Term Information

Effective Term	Autumn 2024

General Information

Course Bulletin Listing/Subject Area	Microbiology
Fiscal Unit/Academic Org	Microbiology - D0350
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	4541
Course Title	Introduction to Industrial Microbiology and Bioprocessing Laboratory
Transcript Abbreviation	Industry Micro Lab
Course Description	Discovery-based lab course to introduce students to industrial microbiology. Students will use fermentation processes and biological engineering of microorganisms for the production of value-added molecules. Students will gain operational knowledge of bioreactors and of molecular biology and microbiology techniques relevant to industrial microbiology.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory
Grade Roster Component	Laboratory
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: MICRBIO 4100 or 4000.01/.02; or permission of instructor
Exclusions	
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0502
Subsidy Level	Baccalaureate Course
Intended Rank	Sophomore, Junior, Senior

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- • Demonstrate ability to formulate hypotheses and design experiments based on the scientific method.
- • Analyze and interpret results from a variety of microbiological methods.
- • Communicate and collaborate with others.

Content Topic List

- • Microbiology lab and safety
- • Microbial culturing and gene expression regulation
- • Bioreactor operation and fermentation parameters
- • Design of promoters for regulating production of value-added molecules
- • Purification of desired molecules

Sought Concurrence

Yes

Attachments

- Industrial Microbiology Syllabus_AU24.pdf: Syllabus

  (Syllabus. Owner: Ruiz,Natividad)
- Mapping2LG_4145.pdf: Mapping of Course Learning Objectives to PLG

  (Other Supporting Documentation. Owner: Ruiz,Natividad)
- M4145_Cover letter.pdf: Cover letter

  (Cover Letter. Owner: Ruiz,Natividad)
- Ohio_State_Course_Review_Concurrence_Form.pdf: Concurrence request

  (Concurrence. Owner: Ruiz,Natividad)

Comments

- I requested concurrence but after 2 weeks, I did not receive a response (see cover letter). *(by Ruiz,Natividad on 02/02/2024 08:44 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Ruiz,Natividad	02/02/2024 08:45 AM	Submitted for Approval
Approved	Ruiz,Natividad	02/02/2024 08:45 AM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	02/08/2024 03:50 PM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Neff,Jennifer Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	02/08/2024 03:50 PM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

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College of Arts and Sciences

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February 2, 2024

Dear Colleagues,

We propose a new laboratory course, **MICRBIOL 4145: Introduction to Industrial Microbiology and Bioprocessing Laboratory**. This 3.0-credit microbiology elective laboratory course was developed to provide hands-on training to support a rising demand of expertise in industrial microbiology. This laboratory course will give upper-level undergraduate students with a microbiology background the opportunity to further develop skills in fermentation, bioprocessing, and small-scale bioreactor usage while working in a collaborative environment. Students will learn to use microbial gene expression systems and fermentation to produce value-added molecules such as plasmids, components of sunblock, sunless spray tan, and/or biodegradable plastics. Students will also gain critical operational knowledge of bioreactors, which are not widely accessible due to the cost of this equipment. The laboratory course will build on foundational concepts currently taught in courses offered by the Department of Microbiology and expand our curriculum by allowing students to focus on industrial microbiology practices that are becoming highly desired in the STEM workforce and research groups. Indeed, Central Ohio is becoming a nationally recognized biotechnology center where academic (OSU, Carmenton), medical (Wexner, Nationwide Children's Hospital) and governmental (Battelle, Wright-Patterson Air Force Base) institutions, as well as private companies (e. g. Forge, Sarepta, Amgen, Andelyn, and brewing industry) will be looking to hire well-trained personnel with industrial microbiology expertise.

We are particularly excited about this course because A) it adds an elective laboratory course to our program, one that can be taken by majors and non-majors; B) it strengthens our ability to train students on topics and techniques relevant to industrial microbiology; and C) we expect it might complement courses already existing in Food, Agricultural, and Biological Engineering (FABENG 3500: Biological Engineering; FABENG 4500: Advanced Biological Engineering; FABENG 5520: Phytotechnology and Phytoremediation) and Chemical and Biomolecular Engineering (CBE 3631 & 3632: Chemical and Biomolecular Engineering Unit Operations Laboratory I & II; CBE 5766: Biotechnology and Bioprocess Engineering).

I have attached a syllabus and a list of the course learning objectives mapped to the Microbiology BS Program Learning Goals.

I requested concurrence from Food, Agricultural, and Biological Engineering and Chemical Biomolecular Engineering by emailing the respective chairs, Professors Scott Shearer and Umit Ozkan, on 1/17/2024. I provided them with the proposed course syllabus for MICRBIOL 4145 and the attached Ohio State Department Course Review Concurrence Form. Having received no response after two weeks, I am moving forward with this request.

Thank you for your consideration.

