## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>I.</th>
<th>Introductory Information</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>II.</td>
<td>Useful Information:</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Instructor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conference Hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Textbooks</td>
<td></td>
</tr>
<tr>
<td>III.</td>
<td>General Rules</td>
<td>5</td>
</tr>
<tr>
<td>IV.</td>
<td>Lecture Section</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Schedule</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Study Guide</td>
<td>9</td>
</tr>
<tr>
<td>VII.</td>
<td>Reference Reading List</td>
<td>25</td>
</tr>
<tr>
<td>VI.</td>
<td>Laboratory Section</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Rules</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Safety (Very Important, Must Read)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Schedule</td>
<td>36</td>
</tr>
</tbody>
</table>

General Microbiology

Page 2
GENERAL MICROBIOLOGY
BIO 220

COURSE OUTLINE & STUDY GUIDE
Spring, 2010

INTRODUCTION

General Microbiology is the introductory course in Microbiology. It is a four credit hour lecture and laboratory course. The course is especially designed for undergraduate students in the natural sciences or health sciences. It covers the basic principles required for the understanding of microbial cell life, including cell structure and function, growth and metabolism, microbial genetics, microbial evolution and diversity, host-parasite relationship, microbial diseases, immunology and ecology.

The laboratory sections are designed to complement the lecture section. Students are encouraged to work independently under the supervision of the instructor. Microbiological laboratory procedures such as aseptic and diagnostic techniques are employed in the characterization of microorganisms. Since this is a wet laboratory where live microorganisms are used, it is absolutely important that all students familiarize themselves with the safety rules as outlined in the pertinent section of this syllabus.
USEFUL INFORMATION

INSTRUCTOR: Dr. Broderick E. Eribo

OFFICE LOCATION: Room 208, E. E. Just Hall

CONFERENCE HOURS: M—W: 12:00-3:00 pm or by Appointment

LECTURE ROOM: Auditorium, E. E. Just Hall

LABORATORY ROOM: Room 209, E. E. Just Hall

LABORATORY T/A: TBA

TEXTBOOKS:

Lecture: Brock Biology of Microorganisms, 12th Edition
M. T. Madigan, J. M. Martinko, P. V. Dunlap and D. P. Clark
Pearson Benjamin Cummings, Publisher, 2009

Laboratory: Benson's Microbiological Applications, 11th Edition
(complete version), A. Brown.
McGraw Hill Publisher, 2009
GENERAL RULES, REGULATIONS AND PROCEDURES

1. REFERENCE BOOKS: Some key references are in Founders Undergraduate Library or the Health Science Library. While specific references will be made to some, the others are for your use in getting a better and more thorough understanding of topics.

2. GRADING:
   Lecture Exams and Quizzes 700
   [NOTE: Total # of points on Exams = 600, points on Quizzes = 100]
   Laboratory 300
   TOTAL POINTS 1000

3. PLAGIARISM: WILL NOT BE TOLERATED: Anyone caught cheating on exams will be dealt with according to the rules of the College of Arts and Sciences.

4. CONDUCT IN LECTURES: Attendance is required. NO TALKING, NO SMOKING, NO EATING permitted during lectures. Lectures start at 11:10 a.m.

5. CONDUCT IN LABORATORY: NO EATING, NO SMOKING! You are asked to respect and be guided by your Teaching Assistant (T.A.). Attendance at each class is required. Accidents of any type must be reported to your T.A.

6. SCHEDULED EXAMINATION: There are NO MAKE-UP EXAMS, except in extraordinary cases, and such cases must be backed with the necessary valid documents.

   Lecture Exams will be objective, short answer, multiple choice and true or false. About 80% of lecture exam will consist of material from lectures (includes parts of study guide, text, reference and other materials). About 70% will consist of questions and material covered in the attached study guide. The remainder may come from text assignments alone, or in combination with assigned reference materials.

7. LECTURE QUIZZES: Unannounced quizzes will be given during the semester. (THERE ARE ABSOLUTELY NO MAKE-UPS FOR THESE QUIZZES)

8. HOW TO DO WELL: Read and be thoroughly familiar with this handout. Study habits should include:
   (1) Going over lecture material and notes daily. Do not wait till the last day before the exam to go over the study materials. (30 min/day better than taking, say, 6 hours one day per week).
   (2) Understanding terms and concepts from lecture, study guide and text.
   (3) Reading text assignments in advance of lecture.
   (4) Knowing and understanding everything from study guide.

