



School of Molecular & Cellular Biology

MCB 424, Spring 2025

Microbial Biochemistry, 3 Credit Hours

Instructor

William Metcalf

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B415 CLSL

Office Hours: Mondays 4:00 - 5:00 PM, or by appointment.

Class Meeting Schedule

M, W, F 10:00 – 10:50 PM; 384 Armory

Course Overview and Description

The course examines the biochemical and physiological adaptations that allow microbes to compete and succeed in diverse environments. Emphasis is placed on the role of metabolism in the living organism and on the specific evolutionary advantages conferred by different metabolic strategies.

Course Prerequisites, Requirements met (general education, major, minor)

MCB 250 and MCB 354 or MCB 450, or consent of instructor.

Student Learning Outcomes

At the end of the course, through assignments, discussions, activities and assessments, students will be able to:

- Understand the chemical logic of microbial metabolism
- Understand how microbes conserve energy in oxic and anoxic environments
- Understand how microbial metabolism influences adaptation to specific environments
- Apply knowledge of metabolism and biochemistry to predict new metabolic pathways

Course Text/Materials Information

Suggested Text:

The physiology and biochemistry of prokaryotes, by David White, Oxford University Press

Other useful texts:

Biology of the Prokaryotes, edited by Joseph W. Lengeler, Gerhart Drews and Hans Schlegel, 1999, Blackwell Science

Bacterial Metabolism, by Gerhard Gottschalk, 1985, Springer-Verlag

Assigned Reading: Periodic reading will be assigned as the course progresses. These will be from a variety of sources, including the recommended text cited above. Whenever possible I will have links for these readings on the course web site.

Course Website

<http://www.life.illinois.edu/mcb/424>

The web page contains lecture slides, problem sets and problem set answers.

Important: the lecture slides are NOT meant as a substitute for class notes. If you rely on these as your sole source of class material, you are unlikely to do well on the exams.

Grading Information and Breakdown

Option I: An initial grade based on 400 total points will be assigned after the third exam. If the student is satisfied with this grade, then the Final Exam is not required.

3 exams	= 300 points
6 problem sets	= 60 points
10 muddiest points	= 10 points
1 quiz	= 30 points
Total	400 points

Option II: If the student is not satisfied with the initial grade, the final exam may be taken. In this case, the grade will be based on 600 total points. The percentage score required to achieve each grade will be identical to that used for Option I. You **cannot** lower the initial grade by taking the final.

3 exams	= 300 points
6 problem sets	= 60 points
10 muddiest points	= 10 points
1 quiz	= 30 points
Final exam	= 200 points
Total	600 points

Problem Sets: Six problem sets will be given over the semester, two for each third of the course. Each will be worth 10 points. Grading will be based on whether an effort was made to solve the problems, not on whether the right answer was obtained. Partially complete homework will receive partial credit. ***Problem sets will be due at midnight on the dates indicated below.*** They can be turned in during class, or in my mailbox in B103, CLSL, or via email. **If submitted by email, your answers must be compiled into a single PDF document. "Cut and paste" answers from other sources will not receive credit.** Answers will be posted online after the due date. Fully completed, late homework will be accepted prior to the last day of class, but will only be worth 5 points each. (Print-outs and copy-paste of posted answers will NOT be accepted for late credit.) No partial credit will be given for late homework.

February 7	Problem set #1
February 19	Problem set #2
March 12	Problem set #3
March 31	Problem set #4
April 16	Problem set #5
May 2	Problem set #6

This is a tentative schedule and may change depending on the pace of lectures.

Muddiest Point: Students often feel that certain topics covered in class are not well explained or confusing. When this occurs, please write a short email (1-2 sentences) asking that this be explained again. **Send these to me (metcalf@illinois.edu) with the subject heading “Muddiest point”.** Each Monday at the beginning of class the most commonly asked question(s) will be discussed. To encourage participation in this feedback exercise, these will be worth 1 point each, up to a maximum of 10 points. You can submit as many questions as you like, but you will receive credit for a maximum of one point per week (*i.e.* you can’t submit ten questions in the last week of class to improve your grade).