Natividad Ruiz

Professor of Microbiology
Vice Chair for Teaching & Undergraduate Affairs

MICROBIOLOGY 4145
Introduction to Industrial Microbiology and Bioprocessing Laboratory Syllabus
The Ohio State University | AU2024 | 3 credit hours

Course Instructors
Steven Carlson, PhD
Office: 374 Biological Sciences Building
Email: carlson.271@osu.edu
Office Hours: TBD; By appt (in-person or Zoom).

Teaching Assistants: See Carmen for updated list**.**

Lab (class) meetings: In-person; Day 1, 3hr 15min | Day 2, 2hr 5min

Lab (class) location: Biological Sciences Building 332

Suggested Reference Text (not required)

- Industrial Microbiology: An Introduction. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. John Wiley & Sons, May 22, 2013 - 304 pages: ISBN 978-0632053070
- Additional reference text will be provided by the instructor and posted to Carmen

Lab Manual (no purchase required)

- There is no required lab manual to purchase. Weekly protocols will be provided digitally via Carmen for use as a digital file or for printing.

COURSE DESCRIPTION

MICRBIO 4145 is an introduction to industrial microbiology specifically focusing on fermentation processes and biological engineering of microorganisms for the production of value-added molecules. This lab course is discovery-based and divided into two parts culminating in microbial fermentation using gene expression systems designed and tested by students to produce compounds of interest, including plasmids, components of sunblock, sunless spray tan, and/or biodegradable plastics. The first part of the course focuses on industrial fermentation principles and basic microbiological practices such as culturing, enumeration, and microscopy. Students will get weekly hands-on use of a small-scale fermentation/bioreactor system performing several microbial growth experiments. The second part, running in parallel, focuses on gene expression systems in bacteria used to regulate the production of chemicals. Students will design, create, and test a heterologous gene expression system in *E. coli* to optimize production of a compound of interest using molecular cloning techniques. Ultimately, students will use these discovered expression capabilities to produce and quantify target products via the bioreactor system. Students will work in teams throughout the course as well as report their findings to the entire class via small presentations. Current good manufacturing and documentation practices will be introduced. By the end, students will become proficient using the bioreactor systems and performing molecular genetics techniques including DNA isolation, PCR amplification, cloning, and microbial transformation. The course potentially includes presentations by industry guest speakers.

Prerequisites: MICRBIO 4100 or MICRBIO 4000.01/.02 or permission from instructor

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LEARNING OBJECTIVES

(adapted, in part, from the American Society for Microbiology)

1. Apply the process of science.
    a. Demonstrate an ability to formulate hypotheses and design experiments based on the scientific method.
    b. Analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations.
2. Communicate and collaborate with others.
    a. Effectively communicate fundamental concepts of microbiology in written and oral format.
3. Properly prepare and view specimens for examination using microscopy (bright field and phase contrast).
4. Use pure culture and aseptic technique to manipulate and transfer specific microorganisms.
5. Use appropriate methods to identify microorganisms (media-based and molecular).
6. Use appropriate microbiological and molecular lab equipment and methods including micropipettes, spectrophotometers, benchtop bioreactors, enzyme assays, cloning, and microbial culturing techniques.
7. Practice safe microbiology, using appropriate protective and emergency procedures.
8. Use practices of molecular genetics to construct DNA elements and transform microorganisms.
9. Document and report on experimental protocols, results and conclusions.
10. Understand how humans utilize and harness microorganisms and their products.
11. Understand that the growth and target compound production by any microorganism in a fermentation process depends on its metabolic characteristics.
12. Understand that the growth of microorganisms can be controlled by physical, chemical, mechanical, or biological means.
13. Understand that humans have an ethical responsibility for the safe engineering, growth, and disposal of microorganisms employed for industrial fermentation and production processes.

HOW THIS COURSE WORKS

Mode of delivery: The lab will be 100% in-person and take place in the scheduled room at the scheduled times. We will use Carmen for assignments, resource distribution, video viewing, etc. Some assignments will be available for download to complete at a later time without requiring internet access while others (such as Carmen questions, etc.) will require you to be online to complete. The majority of lab work is completed without requiring a specific time to be online or logged into Carmen.

Overview: This course utilizes microbiological, molecular biology, and industrial bioprocessing techniques. You will be trained to properly work in a BSL1 Microbiology lab while performing the multi-lab investigations. Majority of the work is performed as a team/small group as well as coordination and communication with the class as a whole. More detailed descriptions of the lab, schedule, and assignments are provided below.

Lab Attendance and participation requirements: Because the lab is in-person, <u>your attendance is required</u>. When coming to lab please arrive early or on time and be prepared.