General Microbiology
<table>
<thead>
<tr>
<th>DATE</th>
<th>TOPIC</th>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/11</td>
<td>Introduction: History and scope of microbiology</td>
<td>1,2</td>
</tr>
<tr>
<td>1/13</td>
<td>Review of Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>1/15</td>
<td>Organization and Structure of Procaryotic and Eucaryotic cells</td>
<td>2, 4</td>
</tr>
<tr>
<td>1/18</td>
<td>Holiday—Martin Luther King</td>
<td></td>
</tr>
<tr>
<td>01/20</td>
<td>Organization and Structure of Procaryotic and Eucaryotic cells</td>
<td>2, 4</td>
</tr>
<tr>
<td>1/22</td>
<td>Microbial Nutrition</td>
<td>5.1-5.3</td>
</tr>
<tr>
<td>1/25</td>
<td>The Bacterial Growth</td>
<td>6</td>
</tr>
<tr>
<td>1/27</td>
<td>The Bacterial Growth Curve</td>
<td>6</td>
</tr>
<tr>
<td>1/29</td>
<td>EXAMINATION (150 Points) ALL OF THE ABOVE</td>
<td></td>
</tr>
<tr>
<td>2/1</td>
<td>Microbial Metabolism: Energy, Kinetics, Enzymes</td>
<td>5.4-5.13</td>
</tr>
<tr>
<td>2/3</td>
<td>Microbial Metabolism: Fermentation and Respiration</td>
<td>5.4-5.13, 21</td>
</tr>
<tr>
<td>2/5</td>
<td>Autotrophic and Phototrophic Metabolism</td>
<td>20.120.5</td>
</tr>
<tr>
<td>2/8</td>
<td>Regulation of Enzyme activity</td>
<td>5.18</td>
</tr>
<tr>
<td>2/10</td>
<td>Molecular Biology of Microorganisms: DNA Structure and Replication</td>
<td>7</td>
</tr>
<tr>
<td>2/12</td>
<td>RNA Structure, Transcription and Translation</td>
<td>7</td>
</tr>
<tr>
<td>2/15</td>
<td>Holiday—President’s Day</td>
<td></td>
</tr>
<tr>
<td>2/17</td>
<td>Regulation of gene expression in microorganisms</td>
<td>9</td>
</tr>
<tr>
<td>2/19</td>
<td>Microbial Genetics: Principles</td>
<td>11</td>
</tr>
<tr>
<td>2/22</td>
<td>Recombinant DNA Technology: Cloning Vectors</td>
<td>12</td>
</tr>
</tbody>
</table>

General Microbiology
2/24  Microbial Genomics: Bioinformatics 13
2/26  EXAMINATION (150 Points) ALL OF THE ABOVE 10, 19
3/1   Viruses 10, 19
3/3   Microbial systematics and Evolution 14
3/5   The Bacteria 15, 16
3/8   The Bacteria 15, 16
3/10  Eucaryotic Microorganisms: Fungi and Protozoa 18
3/12  Charter Day (Classes Suspended 10:00 am—1:00 pm)
3/13-21 Spring Recess
3/22  EXAMINATION (150 Points) ALL OF THE ABOVE 22, 23, 24
3/24  Microbial Ecology—Intro. to Various Microbial Interactions 22, 23, 24
3/26  Host-Parasite Relationships: Pathogenicity, Resistance and 28
3/29  Microbial Diseases 32, 34
3/31  Microbial Control: Physical and Chemical Agents 27
      Antimicrobial Chemotherapy
4/5   Immunology—General Concepts 29
      normal microbiota and nonspecific immunity
4/7   Immunology—Host Defense and Diseases 30
4/9   Molecular Immunology 31
4/12  Principles of Clinical Microbiology 32
      Immunology—Diagnostic application, Immune disorders
4/14  Food Microbiology 37
      Industrial Microbiology 41
4/16  Recap
4/19  EXAMINATION (ALL OF THE ABOVE)
4/21  MAKE-UP EXAMINATION ALL OF THE ABOVE
I. Introduction to the Discipline of Microbiology

A. Historical background: List the contributions of the following individuals to the field of Microbiology:

1. Leeuwenhoek
2. Pasteur
3. Redi
4. Metchnikoff
5. Fleming
6. Jenner
7. Semmelweis
8. Cohn
9. Needham
10. Janssen
11. Tyndall
12. Hooke
13. Winogradsky
14. Beijerinck
15. Waksman
16. Lister
17. Gram
18. Ivanowski
19. Koch
20. Jacob and Monod
21. Arber and Smith
22. Kohler and Milstein
23. Montagier and Gallo
24. Reed
25. Woese and Fox
26. Kohler and Milstein
27. Jenner
28. Chamberland
29. Emil von Behring
30. Alexander fleming
31. Rita Colwell
32. Neidhardt

B. What major events led to developments in the following areas of Microbiology?

1. Microscope
2. Spontaneous generation
3. Fermentation
4. Germ Theory of Disease
5. Chemotherapy
6. Soil Microbiology
7. Pure Culture

II. The Scope of Microbiology

A. Microbiology as a basic Biological Science:

1. Bacteriology
2. Mycology
3. Phycology
4. Prozoology
5. Virology
6. Immunology
7. Parasitology
8. Microbial Ecology
9. Microbial Physiology
10. Molecular Biology

B. Microbiology as an Applied Biological Science

1. Pathogenic Microbiology
2. Environmental Microbiology
3. Food Microbiology
4. Public Health Microbiology
5. Biotechnology
6. Industrial Microbiology
III. Review of Cell Chemistry

A. Elements of Cell Chemistry
1. Carboxyl group
2. Hydroxyl group
3. Sulfhydryl group
4. Covalent
5. Structural formulas of the 20 amino acids
6. Monosaccharides and disaccharides

