# Biology 2230 Course outline (2015)



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**PREAMBLE:**
Since this course is a second year BIOLOGY course, it will be **taught at a level suitable to second year Biology students** and assume introductory basic knowledge. Attempts will be made to help those with deficiencies. This will be through the tutorials, but those students will also need to do EXTRA READING to fill in any gaps. Some students opt for free additional tutoring provided by the Learning Center. I sympathize with those of you holding jobs, or if you have personal problems, but in the final analysis I have to be fair to everyone and cannot use dual marking scales.

**GOALS OF THE COURSE**
a) Quickly review the small molecules and macromolecules from which cells are built.
b) Discuss some methods used in cell biology – but Biology 2910 is designed to complement this course
c) Dissect the cell into cellular sub-compartments (organelles) and study organellar function in depth
d) Review the genetic systems of the cell at the level of gene replication and expression.
e) Emphasis will be placed on developing the basic vocabulary and concepts associated with cell and molecular biology.
f) Reading and writing exercises are used to remind students of the importance of written communication and critical thinking in science.

**TWO TEXTBOOKS**
**1. Molecular Biology of the Cell, 5th edition**, Garland Publishing, N.Y., London, 2008, Alberts et al.
Web link to the previous edition, which contains the course-relevant information, but cannot be browsed, only searched: http://www.ncbi.nlm.nih.gov/books/bv.fcgi?call=bv.View..ShowTOC&rid=mboc4.TOC&depth=2

**2. Reading Primary Literature - A practical guide to evaluating research articles in Biology**, Christopher M. Gillen, Pearson-Benjamin Cummins, San Francisco, 2007. This textbook is used for the weekly writing exercises. The ability to read and critically evaluate the content of scientific articles is the foundation of ALL aspects of biology (and science in general).

The lectures will be your study guide and will give you a feel for what is important and what is being emphasized in the course. You clearly will **not be able to, or expected to, learn all the details in the pertinent textbook chapters of "FAT ALBERTS".** However, you are responsible for both material covered in the lectures and material assigned as READING ONLY MATERIAL. The main lectures (Powerpoint presentations) are posted on the D2L link to this course.

| MARKING | PERCENT OF FINAL GRADE |
|---|---|
| Quizzes (first 2 @ 10%, last 3 @ 15% each) | 65% |
| Assignments 1, 2, 3, 4, 6, 7, 8 (3% each) | 21% |
| Critical evaluation of a paper # 5 | 4% |
| Specialized cell - writing assignment # 9 | 10% |
| **TOTAL** | **100%** |

**QUIZZES**
To ensure that continuous attention is given to the course, there will be **five unannounced quizzes** given in class throughout the course, for 65% of the total mark. Sample multiple choice questions will be given to you, **but short answer and fill-in blanks types of questions may be included**. There is no typical final exam in this course (the last quiz is scheduled during the exam period, though). This may imply to you that you don't have to pay attention to material from the early part of the course. THIS IS NOT THE CASE, the course builds on information acquired earlier and your ability to answer questions later in the course depends on the TOTAL SYNTHESIS of the body of knowledge acquired.

**SUPPLEMENTAL EXAMS POLICY:** There will be a supplemental exam given for one of the first two (10%) quizzes missed for medical or compassionate reasons (please, provide evidence) during the course. This will be done in one of the tutorial periods. **Additional second supplemental test will be open to all participants in the course, and will be scheduled as a short final exam, in the final exam period at the end of term.**

**OFFICE HOURS:**

Wednesdays 1-3 pm or by appointment. Marks, exam answers, assignment answers and additional course information will be posted on the D2L site and outside CB 3007. Completed assignments can be handed in on D2L or in a wooden box outside CB 3010A . **20% of assignment value will be deducted per each late day.**