- **Excused absences**. Legitimate excuses for missing lab (e.g. illness, COVID-19 testing, quarantine, death of family member, OSU athletic commitment, professional interview that cannot be rescheduled, religious observation) may be honored with either a make-up assignment or an opportunity to complete the work in a following lab. DOCUMENTATION IS REQUIRED.
- **Unexcused absences**: Points will be deducted (participation, missed assignment, etc) or lost (in-ability to collect data worth points, etc) for unexcused absences. If a student misses 2 labs without contacting the teaching staff, we will contact the Student Advocacy Center. Make-ups will not be accommodated for unexcused absences.
- **If excessive lab absence becomes an issue (<u>starting at more than a total of 4 excused and/or unexcused</u>) to the point of not being able to achieve the expected learning outcomes, then the student may not be able to pass the course regardless of the grade in the course**. The lab section is considered in-person so we cannot fully

supplement lab experience with online/remote assignments or alternative lab make-up times. There is limited opportunity and resources for alternative time lab make-ups… so please ask but be prepared that we may not be able to accommodate a different time.

Preparation for lab: Preparation for lab and in-lab participation/contributions are important to student learning. The most valuable contributions often begin with the words "I don't understand." To do well, complete the assignments, come to lab prepared, and participate. Above all, ask questions when you do not understand or need more information. The course is designed for you to succeed. In the event that you must miss class, you are responsible for the contents of the lab and/or discussions.

Cellphones and Laptops. Personal laptops and tablets are at risk of microbial contamination so care must be taken if they are needed during lab. Placing tablets in ziplock bags is advised as they can still be used but are protected from spills. Cellphones are permitted for the use of photographing results, but care should be taken to eliminate the risk of contamination. Do not leave cellphones sitting on the lab benches, chairs, floors, etc. The instructors reserve the right to impose a more comprehensive policy should these provide on-going distractions or problems.

Food and Beverage. No food or beverage is permitted in the lab (including water bottles). Space directly outside the lab is dedicated for food and drink to be stored during lab.

Health and safety requirements: All students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (https://safeandhealthy.osu.edu). Non-compliance will be warned first and disciplinary actions will be taken for repeated offenses.

Credit hours and work expectations: This is a **3-credit-hour lab course**. According to Ohio State policy, students should expect around 6 hours per week of time spent in the lab in addition to 3-4 hours of outside work per week (reading, assignment preparation, for example) to receive a grade of (C) average.

Short-term cancellation of in-person classes: Should in-person classes be canceled I will notify you as to which alternative methods of teaching will be offered to ensure continuity of instruction for this class. Communication will be via CarmenCanvas.

COURSE TECHNOLOGIES

COURSE TECHNOLOGY: For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

Baseline technical skills for online portions of the course

- Basic computer and web-browsing skills
- Navigating Carmen: for questions about specific functionality, see the Canvas Student Guide.
- Carmen Zoom: for any virtual office hours or optional sessions

Suggested technology skills specific to this course that can be learned during the course

- Use of benchtop bioreactor and data analysis software
- Use of Word/Excel to make figures and perform calculations

Required equipment

- Computer with high-speed internet connection
- Other: a mobile device (smartphone or tablet) or landline to use for BuckeyePass authentication

Required software

- Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Full instructions for downloading and installation can be found at go.osu.edu/office365help.

Carmen access: You will need to use BuckeyePass multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

GRADING

Grade Distribution: Final course grades will be calculated as follows:

TABLE 1.1 Point Distribution for class (Subject to Change)

Assessment	% of grade		Points
Assignments	20%	4 assignments	40
Gene Expression Design & Strain Performance Report	20%	1 report	40
Group Project/Presentation	20%	1 presentation	40
Lab Notebook (Periodic Checks)	20%	3 checks	40
Participation Points	20%	Data sharing and mini-presentations	40
Total Lab Points/%	100%		200

TABLE 2. Letter grade percentages

GRADE	A	A-	B+	B	B-	C+	C	C-	D+	D	E
%	100-92.5	92.4-89.5	89.4-86.5	86.4-82.5	82.4-79.5	79.4-76.5	76.4-72.5	72.4-69.5	69.4-66.5	66.4-59.5	59.4-0

Lab assignments (*can be completed with reference material, help from instructor/TAs/peers*): Lab assignments will consist of questions that relate to the in-person experience and background information provided. Lab assignments will be provided as Word files or pdfs for download which can be completed offline. The answers/results for the assignment can then be uploaded to Carmen for submission. Assignment format and expectations will vary depending on the exercises/experiments that are being performed. Due dates will be available on the lab schedule/Carmen and instructions for each assignment will be provided in the assignment. Assignments consist of smaller worksheets related to basic information as well as larger reports with data analysis that accompany a specific module. Details regarding the extent of collaboration or independence when completing an assignment will be provided in the assignment instructions.

Participation: Active engagement with the experiments, presentations, and in-class discussions will be noted and count toward your participation grade. Most of the work is performed with a group so be sure to equally contribute. In addition, throughout the semester we will be collecting data and sharing it amongst the class to be used for different assignments and discussions. Participation points will consist of providing data for yourself/pair/group to then be used by the class as a whole. Google docs on Carmen will be used to enter and share your data with the class. Excused absences (professional days, sickness, quarantining, death in the family, religious observations, etc.) will be taken into account when considering missing data entries.