B. Note the composition of the various macromolecules in bacterial cell.

C. Draw the structure of a dipeptide and indicate the position of peptide bond.

D. Define and explain the primary, secondary, tertiary and quaternary structures of proteins.

IV. Microbial Anatomy

A. Words and concepts to be understood:

1. The cell envelope.
2. Light, electron, dark-field, and phase contrast microscopy.
3. Differential, simple, and negative staining of cells.
4. Mucocomplex and peptidoglycan unit.
5. Significance of diaminopimelic acid in bacteria.
6. L-forms, protoplasts, spheroplasts, and mycoplasmas.
7. Effect of lysozyme and penicillin on bacterial cell walls
8. The unit membrane: Energy generation.
9. Chemical composition of gram positive and gram negative bacterial cells walls.
10. Active and passive transport.
12. Facilitated diffusion
13. The fluid Mosaic model
14. Procaryote
15. The different shapes and arrangements of bacteria.
16. Capsules and Slime Layers
17. Bacterial Chromosome
18. Plasmids
19. Ribosomes
20. Storage Granules
21. Flagella
22. Tactic Responses (chemotaxis)
23. Glycocalyx
24. Pili
25. Endospores

General Microbiology
B. Diagram a bacterial cell and label all known structures. This is VERY IMPORTANT. Use an 8 1/2 x 11" page for your cell. On the opposite side of the page, list each cell structure shown and indicate, (1) its general chemical composition, (2) its primary function of the cell.

1. Compare bacterial, plant, and animal cells.
2. Cell size - Compare size of the bacterial cell to the eukaryotic cell.
3. Genome size - Compare DNA size of the bacterial cell and DNA size in the eukaryotic cell.

C. Diagram in detail, structures of the following bacterial components:

1. A gram negative bacterial cell envelope.
2. A gram positive bacterial cell wall.
3. Peptidoglycan.
4. Flagellum.
5. Endospore.

D. Compare and contrast, a gram positive bacterial cell and a gram negative bacterial cell.

V. Culture and Growth of Microorganisms

A. Culture

1. Sterilization procedures - What is an autoclave?
2. Different types of culture media: synthetic, selective, differential, defined, enrichment culture technique.
3. How can you grow anaerobes?
4. Macromolecular synthesis, cellular differentiation and morphogenesis: binary fission, budding, endospore formation.
5. Explain the meaning of the terms: pure culture, Enrichment culture, lyophilization.

B. Growth Requirement

1. Temperature
2. Osmotic pressure
3. pH
4. Nitrogen
5. Oxygen
6. Water activity
7. Minerals
8. Carbohydrates
9. Amino acids, proteins
10. Phosphorus
11. Sulfur
12. Iron
13. Vitamins

C. The growth curve batch cultures

1. Be able to draw and label the four main phases of a bacterial growth curve. Be able to know the distinguishing features of the phases of the growth curve.
Calculations of the number of generations produced by a culture in a flask:
\[
n = \frac{\log N_t - \log N_0}{\log 2} = \frac{\log N_t - \log N_0}{0.301}
\]
Practice calculations with the formulae, using your own numbers to calculate \(n\).

D. Measurement of Microbial Growth

1. Direct count with microscopes
2. Petroff-Hausser Chamber
3. Electronic counters
4. Plate counts
5. Membrane filters
6. MPN
7. Gene probe
8. Endotoxin determination
9. Immunological methods
10. Biochemical determinations - (ATP, protein, fatty acids, etc.)
11. Dry weight measurement

E. Continuous Culture of Microorganisms

1. What is a chemostat?
2. What is a turbidostat?
3. How is continuous culture different from batch culture?

VI. Influence of Environmental Factors and Growth

A. Water, osmosis, and water activity (Aw)

B. Define the terms, halophiles, osmophiles, xerophiles and compatible solutes.

C. pH-acidiophiles, neutrophiles, and alkalinophiles

D. Importance of buffers

E. Temperature

1. What are the cardinal temperatures?
2. Define: psychrophiles, psychrotrophs, mesophiles, thermophiles
3. Important: What physiological molecular adaptations have psychrophiles and thermophiles made to be able to grow in their particular environments?
4. What is the significance of Taq polymerase?

F. Oxygen Concentration

1. Define: aerobe, anaerobe, obligate aerobe, obligate anaerobe, facultative anaerobe, and microaerophile
2. What compounds are toxic to anaerobes?
3. What forms of oxygen are toxic to bacteria?

4. What compounds are toxic to anaerobes?

5. What are the specific functions of catalase, peroxidase and superoxide dismutase?

G. Radiation:
1. Ionizing radiation
2. Ultraviolet
3. Visible light

VII. Microbial Nutrition and Metabolism:

It will be helpful to review Appendix 1 before reading this section. The basic principles of metabolism are better understood through the laws of thermodynamics.

A. List the elemental composition of bacterial cell.

B. List and identify the rate of micronutrients and macronutrients in bacterial nutrition.

C. Define and explain the following terms/concepts:
   1. Anabolism
   2. Catabolism
   3. Heterotrophs
   4. Phototrophs
   5. Lithotrophs
   6. Organotrophs
   7. Enzyme
   8. Substrate
   9. Coenzyme
   10. Free energy
   11. Prosthetic group
   12. Apoenzyme
   13. Electron transport system
   14. Oxidation: reduction
   15. High energy bond
   16. Oxidative and substrate level phosphorylation
   17. Proton - motive force
   18. Fermentation
   19. Activation energy
   20. ATP
   21. Kreb cycle
   22. Photosynthesis
   23. Role of NAD\(^+\) and NADH\(_2\) in

D. Pathways to learn: You do not need to learn structural formulas, but you should have a good knowledge of the starting chemical, the final product and important molecules produced in the pathway.