Quiz: One take-home quiz covering material you should have learned previously in prerequisite courses will be given on January 26, in class. ***The answers are available online prior to the quiz.***

Exams: All exams will be taken during class on the dates indicated below. Questions will be in essay/problem solving format, similar to the questions in the problem sets. Makeup Exams will ***not*** be given, if you miss an exam you must take the final, which will then count the same as a regular exam. Grading option II is not available if you miss a test.

February 21	Exam #1
April 2	Exam #2
May 5	Exam #3

This is a tentative schedule and may change depending on the pace of lectures.

Optional Final Exam: Friday May 15, 1:30-4:30, 384 Armory

Tentative Course Calendar

Day	Date	Time	Lecture #	Topic	Assignments
Wednesday	1/22/25	10:00 AM	1	Class policies/Introduction to Microbial Diversity	
Friday	1/24/25	10:00 AM	2	Introduction to Microbial Diversity	
Monday	1/27/25	10:00 AM	3	Phylogeny/Classification of Prokaryotes	
Wednesday	1/29/25	10:00 AM	4	Phylogeny/Classification of Prokaryotes	
Friday	1/31/25	10:00 AM	5	Basic Microbial Physiology/Glycolysis	Quiz (in class)
Monday	2/3/25	10:00 AM	6	Basic Microbial Physiology/Glycolysis	
Wednesday	2/5/25	10:00 AM	7	Thermodynamics and Glycolysis	
Thursday	2/6/24	5:00 PM		Problem Set 1 help session	
Friday	2/7/25	10:00 AM	8	Pyruvate Oxidation and TCA Cycle	Problem set #1 due
Monday	2/10/25	10:00 AM	9	Electron Transport	
Wednesday	2/12/25	10:00 AM	10	Electron Transport	
Friday	2/14/25	10:00 AM	11	Energetics of Redox Reactions/ATPase	
Monday	2/17/25	10:00 AM	12	Biosynthesis and Metabolic Diversity	
Tuesday	2/18/24	5:00 PM		Problem Set 2 help session	
Wednesday	2/19/25	10:00 AM	13	Biosynthesis and Metabolic Diversity	Problem set #2 due
Thursday	2/20/24	5:00 PM		Exam 1 Help Session	
Friday	2/21/25	10:00 AM		Exam #1 (in class)	Exam #1 (in class)
Monday	2/24/25	10:00 AM	14	Anaplerotic Reactions	
Wednesday	2/26/25	10:00 AM	15	Anaplerotic Reactions/Catabolism of Polymers	
Friday	2/28/25	10:00 AM	16	Catabolism of Polymers	
Monday	3/3/25	10:00 AM	17	Hydrocarbons and the Anaerobic World	
Wednesday	3/5/25	10:00 AM	18	Hydrocarbons and the Anaerobic World	
Friday	3/7/25	10:00 AM	19	Fermentation I	
Monday	3/10/25	10:00 AM	20	Fermentation I	
Tuesday	3/11/24	5:00 PM		Problem Set 3 help session	
Wednesday	3/12/25	10:00 AM	21	Fermentation II	Problem set #3 due
Friday	3/14/25	10:00 AM	22	Fermentation II	
Monday	3/17/25	10:00 AM		No Class, Spring Break	
Wednesday	3/19/25	10:00 AM		No Class, Spring Break	
Friday	3/21/25	10:00 AM		No Class, Spring Break	
Monday	3/24/25	10:00 AM	23	Fermentation III	
Wednesday	3/26/25	10:00 AM	24	Decarboxylation/Anaerobic respiration: denitrification	
Thursday	3/27/24	5:00 PM		Problem Set 4 help session	
Friday	3/28/25	10:00 AM	25	Anaerobic respiration: denitrification	
Monday	3/31/25	10:00 AM	26	Anaerobic respiration: metals	Problem set #4 due
Tuesday	4/1/24	5:00 PM		Exam 2 Help Session	
Wednesday	4/2/25	10:00 AM		Exam #2 (in class)	Exam #2 (in class)
Friday	4/4/25	10:00 AM	27	Anaerobic respiration: metals	
Monday	4/7/25	10:00 AM	28	Anaerobic respiration: sulfur	
Wednesday	4/9/25	10:00 AM	29	Anaerobic respiration: sulfur/Acetogenesis	
Friday	4/11/25	10:00 AM	30	Acetogenesis	
Monday	4/14/25	10:00 AM	31	Acetogenesis/Methanogenesis	
Tuesday	4/15/24	5:00 PM		Problem Set 5 help session	
Wednesday	4/16/25	10:00 AM	32	Methanogenesis/Syntrophy	Problem set #5 due
Friday	4/18/25	10:00 AM	33	Syntrophy/Anaerobic Ecosystems	
Monday	4/21/25	10:00 AM	34	Aerobic Methanotrophs/Methylotrophs	
Wednesday	4/23/25	10:00 AM	35	Chemolithotrophic Growth	
Friday	4/25/25	10:00 AM	36	Chemolithotrophic Growth	
Monday	4/28/25	10:00 AM	37	Photosynthesis I	
Wednesday	4/30/25	10:00 AM	38	Photosynthesis I/II	
Thursday	5/1/24	5:00 PM		Problem Set 6/Exam 3 help session	
Friday	5/2/25	10:00 AM	39	Photosynthesis II	Problem set #6 due
Monday	5/5/25	10:00 AM		Exam #3 (in class)	Exam #3 (in class)
Wednesday	5/7/25	10:00 AM		Grades/in class time for ICES forms	
Thursday	5/15/25	1:30-4:30		Optional Final Exam	