YOU WILL NEGATIVELY AFFECT YOUR PARTICIPATION GRADE BY:

1. Not attending class (unexcused), or **arriving to class late**.
2. Using electronic devices (*e.g.* cell phone, iPad, computer, etc.) for personal, non-class related reasons.
3. Dominating class discussions, thereby restricting others' participation.
4. Making offensive, and/or disrespectful comments during discussions.

Lab Notebook: Each student will maintain a daily lab notebook where information pertaining to the lab exercises/duties for the day will be recorded. The "lab notebook" can have many forms including a physical notebook or a digital file that is maintained. Students will be required to turn in the notebook to be checked for points 2-3 times during the semester. This means a digital file has to be submitted (pictures/scans can be taken of a paper notebook). Guidelines for the formatting of the lab notebook will be provided in class.

Gene Expression Design and Strain Performance Report: Each student will write a 2-4 page summary, based on their experience constructing gene expression genetic elements, transforming microorganisms with these elements for target compound production, and testing the performance and products yields of the manipulated microorganism in a fermentation process. Individual data collected from class will be used. All outside reference material used as a source should be cited. You must also cite outside sources you use in your writing. We will provide you with detailed instructions for properly citing, but if you have questions about how to do this, please ask. Written assignments must be submitted through Carmen (not via email), and they will be scanned through Turnitin Feedback Studio to assess plagiarism and group work. Prior to document submission, we encourage you to scan your work with iThenticate in order to identify and correct any citation omissions.

Final Group Presentation: Students will work in groups to prepare a 10-20 minute in-class presentation on a current microorganism product engineering and fermentation process. A guideline and rubric will be provided.

LATE SUBMISSIONS OF ASSIGNMENTS: All students are responsible for knowing and adhering to the deadlines for course assignments.

- There will be a 10% reduction in score for each 24 hr period beyond the due date that an assignment is late.
    - Your first late submission will not receive a point deduction. The assignment must be received within 7 days of the original due date. No questions asked.
    - If you anticipate a problem in completing your work on time, you must contact the instructors. If you do not hear back, you should assume that your work is due on the original date.

LABORATORY SCHEDULE

Subject to change
Found at the end of the syllabus

INSTRUCTOR FEEDBACK AND RESPONSE TIME

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

- **Grading and feedback:** For large weekly assignments, you can generally expect feedback within **7 days**.
- **Email:** I will reply to emails generally within **48 hours.**

DISCUSSION AND COMMUNICATION GUIDELINES

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.
- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.
- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.
- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

PLAGIARISM AND ACADEMIC MISCONDUCT

It is the responsibility of the Committee on Academic Misconduct (COAM) to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed, illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Plagiarism is presenting another person's words, ideas, or sequence of arguments as your own without attribution. We will discuss what constitutes plagiarism and how to cite sources properly in this course. If at any point, however, you have a question about this, please ask. If you are tempted to plagiarize or find yourself using material from the Internet or any other source and trying to pass it off as your own, stop working on the assignment and contact the instructors. It is better to submit work late than to violate the Code of Student Conduct. It is the instructors' responsibility to report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487), and the professor and discussion section leaders take this responsibility seriously. For additional information, see the Code of Student Conduct (http://studentlife.osu.edu/csc/.) Examples of academic misconduct most applicable to this course include the following: Plagiarism; Knowingly providing or receiving information during an exam; Falsifying documentation to excuse a missed exam or class; Lying about a death in the family to excuse a missed exam or class; Asking instructors to alter your grade as a special personal favor.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely

fashion. If you are isolating while waiting for a COVID-19 test result, please let me know immediately. Those testing positive for COVID-19 should refer to the Safe and Healthy Buckeyes site for resources. Beyond five days of the required COVID-19 isolation period, I may rely on Student Life Disability Services to establish further reasonable accommodations. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

YOUR MENTAL HEALTH

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at suicidepreventionlifeline.org.

STATEMENT ON TITLE IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources. **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 (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at titleix@osu.edu.

DIVERSITY AND INCLUSION STATEMENT

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited. All violations of this policy should be reported to the OSU Bias Assessment and Response Team (BART, http://studentaffairs.osu.edu/bias/).

RELIGIOUS ACCOMMODATIONS

It is Ohio State's policy to reasonably accommodate the sincerely held religious beliefs and practices of all students. The

policy permits a student to be absent for up to three days each academic semester for reasons of faith or religious or spiritual belief. Students planning to use religious beliefs or practices accommodations for course requirements must inform the instructor in writing no later than 14 days after the course begins. The instructor is then responsible for scheduling an alternative time and date for the course requirement, which may be before or after the original time and date of the course requirement. These alternative accommodations will remain confidential. It is the student's responsibility to ensure that all course assignments are completed.

