Term Information

Effective Term	Autumn 2020

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	2100
Course Title	Wild Yeast: Isolation to Fermentation
Transcript Abbreviation	Wild Yeast Ferment
Course Description	An introduction to yeast biology and microbiological techniques used in fermentation. Students will isolate an unknown yeast from the environment and characterize the growth behavior of the wild strains; use molecular biology and bioinformatics to determine the yeast species they have isolated; use the wild yeast to prepare a fermentation and characterize the finished “wild" ferment.
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	Bio 1110 or 1113 AND Chem 1110 or 1210 OR permission of instructor
Exclusions	None
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0502
Subsidy Level	Baccalaureate Course
Intended Rank	Freshman, 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 an ability to formulate hypotheses and design experiments based on the scientific method and Analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations.
- Effectively communicate fundamental concepts of microbiology in written and oral format.
- Properly prepare and view specimens for examination using microscopy (bright field and phase contrast).
- Use pure culture and selective techniques to enrich for and isolate microorganisms.
- Use appropriate methods to identify microorganisms (media-based and molecular).
- Estimate the number of microorganisms in a sample (using direct count, viable plate count, and spectrophotometric methods).
- Use appropriate microbiological and molecular lab equipment and methods.
- Practice safe microbiology, using appropriate protective and emergency procedures.
- Document and report on experimental protocols, results and conclusions.
- Understand how humans utilize and harness microorganisms and their products.
- Understand that microorganisms are ubiquitous and live in diverse and dynamic ecosystems.
- Understand that the survival and growth of any microorganism in a given environment depends on its metabolic characteristics.
- Understand that the growth of microorganisms can be controlled by physical, chemical, mechanical, or biological means.
- Understand that while microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different.

Content Topic List

- Introduction to the microbiology lab and safety; Introduction to microscopy; Introduction to yeast; Maintaining lab notebook
- Comparing yeast, mold, and bacteria
- Yeast metabolism and fermentation introduction
- Diversity/ecology of yeast strains – Saccharomyces, Brettanomyces, and other wild yeast
- Enrichment, isolation and storage of wild yeast
- Yeast genetics, molecular biology, and bioinformatics
- Preparation of media and protocol design for isolated wild yeast fermentation
- Methods for controlling fermenting bacteria (friend vs foe)
- Wild yeast fermentation characterization

Sought Concurrence

Yes

Attachments

- Mapping2LG_2100.pdf: Mapping of Course Learning Objectives to PLG

  (Other Supporting Documentation. Owner: Kwiek,Jesse John)

- Microbiology2100_Coverletter_Jan2020.pdf: Cover Letter

  (Cover Letter. Owner: Kwiek,Jesse John)

- Yeast Discovery and Fermentation Syllabus_submit.pdf: Syllabus

  (Syllabus. Owner: Kwiek,Jesse John)

- Concurrence_Form_10-15-15 copy.pdf: Concurrence Request

  (Concurrence. Owner: Kwiek,Jesse John)

- Concurrence_Form_10-15-15 copy.pdf: Concurrence received

  (Concurrence. Owner: Vankeerbergen,Bernadette Chantal)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Kwiek,Jesse John	01/22/2020 02:00 PM	Submitted for Approval
Approved	Kwiek,Jesse John	01/22/2020 02:11 PM	Unit Approval
Approved	Haddad,Deborah Moore	01/24/2020 05:13 PM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Oldroyd,Shelby Quinn Vankeerbergen,Bernadette Chantal	01/24/2020 05:13 PM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

