Microbiology (BioSc3313)

Instructor
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Office Hours – MW 11:00 – 11:45 (202 Schrenk)
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Course Webpage - All material in this syllabus plus supplemental lecture material can be found on the course Blackboard site. Older materials can be found at the following URL: http://www.mst.edu/~microbio/Bio221.html

Textbook. (The following book is required for all students)

Biology of Microorganisms 14th Edition. By Madigan, Martinko, Bender, Buckley and Stahl
A copy of this book will be available in the library. Older versions are acceptable but the content may be organized differently than described in this syllabus.

Course Learning Goals.

Please see the next to last page of this syllabus for the curriculum guidelines from the American Society for Microbiology. The concepts and statements presented in these guidelines will form the foundation of this course. Successful students will demonstrate a working knowledge of these concepts and their application. Specific learning objectives for each section of the course can be found on Blackboard.

Examinations and Grading: The course will be worth a total of 1200 points.

Exams (600 pts). There will be 4 exams of equal value (150 pts each). (See the schedule for exam dates). The fourth exam will be during the final exam period and will not be comprehensive. There will be no make-up exams during the semester. If you miss an exam for a legitimate reason it may be possible to take a make-up exam during the final exam period. The make-up exam will be a comprehensive exam.

ATCC Project (100 pts). During the semester, each student will be given homework assignments to find information on microorganisms. This will focus on microorganism available through the American Type Culture Collection (ATCC). Each student will use various resources to collect information on their assigned organism. Throughout the semester, students may be randomly asked to provide information on their organism - so be prepared.

My’ Crobe Project (120 pts). Students will choose an unusual organism and write a report on that organism. After the second exam, you will choose your organism and write a report on the information you have learned about the organism. Your report is to be posted on the course Blackboard site for other students to read and offer comments. Throughout the semester, the instructor may select microbes during class. Be prepared to BRIEFLY say something about your organism such as why you chose it or what made it interesting to you.
Quizzes (100 pts). There will be frequent quizzes during the semester. Quizzes will be made available at various times and remain open until the corresponding exam. Not all material on quizzes will be covered in class meetings but all relevant information should be available in the textbook. The quizzes are an opportunity to apply the material presented in class meetings and to become familiar with the appropriate microbiology terminology being covered. Use these quizzes as a study guide along with the other material being covered during class. The best 10 scores will count towards your final grade.

Clickers (100 pts). Each student must have a personal response device (clicker or appropriate smart phone app) for answering daily questions during class time. Clicker questions will be based on material from the previous class meeting, questions posed by the instructor during class and assigned readings.

Participation (100 pts). Students must participate in discussions throughout the semester either online or in class. Participation can include commenting on posts by others, asking questions, or posting news articles. Everyone is required to post at least one microbiology related news story from the popular press and comment on the article to promote discussion. These should not be from science news services such as “Science News” or “Scientific American”. You should discuss the accuracy of the information in the article.

Additional Homework assignments (80 points). There will be several homework assignments during the semester. The best 16 scores will count towards your final grade.

Topics to be covered.

Course topics and their corresponding chapters are presented below. You will be expected to have read the appropriate material and watch assigned videos prior to the coverage of each topic. Questions that you have on the material you read and assigned videos will help guide what we cover in the classroom. Posted learning objectives, homework assignments, in-class work and quizzes are designed to engage you with the material in the book. Questions you have from the textbook but not covered during class meetings are highly encouraged.

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<tr>
<td>History of microbiology</td>
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<td>Nutrition, Culture</td>
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<td><strong>Friday 2/12</strong></td>
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<td><strong>Microbial Metabolism and Regulation</strong></td>
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<td>Metabolism, Energetics</td>
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<td>Microbial Genomics</td>
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<td>Metabolic Regulation</td>
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<td>Genetics of Bacteria and Archaea</td>
<td>Chapter 10</td>
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<td><strong>Wednesday 3/9</strong></td>
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**Microbial Taxonomy**
Viruses and Virology Chapters 8 and 9
Microbial Evolution and Systematics Chapter 12
Functional Diversity Chapter 14
Diversity of Bacteria Chapter 15
Diversity of Archaea Chapter 16