COPYRIGHT PROTECTION

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Lab Schedule (subject to change)

Wk	Topic	Date (Potential W/F schedule)	Lab	Protocols/*Activities*	Assignment (due by 11:59pm on Carmen)
1	Introduction to the Course and Basics	8/21	1	**Lab Basics** - *About the lab, industrial microbes, and "fermentation"* - *Introduction to good management and documentation practices* **Microbiology Basics** - *Aseptic technique and micropipette practice* - *E. coli culturing and plating*	
		8/23	2	**Bioprocessing** - *Overview of the bioprocessing pipeline* **Microbial Growth/Enumeration** - *E. coli microscopy and enumeration (biomass, plate counting, and spectrophotometer use)*	Carmen Safety Quiz
2	Microbial Culturing and Gene Expression Regulation	8/28	3	**Gene Expression** - *Molecular biology behind plasmid production in bacteria* - *Transformation using provided plasmid* **Microbial Growth/Enumeration** - *Inspect growth by turbidity, dry cell weight, and plate counting*	
		8/30	4	**Gene Expression** - *Regulation of chemical production in bacteria* - *Observe transformation results; Select/culture isolate for plasmid production* **Microbial Growth/Enumeration** - *Complete growth inspection*	Micropipette Use Check
3	Microbial Culturing and Gene Expression Regulation	9/4	5	**Gene Expression** - *Plasmid isolation and quantification* **Microbial Growth/Enumeration** - *Microbial growth modes and features* - *Batch culture experiment setup – respiration vs fermentation vs induction*	
		9/6	6	**Microbial Growth/Enumeration** - *Measure growth and induced chemical production from batch culture experiments*	Assignment #1
4	Bioreactor Operation and Fermentation Parameters	9/11	7	**Microbial Growth** - *Complete growth/chemical measurements* **Bioreactor** - *Bioreactor design and operation*	Lab Notebook Check + Data Submission

				- *Practice handling bioreactor and using controller*	
		9/13	8	**Microbial Growth** - *Mini-presentations on batch culture experiments* **Bioreactor** - *More practice handling bioreactor and using controller* - *Recipe design using controller software*	
5	Bioreactor Operation and Fermentation Parameters	9/18	9	**Bioreactor** - *More practice handling bioreactor and using controller* - *More recipe design using controller software* - *Pre-culture preparation (plate)* **Promoter Construction** - *Introduction to promoter design and gene expression (Central Dogma)* - *Design primers with group for promoter construction*	Bioreactor Use Check
		9/20	10	**Bioreactor** - *Media, equipment, and pre-culture (broth) preparation for Experiment #1* **Promoter Construction** - *Complete primer design and submit for ordering*	
6	Fermentation Parameter Testing and Promoter Construction	9/25	11	**Bioreactor** - *Start Bioreactor Experiment #1 – Carbon source variation* - *Pre-culture preparation (plate)* **Promoter Construction** - *Set up promoter PCR amplification reactions using ordered primers*	
		9/27	12	**Bioreactor** - *Measure growth and induced chemical production from Experiment #1* - *Prepare data slides to share* - *Media, equipment, and pre-culture (broth) preparation for Experiment #2* **Promoter Construction** - *Perform gel electrophoresis of promoter DNA sequence*	Assignment #2
7	Fermentation Parameter Testing and Promoter Construction	10/2	13	**Bioreactor** - *Start Bioreactor Experiment #2 – pH variation* - *Present Experiment #1 data slides* - *Pre-culture preparation (plate)* **Promoter Construction** - *Perform PCR cleanup of amplified promoter sequence* - *Perform digestion of instructor provided plasmid and amplified promoter DNA for cloning*	
		10/4	14	**Bioreactor** - *Measure growth and induced chemical production from Experiment #2*	

				- *Prepare data slides to share* - *Media, equipment, and pre-culture (broth) preparation for Experiment #3* **Promoter Construction** - *Perform cleanup of digestion reactions* - *Perform DNA concentration analysis; set up ligations*	
8	Fermentation Parameter Testing and Promoter Construction	10/9	15	**Bioreactor** - *Start Bioreactor Experiment #3 – DO variation* - *Present Experiment #2 data slides* - *Pre-culture preparation (plate)* **Promoter Construction** - *Transform ligated promoter and plasmid into E. coli*	
		10/11	-	*Fall Break (No Class)*	
9	Fermentation Parameter Testing and Promoter Construction	10/16	16	**Bioreactor** - *Measure growth and induced chemical production from Experiment #3* - *Prepare data slides to share* - *Pre-culture preparation (plate)* **Promoter Construction** *Pick colonies from plates of transformed E. coli with constructed plasmids for plasmid isolation and grow overnight*	Lab Notebook Check + Data Submission
		10/18	17	**Bioreactor** - *Media, equipment, and pre-culture (broth) preparation for Experiment #4* **Promoter Construction** - *Isolate plasmids, test digest, and analyze by gel electrophoresis to identify plasmids containing constructed promoter insert* - *Submit plasmids with insert for sequencing*	Assignment #3
10	Fermentation Parameter Testing and Promoter Construction	10/23	18	**Bioreactor** - *Start Bioreactor Experiment #4 – Final variable testing* - *Present Experiment #3 data slides* **Promoter Construction** - *Analyze sequences to determine correct plasmid sequence* - *Transform E. coli with correct plasmid and plate to select for transformants with plasmid*	
		10/25	19	**Bioreactor** - *Measure growth and induced chemical production from Experiment #4* - *Prepare data slides to share* - *Media, equipment preparation for Promoter Experiment #1* **Promoter Construction** - *Inoculate broth culture with transformant for stock culture and Promoter Experiment #1*	