Department of Microbiology

105 Biological Sciences Building
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Columbus, OH 43210

614-292-2301 Phone

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22 January 2020

RE: New Course Proposal: Microbiology 2100

Dear Colleagues,

We propose a new laboratory course, **Microbiology 2100: Wild Yeast: Isolation to Fermentation,** a 3.0 credit microbiology elective that uses scientific discovery to introduce undergraduate students to the awesome power of yeast genetics, physiology and metabolism. In addition to the benefits realized from achievement of the academic learning goals, which are adapted from the American Society for Microbiology curriculum guidelines, we expect that this course will provide a real-world scientific experience to the students: some groups will discover new yeast that produce pleasant fermentations, while others will discover yeast that produce unpleasant fermentations. In the process of discovery, the students will identify the molecular and physiological underpinnings used by the yeast to create the various fermentation products. We are particularly excited about this class because A) it adds an additional high-impact microbiology course to our program, one that can be taken by majors and non-majors, B) the yeast that the student describe can be used as the substrate for future microbiology courses, both wet laboratory-based (e.g. M4140: Molecular Microbiology Lab, MICRO 5546/FST 5546: Food Microbiology Lab), computer(dry) laboratory-based (M5161: Bioinformatics and Genomics), and C) owing to its focus on the microbiology and metabolism of yeast, we expect this class will complement existing food fermentation classes in the Department of Food Science and Technology (e.g. FDSCTE 2410: Brewing Science, FDSCTE 5430: Food Fermentations). To facilitate your evaluation of this proposal, I have attached a syllabus and a list of the course learning objectives mapped to the Microbiology BS Program Learning Goals. Concurrence from Food Science and Technology has been requested and will be submitted when it is obtained.

I thank you for your consideration.
Regards,

Jesse J. Kwiek
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Vice Chair for Teaching & Undergraduate Affairs
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Microbiology 2100
Wild Yeast: Isolation to Fermentation

Autumn 2020

Instructors:	Steven Carlson, Ph.D. Assistant Professor Dept. of Microbiology	Jeremy McKinney, Lab Preparator Dept. of Microbiology
Office:	318 Bio. Sci.	384 Bio. Sci.
Email:	carlson.271@osu.edu	Mckinney.90@osu.edu
Phone:	614.292.3140	614.292.3277
Office hours:	By appointment	By appointment

Class meetings: Tuesday, 1:50p - 5:05p and Thursday, 1:50p - 3:55p

Class location: Bio. Sci. 316

Required Texts: Nina Parker, *Microbiology* (OpenStax CNX, 2016). ISBN 13: 9781938168147
Additional text will be provided by the instructor

Course Description: This course is an introduction to yeast biology and microbiological techniques used in fermentation. The course is discovery-based broken into two blocks culminating with testing the ethanolic fermentation capabilities of wild yeast strains collected by students during the semester. The first half of the course introduces yeast structure, growth, metabolism, genetics, isolation, and identification. During this time, students isolate an unknown yeast from the environment and perform physiological tests to characterize the growth behavior of the wild strains. Students also learn molecular genetics techniques including DNA isolation, PCR amplification, ITS sequencing and basic bioinformatic analysis to determine the yeast species they have isolated. The second half of the course is fermentation-focused introducing analysis of fermentation products, fermentation protocol design, and characterization of finished "wild" ferments generated by their yeast. The course includes presentations by brewing industry guest speakers and a tour of a local brewery.

Prerequisite: Bio 1110 or 1113 AND Chem 1110 or 1210, or permission of instructor

Learning Objectives (adapted, in part, from the American Society of Microbiology)

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 wild yeast fermentation protocol to test the ability of their wild yeast to utilize the proposed resources and conditions for fermentation to occur.
    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 are first taught several common microbiological methods in the first half of the course such as streak plating, cell viability testing, microscopic analysis, etc. and then asked to apply these techniques when evaluating the wild yeast fermentation performed by their isolated wild strain.
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 as well as a final paper. The group presentation will introduce and explain a fermentation topic related to yeast and/or bacteria while the final paper report on the isolation of their wild yeast strain and its ability to ferment.
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 in Weeks 1, 3-5, 8, 11
4. Use pure culture and selective techniques to enrich for and isolate microorganisms. This objective will be achieved in lab exercises and experiments performed in Weeks 2, 3, 4, 5, 11
5. Use appropriate methods to identify microorganisms (media-based and molecular). This objective will be achieved in lab exercises and experiments performed in Weeks 1- 7, 11
6. Estimate the number of microorganisms in a sample (using direct count, viable plate count, and spectrophotometric methods). This objective will be achieved in lab exercises and experiments performed in Weeks 2, 5, 8
7. Use appropriate microbiological and molecular lab equipment and methods. This objective will be achieved in lab exercises and experiments performed in Weeks 1-9, 11, 13, 14
8. Practice safe microbiology, using appropriate protective and emergency procedures. This objective will be achieved in lab exercises and experiments performed in Weeks 1-9, 11, 13, 14
9. Document and report on experimental protocols, results and conclusions. This objective will be achieved in lab exercises and experiments performed in Weeks 1- 14 as well as in the final report and presentations.
10. Understand how humans utilize and harness microorganisms and their products. This objective will be achieved through teaching the process of isolation of an unknown wild yeast strain and then how to properly test its ability to ferment sugars.
11. Understand that microorganisms are ubiquitous and live in diverse and dynamic ecosystems. This objective will be achieved through lessons taught concerning the ecology and diversity of yeast prior to students selecting possible sample sites from which to isolate wild yeast.
12. Understand that the survival and growth of any microorganism in a given environment depends on its metabolic characteristics. This objective will be achieved through the manipulation and testing of growth conditions and nutrition required of yeast and bacteria for culture maintenance, control, production of metabolites, and fermentation in the lab.
13. 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 and nutrition required of yeast and bacteria for culture maintenance, control, production of metabolites, and fermentation in the lab.
14. Understand that while microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally different. This objective will be achieved through comparing yeast, mold, and bacteria pertinent to lactic acid and ethanolic fermentation using a variety of techniques including microscopy, colony morphology, growth conditions/characteristics, physical/chemical control agents, and gene sequencing.