**LECTURES AND TUTORIALS**

***Read assigned material before the lectures!!***

| **A) INTRODUCTORY (REVIEW) LECTURES AND TUTORIALS:** Microscopy, basic chemistry of small molecules and macromolecules, intro thermodynamics, proteins as enzymes. | | |
|---|---|---|
| ***READ** by January 16th or so: Fat Alberts Chapter 1, Chapter 2 (except p.88-103), Chapter 3 (except details of self-assembly, mathematics of enzyme kinetics, NO reaction mechanisms), Chapter 9 on microscopy; portions of Chapters 10 and 11 on membranes as covered in lectures.* | | |
| **Lectures:** | | **Reading:** |
| 1 | Course outline, Light and electron microscopy | 579 – 593 |
| 2 | Scanning electron microscopy, freeze fracturing | 604 – 610 |
| 3 | Slides - review of images of cells | |
| 4 | Chemical composition of cells,<br>Protein structure and diversity of proteins | (Ch 2) 45 – 121<br>(Ch 3) 125 – 190 |
| 5 | Membrane structure and lipids<br>Membrane transport | (Ch10) 617 – 648,<br>(Ch 11) 651 – 692 |
| 6 | Enzyme function | Ch 2, 3 |
| 7 | Metabolic role of enzymes, intro to thermodynamics | Ch 2, 3 |
| 8 | Energy and metabolic intermediates | Ch 2, 3 |
| 9 | Specific enzyme examples | |
| 10 | Regulation of enzymes and metabolic pathways | 169 – 171 |
| **B) INFORMATION FLOW IN CELLS: from nucleus/DNA to proteins and structure/function of cells:** | | |
| ***READ**: Alberts 5th ed - Chapter 4 (but many details of nucleosome structure and chromosome structure are not dealt with), Chapter 5 (to page 294, NOT DNA repair, recombination), Chapter 6 (no details of RNA splicing/processing, i.e. only material covered in lectures p.329-348; no RNA world pages 400-408), Chapter 7 - Prokaryotes and selected details from text dealing with Eukaryotes.* | | |
| 11 | Discovery of DNA as genetic material | No reading |
| 12 | Cell cycle, replication of DNA | 1053 - 58, 263 -295 |
| 13 | Details at the replication fork, topoisomerase, helicase | 263 -295 |
| 14 | Conversion of DNA to RNA, co-linearity, mRNA (tRNA, rRNA) synthesis, physical structure of a gene | 331 - 366 |
| 15 | RNA polymerase reactions | 333 - |
| 16 | Breaking the genetic code, RNA to protein co-linearity | 366 - 400 |
| 17 | Transfer RNA as the adapter, RNA synthetases | 366 - |
| 18 | Polyribosomes, rRNA and translation | 381 - |
| 19 | Nucleus - RNA processing, macromolecular movement in and out of the nucleus | 358 - 366 |
| 20 | Histones and gene regulation | 210 – 218 |
| 21 | Elaboration on gene regulation in Eukaryotes | 411 - 415 |
| 22 | Post-translational gene expression regulation by proteolysis | 477 - 497 |

| **C) GENETICALLY SEMI-AUTONOMOUS "energy" ORGANELLES:** |
|---|
| *Alberts 5th edition: Chapter 14, nearly the whole chapter, but not evolution issues and some of the details of techniques* |

| | | |
|---|---|---|
| 23 | Mitochondrion – electron transport and ATP synthesis | Ch 14: 815 - 838 |
| 24 | Mitochondrion as a genetically semi-autonomous organelle | 856 - |
| 25 | Photosynthetic reaction centers and electron transport | 840 - |
| 26 | Dark reactions and chloroplast genome | 841 |
| 27 | TBA | |
| **D) INTRACELLULAR COMPARTMENTS, PROTEIN SORTING, DNA TECHNOLOGY, CYTOSKELETON** | | |
| *Chapter 12 (Except details of nuclear pores, insertion of multiple pass proteins, but be aware of glycosylation mechanisms). Chapter 13 as covered in lectures. Chapter 8 only on DNA technology (no study of proteins). Chapter 16 – only introduction – Panel 16-1 and whatever detail will be given in the last lecture.* | | |
| 28 | DNA transgenic technology | Ch 8 |
| 29 | Import of proteins into chloroplasts and mitochondria | 713 - 721 |
| 30 | Peroxisomes | 721 - 723 |
| 31 | Golgi Body and exocytosis | Ch 13 |
| 32 | Endocytosis and lysosomes | 779 - 799 |
| 33 | Cytoskeleton | Ch 16 |

| **Tutorials:** | | **Date:** |
|---|---|---|
| T1 | Library orientation | TBA |
| T2 | Importance of carbon, water, chemical bonds, small molecules in living cells | January 14 |
| T3 | Review, questions & answers | January 21 |
| T4 | Polymeric molecules - polysaccharides, proteins, nucleic acids | January 28 – Assgt 1 due! |
| T5 | Review, questions & answers | February 4 |
| T6 | Introduction to DNA, Central dogma | February 11 |
| T7 | Review, questions & answers | February 25 |
| T8 | The operon concept and gene regulation | March 4 |
| T9 | Review, questions & answers | March 11 |
| T10 | Intro to mitochondrion, glycolysis, TCA cycle | March 18 |
| T11 | Review session, discussion of graduate work, financing research, careers | March 25 |
| T12 | Chloroplast structure | April 1 |

**ASSIGNMENTS**

Exercises in writing, reading and critical evaluation of **primary** scientific cell biology literature (i.e. scientific articles, NOT reviews, books, websites and dictionaries). **FOCUS ON CELL BIOLOGY**. All assignments will be based on articles from **cell biology journals**, or journals using molecular biology to answer questions pertaining to cell structure and function. No assignments based on microbiology, physiology, kinesiology, ecology or any other unrelated discipline.