**Wednesday 4/13** Exam 3

**Host Microbe Interactions**
Microbial Ecosystems Chapter 19
Microbial Symbiosis Chapter 22
Microbial Interactions with Humans Chapter 23
Immunity and Host Defense Chapter 24
Diagnostic Microbiology Chapter 27

**Wednesday 5/11** Exam 4 12:30 pm to 2:30 pm

**Deadlines:**

**Exams**
Friday 2/12 Exam 1
Wednesday 3/9 Exam 2
Wednesday 4/13 Exam 3
Wednesday 5/11 Exam 4 (12:30 am – 2:30)

**Quizzes:** Quizzes will be opened at various times and announced in class. They will remain open until the corresponding Exam.

**ATCC Project** - You will receive the name and ATCC (American Type Culture Collection) number of a random microorganism in class. You will complete the following assignment using that organism. (10 points each except for the final report which will be worth 50 points)

**ATCC1 - 1/25** - Search the ATCC website for your organism. Find out who submitted the organism and when. Post this information on Blackboard along with additional information such as why the organism was isolated, how it is used, etc. Note the cost to buy the organisms.

**ATCC2 - 2/1** - Search the ATCC website for the appropriate medium and growth conditions for your organism. Post the recipe and general description on Blackboard.

**ATCC3 - 2/8** - Submit an annotated bibliography of research articles related to your organism. The bibliography should include at least 3 articles from the primary literature. Each article can be cited using any appropriate citation format but should reference the journal citation information and not the URL for the online version of the article. Websites may be included in your bibliography but do not count toward the 3 articles.

**ATCC4 - 2/22** - Identify the primary metabolic characterization of your organism (chemoautotroph, photoheterotroph, etc.) and justify your characterization. Is your organism capable of multiple modes of metabolism?

**ATCCReport - 3/16** - Submit a 500+ word essay on your ATCC organism.

**ATCC5 - 4/8** - Find the genome sequence of your organism on the BacMap website. Examine the genome for any interesting features associated with its metabolism or other functions. Post this information along with the size and complexity of the genome (i.e. number of chromosomes, plasmids, etc.)
My’Crobe Project (20 points for posting name, 100 points for final report)

3/11 - Post on Blackboard the name of a bacterium you would like to study and learn more about for this assignment. The organism must be a bacterium (you will lose points for posting a non-bacterium). The organism must be different from your ATCC organisms. Five bonus points will be awarded for selecting an unusual or newly discovered bacterium. Two or more students may not select the same organism so the selection is first come, first served. Check which organisms have already been posted before you make your selection.

4/29 - Submit an 800+ word essay on your My’Crobe.

Homework (5 points each)

You will have multiple homework assignments throughout the semester. Some of these homework assignments will be worked on in class and in groups. If you miss class on one of those days, you will not be allowed to make it up unless I have received appropriate notice.

**Homework for Exam 1 topics**
- Microbiologists
- Important events in microbiology history
- Microscopy (Differential stain)
- Counting microbes - serial dilution
- Microbial growth curve
- Sterilization/disinfection
- Minimal Inhibitory Concentration (MIC)
- Antibiotics

**Homework for Exam 2 topics**
- Biosynthesis
- Energetics - fermentation
- Energetics - respiration
- Gene expression - repression
- Gene expression - activation

**Homework for Exam 3 topics**
- Viruses
- Protists
- Evolution
- 16S sequence analysis
- Phylogenetic trees
- Taxonomy - what’s in a name
- Energetic diversity - fermentation
- Energetic diversity - respiration
- Energetic diversity - photosynthesis

**Homework for Exam 4 topics**
- Element cycles
- Host-microbe interactions
- Microbiome
- Barrier defenses
- Complement system
- Immune system
Evolution

- Cells, organelles (e.g. mitochondria and chloroplasts) and all major metabolic pathways evolved from early prokaryotic cells.
- Mutations and horizontal gene transfer, along with the immense variety of microenvironments, have resulted in a vast diversity of microorganisms.
- Human impact on the environment influences the evolution of microorganisms (e.g., emerging diseases and the selection of antibiotic resistance).
- The traditional concept of species is not readily applicable to microbes, due to asexual reproduction and the frequent occurrence of horizontal gene transfer.
- The evolutionary relatedness of organisms is best reflected in phylogenetic trees.