Grading: Final course grades will be calculated as follows:

Participation/contributions to in-class discussions	10%
Attendance	10%
Quizzes and Assignments	30%
Group Presentation	30%
Group Project Summary	20%

Grading Scale: 93-100 = A; 90-92 = A-; 87-89 = B+; 83-86 = B; 80-82 = B-; 77-79 = C+; 73-76 = C; 70-72 = C-; 67-69 = D+; 60-66 = D; 0-59 = F.

Course Requirements and Policies

Enrollment: All students must be officially enrolled in the course by the end of the second full week of the semester. No requests to add the course will be approved by the department chairs after that time. Enrolling officially and on time is solely the responsibility of the student.

Attendance and Participation: Students are required to attend all meetings of the course. Attendance will be taken for each lab. Unexcused absences will not be made up and all data/points for that day will be lost. Loss of attendance points will occur for each unexcused absence after the first in the following manner:

The 2nd unexcused absence: Loss of 25% of attendance points

The 3rd unexcused absence: Loss of 50% of attendance points

The 4th unexcused absence: Loss of 100% of attendance points

After the 4th unexcused absence: Student is unable to complete the course

Preparation for lab and in-lab participation and contributions are important to student learning. The highest participation grades will go to those who help build the discussions through their own contributions and their questions to peers. The most valuable contributions often begin with the words "I don't understand." To do well, complete the reading assignments, come to lab, and participate. Above all, ask questions when you do not understand or need more information. The course is designed for you to succeed.

Note that students who are not in lab are unable to participate and students with spotty or poor attendance will have lower participation grades. In the event that you must miss class, you are responsible for the contents of the lecture, lab and/or discussion. Students who must miss class for religious observances must notify the instructor of their absence in advance.

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.

Cellphones and Laptops. Personal laptops and tablets are not allowed to be used in the lab while exercises and/or experiments are being performed due to risk of microbial contamination. 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.

Research Summary: Students will write a 2-page group project summary, based on their experience isolating wild yeast, characterizing isolates, testing isolates for feasibility and potential application of the new isolate. All direct quotes and any outside material used as a source should be cited. Direct quotes must be noted with quotation marks and their 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.

Group Presentation: Students will work in groups to prepare a 10-minute presentation, which will be evaluated according to the following rubric:

	Exceeds Expectations	Meets Expectations	Approaching Expectations	Does NOT Meet Expectations
Organization	Information presented in logical, interesting sequence that audience can follow	Information presented in reasonably logical sequence that audience generally can follow	Audience has difficulty following presentation because the material is not presented logically	Audience cannot follow presentation; sequence of information is confusing or contradictory
Subject Knowledge	Presenter(s) demonstrates full knowledge of topic (more than required), shows nuance and detailed under–standing; answers questions very well	Presenter(s) at ease with topic and provides a solid basis for understanding the topic with some sophistication; solid answers to questions	Presenter(s) uncomfortable with information; presentation includes partial or incomplete information; incomplete answers to questions	Presenter(s) does not have grasp of information; knowledge superficial or lacking; unable to respond appropriately to questions
Visual Appeal/ Creativity	Slides were engaging, relevant, and always complemented spoken presentation	Slides were engaging, mostly relevant, but didn't always complement spoken presentation	Slides somewhat engaging[4] but rarely relevant or complementary to spoken presentation	Slides were not relevant to spoken presentation or difficult to understand/interpret

Late work: All students are responsible for knowing and adhering to the deadlines for course assignments. Late work will be penalized. The only exception to this will be when you have explicit, advance permission from the one of the professors. 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.