MCB Curriculum Policies

For non-academic campus assistance and support:

- See Office of Diversity, Equity and Access (ODEA) information at the end of this document.

Student Advocacy Resources:

- For student-centered advocacy programs and services visit: mcb.illinois.edu/undergrad/advising/resources.

Contacting MCB Course Personnel:

- MCB course personnel are more than happy to assist students.
- Emails to instructors, TAs, or course coordinators will only be answered if they come from an @illinois.edu account. We will only use this account in order to protect your educational information and profile. As a student, please remember that when you email a staff member, it is important to include all pertinent information so that we can assist you in the most efficient and effective manner possible. This information includes:
 - The course rubric in the subject line
 - Your full first and last name
 - Your NetID (the first part of your illinois.edu email account)
 - Your UIN (9 digit number that can be found on your ICard)
 - The course that you are concerned about (the course personnel often work with multiple courses)
 - Your section letter/number
 - The previous email "thread" or previous communicated information pertinent to the situation
- Your cooperation will help us respond much more quickly to your concerns.

Policies:

- Unfamiliarity with policies is not a defense for not knowing what they cover.

Adding the Course after the Semester Starts:

- We understand that the University has an add deadline 10 days into the semester, but the University lets individual courses and/or programs determine their policies for late adds. We feel that students who choose to add a course late do so at their own discretion with knowledge that there may be points lost in the process.

Religious Observances and Practices:

- Students are required to submit the Request for Accommodation for Religious Observances Form (which can be found at www.odos.illinois.edu/.../Religious_Observance_Accommodation_Request_Form.docx) to their instructors and the Office of the Dean of Students requesting accommodation by the end of the second week of the course. Requests that are not submitted within this time frame may not be granted. Information about accommodations can be found in the Student Code: <http://studentcode.illinois.edu/>.

DRES Accommodations:

- We are committed to providing a learning environment where our students can succeed. If you require special accommodations, please contact us and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak Street, Champaign, call 217.333.4603, or email disability@illinois.edu. We will try to meet all accommodations once the process has started. Please note that accommodations are not retroactive to the beginning of the semester, but begin the day you contact your professor, instructor or coordinator with a current letter of accommodation from DRES.
- If a student believes that they need DRES accommodations, they should contact DRES at disability@illinois.edu.