| **Assignments:** | | **Percent of final grade:** | **Due:** |
|---|---|---|---|
| 1 | SECTION 2 EXERCISES 1-7 in Gillen (p. 6-7) | 3 | Wed. Jan 28 @ 4:30 pm |
| 2 | a) SECTION 3 EXERCISES 1-7 in Gillen ( p. 14-15) and<br>b) Literature Cited Exercise | 3 | Wed. Feb 4 @ 4:30 pm |
| 3 | SECTION 4 EXERCISES 1-9 in Gillen (p. 20) | 3 | Wed. Feb 11 @ 4:30 pm |
| | Reading week – work on assgts 4 and 5! | | |
| 4 | SECTION 5 EXERCISES 1-9 in Gillen (p.28-29) | 3 | Wed. Feb 25 @ 4:30 pm |
| 5 | **Critical Analysis of a scientific paper** | **5** | |
| 6 | SECTION 6 EXERCISES 1-7 in Gillen (p.37) | 3 | Wed. Mar 4 @ 4:30 pm |
| 7 | SECTION 7 EXERCISES 1-7 in Gillen (p.40-41) | 3 | Wed. Mar. 11 @ 4:30 pm |
| 8 | Applications of single cell or small colonial organisms | 3 | Wed. Mar. 18 @ 4:30 pm |
| 9 | **Cell types and diversity** | **9** | Wed. Mar. 25 @ 4:30 pm |

Format: no title page – top of first page: your full name, student ID #, assignment number and title.
Select a **different article for each exercise** - all related to **cell biology**

**DESCRIPTION OF ASSIGNMENTS:**

**Llibrary orientation** Prior to doing the assignments attend the library orientation session. You will be guided through some of the features of our library system, particularly the primary literature searching systems. This will help you in dealing with some of the subsequent assignments and in finding information for assignments in other Biology courses.

**Assignment 1** Read 'Finding Research Articles' (Gillen pages 1 to 6, answer questions on p. 6-7). If you can't think of any topic of interest to you, you may use these keywords as a guide: fluorescence microscopy, essential fatty acids, RNA polymerase, histones.

**Assignment 2 - parts a) and b)**

**a)** Read "The Anatomy of a paper" (Gillen page 7 to 14) and answer Section 3 Exercises (on pages 14-15). WRITING A "LITERATURE CITED" SECTION. Examine the structure of the last section of scientific articles in several cell biology journals, variously entitled: References, Literature Cited, Bibliography, etc. This section lists the primary articles, as well as reviews and book chapters the authors have used to: A) introduce the topic of their research in the Introduction section of their article and B) evaluate their own results against in the Discussion section.

**b)** Prepare a 'Literature Cited' section in the style of the journal **Plant Physiology** containing five to six references only. (*http://www.plantphysiol.org/site/misc/ifora.xhtml#TEXT%20REQUIREMENTS*) Watch for: capitalization, bolding of **author** names and journal volume, punctuation and of course spelling. TOPICS: 1) Cell cycle regulation; 2) protein degradation via the ubiquitin and proteasome system; 3) DNA replication (NOT repair); 4) protein structure - any protein.

**Assignment 3** Read "The Introduction" (Gillen, pages 15 - 20, answer questions on page 20). Select a different article from that used for Exercise 2, provide the article's title page with the Abstract with your assignment.

**Assignment 4** Read "The Materials and Methods" (Gillen, pages 20 to 28, answer questions on pages 28 - 29). Select a different article from those used previously, provide the article's Abstract with your assignment.

**Assignment 5 CRITICAL ANALYSIS OF A SCIENTIFIC PAPER**

Search the internet for a SHORT primary research article on DNA replication, transcription or translation (i.e. any aspect of the central dogma). **Submit a printed version of the article stapled to your report**
In two additional pages MAXIMUM (double spaced, 12 pt font), critique the paper based on the points below. This can be a positive or negative criticism. In general, you should focus on the following:

1. What is the scientific significance and originality of the findings – are the authors making (1) significant new contribution to the field, (2) only slight modification of previously made observation(s), or (3) something in between?
2. Is the approach and experimental design appropriate – i.e. do the methods serve to answer the question well? Are the methods appropriate?
3. Are the statistical methods applied valid – adequate – required?
4. Is correct scientific nomenclature adhered to? Use of platitudes/slang/excessive jargon?
5. Are the conclusions reached sound and borne out by the experimental data, Figures and Tables appropriate?
6. Is the paper organized well? Appropriate information in the appropriate sections? Is it repetitious? Is the discussion relevant to the topic?
7. Are there outright errors in calculations, spelling, grammar, sentence structure – if clarity is lacking point this out in the printed article (by underlining or highlighting).
8. Is the title appropriate and does the abstract reflect the article content?
9. Are the citations used correctly – according to instructions, consistent in format and their contents interpreted correctly?

