

EARTH SCIENCE 2206A MINERAL SYSTEMS, CRYSTALLOGRAPHY, AND OPTICS Fall 2017

Instructor: Roberta Flemming: B&GS room 0172, rflemmin@uwo.ca (office hours TBA)

Teaching assistants: Mitchell Galarneau mgalarne@uwo.ca and Victoria Houde vhoude@uwo.ca

Lectures: Mondays and Wednesdays, 9:30 am to 10:20 am, PAB 34 (Physics and Astronomy Building)

Laboratory: B&GS 1069: Tuesdays 6:00-9:00 pm or Wednesdays 2:30-5:30 pm

Objectives: This course introduces students to minerals. We will examine their crystalline nature, chemical composition, physical and optical properties. Students will also develop an understanding of the connections between these phenomena. From a theoretical perspective, students will understand how the properties of minerals are a product of their crystalline nature and how mineral structures can be understood systematically. Practical laboratories will strengthen students understanding of the above concepts; students will become proficient at identifying minerals using physical and optical properties.

Corequisite: Earth Sciences 2200a or Enrolment in the Materials Science Program

		Course topics/themes - Tentative schedule	Reading in Text
Crystallography			Klein and Dutrow:
Week 1:	Sept 11, 13	Introduction, Physical properties of minerals; Point symmetry	Ch 1-2
Week 2:	Sept 18, 20	Six crystal systems: symmetry & axes; Crystal forms & Miller indices	Ch 6
Mineral Chemistry			Klein and Dutrow:
Week 3:	Sept 25, 27	Periodic table, radius ratio, coordination polyhedra, closest packing	Ch 3-4
Week 4:	Oct 2, 4	Chemical substitution, solid solution, immiscibility and ordering	Ch 3-5, 11, 12
Week 5:	Oct 9, 11	***** Thanksgiving and Fall Study Break *****	*****
Optical mineralogy			Nesse:
Week 6:	Oct 16, 18	Polarized light; optical properties of minerals	Ch 1, 3-5
Week 7:	Oct 23, 25	Uniaxial minerals (tetragonal, hexagonal), MIDTERM	Ch 6
Week 8:	Oct 30, Nov1	Biaxial minerals (orthorhombic, monoclinic, triclinic)	Ch 7
Systematic mineralogy of rock-forming minerals			Klein and Dutrow:
Week 9:	Nov 6, 8	Structural principles of silicates; Orthosilicates & Ring silicates	Ch 18
Week 10:	Nov 13, 15	Single vs double chain silicates: pyroxenes, amphiboles	Ch 18-19
Week 11:	Nov 20, 22	Sheet silicates: clays, serpentine, micas, chlorite	Ch 18-19
Week 12:	Dec 27, 29	Framework silicates: quartz, SiO ₂ polymorphs, and feldspars	Ch 18-19
Week 13:	Dec 4, 6	Non-silicate minerals: native elements, oxides, sulfides, carbonates	Ch 15-17

Laboratory topics:

Labs	Date	Crystallography/Optical Mineralogy	Quiz	Minerals
Week 1:	Sept 12	Physical Properties of Minerals	no	native elements, halides
Week 2:	Sept 19	Point symmetry operations; six crystal systems	yes	oxides
Week 3:	Sept 26	External morphology: crystal forms Miller indices	yes	sulphides
Week 4:	Oct 3	Closest packing and coordination	yes	carbonates, sulphates
Week 5:	Oct 10	***** Fall Study Break *****		
Week 6:	Oct 17	Optical microscopy - plane & cross polarized light	yes	orthosilicates
Week 7:	Oct 24	Optical microscopy – Anisotropic - uniaxial	yes	ring & chain silicates
Week 8:	Oct 31	Optical microscopy – Anisotropic – biaxial	yes	sheet silicates
Week 9:	Nov 7	Optical microscopy – Rock forming minerals I	yes	framework silicates
Week 10:	Nov 14	Optical microscopy – Rock forming minerals II	yes	
Week 11:	Nov 21	Optical microscopy – Rock forming minerals III	no	
Week 12:	Nov 28	Review session (mock final exam)		mock mineral exam
Week 13:	Dec 6*	Final lab exam*		Final mineral exam*

* **NOTE: FINAL LAB EXAM** for **ALL STUDENTS** will be on the **SAME DAY** as decided by **CLASS VOTE**. Choices are either Dec 6: 5:30-9:30 pm or Dec 7: 3:30-7:30 pm (4 hr time slot is divided into 2 groups).