Class Absences:

- Regular class attendance is expected of all students at the University. (http://odos.illinois.edu/studentAssistance/absence/revised_code.asp)
- If you find yourself ill, you must submit confirmation of a visit with a medical practitioner within 24 hours of your absence. The confirmation cannot be provided by a relative, even if the relative is a practitioner.
- The Office of the Dean of Students will only provide informative letters to instructors for protracted illness of 3 or more days, certain emergencies and to be present during the serious illness of immediate family members (parents, legal guardian, spouse/partner, siblings, children, or grandparents). These letters do not excuse you from class but merely provide information for the instructor to consider with regard to excusing the absence and permitting make-up work. Students must request absence letters from the Office of the Dean of Students after the student has returned to class but not more than 10 business days after the last date of absence.
- Absences that may be excused without a letter include circumstances beyond the student's control such as medical treatment, surgery related to prolonged illness or injury, pregnancy, legal matters, citizenship or naturalization processes, or acts of nature which cause destruction to a primary residence or disrupt air travel. All will require documentation.
- Absences that may also be excused without a letter include a conference or job, graduate or professional school interviews, though a best effort should be made to schedule these events to minimize class attendance disruption. All will require documentation.
- Absences planned for the items listed in previous bullet point must be communicated to your instructor or course coordinator at least two weeks in advance of the absence. Failure to do so may result in the loss of opportunity to reschedule the missed class period and the portion of the grade associated with this class period.
- Absences that will not be excused include family events such as reunions or weddings, or presence during serious illness of extended family members (aunt, uncle, niece, nephew, or cousin).
- Unplanned absences may result in the loss of opportunity to reschedule the missed class period and, therefore, the portion of the grade associated with this class period.
- Absences will be handled according to individual course policy.

Final Exam Conflict:

- Conflict final exams may only be granted for any one of the following situations:
 - Students with three final exams scheduled within a 24 hour period as defined in Section 82.A.4). Final Examinations of the *Code of Policies and Regulations*

Applying to All Students which can be found at:

www.illinois.edu/admin/manual/code/

- Students who have two final exams scheduled at the same time. Final conflict exam requests should be made to the course with larger enrollment. Course personnel can assist with information to determine which course this would be.
- Students who have a verified personal problem, and who have received written permission to take a conflict final exam from a dean in their college.
- Students who have DRES academic accommodations.
- Students that find themselves in any of the above situations should complete the online Conflict Final Exam Request Form which can be found on the course website. This request must be made by 5:00 pm on the last day of class in order for the request to be granted. Any requests made after this time may not be granted. If a conflict final exam is granted, it may be scheduled at any time during the final examination period and is at the discretion of the instructor or course coordinator.

Academic Integrity:

- The Code of Policies and Regulations Applying to All Students will be applied in all instances of academic misconduct committed by students. This applies to all exams, presentations, assignments and materials distributed or used in this course. You can review these policies at the following website:
<http://admin.illinois.edu/policy/code/index.html> and specifically here:
<http://studentcode.illinois.edu/article1/part4/1-401/>
- Science cannot exist without honesty. The faculty and staff in MCB require students, as scientists-in-the-making, to hold the highest standards of scientific and academic conduct. Any form of cheating on any graded work in courses is unacceptable.
- We require that all graded work be entirely your own, and that anything you write using the words of other writers be correctly attributed. Some specific points follow.
- On exams, the answers that your turn in for grading must be your own, formulated during the exam from your own understanding of the material and without any supporting information, be it written, verbal or electronic. Copying the work of another student, or allowing another to copy your work, or copying work from any other source, is unacceptable. Since we cannot always monitor you as you complete your work, we must rely upon appearance of your work from which to judge. If the work you submit resembles that of another student or another source too closely, we may conclude that it was not your original work. Always make a conscious effort to complete your work on your own and to protect it from the view of others, in order to ensure that it will be seen as your own. Failure to adhere to these standards for any portion of an exam may result in a grade of zero for the entire exam or quiz for all persons involved.
- Texting, or the use of a cell phone or any other device for any purpose, during a quiz or exam is prohibited. Doing so may earn you a zero or a more extreme penalty on the quiz or exam at the discretion of the instructor.
- Use of any social or electronic media to share information, request information or make confidential information public is prohibited. Any use of this type may earn you a zero on the exam or a more extreme penalty at the discretion of the instructor.
- On written or electronic assignments, the answers that you turn in for grading must be written in your own words, formulated from your own understanding of the material. While you may be working with other students in the course, you must formulate and submit your own answers. Copying or paraphrasing the work of another student, or allowing another to copy or paraphrase your work, is unacceptable. Since we cannot monitor you as you complete your work, we have only the appearance of your work