   1. Glycolysis or Embden - Myerhoff: Substrate level phosphorylation - what is it and where does it occur in glycolysis?

   2. Pentose phosphate pathway - learn what is produced in this pathway that the cell needs.

   3. Entner-Doudoroff pathway - again, what is produced? (See Fig. 9.6, p. 169).
4. Fermentations
   a. Importance of the reoxidation of NADH2 in the absence of oxygen. What are some possible electron acceptors instead of oxygen? What are some products of
   b. You should have a definition of fermentation clearly in your mind.

5. Tricarboxylic Acid Cycle or Krebs cycle
   a. This is a very important cycle in aerobic cells.
   b. Know why?

6. Electron Transport
   a. Where does this occur in prokaryotes and eukaryotes?
   b. What happens in electron transport? What are the final products?

7. How is electron transport connected with oxidative phosphorylation?

8. Chemiosmotic Hypothesis
   a. Generation of protonmotive force (PMF) to make ATP.
   b. How many ATPs are generated in oxidative phosphorylation from one mole of glucose?
   c. You should have a definition of respiration clear in your mind.
   d. Contrast the process of respiration with fermentation.

E. Metabolic Diversity Among Microorganisms - Pay particular attention to the following:
   1. Classification of organisms according to energy source (See Table 5.2).
   2. Anaerobic respiration
   3. Photosynthesis:
      a. Photosynthesis
      b. Role of NADP+
      c. Light reaction,
      d. Anaerobic vs Oxygenic

General Microbiology
4. Lithotrophy:
   a. Hydrogen oxidizing bacteria
   b. Sulfur bacteria
   c. Iron-oxidizing bacteria
   d. Ammonium and Nitrite-oxidizing bacteria
   e. Anaerobic respiration
   f. Nitrate and sulfate reduction
   g. CO2 as an electron acceptor
   h. Anaerobic fermentation

VIII. Microbial Genetics

A. Review the structure of DNA and RNA

B. What is a gene?
   1. Differentiate between the gene structures of procaryotes and eucaryotes.
   2. What are histones, chromosomes, palindrome, inverted repeats and stem-loop?

C. Outline the procedure for isolating detecting and cloning DNA in the laboratory

D. Outline the process of DNA replication and note the roles of topoisomerases, replication fork, DNA polymerases, Okazaki fragments, DNA ligases, primer, and restriction enzymes in the process.

E. Define/explain the following:
   1. Genetic elements
   2. Rolling circle mode of replication
   3. Theta structure
   4. Plasmids
   5. Viroids
   6. Chromosome
   7. Nucleosome
   8. Gene Probes
   9. Southern Blotting
   10. Site directed mutagenesis
    11. Transfection
    12. Chimera
    13. Cosmids
    14. Northern Blotting
    15. Western Blotting
F. The Process of Transcription:

1. Know the structure and function of the three RNA molecules.
2. The role of RNA polymerase in the process.
3. Outline the significance of hairloop, rho protein and Pribnow box in the process.
4. Differentiate between procaryotic post-transcriptional modification of RNA and that of eukaryotes.
5. Note the role of split genes (introns and exons).
6. What role do ribozyme play in the process?

G. The Process of Translation

1. Refer to the genetic code on p.258 and note the role of the three RNA molecules in this process.
2. How does the process of activation occur?
3. Why is activation necessary to initiate protein synthesis?
4. Outline the following steps:
   a. Initiation
   b. Elongation
   c. Termination
   d. Post transnational processing of newly synthesized polypeptides

H. Regulation of Protein Synthesis:

1. Inducible enzymes
2. Repressible enzymes
3. Role of inducers and corepressors
5. Catabolite Repression
6. Role of catabolite activator protein (CAP), Cyclic AMP, diauxic growth
7. Positive and negative control of protein synthesis.
8. Attenuation

General Microbiology
I. Mutation

1. Point mutations
2. missense mutations
3. silent mutations
4. wobble hypothesis
5. nonsense mutation
6. polar mutation
7. deletion mutation
8. insertion mutation
9. frame shift mutation
10. Ames test
11. suppressor mutation
12. Replica plating technique
13. auxotrophs, prototrophs
14. chemical mutagens
15. Radiation effect on genes
16. thymine dimer
17. photoreactivation, excision repair, SOS system dark
18. carcinogens
19. Plasmids (resistance, F and I pili, conjugative, toxins, incompatibility)

J. Recombination:

1. transposable genetic element
2. insertion sequence, transposons
3. DNA as the genetic material
4. transduction (generalized, specialized)
5. conjugation (F plasmid, HFr)
6. gene mapping
7. protoplast fusion
8. Gene cloning
9. Genetic engineering

K. Questions/problems

1. Diagram a 6-nucleotide-pair section of DNA showing exactly how and where the following belong: phosphate, adenine, cytosine, deoxyribose, covalent bonds, thymine, guanine, and hydrogen bond.

