**ESSEX COUNTY COLLEGE**

**Biology and Chemistry Division**

**BIO 211 *–* Microbiology**

**Course Outline**

**Course Number & Name:**  BIO 211 Microbiology

**Credit Hours:**  4.0 **Contact Hours:**  6.0 **Lecture:** 3.0 **Lab:**  3.0 **Other:**  N/A

**Prerequisites**:  Grades of “C” or better in CHM 101 **or** CHM 103 and BIO 104 **or** BIO 122

**Co-requisites:** None **Concurrent Courses:** None

**Course Outline Revision Date:** Fall 2010

**Course Description:** Microbiology is the study of microorganisms, and as such, this course examines life at the microscopic level (including eukaryotic cells: protozoa and fungi; prokaryotic cells: bacteria, rickettsia and mycoplasma; viruses: viroids; and infectious agents: prions). Lecture and laboratory sessions consider techniques in conventional culturable methods and examination and identification of microorganisms. Topics to be covered include nutritional requirements, environmental constraints, biochemical activities, genetic make-up and expression. Additionally, the role that microorganisms play in human and animal hosts during health and disease will be explored. Also included are aspects in pathogenicity, virulence, immunology, natural defense and environmental control factors. Laboratory sessions consider techniques in aseptic technique and sterile transfer, instrumentation (e.g., microscopy and pipetting), culturing bacteria, application of critical analysis of experimental data and presentations.

**Course Goals:** Upon successful completion of this course, students should be able to do the following:

1. demonstrate knowledge of fundamental concepts and themes in microbiology;
2. proficiently use tools in the microbiology lab to perform appropriate laboratory procedures;
3. discuss basic concepts in microbial genetics, nutrition, metabolic pathways, and mechanisms of regulation for each;
4. describe the physical, mechanical, and chemical methods of controlling the growth of microorganisms; and
5. explain the host-microbe relationship especially interactions during health and alterations of health, the progression of an infection, the host defense mechanisms, and disorders of the immune system.

**Measurable Course Performance Objectives (MPOs)**: Upon successful completion of this course, students should specifically be able to do the following:

1. Demonstrate knowledge of fundamental concepts and themes in microbiology:

1.1 *define the term ‘microbiology’;*

1.2 *identify and describe major groups of microorganisms, including their characteristics, range, distribution, and taxonomy;*

1.3 *discuss the scope of microbiology and related fields;*

1.4 *identify and explain how microorganisms can be used for beneficial applications;* and

1.5 *identify and discuss the history of and key contributions made to microbiology from 400 BC to the present*

1. Proficiently use tools in the microbiology lab to perform appropriate laboratory procedures:

2.1 *aseptically inoculate culture into media and differentiate the characteristics of each;*

2.2 *apply techniques in microscopy to distinguish basic morphological characteristics of eukaryotic and prokaryotic cells;*

2.3 *analyze and* *assess physiological characteristics of prokaryotic cells;* and

2.4 *design and implement experiments to analyze the effectiveness of various antimicrobial agents (e.g., disinfectants and antibiotics)*

3. Discuss basic concepts in microbial genetics, nutrition, metabolic pathways, and mechanisms of regulation for each:

3.1 *explain the role of enzymes in metabolism, induction, and repression;*

3.2 *compare common metabolic pathways;*

3.3 *describe the physical and physiological factors necessary for microbial growth;* and

3.4 *discuss the central dogma and transfer of genetic information between biological entities and related genetic engineering protocols*

4. Describe the physical, mechanical, and chemical methods of controlling the growth of microorganisms:

4.1 *distinguish between physical, mechanical, and chemical methods used to control the growth of microbes;* and

4.2 *describe factors affecting the potency of antimicrobial agents and describe how the potency is assessed*

5. Explain the host-microbe relationship especially interactions during health and alterations of health, the progression of an infection, the host defense mechanisms, and disorders of the immune system:

5.1 *describe the human-microbe relationship and the role played by the resident biota;*

5.2 *describe factors that weaken host defenses and explain how microbes enter/exit the body;*

5.3 *explain the role played by virulence factors in the establishment and progression of a disease;*

5.4 *describe the spread of diseases in the community/population, modes of transmission, and mechanisms applied to control the spread of infectious diseases;* and

5.5 *identify and discuss host defense mechanisms and disorders of the immune system*

**Methods of Instruction**: Instruction will consist of didactic instruction, laboratory illustrations, demonstration-return-demonstrations, and student group and individual presentations.

**Outcomes Assessment:** Test and exam questions are blueprinted to ensure that the objectives of the course are met by the students. Rubrics are used to evaluate lab performance, lab notebooks, the research reports, and oral presentations for the presence of course objectives. Data is collected and analyzed to determine the level of student performance on these assessment instruments in regards to meeting course objectives.  The results of this data analysis are used to guide necessary pedagogical and/or curricular revisions.

