

# Earth Sciences 3369B Geomicrobiology Course Outline: Winter 2025



# **1. Course Information**

**Description:** This course will explore how microbes impact geochemical cycles in ancient and contemporary environments. Emphasis will be on microbe-mineral interactions and environmental biogeochemistry. Topics will include an introduction to microbes, microbial metabolism, microbial zonation, microbial weathering, analytical techniques, biomineralization, mineral exploration, bioremediation, precious metals, carbon sequestration, special topics, other environments. Practicums will help develop laboratory skills in fundamental bacteriology, aseptic techniques, and experimental design while seminars will explore how we can collectively solve complex, real-world challenges.

Lecture: Tuesday/Thursday, 9:30–10:30 AM, BGS Building, Room 1053 Seminar/Practicum: Friday, 2:30–5:30 PM, Seminar (BGSB 1053) and Practicum (TBA)

**Prerequisites:** A 1.0 credit from *any* of the following courses: Biology 1001A, Biology 1002B, Chemistry 1301A/B, Chemistry 1302A/B, Integrated Science 1001X.

**Notice:** Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) to enroll in it, you may be removed from this course, and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees if you are dropped from a course for failing to have the necessary prerequisites.

# 2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Jeremiah (Jer) Shuster	jshuste3@uwo.ca	BGS 0164	X86989	(see below)

Please use your Western (@uwo.ca) email addresses when emailing me. I have an open-door policy. You are welcome to stop by my office or make an (in-person or online) appointment to guarantee a time. Please feel free to ask questions, voice concerns, or discuss any suggestions.

# **3.** Course Syllabus, Schedule, Delivery Mode

Course Topics and Approximate Timeline of Course Topics		
Date	Format	Topics and Themes
Week 1: Mici	robes	
Jan 7	Lecture 1	Earth as a microbial habitat
Jan 9	Lecture 2	Bacterial design
Jan 10	Seminar 1	Owl trainings
Week 2: Mete	abolism	
Jan 14	Lecture 3	Assimilatory processes
Jan 16	Lecture 4	Energetic processes
Jan 17	Lab 1	Aseptic techniques, bacterial culturing, MPN
Week 3: Zone	ation	
Jan 21	Lecture 5	Microenvironments, biofilms, microbial mats
Jan 23	Lecture 6	Bacteria in natural systems
Jan 24	Lab 2	Fe-Ox bacteria, Gram staining, light microscopy
Week 4: Wea	thering	
Jan 28	Lecture 7	Minerals weathering
Jan 30	Lecture 8	Microbial corrosion
Jan 31	Seminar 2	Case study: Iron tubercles
Week 5: Ana	<u>lytical Techniqu</u>	les
Feb 4	Lecture 9	SEM sample preparation
Feb 6	Lecture 10	SEM analysis and data interpretation
Feb 7	Presentations	Analytical techniques
Week 6: Spec	cial Topics	
Feb 11	Lecture 11	Cell surface reactivity
Feb 13	Lecture 12	Biomineralization
Feb 14	Midterm	Option 1: To be voted
		Reading Week
Week 7: Mice	robe-mineral in	teractions
Feb 25	Lecture 13	Indigenous geomicrobiology
Feb 27	Lecture 14	Canga and BIFs
Feb 28	Midterm	Option 2: To be voted
Week 8: Reso	purces and Bior	emediation
Mar 4	Lecture 15	Metal sulphide deposits and supergene weathering
Mar 6	Lecture 16	Acid mine drainage
Mar 7	Seminar 3	Case study: Acid mine drainage
Week 9: Gold	d geomicrobiolo	<u>gy</u>
Mar 11	Lecture 17	Gold geomicrobiology
Mar 13	Lecture 18	Placer gold grains
Mar 14	Lab 3	TBA
Week 10: Oth	her "Extreme" l	Environments
Mar 18	Lecture 19	Deep-sea geomicrobiology
Mar 20	Lecture 20	Astrobiology
Mar 21		(No Lab or Seminar)
Week 11: En	vironmental Co	ntaminants
Mar 25	Lecture 21	Heavy metal contamination

Mar 27	Lecture 22	Hydrocarbon degrading bacteria
Mar 28	Seminar 4	Case study: Oil spills
Week 12: Carbon Sequestration		
Apr 1	Lecture 23	Microbialites and beach rock
Apr 3	Lecture 24	Mine tailings
Apr 4	Seminar 5	Case study: Greenhouse gas emissions

#### **Learning Outcomes:**

On successful completion of this course, you will be able to:

Knowledge:

- describe fundamental concepts, principles, and terminology used in geomicrobiology.
- apply principles to new or complex contexts in Earth and environmental science.

Skills:

- effectively collaborate as part of a team to address real-world challenges.
- apply effective oral, written, and visual communication skills to present coherent ideas and concepts to a public or specialist audience.

#### **Key Sessional Dates:**

Classes begin: 6 January 2025 Reading week: 15–23 February 2025 Classes end: 4 April 2025 Study days: 5–6 April 2025 Exam period: 7–30 April 2025 (Note, 18 and 20 April 2025 are holidays and Western will be closed)

#### **Contingency plan:**

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will **not** change. Any assessments affected will be conducted online as determined by the course instructor.

### 4. Course Materials

There are **no** textbooks required for this course. Supplemental information from publications will be provided or referenced to in class and posted on OWL (http://owl.uwo.ca). Recommended reading from textbooks (listed below) will also be referenced in lecture. Textbooks are available through Western Libraries (https://www.lib.uwo.ca).

