

University of Alberta

EAS 224: Mineralogy I Fall 2021

Instructor: Sasha Wilson
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Office Hours: Tuesdays and Thursdays 1–2 pm in ESB 4-15, or via zoom by appointment. Assistance is also available via eClass, the EAS 224 Study Group Discord and by email.

Course Format: In-person lectures and laboratories.

Lecture and Lab Venues & Times:

Lecture: MWF 1100 – 1150 Mountain Time in ESB 2-36

Labs: ESB 3-04, MW 1400 – 1700

Lab Coordinator: Marilyn Huff (huff@ualberta.ca)

GTAs: Avni Patel (avni1@ualberta.ca) and Baolin Wang (baolin1@ualberta.ca)

COVID-19 PANDEMIC DISCLAIMER

University and public health policies and regulations are likely to change several times during the Fall 2021 term. These evolving regulations and policies take precedence over anything published in this syllabus. The instructor will notify students of any pertinent changes by email and in class, but students are ultimately responsible for keeping aware of new and evolving University regulations.

COURSE CONTENT

Course Description: An introduction to minerals, their properties, compositions and crystal structures in the context of the Earth Sciences. The course aims to teach you how these aspects of mineralogy relate to each other, as well as to provide hands-on experience in mineral identification.

Course Prerequisites: EAS 101, 105, 210 or SCI 100, or approved transfer equivalents. If you have not completed any of these options, you must complete a waiver request form and request instructor approval of this form. This form is available from a rack outside ESB 1-26 or electronically from the undergraduate administrator for EAS. Do not try to take this course without the pre- or co-requisites. By enrolling in this course, you represent that you have passed the prerequisites for it or have received an official waiver from the instructor and the Department of

Earth and Atmospheric Sciences. The Department reserves the right to remove students from courses for which they do not have the prerequisites or a waiver.

Course Objectives and Expected Learning Outcomes: This course will enable you to gain practice with concepts in crystal chemistry, crystallography, and the relationships between the atomic structures, physical and chemical properties, and behaviours of minerals in the context of understanding the Earth and other planets.

As an outcome of this course, you should (1) be able to identify a number of common rock-forming minerals based on their properties, (2) be able to describe and predict connections between the atomic structures, physical properties, and behaviours of minerals in Earth and planetary materials, (3) be able to apply structure–property–behaviour relationships of minerals to interpret and make predictions about geological processes, and (4) be able to give examples of how the chemical and structural information preserved in minerals can be used to understand Earth history.

This course extends learnings from introductory Earth science courses (EAS 100 and 105). It provides the opportunity to build the mineralogy skills needed for more advanced undergraduate study in courses such as Mineralogy II (EAS 232), Geochemistry I (EAS 320), Igneous Petrology (EAS 331), Metamorphic Petrology (EAS 332), Ore Deposits Geology (EAS 368), Planetary Geology (EAS 467) and Geochemical Processes (EAS 468).

Organization of Course: This course is divided into topics on a weekly basis. Recommendations for readings from the textbook are given for each week’s material. The textbook (Klein and Dutrow) is very detailed, the first edition having been published 173 years ago in 1848, with updates every few years; thus, some content is of more historical than practical interest. This means that not all subjects covered by the textbook will be covered during the course. As such, to help you optimize your time, a reminder will be given at the start of each lecture about which readings are most useful.

For each subject, context will be given regarding real-world applications of the material you are learning. Please don’t hesitate to ask questions about how the material and techniques you’re learning relate to Earth sciences outside the classroom!

Demonstrations, observation of mineral samples, as well as class-based exercises and discussion will be used in the Zoom lectures. Mineralogy, as a field, is currently undergoing a renaissance, which is something that comes with new insights and changes to definitions. As such, some of the material we cover in class will reflect more recent research in the discipline than what is presented in this (or any) undergraduate mineralogy text.

Commitment to Continuous Improvement: This version of EAS 224 was taught for the first time in Fall 2018. The following improvements have been made based on formal and informal student feedback throughout and following the Fall 2018, 2019 and 2020 semesters:

- More mineral samples are now used in lectures.
- Physical crystal structure models are now used more frequently in lectures when possible.
- The lectures and lab on stereographic projection were removed from the course in 2019 since this technique is no longer used in the day-to-day practice of mineralogy. This allows the lectures and labs to synchronize more effectively and provides more time to learn about the silicate minerals without adding new content.
- More real world context and applications have been added to the lectures and lab exercises.

- Free access to the CrystalMaker software suite is now provided to everyone enrolled in the class. This is academic and industry standard visualization and simulation software used by crystallographers.
- Recordings of lectures will be made via Zoom during in-person lectures. These will be posted to eClass or the University of Alberta Google Drive to support your studies. More information about recordings is provided later in the syllabus.

