湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Environmental Microbiology
Course Code	ENVR 3403
Semester	Spring 2026
Course Length	8 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite	BIOL 1103 Principles of Biology ENVR 2253 Environmental Studies
Antirequisite	ENVR 3401 Environmental Microbiology (4 Weeks)

Course Description:

This course examines the functional role of microorganisms in natural and engineered environments. We explore the evolutionary history of microbial life, from the origins of prebiotic chemistry to the development of complex metabolic pathways. Students will analyze how microbes drive global biogeochemical cycles, influence mineral-water interactions, and provide solutions for contemporary environmental challenges such as contamination, waste management, infrastructure decay, and resource recovery.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical Thinking Skills** – Students will engage in analytical thinking, demonstrating the ability to critically evaluate, synthesize, and apply knowledge to complex problems, and construct well-reasoned solutions and arguments.
- **Independent Research and Inquiry** – Students will conduct independent research, utilizing academic resources to explore relevant topics, formulating research questions, analyzing data, and presenting findings in a coherent, scholarly manner.
- **Problem-Solving and Application** – Students will apply theoretical concepts and methodologies learned in the course to real-world problems, demonstrating the ability to develop practical solutions informed by academic inquiry.
- **Global and Cultural Awareness** – Students will gain awareness of the global and cultural contexts relevant to the course, appreciating diverse perspectives and considering the implications of their studies in a broader, international context.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Explain how microbial metabolisms drive elemental cycling and energy flow in diverse environments;
- Evaluate how physical and chemical variables in the environment dictate microbial community structure and growth patterns;
- Map the movement of electrons through various organic and inorganic substrates to understand nutrient cycling and metal mobility;
- Design microbial-based solutions for industrial challenges such as wastewater treatment and metal remediation;
- Develop a conceptual model of a specific problem in environmental microbiology and use the model to identify causes, major players and their relationships to identify ways to solve the problem;
- Communicate scientific information and argue specific problems using scientific evidence to support their position to an audience of peers.

Textbooks/Supplies/Materials/Equipment/ Technology or Technical Requirements:

Primary Textbook: *Environmental Microbiology, 3rd Edition.* Pepper, Gerba, & Gentry (Academic Press).

Secondary Reference: *Brock Biology of Microorganisms, 16th Edition.* Madigan et al. (Pearson).

Course Requirements:

Practical Synthesis Reports (10%)

Throughout the semester, students complete several assigned short synthesis reports based on case studies or data interpretation exercises provided in class. These reports require students to apply mathematical models of microbial growth or redox chemistry to real-world datasets, ensuring they can translate theory into practical environmental management solutions.

Midterm Exams (30%, 15% each)

Two non-cumulative midterm examinations assess students' understanding of environmental microbiology concepts and their application to environmental systems. The exams emphasize microbial metabolism, biogeochemical cycling, redox processes, and microbe-environment interactions, with questions focused on conceptual reasoning and interpretation of environmental scenarios. The first midterm covers foundational principles, while the second emphasizes applied topics in natural and engineered environments.

Final Exam (30%)

A cumulative examination that tests the student's ability to apply course concepts to new, hypothetical environmental scenarios.

Research-Based Group Project (30%)

Students will work in small teams (3-4 students) to examine a series of environmental microbiology case studies drawn from natural and engineered systems (e.g., contaminant degradation, metal cycling, wastewater treatment, eutrophication, or

infrastructure-related microbiology). All teams will engage with the same set of case studies over the term, with responsibility for leading discussion or responding to specific questions assigned by the instructor.
The project culminates in an in-class presentation that evaluates microbial mechanisms, environmental significance, and practical implications. After the group presentation, individual students may be called upon to respond to specific questions, interpret data, or defend the team's reasoning. Students may also contribute by expanding on or critically evaluating responses provided by others during discussion. In addition, following each case study, teams will submit short written summaries (2-3 paragraphs per guiding question, maximum 300 words per question) synthesizing the discussion and addressing any aspects not fully resolved in class.

Assessments: Activity	**Percent Contribution**
Practical Synthesis Reports	10%
Midterm Exams (2)	30%, 15% each
Final Exam	30%
Research-Based Group Project	30%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	**Percentage of available points**
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

ENVR 3403 Schedule		
Lecture	Topic	Primary Readings
L1	Perspectives on Environmental Microbiology	Ch. 1
L2	Early Earth Chemistry & Origins of Life	Ch. 3
L3	The RNA World & Early Bioenergetics	Ch. 3
L4	Evolution of the First Cellular Entities	Ch. 3
L5	Metabolic Innovation: Oxygenic Photosynthesis	Ch. 14
L6	Rise of the Eukaryotic Cell: Endosymbiosis	Ch. 4
L7	Principles of Microbial Bioaugmentation	Ch. 18
L8	The Great Plate Anomaly & Molecular Tools	Ch. 9
L9	Life in Aggregates: Biofilm Dynamics	Ch. 21

L10	**Midterm Exam 1**	/
L11	Microbial Mats & Stratified Communities	Ch. 6
L12	Energetics: Redox Couples & Free Energy	Ch. 12
L13	Carbon Mineralization: Aerobic Pathways	Ch. 16
L14	Deep Earth & Anaerobic Respiration Case Study: Microbial Catalysts for Bioenergy	Ch. 16
L15	Metals in the Environment: Cycling & Toxicity Case Study: Microbial Adaptive Strategies and Resistance	Ch. 19
L16	Microbe-Mineral Interactions	Ch. 15
L17	Carbonatogenesis & Biomineralization Case Study: Microbial Transformation of Environmental Pollutants	Ch. 15
L18	**Miderm Exam 2**	/
L19	Biodeterioration of Infrastructure	Ch. 26
L20	Sulfur Dynamics & Corrosion Prevention	Ch. 17
L21	Microbiology of Wastewater Treatment Case Study: Biogeography and Survival in Extreme Niches	Ch. 25
L22	Advanced Biological Nutrient Removal Case Study: Optimizing Microbial Consortia for Waste Stream Processing	Ch. 25
L23	Eutrophication: Impacts and Management Case Study: Oceanic Microbiota and Global Biogeochemical Fluxes	Ch. 23
L24	Group Presentations: Part I	/
L25	Group Presentations: Part II	/
/	**Final Exam**	Above all

Accommodation Statement:

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention, as he/she is not legally permitted to inquire. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or outside the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations
All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates
All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work
The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities
Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.