2. Compare and contrast: bacterial transformation, transduction and recombination.

3. Compare: plasmids, F1 factors, and transposons.

4. List three types of RNA found in bacterial cells and characteristics each relative to molecular size and function.

5. Diagram the way in which bacteriophage multiply.

6. Repeat #1 above

7. Repeat IV B (It is impossible to do well in this course if you do not know the bacterial cell well !!!).
8. What is the relationship between F⁺ and HFr cells.

9. List all known functions of RNA polymerase.

10. What is meant by 5' to 3' reading?

11. How does DNA differ from RNA?

12. How do bacterial ribosomes differ from those of a fungus?

13. Diagram bacterial transduction showing the point at which transduction is effected.

14. Do you understand the lac operon?

15. What is the Ames test?

16. How would you go about the process of genetically engineering a bacterium?

IX. Viruses

1. Definition and Concepts:
   a. replicative form
   b. Virion, viroid
   c. Capsid
   d. Capsomere
   e. Interferon
   f. Tissue culture
   g. Receptor site
   h. Bacteriophage
   i. Plaque forming unit
   j. Icosahedron
   k. Prophage
   l. Vector, fomite
   m. T-phages
   n. Obligate parasitism
   o. Lytic phage
   p. Lysogene/temperate
   q. Prion
   r. Burst size
   s. Reverse transcription
   t. Retroviruses
Questions/problems, etc.:

a. Compare: bacteria, algae, fungi, and viruses relative to the following: size range, general chemical composition, genome size, habitat range, morphology, cellular structures presence of RNA and DNA, ability to make ATP, and virulence for man.

b. Are viruses living organisms? Support your answer.

c. Relate the nucleic acid composition of viruses to bacteria.

d. List several viral diseases that specifically affect organs and tissues of the body.

e. List the pros and cons of viruses as etiologic agents of cancer.

f. Why are viruses relatively nonsusceptible to clinically useful Antimicrobial agents?

g. Compare viruses as organisms to the classical bacteria. Are they more or less primitive than bacteria?

h. Compare the growth and cultivation of viruses, and bacteria.

X. Microbial Evolution and Systematics

A. Ribosomal RNA as evolutionary chronometers

1. Eubacteria
2. Archae
3. Eucaryotes

B. Definitions/concepts

1. Taxonomy
2. Nomenclature
3. Classification
4. Genus, species, strains
5. Binomial system
6. Taxonomic characteristics
7. Phylogeny
C. Bacterial classification:

This section (Chapters 20-24) is intended for a general familiarization of the different groups of bacteria. It will be helpful to go through Appendix IV at this time since the information here directly complements this section.

1. Spirochetes
   a. *Treponema pallidium*
   d. *Spirillum*
   b. *Borrelia*
   e. *Campylobacter*
   c. *Leptospira*
   f. *Bdellovibrio*

2. Gram-negative Aerobic Rods and Cocobacilli
   a. *Pseudomonas*
   g. *Branhamella*
   b. *Agrobactericum*
   h. *Moraxella*
   c. *Rhizobium*
   i. *Brucella*
   d. *Legionella*
   j. *Bordetella*
   e. *Neisseria*
   k. *Alcaligenes*
   f. *Acinetobacter*
   l. *Acetobacter*

3. Gram-negative Facultative Anaerobes
   a. *Enterobacter*
   h. *Plesiononas*
   b. *Escherichia*
   i. *Vibrio*
   c. *Citrobacter*
   j. *Photobacterium*
   d. *Salmonella*
   k. *Providencia*
   e. *Shigella*
   l. *Yersinia*
   f. *Proteus, Hafnia,*

4. Gram-negative Anaerobic Rods
   a. *Bacteroides*
   c. *Leptotrichia*
   b. *Fusobacterium*

5. Gram-negative Anaerobic Cocci
   a. *Veillonella*

6. Rickettsias and Chlamydia
   a. *Rickettsia*
   b. *Chlamydia*

7. Mycoplasma
   a. *Spiroplasma*
   c. *Mycoplasma*
8. Gram-positive Cocci
   a. *Micrococcus*
   b. *Staphylococcus*
   c. *Streptococcus*
   d. *Peptococcus - Obligate anaerobe*

9. Endospore Forming Rods
   a. *Bacillus*
   b. *Sporolactobacillus*
   c. *Clostridium*
   d. *Sporosarcina*

10. Gram-positive Asporogenous Bacteria
    a. *Lactobacillus*
    b. *Listeria*
    c. *Erysipelothrix*
    d. *Corynebacterium*
    e. *Kurthia*
    f. *Arthrobacter*
    g. *Actinomycetes - Streptomycetes*

11. Archaea
    a. *Sulfolobus*
    b. *Halococcus*
    c. *Halobacterium*
    d. Methanogens (*Methanococcus*)
    e. *Thermoplasma*
    f. *Thermococcus*

D. Eucaryotic Microorganisms: Note the distinguishing characteristics of the following groups:

1. Algae
2. Fungi
3. Slime molds
4. Protozoa

XI. Control of Microorganisms

H. Definitions and Concepts:

1. Chemotherapy
2. Antibiotic
3. Disinfectant
4. Antiseptic
5. Sanitizer
6. Sterilization
7. Pasteurization
8. germicides
9. Competitive inhibitor
10. Thermal death time
    11. Decimal Reduction Time (value)
    12. Phenol coefficient
    13. Oligodynamic action
    14. Minimal inhibitory concentration
    15. Beta-lactam antibiotic
    16. Aminoglycoside
    17. Microbiostatic
I. What is the specific mode of action of each of the following agents on microorganisms?

