BIOLOGY 663 SYLLABUS

COURSE: Biology 663, Graduate Cell Biology, Summer 2014
Lecture: MTWTh 12:30 – 5:30
Lab: is incorporated into lecture at varying times during the day

OBJECTIVES:
Graduate Cell Biology is a 3 week intense summer course about the inner functions of cells. The cell is the basic building block of all living organisms, but yet is extremely complex. Every cell in your body must at one time undergo differentiation, must consistently coordinate and regulate division, movement, gene expression, and protein synthesis, must constantly create and recycle various organelles, and must be able to communicate with other cells, both near and far. Other courses are dedicated to specific aspects such as metabolism (advanced biochemistry) and gene expression (molecular biology) so we will not focus on all of these topics. However, as we study the processes that facilitate cell function, I hope that you will gain a thorough appreciation of the inherent beauty and complexity that is innate to even the most basic building block of life, the cell. Our goal is that by the end of this course, you will be able to relate and apply your detailed knowledge of cell function to biological properties and medical issues that arise from problems with these cellular functions. Along the way, we hope that you will grow in your own appreciation of the creative brilliance of our God and Creator at work through evolution.

Learning outcomes; Besides these ultimate objectives, students will also be able to:

- Utilize major cell biology experimental procedures to section and stain tissues, and grow, maintain, differentiate, and stain cells in culture.
- Understand and explain the major principles of cellular life including the roles of cell membranes, cellular transport, cytoskeleton remodeling, cell signaling, and cell division.
- Apply knowledge of the major aspects of cell signaling, intracellular signaling, and cell adhesion.
- Comprehend, critically evaluate, and present current research from the primary literature in the topics of cell biology.
- Utilize self-learning techniques to help yourself and others understand how to obtain, understand, and apply information about cell biology.
- Apply knowledge of cell properties to clinical diseases by describing how alterations in normal cell function can lead to detrimental phenotypes.

INSTRUCTORS: Dr. Mike Dorrell Dr. Judith Williams (DrJ)
Rohr Science 107, 619-849-2962, mdorrell@pointloma.edu
For Contacting both Instructors- Feel free to set up a time by email. We will both be on campus most mornings prior to class and are willing to stay after class to help.

TEXTBOOK: Alberts et. al., Molecular Biology of the Cell, 5th Ed.,
Garland Science, New York, 2008. (Required)
We realize that this is a thick and expensive textbook. However, this textbook is a great resource for Biology in general. I can tell you from experience that it will be a wonderful reference as you prepare for Graduate School and while you are studying, or employed in, anything related to biology. Plus, after evaluating many texts, I realized that it doesn't cost much more that other text options.

COURSE FORMAT:
The Course Format is based on 6 Units or Topics. These are some of the most important overall concepts needed to understand cell function. We will utilize lecture, lab and much discussion for concept clarification of each Unit.

Active Learning with Jigsaw / Peer teaching format:
Students will be assigned to one of 5 different groups. For each unit, different groups will be assigned portions of the content (rotating throughout the course). The groups will be responsible for the content of their Unit and will lead group and class discussions.

Theory behind active learning:
The overall format for this class is likely to be different from most other courses that you have taken throughout your educational career. Extensive data has effectively demonstrated that students learn better by taking part in the learning process, a process called 'active learning'. "Active learning involves providing opportunities for students to meaningfully talk and listen, write, read, and reflect on the content, ideas, issues, and concerns of an academic subject." (Meyers and Jones, *Promoting active learning; strategies for the college classroom*. San Franscisco: Jossey-Bass). In addition, with the technology available today, science is becoming less and less about memorizing certain facts, and more and more about learning to think, analyze, and evaluate information scientifically. Although content and memorization will always be an important aspect of science, it is becoming more important to know what information you need, and how to find and use that information. To this end, this course will incorporate several active learning techniques, including 'Jigsaw' and 'peer teaching'.