11	Gene Expression System Testing 1/2	10/30	20	**Bioreactor** - *Start Promoter Experiment #1* - *Pre-culture preparation (plate)* - *Present Experiment #4 slides* **Promoter Construction** - *Make stock culture of transformant E. coli strain*	
		11/1	21	**Bioreactor** - *Measure growth and induced chemical production from Promoter Experiment #1* - *Prepare data slides to share* - *Media, equipment, and pre-culture (broth) preparation for Promoter Experiment #2*	
12	Gene Expression System Testing 1/2	11/6	22	**Bioreactor** - *Start Promoter Experiment #2* - *Present Promoter Experiment #1 data slides* - *Pre-culture preparation (plate)* **Downstream Processing** - *Product purification from Promoter Experiment #1*	
		11/8	23	**Bioreactor** - *Measure growth and induced chemical production from Promoter Experiment #2* - *Prepare data slides to share* - *Media, equipment, and pre-culture (broth) preparation for Alternative Microbe Experiment #1*	Assignment #4
13	Alternative Microbes	11/13	24	**Bioreactor** - *Start Alternative Microbe Experiment #1* - *Present Promoter Experiment #2 data slides* - *Pre-culture preparation (plate)* **Downstream Processing** - *Product purification from Promoter Experiment #2*	
		11/15	25	**Bioreactor** - *Measure growth and/or induced chemical production from Alternative Microbe Experiment #1* - *Prepare data slides to share* - *Final clean-up*	
14	Alternative Microbes	11/20	26	**Bioreactor** - *Present Alternative Microbe Experiment #1 data slides* **Group Project Prep** - *Work on group presentation*	Lab Notebook Check + Data Submission
		11/22	27	**Group Project Prep** - *Work on group presentation*	
15		11/27		**Thanksgiving Break (No Lab)**	

		11/29		**Thanksgiving Break (No Lab)**	
16	Group Projects	12/4	28	**Final Group Project Presentations**	Strain Performance Report (due last day of semester)

Ohio State Department Course Review Concurrence Form

The purpose of this form is to provide a simple system of obtaining departmental reactions to proposed new courses, group studies, study tours, workshop requests, and course changes. A letter may be substituted for this form.

Academic units initiating a request which requires such a reaction should complete Section A of this form and send a copy of the form, course request, and syllabus to each of the academic units that might have related interests in the course. Initiating units should allow at least two weeks for responses.

Academic units receiving this form should response to Section B and return the form to the initiating unit. Overlap of course content and other problems should be resolved by the academic units before forwarding this form and all other accompanying documentation to the Office of Academic Affairs.

A. Information from academic unit *initiating* the request:

Initiating Academic Unit: Microbiology Date: 1/17/24

Registrar's Listing: MICRBIO

Course Number: 4145 Level: U ☑ P ☐ G ☐ Credit Hours: 3

Course Title: Introduction to Industrial Microbiology and Bioprocessing Lab

Type of Request: ☑ New Course ☐ Group Studies ☐ Workshop ☐ Study Tour ☐ Course Change

Academic Unit with related interests asked to review the request (use a separate form for each unit while requesting concurrences from multiple units):

Date responses are needed:
January 31, 2024

B. Information from academic units *reviewing* the request:

☐ The academic unit ***supports*** the proposal
☐ The academic unit ***does not support*** the proposal.
Please explain:

☐ The academic unit suggests:

Signature of Department Chair Signature of Graduate Studies Chair (if applicable)

Required Prerequisites for the Major

Semester Course Number		Course Title	Semester hrs	Learning Goals 1	2	3	4	5
BIOL 1113		Biological Sciences: Energy Transfer and Development	4	B			B	
BIOL 1114		Biological Sciences: Form, Function, Diversity, and Ecology	4	B			B	
MATH Req. #1	MATH 1151	Calculus 1 (5 Hrs)	5	B				
	or							
	MATH 1156	Calculus for Biol. Sciences (5 Hrs)						
MATH Req. #2	MATH 1152	Calculus 2 (5 Hrs)	3 - 5	B				
	or							
	MATH 1157	Math. Modeling for Biol. Sciences (5 Hrs)						
	or							
	STATS 1450	Intro. to the Practice of Statistics (3 Hrs)						
	or							
	STATS 2480	Statistics for the Life Sciences (3 Hrs)						
CHEM 1210		General Chemistry 1	5	B				
CHEM 1220		General Chemistry 2	5	B				
CHEM 2510		Organic Chemistry 1	4	B	B			
CHEM 2520		Organic Chemistry 2	4	B	B			
CHEM 2540		Organic Chemistry Lab 1	2	B	B		B	
PHYS 1200		Mechanics, Thermal Physics, Waves	5	B			B	
		Total Hrs.	**41 - 43**					