1. Heavy metals
2. Formaldehyde
3. Alcohols
4. Sulfur drugs
5. Radiation
6. Tetracycline antibiotics
7. Tetracycline antibiotic
8. Phenols
9. Detergents
10. $\text{H}_2\text{O}_2$
11. Halogens
12. Penicillins

J. List antimicrobial agents that act at or upon the following parts of the bacterial cell:

1. Membrane
2. Cell wall
3. DNA
4. mRNA
5. 30S ribosome
6. 50S ribosome
7. tRNA

XII. Host-Parasite Interactions

A. Definitions/concepts

1. Parasite
2. Virulence
3. Exotoxins
4. Endotoxins
5. Infection
6. Compromise host
7. Inflammation
8. Pyrogen
9. Reticuloendothelial system
10. Bacteremia
11. Disease
12. Colonization
13. Host-factors

B. List the several roles played by normal bacterial flora in the prevention of pathogenic infections.

XIII. Immunology and Immunity

A. Definitions/concepts

1. Immunogen/antigen
2. Antigenic determinants
3. Immunoglobulin
4. Haptens
5. Antitoxins
6. Lymphocytes
7. Macrophages
8. Histocompatibility
9. Hypersensitivity
10. Plasma cells
11. 18. Lymphocytes
12. Natural killer cells
13. 19. Lymphokines
14. 20. Mast cells
15. Basophils
16. Monocytes
17. Immune tolerance
18. Autoimmune diseases
19. Opsonin
20. Properdin

General Microbiology
11. Monoclonal antibody
12. Hybradoma
13. Serology
14. Agglutination
15. Precipitation
16. Humoral Immunity
17. Cellular Immunity
28. Anaphylaxis
29. Allergy
30. Toxoids
31. Active Immunity
32. Passive Immunity
33. Clonal Selection

B. Immunodiagnostic Tests
1. ELISA
2. Radioimmunoassay
3. Fluorescent Antibody
4. Immunodiffusion
5. Complement Fixation

C. Distinguish between:
1. Humoral and cellular immunity
2. Immediate vs delayed type hypersensitivity
3. Autoimmune disease and allergic reactions
4. Active and passive immunity

D. Draw a label of a detailed structure of an immunoglobulin.

E. List and characterize the five classes of immunoglobulin (See table 30.3, p. 617).

XIV. Microbial Biotechnology
A. Industrial fermentation
B. Xenobiotic
C. Idiophase
D. Immobilized enzyme

XV. Microbial Ecology
A. Ecosystem
B. Decomposers
C. Biodegradation
D. Winogradsky Column
E. Biogeochemical Cycle
F. Mycorrhizae
G. Lichens
H. Primary Producers
I. Hydrothermal Vents
A wealth of information on all aspects of Microbiology can be assessed in the web site for the American Society for Microbiology (http://www.asm.org)


5. Microbial Physiology. 2002. A. Moat and J. Foster


LIGHT AND ENJOYABLE READING FROM SCIENTIFIC AMERICAN

1. The Virus: Life's Enemy, Smith

2. Microbes and You, Wedberg

3. Pomp and Pestilence, Hare

4. Shadow on the Land: Syphilis, Parren

5. The Miracle Drugs, Sokoloff

6. You and T.B. by Perkins and Feldman

7. The Microbes, Our Unseen Friends, H.W. Rossmore

8. Wish I Might, B. Smith

10. The Black Death, Nohl
11. The Microbe Hunters, P. KeKruif
12. The Story of Microbes, A. Shatz
13. No One Must Ever Know, B. Martin
14. The World of Microbes, H. Gest
15. The Coming Plague: Newly and emerging disease in a world out of balance, L. Garrett
16. Flu: The story of the great influenza pandemic of 1918, G. Kolata

FROM SCIENTIFIC AMERICAN
1. Model of Cell Membrane, 3/74
2. Herpes Viruses and Cancer, 10/73
3. Complement, 11/73
5. A DNA Operator-Repressor System, 1/76
6. The Antibody Combining Site, 1/77
7. Cancer Immunology, 5/77
8. The Recombinant-DNA Debate, 7/77
9. How Cells Make ATP, 3/78
10. The Assembly of a Virus, 11/78
11. The Proteins of Oncogens, 8/84
12. Transposable Genetic Elements in Maize, 6/84
13. Viroids, 1/81
14. Autoimmune Diseases, 2/81
15. Archae, 6/81