Classroom participation / Jigsaw learning / Peer teaching:
Students will be in charge of learning a portion of each unit on their own and then teaching that portion to the other members of a group who were assigned different portions of the unit content to learn. The information obtained by the group as a whole will be used to answer various questions and solve different problems both in and out of class. The goals of this type of learning process include:

1) Becoming a self-driven student (access and understand information)
2) Gaining foundational knowledge about cell biology
3) Learning to effectively work, learn, and teach within a group setting amongst scientists
4) Integrating different topics, knowledge, and ideas to solve single goals
5) Applying knowledge to similar, but distinct tasks related to learned content

General timetable within units 2 - 6 (note that unit 1 is a review unit led by the instructors):

Part 1: Introduction

- Exercise designed to initiate interest in, and thoughts about, the topic.
- Background information necessary to understand your assigned portions..

Same group discussions and exercises

- Student discussion in groups with others assigned the same topic portion (~30 min)
- Come to class having completed the individual unit worksheet.
  - Submit a copy to Eclass for grading **PRIOR** to class on that day.

    - Bring a copy for yourself to use as part of the discussion / teaching
- Discuss the assigned topic with peers who were assigned the same content
- Teach each other based on your worksheets and the assigned text / figures
    - Revise misconceptions and clear up confusing aspects
    - Prepare / practice effective teaching of the key concepts and figures

Mixed group work.

- Students will assemble in assigned mixed groups
    - Groups of 5; 1 person from each of the content groups
    - Mixed groups will rotate for each unit such that you will be with a different mix of students for each unit.
- Students will teach each other their own assigned content (~20 minutes each)
- With extra time, begin to work together to answer the mixed group questions.
- Throughout the group work, the professor will be helping clear up misconceptions and confusion. Feel free to flag down and instructor for help as needed.

Concept clarification and group problem work

- Instructor led discussions / lectures about different topics within the unit
- These discussions will be focused on:
    - Further implementation and application of the learned concepts such as how these relate to disease, normal cellular life and function, etc.
    - Clarifications of commonly misunderstood concepts
    - Discussion of the confusing aspects based on observations during mixed group.
- Periodically during discussion, we will introduce a problem from the mixed group questions that you are to work on together in class with your mixed group.
- You should be working with your mixed group some outside of class to complete the other mixed group problems. ***Note: We take group participation and evaluations very seriously so you should be sure to be pulling your own weight when questions require some time and effort outside of class to complete.***

EVALUATION AND GRADING; Letter grades will be assigned at the end of the course based on your percentage of total possible points, according to the following **approximate** scale:

A	90 – 100%
B	80 – 89%
C	70 – 79%
D	60 – 69%
NC/F	< 60%

As a general rule +/- 2-3% from the cutoff grades will usually be given +/- grades. However, plusses and minuses (*e.g.*, B+/A-) will be determined at the instructor's discretion. A major factor in this decision will be *class participation and preparation*.

Grading scale:

Laboratory grade	15%
Individual worksheets / crosswords	15%
Primary literature presentation	10%
Mixed group problems	10%
Group participation and contribution	10%
Two Quizzes	20%
Final exam	20%
Total	100%

Worksheets:
In order to help you focus your thoughts while reading about and studying your particular assigned content, you will be given a worksheet to complete. These will be due before you meet in same groups so that you can bring the completed worksheet to class and use it to confer with students who were assigned the same content. Your individual worksheet is to be submitted to Eclass prior to class on that day (**NO LATE SUBMISSIONS WILL BE ACCEPTED**). Your group will then teach each other, helping to explain important concepts and eliminate misconceptions and confusion. Please use your professor during this time (PLEASE-ASK QUESTIONS OF US). Although these worksheets only total 10 - 15% of your grade, they are a big step in your understanding of the material and will greatly help you lead summary discussions and participate in the mixed group activities. If one considers the worksheets are done <u>first,</u> to help the mixed group work and participation, these worksheets really contribute to a large percent of your grade (at least indirectly) and thus should be taken very seriously.

