EARTH SCIENCE 2206A MINERAL SYSTEMS, CRYSTALLOGRAPHY, AND OPTICS Fall 2025

Instructor: Dr. Nigel Blamey: B&GS room 1000-D, nblamey2@uwo.ca (office hours TBA)

Teaching assistant: TBD

Students must use their Western (@uwo.ca) email addresses when contacting their instructors

Lectures: Mondays and Wednesdays, 9:30 am to 10:20 am in UCC-61

Laboratory: Wednesdays, 2:30-5:30 pm or 6:00-9:00 pm in BGS-1069

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 Planetary Science

		Course topics/themes - Tentative schedule	**Reading in Text**
Crystallography			**Klein and Dutrow:**
Week 1:	Sept 8, 10	Introduction to mineralogy, Physical properties; Point symmetry	Ch 1, 2
Week 2:	Sept 15, 17	Six crystal systems: symmetry & axes; Crystal forms & Miller indices	Ch 6
Mineral Chemistry			**Klein and Dutrow:**
Week 3:	Sept 22, 24	Periodic table, radius ratio, coordination polyhedra, closest packing	Ch 3-4
Week 4:	Sept 29, Oct 1	Chemical substitution, solid solution, exsolution, ordering	Ch 3-5, 11, 12
Optical mineralogy			**Nesse:**
Week 5:	Oct 6, 8	Properties of polarized light; Optical properties of minerals	Ch 1, 3-5
Week 6:	Oct 13, 15	Optical properties cont'd, Uniaxial minerals (tetragonal, hexagonal)	Ch 6
Week 7:	Oct 20, 22	**Midterm**, Biaxial minerals (orthorhombic, monoclinic, triclinic)	Ch 7
Systematic mineralogy of rock-forming minerals			**Klein and Dutrow:**
Week 8:	Oct 27, 29	Structural principles of silicates; Orthosilicates & Ring silicates	Ch 18
Week 9:	**Nov 3-7**	********** **Fall Reading Week** **********	
Week 10:	Nov 10, 12	Single vs double chain silicates: pyroxenes, amphiboles	Ch 18-19
Week 11:	Nov 17, 19	Sheet silicates: clays, serpentine, micas, chlorite	Ch 18-19
Week 12:	Nov 24, 26	Framework silicates: quartz, SiO_2 polymorphs, and feldspars	Ch 18-19
Week 13:	Dec 1, 3	Non-silicate minerals: native elements, oxides, sulfides, carbonates	Ch 15-17

Laboratory topics:

Labs	Date	Crystallography/Optical Mineralogy	Quiz	Minerals
Week 1:	Sept 10	Physical Properties of Minerals	no	native elements, halides
Week 2:	Sept 17	Point symmetry operations; six crystal systems	yes	oxides
Week 3:	Sept 24	External morphology: crystal forms, Miller indices	yes	sulphides
Week 4:	Oct 1	Closest packing and coordination	yes	carbonates, sulphates
Week 5:	Oct 8	Optical microscopy - plane & cross polarized light	yes	orthosilicates
Week 6:	Oct 15	Optical microscopy – Anisotropic – uniaxial	yes	ring & chain silicates
Week 7:	Oct 22	Optical microscopy – Anisotropic – biaxial	yes	sheet silicates
Week 8:	Oct 29	Optical microscopy – Mafic igneous minerals	yes	framework silicates
Week 9:	**Nov 5**	******** **Fall Reading Week** **********		
Week 10:	Nov 12	Optical microscopy – Felsic igneous minerals	yes	
Week 11:	Nov 19	Optical microscopy – Metamorphic minerals	no	
Week 12:	Nov 26	Review session (mock final exam)	mock mineral exam	
Week 13:	Dec 3	**Final lab exam**	**Final mineral exam**	

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, posted to OWL: https://westernu.brightspace.com/.

Evaluation:

Midterm class test: (50 minutes)	October 20	20 %
Lab assignments:	Weekly (8) Due the week following the lab (-10% per day penalty will apply to late labs)	20 %
Lab mineral quizzes:	Weekly (8)	10 %
Lab exam: (2 hours)	Dec 3	20 %
Final exam: (2 hours)	TBD - Scheduled by the Registrar	30 %

No electronic devices may be used during tests/exams. Non-programmable calculators are acceptable.
All **EXAMS** and **QUIZZES** in this course are **closed book**; they are **not collaborative**.