General Microbiology
16. The Beta-Lactam Antibiotics, 6/81
17. The Ribosome, 8/81
18. Industrial Microbiology, Entire 9/81
19. A Genetic Switch in a Bacterial Virus, 11/82
20. Microbiological Mining, 8/82
21. How An Animal Virus Gets Into and Out of Its Host Cell, 2/82
22. The DNA Helix and How It Is Read, 12/83
23. The Molecules of the Immune System, 10/85
24. Symbiosis in the Deep Sea, 6/87
25. The Aids Virus, 1/87
26. Antiviral Therapy, 4/87
27. The Structure of Poliovirus 3/87
28. Reverse Transcription, 9/87
29. What Science Knows About AIDS, 10/88
30. RNA As An Enzyme, 11/89
31. Interleukin 2, 3/90
32. The Unusual Origin of the Polymerase Chain Reaction, 4/90
33. AIDS Related Infections, 8/90
34. Sexually Transmitted Disease in the AIDS Era, 2/91
35. Streptococcal M Protein, 6/91
36. How The Immune System Learns About Self, 10/91
37. Cultured Cells for the Treatment of Disease, 11/91
38. Transgenic Crops, 6/92
39. G. Proteins, 7/92
40. Bacterial Endotoxins, 8/92
41. Toxins of Cyanobacteria, 1/94
42. How Cells Present Antigen, 8/94
43. Disarming Lyme Disease, 9/94
44. The Prion Diseases, 1/95
45. How HIV Defeats the Immune System, 8/95
46. Emerging Virus, 10/95
47. Microbes Deep Inside the Earth, 10/96
48. The Evolution of Immunity, 11/96
49. Why Do Bacteria Communicate, 2/97
53. Biological Warfare Against Crops, 6/99
54. Deciphering the Code of Life, 12/99
57. Battling Biofilms, 7/2001
58. Beyond Chicken Soup, 9/2001
60. Can Chlamidia be stopped, 5/2005
61. Preparing for the Pandemic, 11/2005
62. Did life come from another world, 11/2005
63. An antibiotic resistant fighter, 3/2006
64. A new assault on HIV, 10/2006
65. Viral nanoelectronics, 10/2006

General Microbiology
The laboratory period for **General Microbiology** has been provided for students to obtain valuable first-hand knowledge of certain key microbiological principles through hands-on experience. Since the designated experiments complement most of the materials covered in the lecture, attendance and full participation in all assigned laboratory exercises is necessary for thorough understanding of the subject material and success in the course. The exercises to be performed from your laboratory manual are on page 36-37 in this course guide.

**GRADING:** Note that you will receive one grade in this course. Of the total possible 1000 points in the course, 300 points can be earned in the laboratory section as follows:

- Lab Exams 200 points
- Unknown assignment 50 points
- Quizzes 50 points

**TOTAL 300 points**

**Laboratory Teaching Assistants:** Your T/A will provide you with the following information on first day of your lab section:

- Office hours:
- Office location:
- Telephone number:
- e-mail address:

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General Microbiology
LABORATORY GENERAL RULES

1. Read the rules!

2. Read the entire exercises, introduction and procedures, BEFORE attending lab!

3. Do all parts of the appropriate exercise(s) unless otherwise indicated.

4. Before beginning the lab procedures, check the contents of the group equipment tray. Replace broken or missing items; turn in “extras”.

5. **DO NOT** “BORROW” equipment from other trays, tables or student groups.

6. Use materials organized in a designated area only at that specific area. **DO NOT** take them back to your assigned work area for any length of time. Your colleagues may also need to use such materials.

7. Use open flames with **EXTREME CAUTION**! Hair, clothing, books, and fingers all burn!

8. Refill solution bottles before they are completely empty. **DO NOT** waste solutions.

9. **DO NOT** put solids (paper, slides, coverslips, etc.) in the sink. These items belong only in the appropriate waste containers -- plumbing repair is limited on campus and rather expensive.

10. **DO NOT** pour any unauthorized liquids down the drains. According to environmental regulations, certain chemicals must be collected for safe disposal.

11. Clean up any spills **IMMEDIATELY** following specific instructions detailed under "Safety Rules".

12. Clean up after yourself!
13. Make sure that your equipment is clean when you are finished and that the equipment tray is properly stocked before you leave.

14. **DO NOT** remove **ANY** materials from the lab room unless authorized. This includes slides, coverslips, lens paper, forceps, etc.

15. Read any and all notices regarding safety, organization and procedures.

16. Under **NO CIRCUMSTANCES** should you attempt to disassemble your **MICROSCOPE**. Only a qualified technician should attempt this feat.
SAFETY RULES

1. In order to prevent contamination of clothing by microorganisms and soiling with stains, students are required to wear protective garments such as white coats, which may be purchased in the College of Dentistry Bookstore.

2. There is to be ABSOLUTELY NO EATING, DRINKING, or SMOKING in the laboratory or adjacent areas.

3. Report ANY INJURY, regardless of its triviality, to your GTA IMMEDIATELY! You are dealing with potential pathogens.

4. To reduce the possibility of contamination, wipe the lab table thoroughly with disinfectant BEFORE you begin and AFTER you have completed your lab exercises. Use it to clean minor spills as well. Notify your GTA of major spills.

5. Purses, books, and other materials not specifically used during the course of the lab should be stored in the cabinets beneath the lab desks. Generally, only your lab manual, handouts and writing utensils should be left out. DO NOT PLACE ANYTHING on the floor as the room is quite congested.

6. Broken glass boxes are for broken glass only.

7. Petri dishes must be discarded in the appropriately labeled waste cans only. DO NOT overfill a waste can (ask your GTA to take care of it) or place dishes on top of a tied plastic bag. Dispose of all media according to instructions from your TA as soon as you are finished with it.

8. Papers should be discarded only in the waste baskets -- NOT in the sinks - broken glass containers or petri dish discard!

9. Turn bunsen burners on slowly and only as high as is necessary about one inch of flame. TURN OFF the burners when not in use to prevent burns and to keep the room temperature bearable.