Mixed group problems
Groups of 5 or 6, with one person from each content area, will assemble and help teach each other the various content that everyone is ultimately responsible for in each unit. To help you assemble the information from each member of the group, the groups will work on, and turn in, various problem sets. These should be uploaded to Eclass by a single member of each group, with all the group members' names at the top. We will be working on some (~ ½) of the group problems together in class. You may also have time during peer teaching to work on the other questions. However, some of the questions will require a effort outside of class. Be sure to work together and pull your own weight. We suggest designing a Google document that everyone can add to and revise. You will be grading each other on participation and effort, and I will be taking account of that as well. Remember that your participation is worth 10% of your grade!

<u>Crossword puzzles</u>:
We have created some crossword puzzles using key terms from the chapter. You are to complete these individually. Everyone is required to complete the crossword for unit 1 since it is imperative that everyone understands key terms from this review unit. In addition, you must complete and turn in one of the other Although we like to focus more on concepts, memorizing and understanding terms is Key to Cell biology. Hopefully, this will be a 'fun' activity that will help you study and recognize terms throughout the book. While completing the puzzles, make

sure you understand the terms and their importance to the topic. We will have keys available for everyone along with some indications of why those terms are important, and explanations of their use in cell biology. You are required to complete the crosswords for credit.

Group participation / evaluation
As this course is largely designed based on group work, a significant portion of your overall grade (10%) will be based on your preparation, participation, and contribution to class, all the group activities, laboratory work, and class lecture discussions. There will be opportunities for students to evaluate their fellow group members for preparation, contribution to group problems, and ability to convey their content to the rest of the group. In addition, much of the laboratory work will consist of maintaining cells in culture which will require work outside of class time. Participation includes 1) appropriate contributions to group work in class, 2) appropriate preparation and understanding of your assigned content to be able to teach and contribute to the group problems, 3) equal work with solving group problems outside of class as required, 4) equal work during all the laboratory sessions and in required work outside of scheduled laboratory periods.

Feedback
As you go through each unit, please let me know what concepts are clear, and which need extra clarification during the concept clarification classes. I will do my best to help clarify everything that is unclear, but I do need your feedback to know exactly which topics to focus on. Also, I have continuously revised this course format to help make it as good as possible. However, I understand that people are different so please give me feedback throughout the course so that I can continue to make this better and optimize your learning experience.

Quizzes and Final exam
There will be two Quizzes, one at the end of Week 1 and Week 2. Theses will be a combination of multiple choice, short answer / problems, and essay. These will cover the recent material. However, since all of science is cumulative, you will still be responsible for material covered earlier in the sense that comprehension of this material may be key to answering questions on new material. The final exam will be approximately 40% new material and 60% cumulative.

Primary literature presentation
During each lecture, one of the groups will be assigned to cover a primary literature article on the topic material. Your group will be presenting the article in a ~30 minute, journal club-style presentation during the lab period. You can use the 'same group' session to help each other understand the content and begin preparations for the presentation. **Participation is key to your own learning**, and some of the group problems and content will require knowledge from the primary literature article. See the guidelines for article presentation for helpful hints, presentation formatting, and the grading rubric on this particular project.

Laboratory work
Laboratory handouts can be found online through Canvas. About half of the lab grade will be based on participation. The other half will be based on understanding of the labs, and successful completion (not necessarily "perfect completion") of the projects. The labs we are doing are

critical procedures used in modern cell biology research. Hopefully they will be informative and fun.

COURSE CONTENT: The course will be divided into 6 basic units. Although it is necessary to divide the course into these units for the purpose of assigning content and activities, you should gain an overall appreciation of how these systems interact to make cellular life possible.

Unit 1*: What are the techniques for analyzing cells?* I will present the first unit in a standard lecture style format, although there will be several discussions and activities within this.