Goal: B: Beginning; I, Intermediate; A, Advanced

Required Core for the Major

Semester Course Number		Course Title	Semester hrs	Learning Goals 1	2	3	4	5
MICRBIOL 4100		General Microbiology	5	I	I	I	I	I
MICRBIOL 4110		Pathogenesis and Immunobiology	3	A	A	A		
MICRBIOL 4120		Microbial Physiology and Diversity	3	A	A	A		
MICRBIOL 4130		Microbial Genetics	3	A	A	I		
MICRBIOL 4140		Molecular Microbiology Laboratory	3	I	I	I	A	A
BIOCHEM 4511		Biochemistry	4	I	A			I
		Total Hrs.	**21**					

Goal: B: Beginning;
I, Intermediate; A, Advanced

Electives: Total Required 9 hrs
Group 1: 3-9 hrs

Semester Course Number		Course Title	Semester hrs	Learning Goals 1	2	3	4	5
MICRBIOL 2000		Introduction to MicrOHbIOlogy Research	1.5				B	B
MICRBIOL 2100		Wild Yeast: Isolation to Fermentation	3		B	B	B	B
MICRBIOL 3704		HIV: From Microbiology to Macrohistory	4			I	I	I
MICRBIOL 4145		Introduction to Industrial Microbiology and Bioprocessing Laboratory	3	I	I	I	A	A
MICRBIOL 4150		Immunobiology Laboratory	3	I	I	A	A	A
MICRBIOL 4193		Individual Studies	1-3					
MICRBIOL 4194		Group Studies	1-3					
MICRBIOL 4591S		DNA Finger Printing Workshops in Columbus PS	1				A	A
MICRBIOL 4797		Study at a Foreign Institution	1-19					
MICRBIOL 4798		Study Tour Domestic	1-19					
MICRBIOL 4998		Undergrad Research in Microbiology	1-5				A	A
MICRBIOL 4998H		Honors Research	1-5				A	A
MICRBIOL 4999		Undergrad Research in Microbiology-Thesis	1-5				A	A
MICRBIOL 4999H		Honors Research-Thesis	1-5				A	A

MICRBIOL 5122		Immunology	3			A		
MICRBIOL 5129		Cellular and Molecular Biology of Pathogenic Eukaryotes	3		A	A		
MICRBIOL 5147		Eukaryotic Pathogens	3		A	A	A	
MICRBIOL 5149		Introductory Virology	3		A	A		
MICRBIOL 5150		Microbial Ecology	3	A	A	A		
MICRBIOL 5155		Environmental Microbiology	3	A	A	A		
MICRBIOL 5161		Bioinformatics and Molecular Microbiology	3	A	A	A		A
MICRBIOL 5170		Microbes and Evolution	3			A		
MICRBIOL 5270		Antibiotics and Microbial Natural Products	3		A	A	A	A
MICRBIOL 5536		Food Microbiology Lecture	3		A	I		A
MICRBIOL 5546		Food Microbiology Laboratory	3		A	I	A	A
MICRBIOL 6020*		Microbial Physiology and Biochemistry	3	A	A	A	A	
MICRBIOL 6080*		Advanced Microbial Genetics	3		A		A	
MICRBIOL 6155*		Microbial Ecology & Evolution	3			A	A	A
MICRBIOL 7010*		Cellular and Molecular Immunology	3			A	A	
MICRBIOL 7020*		Physiology Meets Pathogenesis	2	A	A	A	A	
MICRBIOL 7023*		Molecular Immunology: Lecture	3			A	A	
MICRBIOL 7050*		Fermentation Biotechnology	3	A			A	A
MICRBIOL 7060*		Advanced Topics in Molecular Microbiology	2		A		A	
MICRBIOL 7536*		Advanced Food Microbiology	3		A	I	A	A
MICRBIOL 7724*		Molecular Pathogenesis	3		A	A	A	
MICRBIOL 7889*		Host-Pathogen Interactions: Research Seminar	1			A	A	
MICRBIOL 7899*		Microbiology Colloquium	1					
MICRBIOL 8149*		Microbiome Informatics	3	A*	A*	A*		
		Total Hrs.	**3-9**					
				Goal: B: Beginning; I, Intermediate; A, Advanced				

*Indicated graduate-level course. Requires special permission to enroll.