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.

Course Website:

All course material will be posted to OWL: https://westernu.brightspace.com/

Students are responsible for checking the course on OWL (https://westernu.brightspace.com/) 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.

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Policies regarding laboratory work and midterm test:

If you are unable to attend a weekly lab session or unable to write the midterm due to illness or other serious circumstances, please follow the procedures below:

For missed Labs you need to contact the professor and the Teaching Assistant to arrange accommodation. This should be done before the lab, or within 24 hours of your absence:

- You will be required to complete a missed lab on your own time, but you may hand it in up to one week late without penalty.
- Missed quizzes will receive zero (no make-ups), but you will be graded on the best 7 of 8 quizzes.

If a student has received academic accommodation for a missed midterm test, their final exam will be reweighted at 50%. *There will not be a makeup midterm test*.

Further note about midterm test: 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 qualify to have the final exam given full weight (50%) and the midterm grade discounted. (Note that this will not apply if the student fails to write the midterm exam.)

Students should also note that individual instructors are not permitted to receive medical documentation directly from a student, in support of an application for consideration on medical grounds or other reasons.

General Information About Missed Course Work: Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf

This policy does **not apply to** requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage: https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline. All Academic Consideration requests must include supporting documentation. *However,* recognizing that formal documentation may not be available in some extenuating circumstances, *the policy allows students to make **one Academic Consideration** request without supporting documentation* in this course. This will apply to **lab assignments** which will be dealt with directly by the Instructor and Teaching Assistants and the **midterm test**.

However, **the following assessments are excluded** from this, and therefore always require formal supporting documentation (as defined by policy): **Final Lab Exam** & **Final Exam** scheduled by the registrar.

When a student *mistakenly* submits their *one* allowed Academic Consideration request **without supporting documentation** for the assessments listed above, *the request cannot be recalled and reapplied*. This privilege is forfeited.

Evaluation Scheme for Missed Assessments: When a student misses the Final Exam and their Academic Consideration has been granted by Academic Advising, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

Essential Learning Requirements: Even when Academic Considerations are granted for missed coursework, the following are deemed essential to earn a passing grade: **Note** that **you must pass** both the **lecture portion** (combined mark for midterm exam and final exam) and **lab portion** (combined mark for lab assignments, mineral quizzes and final lab exam) **to pass this course**, although it is still possible to pass the course with a failing grade in one or more of these assessments. A passing grade for the course is 50% for all grade components combined. **The writing of both the final lab exam and the final lecture exam is also mandatory in order to pass the course**.

Where legitimate Academic Considerations are granted for a student, that student will not be penalized for failing to meet a specific requirement. For example, a student who misses one or more labs due to illness will be given an opportunity to complete the affected assessments after they recover. For the Final Lecture Exam specifically, it may be permissible for the opportunity to write a makeup to be granted with the next offering of the course, in which case the student will receive a grade of Incomplete (INC) until they complete their course requirements.

Accommodation and Accessibility:

Religious Accommodation:

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

Accommodation Policies:

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

Academic Policies:

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

In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf

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.

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.**

All required reports may be subject to submission for similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

In the event that we pivot to 100% online learning, tests and examinations in this course will be conducted using the remote proctoring service, such as Proctortrack. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. More information about this remote proctoring service including technical requirements, is available on Western's Remote Proctoring website at:

https://remoteproctoring.uwo.ca.

Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. Information about the technical requirements are available at the following link: https://www.proctortrack.com/tech-requirements/

Support Services:

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on add/drop courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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 Accessible Education at http://academicsupport.uwo.ca/accessible_education/index.html if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (http://learning.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 in the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

Additional student-run support services are offered by the USC, http://westernusc.ca/services.

This course is supported by the Science Student Donation Fund, which has regularly funded new mineral specimens and crystal models. If you are a B.Sc. student registered in the Faculty of Science, you pay the Science Student Donation Fee. This fee contributes to the Science Student Donation Fund, which is administered by the Science Students' Council (SSC). Grants from the Fund have allowed for the purchase of equipment integral to teaching this course. You may opt out of the Fee by the end of Sept. each academic year by completing the online form linked from the Faculty of Science's Academic Counselling site. For further information on the awarding of grants from the Fund or how these grants have benefitted undergraduate education, consult the dept. chair or email the Science Students' Council at ssc@uwo.ca.