Please don't hesitate to make suggestions at any time to improve the learning experience for this semester and future ones.

Course Schedule & Assigned Readings:

Timing may be subject to small variations. Recommended readings come from Klein and Dutrow unless otherwise noted.

Week	Dates	Topic(s)	Readings
1	1, 3 Sept	Introduction, and course outline; What is a Mineral? How to identify a mineral (using mineral properties)	p.1–10 p. 19–36
2	8, 10 Sept	Crystal chemistry I: periodic table, electronegativity and the nature of bonding <i>No lecture Monday, 6 Sept (Labour Day)</i>	p. 37–64
3	13, 15, 17 Sept	Crystal chemistry II: Coordination of ions; Pauling's rules; representation of crystal structures; Goldschmidt's rules and solid solution; determination of mineral formulae	p. 66–83
4	20, 22, 24 Sept	Crystal chemistry III: determination of mineral formulae; Crystallography I: Intro to the symmetry elements and their combinations	p. 96–108 p. 109–120
5	27, 29 Sept 1 Oct	Crystallography II: Point Groups; Crystal systems and axes; Miller index notation for faces, forms and zones <i>No office hour Thursday, 30 September (in honour of Truth and Reconciliation)</i> Friday, 1 October: Take-home midterm exam on lecture material — provided at end of the lecture, due at 11.59 pm the same day	p.120–128 p.129–142
6	4, 6, 8 Oct	Crystallography III: Lattices; the unit cell; two- and three- dimensional order; plane groups and space groups	p. 143–168

7	13, 15 Oct	Bowen's/Goldich's reaction series; introduction to structure–property–behaviour relationships in minerals <i>No lecture Monday, 11 October (Thanksgiving)</i>	p. 434–438
8	18, 20, 22 Oct	The systematic mineralogy of silicates: Nesosilicates, Sorosilicates, Cyclosilicates	p. 438–446 (484–505)
9	25, 27, 29 Oct	Inosilicates: pyroxenes, pyroxenoids, amphiboles; Phyllosilicates: clay minerals and micas	p. 446–467 (505–533)
10	1, 3, 5 Nov	Phyllosilicates & biopyriboles; tectosilicates; the radial optical properties of some tectosilicates	p. 467–482 (534–552)
11	8–12 Nov	<i>Fall Reading Break (no classes)</i>	
12	15, 17, 19 Nov	X-ray diffraction demonstration Applying mineralogy: The (very weird) ways that crystals form and grow; nanomineralogy, biomineralization and amorphous phases	Suppl. reading
13	22, 24, 26 Nov	Applying mineralogy: Mineral evolution: the co-evolution of life and the lithosphere; Biologically controlled mineralization: a property of a living planet	Suppl. reading
14	29 Nov 1, 3 Dec	Applying mineralogy: Mineralogy in the Anthropocene and the future of mineral sciences; Exam review	Suppl. reading

Laboratory Schedule:

Lab	Dates (MW)	Topic (Online Delivery)	Minerals covered	*Quiz Topic: minerals (theory)
1	Week 3 13, 15 Sept	Descriptive Mineralogy	Native elements, sulfides	None
2	Week 4 22, 24 Sept	Packing and Co-ordination of Atoms	Oxides	Native elements, sulfides (diagnostic properties)
3	Week 5 27, 29 Sept	Mineral Chemistry	Halides and carbonates	Oxides (diagnostic properties)
4	Week 6 4, 6 Oct	Crystal Symmetry	Sulfates and Phosphates	Halides, carbonates (diagnostic properties)
**Week 7: No labs will be held on Monday, 11 October due to Thanksgiving				
5	**Week 7 11, 13 Oct	Miller Indices	Nesosilicates	Sulfates, phosphates (packing and CN)

6	Week 8 18, 20 Oct	Lattices	Sorosilicates and cyclosilicates	Nesosilicates (mineral chemistry)
7	Week 9 25, 27 Oct	Silicates I	Inosilicates	Sorosilicates, cyclosilicates (wood blocks/crystal systems, symmetry elements)
8	Week 10 1, 3 Nov	Silicates II	Phyllosilicates and Tectosilicates	Inosilicates (wood blocks/crystal system and class, Miller Indices)
<i>No labs the week of Fall Break (Week 11)</i>				
	Week 12 15, 17 Nov	25-mineral quiz and Review Session	None	Phyllosilicates, tectosilicates (wallpaper/unit cell, plane groups)
	Week 13 22, 24 Nov	LAB EXAM – <i>students to attend exams in their own section only</i>		

*All quizzes will be marked, but your lowest 2 marks will be dropped. All quizzes may cover previously learned minerals.