**Course Requirements:** All students are required to:

1. Attend all classes.
2. Complete all assignments.
3. Take part in class and laboratory experiments. Engage in group discussions and presentations.
4. Take all tests and exams as scheduled.

**Methods of Evaluation:** Final course grades will be computed as follows:

**% of**

**Grading Components final course grade**

* **4 or more Lecture Tests** (dates specified by the instructor) **60%**

Tests will show evidence of the extent to which student meet course of objectives, including but not limited to, identifying and applying concepts, and analyzing and solving problems. Pop quizzes may be included as part of the test paradigm.

* Lab Experiments and Participation 10%

Labs are designed to enhance student mastery of material presented in the course. Labs allow students to apply the scientific method and follow correct laboratory procedures and will provide evidence of the extent of student mastery of some course objectives. (See page 7 for Laboratory Guidelines.)

* Lab Notebook   5%

The lab notebook will show evidence of student participation in the labs. Its content will include much information relevant to course objectives. (See page 7 for Laboratory Notebook expectations.)

* Pathophysiology Research Report & Oral Presentation   5%

The research and corresponding oral reports will assess the extent to which students meet some course objectives. They will also allow students to explore current findings in pathophysiology, which should enhance their understanding of the related course material.

* **Final Exam**   **20%**

The final exam has the same objectives as the tests, but should provide evidence of increased achievement of course objectives and synthesis of course material.

**Academic Integrity:** Dishonesty disrupts the search for truth that is inherent in the learning process and so devalues the purpose and the mission of the College.  Academic dishonesty includes, but is not limited to, the following:

* plagiarism – the failure to acknowledge another writer’s words or ideas or to give proper credit to sources of information; could result in a
* cheating – knowingly obtaining or giving unauthorized information on any test/exam or any other academic assignment;
* interference – any interruption of the academic process that prevents others from the proper engagement in learning or teaching; and
* fraud – any act or instance of willful deceit or trickery.

Violations of academic integrity will be dealt with by imposing appropriate sanctions.  Sanctions for acts of academic dishonesty could include the resubmission of an assignment, failure of the test/exam, failure in the course, probation, suspension from the College, and even expulsion from the College.

**Student Code of Conduct:** All students are expected to conduct themselves as responsible and considerate adults who respect the rights of others. Disruptive behavior will not be tolerated. All students are also expected to attend and be on time all class meetings. No cell phones or similar electronic devices are permitted in class. Please refer to the Essex County College student handbook, *Lifeline*, for more specific information about the College’s Code of Conduct and attendance requirements.

**Course Content Outline:** based on the text **Microbiology: A Systems Approach**, 2nd edition, by Cowan and Talaro; published by McGraw Hill, New York, NY, 2009; IBSN #: 978-0-07-299528-2; and the lab manual **Microbiology Application**, by A E Brown; ISBN-13 #: 978-0-07-729829-6

**Lecture Schedule**

**Week Chapter/Class Topics**

1 Ch 1 History and Scope: Main Themes of Microbiology

2 Ch 2 Chemistry of Biology

3 Ch 3 Methods of Studying Microorganisms: Media, Microscopy

Ch 4 Prokaryotic Profiles: The Bacteria and Archaea

**Test 1** on Chs 1 – 4

4 Ch 5 Eukaryotic Cells and Microorganisms

Ch 3 Methods of Studying Microorganisms: Staining – Principles and Types

5 Ch 6 Viruses

6 Ch 7 Microbial Nutrition Ecology and Growth

**Test 2** on Chs 3 & 5 – 7

7 Ch 8 Microbial Metabolism

8 Ch 9 Microbial Genetics

9 Ch 10 Gene Transfer and Genetic Engineering (Biotechnology)

**Test 3** on Chs 8 – 10

10 Ch 11 Control of Microbial Growth: Physical Methods (Sterilization and Disinfection)

11 Ch 12 Control of Microbial Growth: Antimicrobial Therapy

12 Ch 13 Host-Microbe Relationship: Pathogenicity – Infection and Disease Process; Epidemiology; Pathophysiology Research Report topics distributed

13 Ch 14 Non-specific Host Defense Mechanisms

**Test 4** on Chs 11 – 14

**Oral Presentations** on topics from Chapters 18 & 19

14 Ch 15 Specific Host Defense Mechanisms: Immunology I

**Oral Presentations** on topics from Chapter 20

**Week Chapter/Class Topics**

15 Ch 16 Disorders Associate with the Immune System; Immunological Tests; Diagnosing Infections

**Oral Presentations** on topics from Chapter 21 – 23

**Final Exam**

Note: Pathophysiology: Diseases will be selected from the following systems: Integumentary (skin, eyes, wounds, and bites); Urogenital (sexually transmitted); Respiratory (lungs and organs of the respiratory system); Gastrointestinal (including all system organs); Cardiovascular; Lymphatic; Immune; and Nervous. Details regarding the oral presentation format will be explained in class.