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://studentaffairs.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.

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. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

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.

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.

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.

Email: Electronic mail is a valuable tool. The instructors will, from time to time, send emails to the class. We are also happy to respond to your email messages that conform to the appropriate standards. In academic and professional settings, all emails should have a descriptive subject line ("Question about Yeast Discovery course assignment"), begin with a respectful salutation ("Dr. Carlson" or "Mr. McKinney"), and conform to standard English with proper punctuation and capitalization. For an excellent overview of how students can most effectively use email with their professors, please see "How to e-mail a professor"
http://mleddy.blogspot.com/2005/01/how-to-e-mail-professor.html

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.

Course Schedule

Wk	Date	Topic	Activities	Technique	Assignment
1	8/25/20	Introduction to the microbiology lab and safety; Introduction to microscopy; Introduction to yeast; Maintaining lab notebook	Safety discussion; Microscopy basics	Safety practices in the lab and working with microorganisms; brightfield microscopy	
	8/27/20	Comparing yeast, mold, and bacteria	Microscopy and preparing live specimens (wet mounts)	phase-contrast microscopy; micropipette usage; aseptic technique	
2	9/1/20	Yeast metabolism and fermentation introduction	Yeast cultivation (nutrition and temperature conditions)	Streak plating; micropipette usage; aseptic technique	Pre-lab quiz #1
	9/3/20	Yeast metabolism and fermentation introduction	Yeast quantification (cell counting, dilutions, viability staining)	hemacytometer; methylene blue staining; dilution plating; micropipette usage; aseptic technique	
3	9/8/20	Diversity/ecology of yeast strains – *Saccharomyces, Brettanomyces*, and other wild yeast	Yeast growth control (selective and differential media, antifungals/antibiotics)	Streak plating; selective/differential media; microscopy	Pre-lab quiz #2
	9/10/20	Diversity/ecology of yeast strains – *Saccharomyces, Brettanomyces*, and other wild yeast	Yeast growth control (Identification of different yeast strains)	Spectrophotometry; microscopy	
4	9/15/20	Enrichment of wild yeast	Enrichment of wild yeast via fermentation	Enrichment media preparation;	Pre-lab quiz #3
	9/17/20	Enrichment of wild yeast	Monitoring fermentation and plating enrichment cultures	Measuring pH, microscopy	
5	9/22/20	Isolation and storage of wild yeast	Monitoring growth of enrichments and selecting wild yeast for purification	Microscopy; selective media plating	Pre-lab quiz #4
	9/24/20	Isolation and storage of wild yeast	Stock preparation		
6	9/29/20	Yeast genetics and molecular biology	DNA isolation and PCR amplification	Chemical and physical cell lysis techniques; DNA isolation; PCR	Pre-lab quiz #5
	10/1/20	Yeast genetics and molecular biology	Gel electrophoresis, PCR cleanup, ITS sequencing	Agarose gel electrophoresis; PCR cleanup; ITS sequencing	Enrichment and isolation results report
7	10/6/20	Bioinformatics	Analyze sequences to determine species (Computer lab)	Sequence analysis; Bioinformatic analysis; BLAST search;	Pre-lab quiz #6