- Konhauser, K. (2007) Introduction to Geomicrobiology. Blackwell Publishing.
- Madigan, M.T., & Martinko, J.M. (2006). *Brock Biology of Microorganisms* (11<sup>th</sup> ed.). Pearson Prentice Hall.

All course material will be posted to OWL (http://owl.uwo.ca) and students are responsible for checking the site 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 unless the instructor directly emails the class.

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

#### **Technical Requirements:**

Technical requirements for this course include laboratory coat, safety goggles, notebook, hair tie (if applicable). Access to a computer with internet is recommended for accessing course material; likewise, application software is recommended for preparing assignments/presentations.

### **5. Methods of Evaluation**

Understanding material and performance will be evaluated through:

Assignments (5)	25%
Labs (2)	20%
<b>Presentation</b> (1)	15%
Midterm Test (1)	20%
Final Exam (1)	20%
Note: Mark distribut	tion is based on recommendations from the 2023-2024 class.

#### **Assignments:**

For each seminar, a small assignment will be described in class. Assignments must be completed to prepare yourself for active participate in meaningful discussions during seminar. All assignments will be submitted to me by *midnight* on the due date. Details on assignment format and assessment will be provided and explained in class.

#### Labs:

All lab reports must be written as a scientific article in the Geomicrobiology Journal format. An example will be provided with details regarding format and assessment during class and practicum. Electronic copies of reports will be submitted to me within the due date window.

#### **Presentation:**

A 15-minute presentation (i.e., 12 min talk + 3 min questions) on commonly used techniques in geomicrobiology research will be shared with the class. Details regarding presentation format and assessment will be made available during class. Suggested resources are listed below.

- Kenney, J.P., Veeramani, H., & Alessi, D.S. (Eds.). (2019) *Analytical Geomicrobiology: A Handbook of Instrumental Techniques*. Cambridge University Press.
- MyScope (https://myscope.training).

Assigned	Due	Topics
Jan 7	Jan 16*	Seminar 1: Owl trainings
Jan 7	Feb 7*	Presentations: Analytical technique presentation
Jan 17	Feb 14-16	Lab 1: Aseptic techniques, bacterial culturing, MPN
Jan 24	Apr 4-6	Lab 2: Fe-Ox bacteria, Gram staining, light microscopy
Jan 28	Jan 30*	Seminar 2: Case study – Iron tubercles
Mar 4	Mar 6*	Seminar 3: Case study – Acid mine drainage
Mar 25	Mar 27*	Seminar 4: Case study – Oil spills
Apr 1	Apr 3*	Seminar 5: Case study – Greenhouse gas emissions

\* Hard deadline (before midnight)

#### Late Submissions (Assignments, Practicum Reports, or Presentations):

If you know that that you will miss any submission deadline, *email me as soon as possible* to discuss a reasonable solution. Any assignment or practicum report submitted after the deadline window, without notifying me, will incur a -10% penalty per day.

#### Notes on Collaboration (Assignments, Practicums Reports):

I fully support collaborations, especially for practicums. Although it is encouraged to work together, *all written assignments and reports must be written in your own words*. If two or more assignments appear identical, then the mark will equally divided.

#### Midterm Test:

The midterm test will cover all material from classes, seminars, and practicums delivered from January 7 to February 7, inclusively. The test will be written and will take approximately 2 hours to complete. The make up exam will take place on an agreed date between February 10–13.

Date	Location	Duration
TBA	BGS 1053	3 hours

#### Final Exam:

The final exam is cumulative and will cover all material from classes, seminars, and practicums presented from January 7 to April 4. A greater emphasis, however, will be on material presented after Spring Break. The exam will be written and will take approximately 3 hours to complete.

Date	Location	Duration
TBA	TBA	3 hours

#### Notes:

If you know that you will need to be absent from class, seminar, or practicums *email me as soon as possible* so that we can find you the most appropriate accommodation. If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

#### Absences from Seminar, Practicums, and Presentations:

Assignments for seminar could be reweighed. For practicums, data can be shared between laboratory partners so that a report can still be generated despite missing the practicum. If a report cannot be submitted, then the practicums could be reweighed.

#### Absences from the Midterm Test or Final Examination

If you miss the midterm, a make-up midterm will be finalized as needed. If you miss the final exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

## 6. Additional Statements

#### **Religious Accommodation**

When conflicts 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 or 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: <u>https://www.edi.uwo.ca</u>.

#### **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 Registrar Services is https://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 their official university address is attended to in a timely manner.

Electronic devices, except for basic calculators, will not be permitted on tests and exams.

**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:

https://www.uwo.ca/univsec/pdf/academic\_policies/appeals/scholastic\_discipline\_undergrad.pdf.

**WARNING:** All course assignments and practicum reports MUST be written in your own words. You may NOT submit an assignment or report produced by generative AI. The assessed work of this course are only meaningful if you are the one preparing these submissions. You may use generative AI to edit or provide feedback on your work; however, your submitted work must be YOUR ideas communicated in Your own words. You must also follow the generative AI policies specified by the university.

# 7. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping 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 <a href="http://academicsupport.uwo.ca/accessible\_education/index.html">http://academicsupport.uwo.ca/accessible\_education/index.html</a> if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (https://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 throughout 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, https://westernusc.ca/services/.