10. Use open flames with EXTREME CAUTION! Hair, clothing, books, and fingers all burn!
11. Used cultures and broth tubes must be discarded in the assigned baskets, in an upright or slanted position. The caps keep out stray bacteria, but are not waterproof. **DO NOT** discard in the petri dish waste containers, as these can be washed and reused.

12. Students with long hair should tie it back to prevent the possibility of its catching fire. Similarly, avoid flowing sleeves, scarves, ties, flammable jewelry, etc.

13. Personal hygiene is important. Wash your hands frequently. Put a band-aid over any cuts. Avoid putting your hands to your mouth, eyes, etc. Be aware of any medical conditions you may have that might be affected by this laboratory environment.

14. **DO NOT** be afraid of this lab, but **DO BE** cautious and have respect for the materials and organisms with which you will be dealing.
### Lab Schedule for Spring 2009

<table>
<thead>
<tr>
<th>SECTIONS</th>
<th>EXERCISE TITLE</th>
<th>EXERCISE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 32 33 34</td>
<td>Check in, the Microscope</td>
<td>1, 2, 3, 4, and 5</td>
</tr>
<tr>
<td>1/19 1/20 1/19 1/20</td>
<td>Survey of Microorganisms: Protozoa, Algae and Fungi The Bacteria</td>
<td>6, 8</td>
</tr>
<tr>
<td>1/21 1/22 1/21 1/22</td>
<td>Preparation of slides: Negative staining Smear preparation, Simple staining</td>
<td>7</td>
</tr>
<tr>
<td>1/26 1/27 1/26 1/27</td>
<td>Introduction to Differential staining: Gram Staining</td>
<td>11, 12, 13,</td>
</tr>
<tr>
<td>2/2 2/3 2/2 2/3</td>
<td>Endospore staining (Shafer-Fulton Method); Acid-Fast staining (Ziehl-Neelsen method)</td>
<td>16</td>
</tr>
<tr>
<td>2/4 2/5 2/4 2/5</td>
<td>Review of all staining methods</td>
<td>17</td>
</tr>
<tr>
<td>2/9 2/10 2/9 2/10</td>
<td>Motility Determination: Wet mount and tube method</td>
<td>14, 15, 16, 17</td>
</tr>
<tr>
<td>2/11 2/12 2/11 2/12</td>
<td>Introduction to culture media preparation</td>
<td>18</td>
</tr>
<tr>
<td>2/16 2/17 2/16 2/17</td>
<td>Pure culture techniques</td>
<td>19</td>
</tr>
<tr>
<td>2/18 2/19 2/18 2/19</td>
<td>Pure Culture Techniques: Streak plate - Quadrant, Pour Plate Method</td>
<td>9, 10</td>
</tr>
<tr>
<td>2/23 2/24 2/23 2/24</td>
<td>Cultivation of Anaerobes (Fluid thioglycollate, Brewers Anaerobic Agar)</td>
<td>20</td>
</tr>
<tr>
<td>2/25 2/26 2/25 2/26</td>
<td>Bacterial Population Count (Quantitative Plate method and Turbidity Determination)</td>
<td>21</td>
</tr>
<tr>
<td>3/2 3/3 3/2 3/3</td>
<td>Review for Lab Exam 1</td>
<td>22</td>
</tr>
<tr>
<td>3/4 3/5 3/4 3/5</td>
<td>Laboratory Mid-Term Examination (NO MAKE-UP)</td>
<td>23</td>
</tr>
</tbody>
</table>

General Microbiology
3/9 3/10 3/9 3/10 Preparation and care of stock cultures

3/11 3/12 3/11 3/12 Review of outline for the identification of unknown

**SPRING RECESS: March 13—March 21, 2010**

Morphological study of unknown bacteria


Use of Bergey's Manual for identification
(API 20E and Enterotube)

4/1 4/2 4/1 4/2 Identification of unknown assignment due
Effect of Temperature on microbial growth
Effects of NaCl/ Aw, pH, UV and lysozyme on microbial growth

4/6 4/7 4/6 4/7 Effect of antiseptics and antibiotics on microbial growth
Effectiveness of hand scrubbing

4/8 4/9 4/8 4/9 Standard plate count of milk and other foods
Microbiology of fermented milk products (yogurt)

4/13 4/14 4/13 4/14 PCR, Plasmid isolation

4/15 4/16 4/15 4/16 RECAP for Lab Final

4/20 4/21 4/20 4/21 LABORATORY FINAL EXAMINATION 100 points

4/23 4/23 4/23 4/23 All Students Lab Scores are due at 12:noon (TA, Please note)

Formal Classes End on April 22, 2010
GENERAL MICROBIOLOGY LABORATORY RULES AGREEMENT

SPRING, 2010

I _______________________________ ___________________________ have read and understand

Last Name    First    ID #

the safety and general rules for the laboratory, and agree to abide by all the rules,
including any additional rule that may be introduced by verbal instructions as
seen fit throughout the duration of the course. I further understand that the
instructor reserves the right to deny my participation in the laboratory for failure
to keep to these rules.

____________________________
Student

____________________________
Graduate Teaching Assistant

____________________________
Instructor/ Dr. B. E.Eribo
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Instructor

General Microbiology