	10/8/20	Preparation of media for wild yeast fermentation	Small-scale wild yeast fermentation	Malting/mashing; starch conversion iodine test;	
8	10/13/20	Small-scale wild yeast fermentation	Wild yeast enumeration and fermentation traits	CO_2 measurement; pH measurement; cell viability/counts;	Sequencing results report
	10/15/20	No Class – Autumn Break			
9	10/20/20	Wild yeast fermentation products and analysis	Ethanol production; metabolite secretion		Pre-lab quiz #7
	10/22/20	Wild yeast fermentation products and analysis	Ethanol production; metabolite secretion		
10	10/27/20	Protocol design optimized for isolated wild yeast fermentation			Pre-lab quiz #8 Protocol submission
	10/29/20	Fermentation Day			
11	11/3/20	Introduction to fermenting bacteria (friend vs foe) – *Lactobacillus* and *Pediococcus*	Bacterial growth (Identification of different bacterial strains)	Microscopy; streak plating; staining	Pre-lab quiz #9
	11/5/20	Methods for controlling fermenting bacteria (friend vs foe)	Bacterial growth control (selective and differential media, antibiotics)	Microscopy; selective/differential media plating	
12	11/10/20	Brewing industry guest speakers			Pre-lab quiz #10
	11/12/20	Analyzing and evaluating ongoing fermentation process			
13	11/17/20	Wild yeast fermentation characterization	Sugar utilization, alcohol/acid/ester production, wild yeast growth behavior	Hydrometer usage; Final gravity calculations	
	11/19/20	Wild yeast fermentation characterization	Sugar utilization, alcohol/acid/ester production, wild yeast growth behavior	Hydrometer usage; Final gravity calculations	
14	11/24/20	Wild yeast fermentation characterization	Hop biology, sulfur-containing additives, and bacteriostatic effects	IBU measurement	
	11/26/20	No Class – Thanksgiving Break			
15	12/1/20	Group presentations			Group presentation
	12/3/20	Group presentations			Group presentation
16	12/8/20	Optional sensory testing of final wild yeast ferments			Group project summary

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	
PHYS 1201		E&M, Optics, Modern Physics	5	B			B	
		Total Hrs.	**46 - 48**					

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	3			I	I	I
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

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 2100 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 wild yeast fermentation protocol to test the ability of their wild yeast to utilize the proposed resources and conditions for fermentation to occur. (**PLG 4B)**

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 are first taught several common microbiological methods in the first half of the course such as streak plating, cell viability testing, microscopic analysis, etc. and then asked to apply these techniques when evaluating the wild yeast fermentation performed by their isolated wild strain.**(PLG 4B)**

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 as well as a final paper. The group presentation will introduce and explain a fermentation topic related to yeast and/or bacteria while the final paper report on the isolation of their wild yeast strain and its ability to ferment.**(PLG 5B)**

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 in Weeks 1, 3-5, 8, 11. **(PLG 4B)**

4. Use pure culture and selective techniques to enrich for and isolate microorganisms. This objective will be achieved in lab exercises and experiments performed in Weeks 2-5, 11.**(PLG 4B)**

5. Use appropriate methods to identify microorganisms (media-based and molecular). This objective will be achieved in lab exercises and experiments performed in Weeks 1- 7, 11.**(PLG 4B)**

6. Estimate the number of microorganisms in a sample (using direct count, viable plate count, and spectrophotometric methods). This objective will be achieved in lab exercises and experiments performed in Weeks 2, 5, 8.**(PLG 4B)**

7. Use appropriate microbiological and molecular lab equipment and methods. This objective will be achieved in lab exercises and experiments performed in Weeks 1-9, 11, 13, 14.**(PLG 4B)**

8. Practice safe microbiology, using appropriate protective and emergency procedures. This objective will be achieved in lab exercises and experiments performed in Weeks 1-9, 11, 13, 14.**(PLG 4B)**

9. Document and report on experimental protocols, results and conclusions. This objective will be achieved in lab exercises and experiments performed in Weeks 1- 14 as well as in the final report and presentations. **(PLG 4B)**

10. Understand how humans utilize and harness microorganisms and their products. This objective will be achieved through teaching the process of isolation of an unknown wild yeast strain and then how to properly test its ability to ferment sugars. **(PLG 3B)**

11. Understand that microorganisms are ubiquitous and live in diverse and dynamic ecosystems. This objective will be achieved through lessons taught concerning the ecology and diversity of yeast prior to students selecting possible sample sites from which to isolate wild yeast. . **(PLG 3B)**

12. Understand that the survival and growth of any microorganism in a given environment depends on its metabolic characteristics. This objective will be achieved through the manipulation and testing of growth conditions and nutrition required of yeast and bacteria for culture maintenance, control, production of metabolites, and fermentation in the lab. **(PLG 2B)**

13. 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 and nutrition required of yeast and bacteria for culture maintenance, control, production of metabolites, and fermentation in the lab. **(PLG 2B)**

14. Understand that while microscopic eukaryotes (for example, fungi, protozoa and algae) carry out some of the same processes as bacteria, many of the cellular properties are fundamentally