**Students in the Monday section to complete Lab 5 (during Week 7) on Thursday or Friday (TBD) of that week. *Please make arrangements with the lab coordinator, Marilyn Huff.*

LEARNING RESOURCES

Required Textbook and/or Other Major Course Materials:

- (1) Klein, C. and Dutrow, B. (2007) **Mineral Science, 23rd Edition.**

Please note that earlier versions of the textbook (e.g., the 22nd Edition) may be used for this course. An electronic version of the textbook can also be purchased or rented for the semester here: <https://www.wiley.com/en-ca/Manual+of+Mineral+Science%2C+23rd+Edition-p-9780470536872>.

Recommended or Optional Learning Resources:

Your class notes and supplementary materials posted on eClass will be helpful for both the lecture and laboratory portions of the course. ‘Further reading’ on new developments in the field of mineralogy may also be posted on eClass for those interested in learning more. Please note that materials indicated as ‘further reading’ will not be examined and they will be clearly marked on eClass.

Course Fees: There are no additional course fees.

Academic Success Centre:

The [Academic Success Centre](#) provides professional academic support to help students strengthen their academic skills and achieve their academic goals. Individual advising, appointments, and group workshops are available year round in the areas of Accessibility, Communication, Learning, and Writing Resources. Modest fees apply for some services.

GRADE EVALUATION

Grade Evaluation:

All laboratory assignments, quizzes and examinations in this course will be given a numerical score. A cumulative course mark will be calculated from those scores, weighted as tabulated below. A final letter grade will be assigned based upon your cumulative mark and the instructor's analysis of the cumulative mark distribution for the class. Where possible, natural breaks in the cumulative mark distribution will be used in assigning grades, but no pre-determined distribution of grades will be imposed on the class. Your grade will reflect a combination of your absolute achievement and relative standing in the class. In past years, the mean grade in this course has been in the B- to A- range. The mean grade this year will be based on the instructor's judgement of the overall calibre of performance for this class relative to past cohorts.

There is no possibility of a re-examination in this course.

ASSESSMENT(S)	WEIGHTING	DATE
<i>Laboratory assignments</i>	20%	<i>Weekly</i>
<i>Laboratory quizzes</i>	10%	<i>Weekly</i>
<i>Laboratory final exam</i>	20%	<i>Week of Nov. 22</i>
<i>Midterm exam on lecture material</i>	15%	<i>Fri, Oct. 1</i>
<i>Final exam on lecture material</i>	35%	<i>*Mon, Dec. 13, 2-5 pm</i>

*Students must verify this date on BearTracks when the Final Exam Schedule is posted.

Grades are unofficial until approved by the Department and/or Faculty offering the course.

Past or Representative Evaluative Material:

Example midterm and final exam questions will be posted on eClass to illustrate the types of questions that will be posed. The instructor will also provide detailed lists of the topics that will and will not be covered on these exams.

POLICIES FOR LATE AND MISSED WORK

Late Policies: Please contact the instructor and lab co-ordinator if you require an extension for laboratory work. Generally, a penalty of 10% per day will be applied on late laboratory assignments without a prior request (for good reason) for an extension.

Missed Term Work:

A student who cannot complete a term examination or complete a term assignment due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for an excused absence. Note: given the COVID-19 situation, even mild cold- or flu-like symptoms will justify requesting an excused absence from an in-person laboratory or lecture-based assessment or exam. To apply for an excused absence, you must contact the instructor within two working days of missing the assessment or as soon as possible. If an excused absence is granted, then due dates for missed assignments and/or midterms will be set within 1 month of their original due dates. An excused absence is a privilege and not a right. There is no guarantee that an absence will be excused. Misrepresentation of facts to gain an excused absence is a serious breach of the Code of Student Behaviour. In all cases, instructors may request adequate documentation to substantiate the reason for the absence at their discretion.

Missed Assessments Where the Cause is Religious Belief:

For an excused absence where the cause is religious belief, a student must contact the instructor(s) within two weeks of the start of Fall or Winter classes to request accommodation for the term (including the final exam, where relevant). Instructors may request adequate documentation to substantiate the student request. Students who failed at the start of term to request exam accommodations for religious beliefs are expected to follow the deferred final examination process outlined below.

Deferred Final Examination:

A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons (e.g. symptoms consistent with a COVID-19 infection at the time of an in-person exam) can apply for a deferred final examination. Such an application must be made to the student's Faculty office within two working days of the missed examination and must be supported by appropriate documentation or a Statutory Declaration (available online at calendar.ualberta.ca/content.php?catoid=34&navoid=10107#attendance). Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. Misrepresentation of facts to gain a deferred examination is a serious breach of the Code of Student Behaviour.

Any deferred examinations will be held from 2–5 pm on Monday, 24 January 2022.

REMOTE DELIVERY CONSIDERATIONS

Recordings of Synchronous Activities:

- Please note that class times for this course will be recorded. Recordings of this course will be used for the purposes of asynchronous learning and as a study aid. Recordings will be

disclosed to other students enrolled in this section of the class, with teaching assistants, and the laboratory instructor.

