- (70-73%); D+ (67-69%); D (64-66%); D- (60-66%); F (0-59%)
Text:

a) Rocks & Minerals (Smithsonian Handbooks), by Chris Pellant (Paperback) - tentative selection, I may change this book

b) Selected readings sent out via email prior to class – preliminary list:


Special technology requirements: None

Student conduct and academic misconduct:
Montana State University expects all students to conduct themselves as honest, responsible and law-abiding members of the academic community and to respect the rights of other students, members of the faculty and staff and the public to use, enjoy and participate in the University programs and facilities. For additional information reference see: www2.montana.edu/policy/student_conduct/student_conduct-code_2008-2009.htm

Section 420 of the Student Conduct Code describes academic misconduct as including but not limited to plagiarism, cheating, multiple submissions, or facilitating others’ misconduct. Possible sanctions for academic misconduct range from an oral reprimand to expulsion from the university.

Academic expectations:
Section 310.00 in the MSU Conduct Guidelines states that students must:

- Be prompt in attending class
- Be well prepared for class
- Submit required assignments (e.g., final mineral report) in a timely manner, as per the assigned deadline;
- Act in a respectful manner toward other students and the instructor and in a way that does not detract from the learning experience

In addition to the above items, students are expected to meet any additional course and behavioral standards as defined by the instructor.