

BIO270 Food Microbiology

Pre-requisite: BIO210 and/or CHE210
4 credits, 6 hours (3 lecture; 3 lab)

Course Description

This course is designed to introduce students to general principles of microbiology with an emphasis on structure, function and growth control of microorganisms important in food processing, food spoilage, and in causing food-borne illnesses. General microbiology topics covered in this course include structure and function of eukaryotic and prokaryotic cells, metabolism, growth of bacterial culture, pathogenic properties of microorganisms, and interaction between microbe and host. Food microbiology topics covered in this course include lactic acid bacteria and their fermentation products, spoilage microorganisms and control of their growth in food, food borne pathogenic bacteria and control of their growth in food, and methods of identification and quantification of microorganisms in food.

Course textbooks

Lecture Required

Food Microbiology an Introduction Montville T.J., Matthews, K.R., and Kniel, K.E.,
ASM Press Washington, DC, 2012, ISBN 978-1-5581-636-0 (hard cover), ISBN 978-1-55581-720-6 (e-book)

Laboratory

Microbiology Laboratory Theory and Application . Leboffe, Michael J. and Pierce, Burton E..
Morton Publishing Company., 2008, Brief Edition – 2 ed, ISBN #0895829479. Older editions are acceptable.

Additional Resources

Campbell Biology – any edition published after 2012 (students have this book from their BIO210/220 courses)

Schedule of classes

Week	Topic	Assignment/Exercise
1	Lecture Introduction to Microbiology. Food Microbiology is a specialized field of Microbiology	Reading: Montville: Ch. I. The trajectory of food microbiology. Handout
	Laboratory Introduction to Microbiology laboratory and safety rules. Aseptic techniques. Common transfer and Inoculation methods.	Reading and Exercise: Leboffe: Introduction to microbiology laboratory Ex. 1-3 Common aseptic transfer and inoculation methods Ex. 1- 4 Streak Plate method of isolation Homework: Outline: Leboffe, Ex. 7-7 Methylene Blue reductase test
2	Lecture: Introduction to Metabolism	Campbell: Ch. 6. An introduction to metabolism. Montville: Chapter 2 (pp. 39-42) Microbial Physiology and metabolism
	Laboratory: Metabolic method of milk quality assessment.	Exercise: Ex. 7-7 Methylene Blue reductase test Homework: Lab report I Methylene Blue reductase test. Outline: Leboffe, Ex. 5-3 Methyl Red and Voges-Proskauer Test) and Ex. 5-1 (O/F Glucose test)

3	<p>Lecture: Metabolism/lactic acid and yeast-based fermentation</p>	<p>Montville: Ch. 19. Lactic acid bacteria and their fermentation products Ch. 20 Fermentation that uses yeast.</p>
	<p>Laboratory: Monitoring yogurt preparation Differentiation between oxidation and fermentation pathways of microbial metabolism. Differentiation between acidic versus non-acidic fermentation.</p>	<p>Exercise: Monitoring yogurt preparation (handout). Setting up 5-3 (Methyl Red and Voges-Proskauer Test) Ex. 5-1 (O/F Glucose) Homework: Outlines: Leboffe, Ex. 3-1 (Simple stain), Ex.3-6 (Gram stain)</p>
4	<p>Lecture Structure of Prokaryotic and Eukaryotic cell.</p>	<p>Reading: Campbell : Ch. 7. A tour of a cell</p>
Lecture Exam 1: Metabolism		
	<p>Laboratory: Introduction to Light Microscopy. Differential staining to reveal structure of bacterial cell wall (Gram stain)</p>	<p>Exercise: Assessment of Methyl Red/Voges-Proskauer and O/F Glucose tests Ex.3-6 (Gram stain) Homework: Laboratory report 2: Methyl Red/Voges-Proskauer and O/F Glucose tests Outline: Leboffe, Ex. 3-9 (Endospore staining)</p>
5	<p>Lecture: Spores and their significance in food industry</p> <p>Laboratory: Differential staining to reveal spores (Endospore staining)</p>	<p>Reading: Montville : Ch.3, Spores and their significance.</p> <p>Exercise: Leboffe: Ex. 3-9 (Endospore staining) Homework Laboratory report 3: Gram staining and Endospore staining Outline: Leboffe Ex. 2-8 (Effect of temperature on microbial growth), , Ex. 2-9 (Effect of pH on Microbial Growth) Ex. 2-10 (Effect of osmotic pressure on Microbial Growth)</p>
6	<p>Lecture: Microbial growth and factors that influence microbial growth.</p> <p>Laboratory: Using hemocytometer to determine cell density.</p>	<p>Reading: Handout "Microbial Growth" Montville: Ch. 2. Microbial Growth, Survival and Death in Foods</p> <p>Exercise Using hemocytometer to determine cell density (handout) Exercise setting up: Leboffe Ex. 2-8 (Effect of temperature on microbial growth) Ex. 2-9 (Effect of pH on Microbial Growth) Ex. 2-10 (Effect of osmotic pressure on Microbial Growth)</p>
Laboratory exam 1: Staining: and metabolic tests.		
7.	<p>Lecture: Control of Microbial Growth</p>	<p>Reading: Handout: Control of microorganisms' growth. Montville: Ch. 25. Control of Microorganisms in food.</p>

