

**COURSE INFORMATION:**

Molecular and Cellular Physiology

11:067:492 (3 Credits)

Offered in the Spring Semester.

The class consists of two 80-minute lectures per week (Cook Douglas Lecture Hall 103, TF 10:55 – 12:15)

**CONTACT INFORMATION:**

Instructor: William J. Belden, Ph.D.

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**COURSE MATERIAL:** Molecular Biology of the Cell (5<sup>th</sup> Addition) by Alberts et al published by Garland Science.

**COURSE DESCRIPTION:** This course is designed to explore the molecular mechanisms of cell biology as it pertains to mammalian physiology. Specific emphasis is placed on the molecular mechanisms of gene expression and genome function including the role of chromatin and non-coding RNA, translation, cell cycle and division, protein trafficking, cellular metabolism and cell signaling. Other topics include the specific function cellular organelles, DNA repair, mRNA processing and translation, the nuclear pore complex and shuttling between the cytoplasm and nucleus, cytoskeleton, protein trafficking between organelles and through the secretory pathway, lipid synthesis, electron transport, cell homeostasis and apoptosis, extracellular matrix, stem cell development and hematopoiesis, and cellular clocks.

**LEARNING OBJECTIVES:** The overall goal of this course is to provide a solid understanding of the molecular basis of how eukaryotic cells function in the context of whole organisms.

1. Students are expected to learn cell organelles, gene/protein nomenclature and the function of specialized cells.
2. Students are expected to gain a fundamental understanding of the molecular mechanisms that guide cell specialization as it pertains to mammalian physiology. Specifically, students will learn the mechanistic control of transcription, translation, cell cycle, the secretory pathway, central metabolism, cell signaling and aspects of development.
3. Students will learn critical reasoning skills, hypothesis development, experimentation, and some rudimentary molecular biology data analysis. The goal is to get them to integrate molecular and cellular mechanisms with physiological processes at the animal level.

**ASSIGNMENTS/RESPONSIBILITIES & ASSESSMENT:**

Students will be responsible for completing reading assignments and have a comprehensive understanding of cellular processes. Assessments will come from 2

exams (25% each, 50% total), a comprehensive final (30%) and 4 online quizzes (20%). The online quizzes will be multiple-choice and will be used to assess mainly Goal 1. Short answer questions on exams will be used to assess goal 2 and large comprehensive questions (1 or 2 per exam) will be used to assess Goal 3. Sample questions to assess the individual learning goals contained on typical exam questions will be as follows;

**Course Schedule**  
**T/F**

**Spring Term, 2014**

- Jan 21:** Course Overview, Introduction to Cells, and Cell Specialization in mammals  
(Reading assignment, Chapter 1 and Chapter 9).
- Jan 24:** Chemistry of cellular components and organelles: Nucleic acids, amino acids, polypeptides, and lipids  
(Reading assignment, Chapter 2)
- Jan 28** Proteins  
(Reading assignment, Chapter 3)
- Jan 31:** The Nucleus, genome structure and Chromatin  
(Reading assignment Chapter 4 pgs 197-219)
- Jan 4:** Chromatin regulation  
(Reading assignment Chapter 4 pgs 219-260)
- Feb 7:** DNA replication  
(Reading assignment Chapter 5, pgs 263-295)
- Feb 11:** DNA, Recombination and Repair  
(Reading assignment Chapter 5 pgs 295- 326)
- Feb 14:** Transcription and splicing  
(Reading assignment Chapter 6, pgs 329 -366)
- Feb 18:** **Exam #1**
- Feb 21:** Translation and the Ribosome  
(Reading assignment Chapter 6 pgs 366- 400)
- Feb 25:** Control of Gene expression  
(reading assignment, Chapter 7, pgs 411-476)
- Feb 28:** Post transcriptional control (miRNA and RNAi)  
(Reading assignment, Chapter 7, pgs 477-499)
- Mar 4:** Cell signaling and homeostasis  
(Reading assignment, Chapter 15, pgs 879-943 & Chapter 17, pgs 1101-1127)
- Mar 7:** Actin and Tubulin cytoskeleton  
(Reading assignment, Chapter 16 pgs 965-1010)
- Mar 11:** Motor proteins  
(Reading assignment, Chapter 16 pgs 1010-1050)
- Mar 14:** **Exam #2**

## **SPRING BREAK**

- Mar 24:** Cell cycle, cell division, mitosis and meiosis  
(Reading assignment, Chapter 17, 1054-1101)
- Mar 28:** Membrane Structure and The Secretory Apparatus  
(Reading assignment, Chapter 10, pgs 617-629, Chapter 12 pgs 695-704)
- Apr 1:** Membrane Proteins and Translocation into the ER and Nucleus  
(Reading assignment, Chapter 10 pgs 629-667 & Chapter 12, 723-745)
- Apr 4:** Vesicle transport  
(Reading assignment, Chapter 13, pgs 750-779)
- Apr 8:** Endosomes, lysosome and phagocytosis  
(Reading assignment, Chapter 13, pgs 779-809)
- Apr 11:** Ion Channels  
(Reading Assignment, Chapter 11, pgs 667-693)
- Apr 15:** Extracellular Matrix  
(Reading Assignment, Chapter 19, 1131-1178)
- Apr 18:** Mitochondria Transport and electron transfer  
(Reading Assignment, Chapter 12, pgs 713-720 & Chapter 14 813-840)
- Apr 22:** Metabolism and ATP synthesis  
(TBA)
- Apr 25:** Cellular stress, apoptosis and senescence  
(Reading Assignment, Chapter 18, pgs 1115-1129)
- Apr 29:** The cellular Clock  
(TBA)
- May 2:** Cellular differentiation, stem cells and hematopoiesis  
(On CD 1450-1463)
- TDB**      **Comprehensive Final Exam**