Western Science

Department of Earth Sciences

Subject ES2206A Course Outline – Fall 2025

1. Course Information

Course Information:
Earth Science 2206A Mineral Systems, Crystallography, and Optics (Fall 2025)

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

Laboratory: Wednesdays, 2:30-5:30 pm in BGS-1069

List of Prerequisites:
Corequisite: Earth Sciences 2200A or enrolment in Planetary Science

Unless you have either the prerequisites for this course or written special permission from the Instructor to enroll in it, you may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record. This decision may not be appealed.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Nigel Blamey (Course Coordinator)	nblamey2@uwo.ca	BGS-1000D		By appointment
Kyran Punch (TA)				By appointment

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

3. Course Syllabus, Schedule, Delivery Mode

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.

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 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**	

Key Sessional Dates:

Classes begin: September 4, 2025; January 5, 2026
Fall Reading Week: November 3 – 9, 2025
Classes end: December 9, 2025; April 9, 2026
Exam period: December 11 – 22, 2025

4. Course Materials

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/.

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

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

5. Methods of 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**.

Use of Generative AI Tools
AI tools (e.g., ChatGPT, Copilot, Gemini) are **prohibited**.

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.

6. Additional Statements

6.1 Religious Accommodation

When conflicts arise with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible, but not later than two weeks prior to the writing of the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays - https://www.edi.uwo.ca

6.2 Academic 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.

6.3 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: 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 email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as "appeals")

Policy on Request for Relief from Academic Decision:
https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

6.5 Support Services
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 (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced GBSV (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. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html