from which to judge. If the work you submit resembles that of another student too closely, we may conclude that it was not your original work. Always make a conscious effort to complete your work on your own and to protect it from the view of others, in order to ensure that it will be seen as your own. You must also make a conscious effort to protect your passwords and accounts. Failure to adhere to these standards may result in a grade of zero for the entire assignment for all persons involved.

- On written or electronic assignments, if you use a statement taken directly from any book or other publication, including the course textbook, you must provide a citation. That is, you must put the text in quotes and put the author of the publication in parentheses after the quotation. Failure to do so will result in zero credit for that answer. Further, using only the words of another author as your entire answer or as the majority of your answer to any question is never sufficient to earn credit. If the majority of your work has been taken directly from a publication, you are likely to receive no credit for the work, since you would not be demonstrating knowledge beyond the ability to copy. Even if you quote another, your answer must be substantially your own words, drawn from your own understanding of the material.

Electronic Media/Device Use:

- Use of any social or electronic media to share course information, request course information or make confidential course information public is prohibited. Any use of this type may earn you a zero on an assignment or exam or a more extreme penalty at the discretion of the instructor.
- Any violation of the social media policy **on your account** may result in a zero on an assignment or exam or a more extreme penalty at the discretion of the instructor.
- Any social media sites created in relation to MCB courses must grant access to course personnel upon request. Failure to provide access will result in a failing grade in the course for the group/site's administrator(s).
- No electronic devices, including smart watches, are allowed at exams.

Course Material:

- Students are welcome and encouraged to make audio recordings of course lectures.
- The material recorded is intellectual and copyrighted property of the University of Illinois Board of Trustees and may be made for personal use only.
- Video recordings of any kind are strictly prohibited.
- Posting of audio recordings or transcriptions on social or electronic media platforms is strictly prohibited.
- Posting or redistributing of course material in any format is strictly prohibited.

University Information of Student Safety - Active Threats:

- **General Emergency Response Recommendations** ([Emergency Response Guide](#)):
- Security Threat. The Department of Homeland Security and the University of Illinois at Urbana-Champaign Office of Campus Emergency Planning recommend the following three responses to any emergency on campus: **RUN > HIDE > FIGHT**
- **Only follow these actions if safe to do so.** When in doubt, follow your instincts - you are your best advocate!
- **RUN** – Action taken to leave an area for personal safety.
 - Take the time to learn the different ways to leave your building **before** there is an emergency.

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- Evacuations are mandatory for fire alarms and when directed by authorities! No exceptions!
 - Evacuate immediately. Pull manual fire alarm to prompt a response for others to evacuate.
 - Take critical personal items only (keys, purse, and outerwear) and close doors behind you.
 - Assist those who need help, but carefully consider whether you may put yourself at risk.
 - Look for **Exit** signs indicating potential egress/escape routes.
 - If you are not able to evacuate, go to an Area of Rescue Assistance, as indicated on the front page of this plan.
 - Evacuate to Evacuation Assembly Area, as indicated on front page of this plan.
 - Remain at Evacuation Assembly Area until additional instructions are given.
 - Alert authorities to those who may need assistance.
 - Do not re-enter building until informed by emergency response personnel that it is safe to return.
 - Active Threat: IF it is safe to do so, run out of the building. Get as far away as possible. Do NOT go to the Evacuation Assembly Area.
- **HIDE** – Action taken to seek immediate shelter indoors when emergency conditions do not warrant or allow evacuation.
 - Severe Weather:
 - If you are outside, proceed to the nearest protective building.
 - If sheltering-in-place due to severe weather, proceed to the identified Storm Refuge Area or to the lowest, most interior area of the building away from windows or hazardous equipment or materials.
 - Active Threat:
 - Lock or barricade your area.
 - Get to a place where the threat cannot see you.
 - Place cell phones on silent.
 - Do not make any noise.
 - Do not come out until you receive an Illini-Alert advising you it is safe.
 - **FIGHT** – Action taken as a last resort to increase your odds of survival.
 - Active Threat: If you cannot run away safely or hide, be prepared to fight with anything available to increase your odds for survival.