Content:

- Review of cell features and functions (Ch. 1; 1-11, Ch. 3; 125 – 153, 173 – 193)

Chapter 1 is a review for tMonday's work and Ch 3 is for Tuesday

- Working with and visualizing cells (Ch. 8; 501 – 510, Ch. 9; 579 – 595, 604-609; [in lab])

General objectives:

- Describe the general functions that are required for cellular life
- Describe various microscopy techniques and the advantages and disadvantages of each.
- Isolate, grow and utilize cells in culture.
- Cryosectioning of heart tissue - what are advantages and disadvantages
- Stain cells from tissue or culture using various techniques and ascribe the advantages and disadvantages of each technique.
- Using Immunohistochemistry, understanding Proteins, Antigen/Antibody conjugation and fluorescent techniques
- Gain an understanding of the jigsaw / peer teaching format and good associated practices to implement during the subsequent chapters:
    - Unit 1 lectures will be used to demonstrate good discussion formats, teaching styles, and techniques for reading and understanding in-depth scientific information.
    - Students will learn what is expected of them and gain a better understanding of how to succeed in the jigsaw / peer teaching format.

Subsequent units will be learned using the jigsaw / peer teaching format (description above).

Unit 2: ***Just as you must remain organized to function effectively (despite what some of your rooms may suggest), cells must maintain compartmentalization and regulate what molecular products are stored within or moved to different parts of the cell. How does the lipid bilayer facilitate this compartmentalization?***

Content:

- Composition and structure of cell membranes (Ch. 10)
- Selective transport across membranes (Ch. 11)

General objectives:

- Describe the major components of cellular membranes and the functions of each.
- Explain how hydrophobicity, hydrophillicity, and the amphipathic nature of phospholipids make compartmentalization and cellular transport possible.
- Design a membrane transport protein that can regulate movement of specific particles across the cellular membrane.
- Explain membrane transport in relation to specific functions such as neuronal signaling.

Unit 3: ***Having spaces for different things only matters if you can get, and keep, the appropriate molecules (proteins etc.,) localized to those areas. How does the cell sort the organelles, macromolecules, and molecules?***

Content:
- Organelles and intracellular compartments (Ch. 12)
- Directed transport of molecules throughout the cell (Ch. 12 – 13)

General objectives:
- Explain the importance for specific localization of different molecules within the cell
- Explain in detail the mechanism by which the cell sorts and divides its cargo to specific destinations
- Given a set of conditions, identify where each protein is destined and the path by which it will get there.

Unit 4*: How does the cell move when necessary, move products to various parts of the cell (during cell sorting), and constantly maintain its structural integrity?*

Content:
- Cytoskeleton (Ch. 16)
- Cell adhesion (Ch. 19)

General objectives:
- Describe how the dynamic properties of cytoskeletal elements make cellular movement and movement of cargo within a cell possible.
- Design 'cellular systems' by which the above processes are regulated and by which cargo is moved in specific directions throughout the cell.
- Describe the different methods of cell-cell, and cell-ECM adhesion.
- Relate abnormal cell adhesion properties to human disease.

Unit 5: ***Cells must coordinate their activities and be able to respond appropriately to signals that are arriving from other cells, hormones, etc., How can cells recognize and respond to extracellular signals in an appropriate and effective manner?***

Content:
- General principles of cell signaling (Ch. 15; 879 – 903)
- Common modalities of cell signaling (Ch. 15; 904 – 944)

General objectives:
- Explain the purpose and necessary components of any cell signal.
- Describe a detailed cell signaling process, given appropriate information.
- Design common regulatory mechanisms for cell signaling.
- Describe G-protein coupled, enzyme-linked, and other common signaling pathways.
- Relate cell signaling to human development and disease.

Unit 6: ***We have been talking a lot about signaling, cell responses, cell integrity, etc., How does this relate to the methods by which we maintain and replace cells within our bodies?***

Content:
- The cell cycle and cell cycle control mechanisms (Ch. 17; 1053 – 1067)
- Apoptosis (Ch. 18)
- Cancer mechanisms and current treatment modalities (Ch. 20; 1205 – 1223, 1256 – 1264)

General objectives:

- Relate different rates of cell division amongst mammalian cells to the cell functions, and different methods of cell cycle division regulation and initiation.
- Relate the roles of Cdks and CkIs during cell cycle regulation.
- Relate programmed cell death to normal function and disease.
- Relate cell cycle control and apoptotic events to signaling cascades described in Unit 5.
- Relate cell cycle control and apoptosis to cancer.
- Describe the rationale behind current cancer treatments, along with the advantages and disadvantages of each.