	Laboratory: Effect of Temperature, pH, Osmotic on bacterial growth.	Exercise Assessment of the effects of temperature, pH and osmotic pressure on microbial growth (hemycotometer use) Homework: Laboratory report 4: effect of environmental conditions on bacterial growth Outline: Leboffe Ex. 2-12 Chemical Germicides
8	Lecture: Epidemiology of food-borne illnesses	Reading: Montville: Handout: Introduction to epidemiology Ch. 7 Regulatory issues [in food preparation].
Lecture exam 2: Cell structure and bacterial growth		
	Laboratory: Effect antimicrobial agents on bacterial growth.	Exercise Setting up: Leboffe Ex. 2-12 Chemical Germicides Homework: Outline: Leboffe: Ex. 4-1 Mannitol-salt Agar, Ex 4-3 Blood Agar, 5-4 Catalase test
9	Lecture: Interaction between the microbe and host	Campbell Ch. 39 The Body's defense
	Laboratory Differential tests	Exercise: Assessment of the Chemical Germicides test 5-4 Catalase test Setting up: Ex. 4-1 Mannitol-salt Agar, Ex 4-3 Blood Agar Homework Laboratory report 5: Effectiveness of different germicides Outline: Leboffe: Ex. 4-5 Hektoen Agar, Ex. 4-6 MacConkey Agar
Laboratory exam 2: Growth of bacterial culture and its control.		
10	Lecture <i>Staphylococcus aureus</i> , <i>Vibrio</i> species	Montville Ch.16 <i>Staphylococcus aureus</i> , Ch.17 <i>Vibrio</i> species
	Laboratory Differential tests	Assessment of bacterial growth on Mannitol-salt Agar and Blood Agar . Setting up: Ex. 4-5 Hektoen Agar, and Ex. 4-6 MacConkey Agar Homework: Laboratory report 6: Identification and differentiation of <i>Staphylococcus</i> spp. Outline: Leboffe Ex. 5-17 SIM media, Ex. 5-18 TSA media (Kligler Iron Agar)
11	Lecture <i>E. Coli</i> , <i>Salmonella</i> , and <i>Shigella</i> species	Montville Ch. 12 <i>Escherichia coli</i> , Ch. 14 <i>Salmonella</i> species, Ch. 15 <i>Shiella</i> species
	Laboratory Differential tests	Assessment of bacterial growth on Hektoen Agar, and MacConkey Agar Setting up: Ex. 5-17 SIM media, Ex. 5-18 TSA media (Kligler Iron Agar) Homework: Laboratory report 7 Identification of enterobacteria- 1
12	Lecture <i>Listeria monocytogenes</i> and <i>Yersinia enterocolitica</i>	Montville Ch. 13 <i>Listeria monocytogenes</i> and Ch. 18 <i>Yersinia enterocolitica</i>

	Lecture exam 3. Host/pathogen relationship	
	Laboratory	Assessment of bacterial growth on SIM media and Kligler Iron Agar. Homework Laboratory report 8. Identification of enterobacteria-I Handout: Using PCR for Food Analysis
13	Lecture Spoilage organisms	Montville Ch. 21 Spoilage Microorganisms
	Laboratory Microbiological analysis of food samples	Handout "Sample preparation and PCR set up". Homework: Handout "Analysis of PCR results"
	Laboratory exam 3 Differential tests	
14	Lecture Yeast and Molds	Montville Ch. 20 Yeast-based and other fermentation. Ch. 22 Molds
	Laboratory Microbiological analysis of food samples	Analysis of PCR results by agarose gel electrophoresis. Preparation of an agarose gel to resolve PCR products, gel electrophoresis, obtaining image of gel electrophoresis.
15	Lecture	Final Examination
	Laboratory	Final Examination

Deadlines for laboratory reports submission

Number	Title	Due
1	Methylene blue reductase test	Week 3
2	Methyl Red Noges-Proskauer and O/F Glucose tests	Week 5
3	Gram staining and Endospore Staining	Week 6
4	Effect of environmental conditions on bacterial growth	Week 8
5	Effectiveness of different germicidal agents	Week 10
6	Identification and differentiation of <i>Staphylococcus</i> spp	Week 11
7	Identification of enterobacteria -I	Week 12
8	Identification of enterobacteria -II	Week 13

Schedule of lecture examinations.

Exam	Topic	Time
1	Metabolism	Week 4
2	Cell structure and bacterial growth	Week 8
3	Host/pathogen relationship.	Week 12
4	Final examination - cumulative	Week 15

Schedule of laboratory examinations.

Exam	Topic	Time
1	Staining and metabolic tests	Week 6
2	Growth of bacterial culture and its control.	Week 9
3	Differential tests	Week 13
4	Final examination - cumulative	Week 14