Structure and Function

- Bacteria have unique cell structures that can be targets for antibiotics, immunity, and phage infection.
- Bacteria and Archaea have specialized structures (e.g., flagella, endospores, and pili) that often confer critical capabilities.
- The replication cycles of viruses (lytic and lysogenic) are dependent on living host cells and determined by their unique genomes and structures.
- The structure and function of microorganisms have been revealed by the use of microscopy (including bright field, phase contrast, fluorescent, and electron).

Metabolic Pathways

- Bacteria and Archaea exhibit extensive, and often unique, metabolic diversity (e.g., nitrogen fixation, methane production, anoxygenic photosynthesis).
- The metabolic abilities of a cell determine how it interacts with other cells and its environment (e.g., quorum sensing, oxygen consumption, nitrogen transformations).
- The survival and growth of any microorganism in a given environment depends on its metabolic characteristics.
- The growth of microorganisms can be controlled by physical, chemical, mechanical, and biological methods.

Information Flow

- Genetic variations can impact microbial functions (e.g., in biofilm formation, pathogenicity, and drug resistance).
- Although the central dogma is universal in all cells, the processes of replication, transcription, and translation differ in Bacteria, Archaea, and Eukaryotes.
- The regulation of gene expression is influenced by external and internal molecular cues and/or signals.
- The synthesis of viral genetic material and proteins is dependent on host cells, and these processes can be different among viruses.
- Cell genomes can be manipulated to alter cell function.

Systems

- Microorganisms are ubiquitous and live in diverse and dynamic ecosystems.
- Most bacteria in nature live in biofilm communities.
- Microorganisms and their environment interact with and modify each other.
- Microorganisms, cellular and viral, interact with both human and non-human hosts in beneficial, neutral, or detrimental ways.

Impact of Microorganisms

- Microbes are essential for life, as we know it, and the processes that support life (e.g., in biogeochemical cycles and plant/animal microflora).
- Microorganisms provide essential models that give us fundamental knowledge about life processes.
- Humans utilize and harness microorganisms and their products.
- Because the true diversity of microbial life is largely unknown, its effects and potential benefits have not been fully explored.
Disability Support Services:  http://dss.mst.edu  Any student inquiring about academic accommodations because of a disability should be referred to Disability Support Services so that appropriate and reasonable accommodative services can be determined and recommended.  DSS is located in 204 Norwood Hall ( 341-4211,  dss@mst.edu)  
"If you have a documented disability and anticipate needing accommodations in this course, you are strongly encouraged to meet with me early in the semester. You will need to request that the Disability Services staff send a letter to me verifying your disability and specifying the accommodation you will need before I can arrange your accommodation."

Academic Dishonesty:  http://registrar.mst.edu/academicregs/index.html Page 30 of the Student Academic Regulations handbook describes the student standard of conduct relative to the System’s Collected Rules and Regulations section 200.010, and offers descriptions of academic dishonesty including cheating, plagiarism or sabotage.  Additional guidance for faculty, including a description of the process for dealing with issues related to academic dishonesty, is available on-line at http://ugs.mst.edu .

Title IX: Missouri University of Science and Technology is committed to the safety and well-being of all members of its community. US Federal Law Title IX states that no member of the university community shall, on the basis of sex, be excluded from participation in, or be denied benefits of, or be subjected to discrimination under any education program or activity. Furthermore, in accordance with Title IX guidelines from the US Office of Civil Rights, Missouri S&T requires that all faculty and staff members report, to the Missouri S&T Title IX Coordinator, any notice of sexual harassment, abuse, and/or violence (including personal relational abuse, relational/domestic violence, and stalking) disclosed through communication including but not limited to direct conversation, email, social media, classroom papers and homework exercises.

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Course Concerns: If you have any comments or concerns regarding this course or either instructor (good or bad) please feel free to discuss them with me. If you are not satisfied with my response or prefer to speak with someone else, you may contact the Interim Chair of the Biology Department, Dr. Yue Wern Huang (huangy@mst.edu, 341-4819) or the Vice-Provost for Undergraduate Studies, Dr. Jeff Cawlfield (jdc@mst.edu, 341-4390).