**BIO 211 LABORATORY GUIDELINES**

The lab component of any microbiology course is vital to comprehending and understanding the material. The following lab elements are essential:

* Safe laboratory practice
* Aseptic technique and sterile transfer
* Instrumentation (microscopy, spectroscopy, pipetting)
* Quantification (serial dilutions, plate counting)
* Documentation of results
* Critical analysis of experimental data
* Written and oral data presentation
* Microbial taxonomy
* Student-designed experiments

**Lab Technique:**

Attention should be paid to the lab technique and precise details noted throughout the term. Improper lab technique can negatively affect a student’s course grade. Computation of the final course grade may include surprise (unannounced) practical testing as well. The “Safety Rules in the Microbiology Laboratory” in the lab text (pages ix-xi) will be used as a general guide in discerning proper laboratory procedures. **THESE SAFETY RULES MUST BE STRICTLY ADHERED TO BY ALL LAB PARTICIPANTS**.

**Lab Notebook:**

The lab notebook must include all finished AND ongoing experiments at the time of grading. Observations should be clearly recorded and labeled. The “five required lab questions” (see ‘laboratory’ section) should be clearly marked within each lab. The lab notebook will be used to keep a log of student results in the lab. For each experiment, the notebook should contain:

* **TITLE** of Experiment (what experiment is being conducted?)
* **OBJECTIVE** (what is the purpose of the experiment?)
* **PROCEDURE** – the experimental procedure need not be written. Instead, the page numbers may be cited. However, in cases where there is a change in the protocol (procedure) a note should be made.
* **RESULTS** (What specific results are expected to be seen (if known)?), and, **actual results** obtained

(all data should be included here)

* **DISCUSSION** of results. (Did the results obtained match (correspond) the expected (anticipated), and, or objective of experiment? In either case, an explanation should be included.)

THE LAB NOTEBOOK SHOULD BE GRADED PERIODICALLY THROUGHOUT THE SEMESTER.

**Laboratory Schedule**

Note: In all labs except Experiment #26, cultures will be provided to students. Also, all labs are subject to change due to unforeseen circumstances. Additional labs may be added at the discretion of the instructor. Labsand lecture may be done on the same day if space is available. Lab quizzes may be done only during the scheduled lab period.

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| **Week** | **Experiment #** | **Pages** | **Lab Objectives:** Students will: |
| 1 |  | *ix* – *x* | a) become familiar with the lab equipment  b) follow safe laboratory practices (Standard Practices 1 – 13) |
| 2 | 38  \*33 | 249 – 255  273 (after index) | a) investigate the effects of hand-washing on the number of microorganisms  b) isolate and identify microorganisms from body fluids (modified) |
| 3 | 9 – 10 | 71 – 91 | a) aseptically transfer bacteria from one culture medium to another  b) work with various types of cultures (broth, agar slant, and plates); modify cultures to include nutrient broth  c) isolate bacteria by the streak plate technique; perform T-streaks |
| 4 | 1 – 3 | 3 – 24 | a) review the principles, functions, types and uses of the microscope  b) prepare wet mount slides and observe living (aquatic) microorganisms |
| 5 | 11 – 12  15 | 95 – 99  109 – 112 | a) prepare smears and perform basic simple staining procedures  b) \*\* perform and interpret Gram stains (students prepare cultures ) |
| 6 | 16 | 113 – 114 | a) revisit Gram staining  b) conduct endospore staining |
| **Week** | **Experiment #** | **Pages** | **Lab Objectives:** Students will: |
| 7 – 8 | 19 | 131 – 144 | a) read the lecture textbook Chapter 7 (Microbial Nutrition)  b) use different types of media to isolate bacteria (refer to handout)  c) use MacConkey, TSI, EMB, and Mannitol salt media  d) analyze results |
| 9 – 10 | 41 – 43 | 278 – 279  270 – 271 | a) read the lecture textbook pp 263 – 264, Physiological Characteristics, Enzymatic Assays of Microbial Metabolism; pp 269 & 282, Carbohydrate Metabolism; pp 278 – 279, Protein Metabolism; p 271, Respiration – Catalase; and p 270, Citrate Utilization  b) analyze results |
| 11 | 29 | 203 – 207 | a) assess the effect of temperatures on microbial growth: mesophiles, psychrophiles and thermophiles  b) use a modified lab - incubate at various temperatures (5oC, 25oC, 37oC and 68oC) |
| 12 | 35 & 36  37 | 227 – 233 &  235 – 242  243 – 248 | a) examine the role of chemicals in the control of microbial growth  b) learn spread plate – students MUST bring their own disinfectants  c) use the disk-diffusion method (Kirby-Bauer test)  d)use disinfectants and antiseptics |
| 13 | Handout | N/A | a) analyze the results of labs 36 & 37  b) do blood smears – identify the cells of the non-specific host defenses |
| 14 – 15 | 44 | 295 – 299 | a) apply previously learned lab procedures (including assays of metabolic activities and staining) to identify unknown microorganisms  b) continue with unknowns – analyze results |