Electives: Total Required 9 hrs
Group 2: 0-6 hrs

Learning Goals

Semester Course Number		Course Title	Semester Hrs.	1	2	3	4	5
MICRBIOL 3798.05		Impact of HIV: Tanzania (study abroad)	4			I	B	I
BIOCHEM 5621		Intro Biological Chemistry Laboratory	4	I			I	
MOLGEN 4500		General Genetics	3		I			
MOLGEN 4606		Molecular Genetics I	4		I			
MVIMG 5000		Evolution of Emerging Viruses	2			A		
PLPATH 5010		Phytobacteriology	2		I	A		
PLPATH 5020		Introduction to Plant Virology	2		I	A		
PLPATH 5040		Science of Fungi: Mycology Lecture	3	I	I	A		
ANSCI 6090*		Anaerobic Microbiology	3		A			
ENR 5263		Biology of Soil Ecosystems	3	I	A			
ENR 5266		Field Soil Investigations	3	I			A	
		Total Hrs.	**0-6**					
		Total Hrs. for the Major	**30**					

*Indicated graduate-level course. Requires special permission to enroll.

Program Learning Goals (B, beginning; I, Intermediate; A, Advanced)

1. Students acquire the ability to interrelate and apply the fundamental concepts of chemistry, physics and mathematics to the functions of living cells.

2. Students understand the chemical properties of biological molecules and how these molecules function in the molecular mechanisms underlying physiological processes in microbial cells.

3. Students understand evolutionary processes, the diversity of microorganisms, and how microorganisms impact their environment, including their roles in human health and disease.

4. Students acquire the ability to design experiments to test hypotheses, perform analyses, interpret and analyze data, and present scientific information in written and oral formats.

5. Students acquire the ability to appraise scientific data presented in the popular press for accuracy and scientific merit and understand issues and ethical conflicts associated with applications of biotechnology.

Microbiology 4145 Learning Goals (Mapped to Program Learning Goals)

1. Apply the process of science
a. Demonstrate an ability to formulate hypotheses and design experiments based on the scientific method. This objective will be achieved when students design their own gene expression system and test the performance and product yields of the manipulated microorganism in a fermentation process. (**PLG 4A)**
b. Analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations. This objective will be achieved as students review several common microbiological methods in the first week of the course such as streak plating, cell viability testing, microscopic analysis, etc. , as well as are first taught techniques relevant to bioreactors and then are asked to apply these techniques when evaluating their experiments using bioreactors for the production of products of interst.**(PLG 4A)**

2. Communicate and collaborate with others
a. Effectively communicate fundamental concepts of microbiology in written and oral format. This will be achieved through both a group presentation and a report on gene expression design and strain performance. The group presentation will be on a current engineering and fermentation process involving microorganisms.**(PLG 5A)**

3. Properly prepare and view specimens for examination using microscopy (bright field and phase contrast). This objective will be achieved in lab exercises and experiments throughout the semester. **(PLG 1I, 4I)**

4. Use pure culture and aseptic technique to manipulate and transfer specific microorganisms. This objective will be achieved in lab exercises and experiments throughout the semester. **(PLG 4I)**

5. Apply media- and molecular-based methods to identify microorganisms. This objective will be achieved in lab exercises and experiments throughout the semester.**(PLG 4I)**

6. Use appropriate microbiological and molecular lab equipment and methods including micropipettes, spectrophotometers, benchtop bioreactors, enzyme assays, cloning, and microbial culturing techniques throughout the semester. **(PLG 4A)**

7. Practice safe microbiology, using appropriate protective and emergency procedures throughout the semester.**(PLG 4A)**

8. Use practices of molecular genetics to construct DNA elements and transform microorganisms during weeks 6-11. **(PLG 4A)**

9. Document and report on experimental protocols, results and conclusions. This objective will be achieved in lab exercises and experiments performed throughout the semester as well as in the final report and presentations. **(PLG 4A)**

10. Understand how humans utilize and harness microorganisms and their products. This objective will be achieved through teaching how fermention processes can be used to produce products that are relevant to industry. **(PLG 3I)**

11. Understand that the growth and target compound production by any microorganism in a fermentation process depends on its metabolic characteristics. This objective will be achieved through the manipulation and testing of growth conditions and nutrition required microorganisms for culture maintenance, control, production of metabolites, and fermentation in the lab. **(PLG 2I)**

12. Understand that the growth of microorganisms can be controlled by physical, chemical, mechanical, or biological means. This objective will be achieved through the manipulation and testing of growth conditions (e. g. respiration vs. fermentation) and nutrition required of microorganisms for culture maintenance, control, production of metabolites, and fermentation in the lab. **(PLG 2I)**

13. Understand that humans have an ethical responsibility for the safe engineering, growth, and disposal of microorganisms employed for industrial fermentation and production processes. These concepts will be introduced to students throughout the semester when designing projects and using bioreactors. **(PLG 3I)**