- If students are joining by zoom, they have the right to not participate in the recording and are advised to turn off their cameras and audio prior to recording; they can still participate through text-based chat. It is recommended that students remove all identifiable and personal belongings from the space in which they will be participating.
- Recordings will be made available until Dec. 30, 2021 and accessible by either Zoom cloud storage on eClass or through the University of Alberta Google Drive. Please direct any questions about this collection to the instructor of this course.

Student Resources for Remote Learning:

Some aspects of this course may be delivered online. Online learning may be new to you. Check out tips for success and find out more about online learning on the [Campus Life](#) page, and specifically on the [Academic Skills Online & Remote Delivery Resources](#) page.

STUDENT RESPONSIBILITIES

Safe and Healthy Learning Environment:

Section 30.3.4(6) c of the Code of Student Behaviour states: “No Student shall create a condition which endangers or potentially endangers or threatens the health, safety or wellbeing of other persons.” Accordingly, students with symptoms of *any* respiratory illness should avoid attending in-person activities for this class while they feel ill.

Academic Integrity:

"The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.governance.ualberta.ca) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University."

All forms of academic dishonesty are unacceptable at the University. Any suspected offence will be reported to the Faculty of Science. Anyone who is found in violation of the Code of Student Behaviour may receive a sanction. Typical sanctions include conduct probation, a mark reduction

or a mark of 0 on an assessment, a grade reduction or a grade of F in a course, a remark on the transcript, and a recommendation for suspension or expulsion.

Students are expected to familiarize themselves with the [Academic Integrity](#) resources (covering the topics of cheating, collaboration, plagiarism, and substantial assistance) on the website of the Office of the Dean of Students.

Appropriate Collaboration:

Exam Conduct (for the in-person final exam and laboratory quizzes only):

- Your student photo I.D. is required at exams to verify your identity.
- Students will not be allowed to begin an examination after it has been in progress for 30 minutes. Students must remain in the exam room until at least 30 minutes has elapsed.
- All cell phones must be turned off and stored in your bags.

Students Eligible for Accessibility-Related Accommodations:

Eligible students have both rights and responsibilities with regard to accessibility-related accommodations. Consequently, scheduling exam accommodations in accordance with [Accessibility Resources](#) deadlines and procedures is essential. Please note adherence to procedures and deadlines is required for U of A to provide accommodations. Contact [Accessibility Resources](#) for further information.

Recording and/or Distribution of Course Materials:

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Learning and Working Environment:

The Faculty of Science is committed to ensuring that all students, faculty and staff are able to work and study in an environment that is safe and free from discrimination and harassment. It does not tolerate behaviour that undermines that environment.

If you are experiencing harassment, discrimination, fraud, theft or any other issue and would like to get confidential advice, please contact any of these campus services:

- [Office of Safe Disclosure & Human Rights](#): *A safe, neutral and confidential space to disclose concerns about how the University of Alberta policies, procedures or ethical standards are being applied. They provide strategic advice and referral on matters such*

as discrimination, harassment, duty to accommodate and wrong-doings. Disclosures can be made in person or online using the [Online Reporting Tool](#).

- [University of Alberta Protective Services](#): Peace officers dedicated to ensuring the safety and security of U of A campuses and community. Staff or students can contact UAPS to make a report if they feel unsafe, threatened, or targeted on campus or by another member of the university community.
- [Office of the Student Ombuds](#): A confidential and free service that strives to ensure that university processes related to students operate as fairly as possible. They offer information, advice, and support to students, faculty, and staff as they deal with academic, discipline, interpersonal, and financial issues related to student programs.
- [Office of the Dean of Students](#): They can assist students in navigating services to ensure they receive appropriate and timely resources. For students who are unsure of the support they may need, are concerned about how to access services on campus, or feel like they may need interim support while you wait to access a service, the Dean of Students office is here to help.

Feeling Stressed, Anxious, or Upset?

It's normal for us to have different mental health experiences throughout the year, particularly as we adjust to returning to campus as we move through a pandemic. Know that there are people who want help. You can reach out to your friends and access a variety of supports available on and off campus at the [Need Help Now](#) webpage or by calling the 24-hour Distress Line: 780-482-4357 (HELP).

Policy about course outlines can be found in [Course Requirements, Evaluations Procedures and Grading](#) of the University Calendar.

Land Acknowledgement:

The University of Alberta respectfully acknowledges that we are situated on Treaty 6 territory, traditional lands of First Nations and Métis people.

To learn more about the significance of this land acknowledgement, please read [this](#) useful article and associated links to more information.

Disclaimer:

Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this syllabus.

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Dr. S. A Wilson, Department of Earth & Atmospheric Sciences, Faculty of Science, University of Alberta (2021).