Course Materials:

- *Manual of Mineral Science*, 23rd Ed. (2008), by C. Klein and B. Dutrow, Wiley. (Required)
[Or you can use previous edition: *Manual of Mineral Science*, 22nd Ed. (2002), by C. Klein, Jr, Wiley.]
- *Minerals in Thin Section*, 2nd Ed. (2003) D. Perkins and K.R. Henke, Prentice Hall. (Optional)
- *Introduction to Optical Mineralogy*, 4th Ed. (2012) by W.D. Nesse, Oxford University Press (Optional).
[Or you can use the previous edition: *Introduction to Optical Mineralogy*, 3rd Ed. (2004) by Nesse]
- Supplementary material will be given weekly, at website <https://owl.uwo.ca>

Evaluation:

Midterm class test: (50 minutes)	October 25 (in class)	20%
Lab assignments:	Weekly (9)	20 %
Lab mineral quizzes:	Weekly (8)	10 %
Lab exam: (2 hours)	Dec 6 or 7 (by class vote)	20 %
Final exam: (2 hours)	Scheduled by the Registrar	30 %

No electronic devices may be used during tests/exams. Non-programmable calculators are acceptable.

Learning Outcomes

Upon successful completion of this course the student will be able to:

1. Classify crystals into six crystal systems based on symmetry, name crystal forms, assign Miller indices.
2. Identify minerals in hand sample by their physical properties through mineral quizzes and a Lab exam.
3. Identify minerals by their optical properties, using a polarizing microscope, and recognize their formation environments (igneous or metamorphic) using mineral textures and associations.
4. Predict cation substitution in mineral structures using Pauling's first rule governing atomic coordination.
5. Relate the properties and stability of silicate minerals to the systematics of silicate crystal structures.
6. Use the chemical formula of minerals to predict their behavior and to write chemical reactions.

Note: It is Faculty of Science policy that a student who chooses to write a test or exam deems themselves fit enough to do so. Claims of medical, physical, or emotional distress after the fact will not be considered. However, if a student improves their grade in their final exam by 10% over their grade in the midterm test, the student may opt to have the final exam given full weight (50%) and the midterm grade discounted. [This does not apply if the student fails to write the midterm exam.] If a student should miss the midterm test for any reason, there will not be a makeup test. Instead the final exam will be reweighted at 50%.

Course Website:

Students should check OWL (<http://owl.uwo.ca>) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class. Students are responsible for checking OWL on a regular basis.

Ethical Conduct: Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Plagiarism: Students must write their assignments in their own words. Whenever you take an idea, or a passage from another author, you must acknowledge this both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence.

Missed Course Components:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible.

If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in WSC 140, and can be contacted at 519-661-3040 or scibmsac@uwo.ca. Their website is http://www.uwo.ca/sci/undergrad/academic_counselling/index.html

A student requiring academic accommodation due to illness must use the Student Medical Certificate (https://studentservices.uwo.ca/secure/medical_document.pdf) when visiting an off-campus medical facility. For further information, please consult the university's medical illness policy at http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam. You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Accessibility:

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x.82147 for any specific question regarding an accommodation.

Support Services:

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.

Learning-skills counsellors at the Student Development Centre (<http://www.sdc.uwo.ca>) are ready to

help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help. Additional student-run support services are offered by the USC, <http://westernusc.ca/services>

The website for Registrarial Services is <http://www.registrar.uwo.ca>

The policy on Accommodation for Students with Disabilities can be found here:
www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Academic Policies

The website for Registrarial Services is <http://www.registrar.uwo.ca>

In accordance with policy, <http://www.uwo.ca/its/identity/activatenonstudent.html> the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.