Student Resources/Where to go for Help:

We Care at Illinois

- For sexual misconduct support, response and prevention visit: wecare.illinois.edu

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: http://oior.illinois.edu/sites/prod/files/SexualMisconduct_ResourceGuide.pdf

Safety and Emergency

University Police Department, Emergency, 9-911; Non-emergency, 217-333-8911

University Fire Department Emergency, 9-911

Crisis Line, 217-359-4141

Emergency Dean, 300 Turner Student Services Bldg., 610 E. John St., 217-333-0050
Counseling Center, 110 Student Services Bldg., 610 E. John St., 217-333-3704
McKinley Health Center, General Information, 217-333-2701
McKinley Mental Health Center, 1109 S. Lincoln, 217-333-2705
Dean of Students, 300 Turner Students Services Bldg, 610 E. John St., 217-333-0050
Local Sexual Assault Center, RACES, 217-384-4444
Women's Resources Center, 703 South Wright Street, 2nd Floor, 217-333-3137
Rape Crisis 24-hour Hotline, 217-384-4444
Suicide & Psychological Emergency, Suicide Prevention Team, 217-333-3704
SafeRides (free nighttime campus ride program), 217-265-RIDE (265-7433)
SafeWalks (free walking escort service by Student Patrol), 217-333-1216

Student Services and Advocacy

Office of the Dean of Students, 300 Student Services Bldg., 610 E. John St., 217-333-0050

Classroom Support, Teaching Skills, and Instructional Strategies

Center for Innovation in Teaching & Learning, 249 Armory Building, 217-333-1462

Counseling Services

Counseling Center, 110 Student Services Bldg., 610 E. John St., 217-333-3704
McKinley Mental Health Center, 1109 S. Lincoln Ave., 217-333-2701
Psychological Services Center, 3rd Floor, 505 E. Green St., 217-333-0041

Disability Services

Disability Resources and Educational Services (DRES), 1207 S. Oak St., 217-333-1970

Lesbian, Gay, Bisexual, Transgender Resource Center

LGTB Resource Center, 323 Illini Union, 1401 W. Green St., 217-244-8863

Veterans Services

Veteran Student Support Services, Office of the Dean of Students, 610 E. John St., 217-333-0050
Center for Wounded Veterans in Higher Education, 908 W. Nevada St., 217-300-3515

General Study Skills Assistance

Office of Minority Student Affairs, 130 Student Services Bldg., 610 E. John St, 217-333-0054
Office of Minority Student Affairs Tutoring Services, 701 S. Gregory Dr., Suite 1, 217-333-7547
Writer's Workshop, 251 Undergraduate Library, 1402 W. Gregory Dr., 217-333-8796
**Additional academic assistance may be available through individual departments

Health Resources

Health Education, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-2701
Alcohol & Other Drug Office, 2nd Floor Counseling Center, 610 E. John St., 217-333-7557
Sexual Health Educator, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-2714
Dial-A-Nurse, McKinley Health Center (24-hour), 1109 S. Lincoln Ave., 217-333-2700
Health Resource Center, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-6000
Health Resource Center, Room 40 Illini Union, 1401 W. Green St., 217-244-5994
McKinley Health Center, General Information, 1109 S. Lincoln Ave., 217-333-2701

Sexual Harassment/Assault & Acts of Intolerance/Hate Crimes

Office of the Dean of Students, 300 Students Services Bldg., 610 E. John St., 217-333-0050

The Office of Diversity, Equity and Access (ODEA):

- For non-academic support visit: diversity.illinois.edu

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- Discrimination & Harassment Prevention
 - Title IX
 - Accessibility & Accommodations
 - Inclusive Illinois