Clearly, you are not yet experts in the field, and will have some difficulty with this challenging assignment. However, the principles of this exercise should be used by you when reading and interpreting primary scientific literature in the future. Furthermore, in your own writing, you should always ask if your paper meets the relevant criteria outlined above. In this instance, you will be evaluated not too harshly on your ability to START looking at a scientific paper critically, and to put your own personal (justified) views and interpretation down on paper.

**Assignment 6** Read "The Results" Gillen Section 6, pages 29 to 37, answer questions on page 37). Select a different article from those used previously, provide the title page with the Abstract with your assignment.

**Assignment 7** Read "The Discussion" Gillen Section 7, pages 38 to 41, answer questions on pages 40-41. Select a different article from those used previously, provide the title page with the Abstract with your assignment.

**Assignment 8 APPLICATIONS OF SINGLE CELL or SMALL ORGANISMS**

Perform a primary literature search (**NOT WEB SEARCH** – see library orientation, Exercises 1 and 2) for any single-celled free living organism, trying to find out commercial, i.e. biotechnological application; disease this organism causes, or any other interesting feature/use of this organism which grabbed your attention. (Yeast for beer is already taken!)
Write **up to three sentences** describing ONE commercial application of one of the organisms. If the application is only a potential one, i.e. yet to be realized, make sure you mention this. **Include a photocopy or computer print out of the front page of the article you worked with.** Select a different article from those used previously. You may use the following species list as a guide:
Protozoans - *Calcarina* sp., *Giardia lamblia, Plasmodium sp.*
Fungi and yeasts – *Armillaria* sp., *Aspergillus* sp., *Penicillium* sp., *Saccharomyces sp. Candida albicans.*
Algae/Diatoms – spp. *Ulva , Botryococcus, Scenedesmus, Asterionella, Cyclotella, Chlamydomonas reinhardtii, Peridinium*
Prokaryotes – *Spirulina* sp., *Agrobacterium tumefaciens, Thiomargarita namibiensis*

**Assignment 9 CELL TYPES and DIVERSITY**

**Part1.** LABELED TRANSMISSION ELECTRON MICROGRAPH AND CAPTION (Figure legend). Perform a search for images and primary information on a **cell type of your choice**, selected from any **multicellular** organism. Use scanned images from library books or journals. MAKE SURE YOU SELECT LARGE IMAGE to work with, so it prints at a decent quality level. Print an image of the cell type at nearly full page size at a minimum of 600 dpi resolution. Write a descriptive figure caption **suitable for publication.** I.e. in a minimalist way tell the reader what the subject is, what the magnification is and by what method the image was prepared.

**Part 2.** Write a short paper dealing with the structure/function of the cell type you selected. Focus on interesting aspects of the cell, how it differs from "typical" cell" and what further information would be interesting based on future research. This should be essentially a Discussion of the image selected. It should be **less than** 2 pages double spaced, 12 point script, **including** title and your name (no need for title page). The well formatted **primary** references and the image/legend page are additional to the allowed 2 page text limit.

Provide an interesting and readable discussion of the cell, frequently relating to and expanding on the accompanying electron micrograph image. But less is often more!!! Do not include pages of text with everything that is known about the cell!!! Do NOT plagiarize, especially from the Internet. The Faculty of Science and Environmental Studies is implementing TurnitIn software to detect plagiarism.

Work individually and make sure you submit a scientifically **unique essay based on YOUR individual work and understanding of the topic**, which may **paraphrase** and **critique** the original work and expand it slightly for more general audience. Slight modifications of the same paper submitted by two or more students will be considered plagiarized and authors will be penalized.

The purpose of the exercise is to introduce you to the variety cell types found in higher organisms, and to teach you how to communicate scientific information in the form of a short Discussion of a specific Figure. Your target audience is not a group of scientists and graduate students, but your own peers, instructors and the general public, (i.e. aim the language level accordingly, define terms as needed, etc.). Your goal is to teach others enthusiastically about the cell type you selected and its function within the organism.

**Evaluation:**

| | | |
|---|---|---|
| Ability to follow instructions | | 3/3 |
| Overall neatness and image quality, topic selection | | 5/5 |
| Content – factual information, logical organization of the discussion | | 5/5 |
| Critical analysis - your OWN interpretation(s) | | 3/3 |
| Grammar/syntax | | 4/4 |
| **TOTAL** | **(10% of final grade)** | **20pts** |