

Biology 2230 Course outline (2014)

Instructor: Ladislav Malek, office CB 4050,

lada.malek@lakeheadu.ca

<http://saximontana.lakeheadu.ca>

Lab assistant and marker: Jessica Grochowski

jmgrocho@lakeheadu.ca

Preamble:

The course historically suffered from the varied background of entering students. This ranges from no background in biology to good high school and subsequent university exposure to the introductory topics such as genetics and chemistry. 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.

Serious attempt 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 highly recommend developing a small social group which meets regularly for coffee/beer/whatever, to review the course material. Isolated students tend to fall through the cracks. 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.

Introductory lecture (L0)

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 greater depth than in previous courses.
- d) Review the genetic systems of the cell at the level of gene replication and expression. DNA technology will be introduced in one lecture.
- e) Whenever possible, examples of societal relevance of specific issues will be brought up.
- f) Emphasis will be placed on developing the basic vocabulary and concepts associated with cell and molecular biology. Reading and writing exercises are used to remind students of the importance of written communication and critical thinking in science.

DUAL NATURE OF THE COURSE

I get two types of students in this course - those who have a fairly good background in biology, and have heard about "central dogma" issues "*ad nauseam*" and those who are very new to cell biology. The first group tends to get bored, and hence I have developed two or three additional lectures dealing with more interesting and current issues of cell biology. Some of the preliminary material that is a review of cell basic chemistry and genetics will be covered in the tutorials, and is aimed in particular at students who have

had limited exposure to these basic concepts. In that respect, the tutorials are of extreme value to those of you who don't feel confident about the foundations of biology.

TWO TEXTBOOKS

1. The comprehensive Alberts *et al.*, *Molecular Biology of the Cell*, 5th edition, Garland Publishing, N.Y., London, 2008 is used. This web link is 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>

This book is particularly valuable to those continuing in the field of biology and is also used in Biology 2910 and 3330). The book is also available in e-format (I believe for Kindle users) at <http://tandf.msgfocus.com/c/1cQ0jasvjwvS0z1Odg4vWWCGH>. If this link does not work, go to Garland Publishing website to look for it.

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 particularly responsible for material covered in the lectures and material assigned as **READING ONLY MATERIAL**. The early tutorials will be of primarily remedial type: i.e. the review of basic concepts of genetics and chemistry. The enhancement material **WILL BE** on the tests, but you will have to take your own notes. The main lectures (Powerpoint presentations) are posted on the Internet and can be found at:

<http://saximontana.lakeheadu.ca/> Select Courses section and log in using the phrase (without the quotation marks) "bio2230" as login name and ALSO as a password.

Additional guest lecture Powerpoints will be e-mailed to the class.

Make sure you study from the textbook if you want to do better than a B grade.

2. Textbook for the weekly writing exercises:

Christopher M. Gillen, *Reading Primary Literature (A practical guide to evaluating research articles in Biology)*, Pearson - Benjamin Cummins, San Francisco, 2007. I had student comments in the past that this material is irrelevant to cell biology - the opposite is true. The ability to read and critically evaluate the content of scientific reports is the foundation of ALL aspects of biology (and science in general). Skills in critical evaluation of scientific information will be elaborated on and improved in upper level courses. This is just the beginning.

QUIZZES

To ensure that continuous attention is given to the course, there will be five unannounced quizzes given 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**. I may also incorporate MCAT and GRE general questions, since cell biology comprises a good part of these tests. 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.**

MARKING

A significant portion of this course is dedicated to the critical analysis of the structure and content of scientific articles. With 100 or so students it is impossible to mark long essays. At least some attempt is made to improve your writing skills. Scientific writing, reading and graphical data presentation are practised in Bio 2910 Lab biology in much greater detail.

Course marking:

Quizzes (first 2 @ 10%, last 3 @ 15% each)	65%
Writing and reading assignments 1, 2, 3, 4, 6, 7, 8 (7 x 3%)	21%
Critical evaluation of a paper # 5	5%
Specialized cell - writing assignment # 9	9%
TOTAL	100%

SUPPLEMENTAL EXAMS POLICY: There will be first 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:

Wednesday 10-11AM or APPOINTMENT BY E-MAIL. Marks, exam answers, assignment answers and additional course information will be posted in or near a glassed-in cabinet outside CB 3007.

Completed assignments are to be placed in a wooden box outside CB 3010A AT THE LATEST by the morning of the day after the due date. **20% of assignment value will be deducted per each late day.**

Course curriculum and textbook chapters to read.

Sections of **FAT ALBERTS (5th edition - previous edition references are ~~crossed-out~~)** covered (attendance of lectures will ensure that you know what was actually dealt with).

READ THIS MATERIAL BEFORE THE LECTURES!!

INTRODUCTORY (REVIEW) LECTURES AND TUTORIALS: Microscopy, basic chemistry of small molecules and macromolecules, introductory thermodynamics, energy relations, proteins as enzymes. READ, by January 16th or so:

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, only as covered in lectures.

Lectures will be presented in the indicated order, however, due to a change in schedule to 1.5 hr lectures, the 33 lectures will be variously combined into 22 lectures. Two or three additional lectures on protein turnover and epigenetics will be inserted at appropriate points.

Lecture/tutorial #

- 1 Light and electron microscopy
- 2 Scanning electron microscopy, freeze fracturing
- 3 Slides - review of images of cells
- 4 Chemical composition of cells, protein structure

5	Diversity of proteins
6	Lipids and membranes
7	Metabolic role of enzymes, intro to thermodynamics
8	Energy and metabolic intermediates
9	Specific enzyme examples
10	Regulation of enzymes and metabolic pathways
T1	Library orientation
T2	Importance of carbon, water, chemical bonds, small molecules in living cells
T3	Polymeric molecules - polysaccharides, proteins, nucleic acids

INFORMATION FLOW IN CELLS: from nucleus/DNA to proteins and structure/function of cells. READ:

Fat Alberts 5th edition:

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 all to page 440 (Prokaryotes only) and selected details from text dealing with Eukaryotes.

11	Discovery of DNA as genetic material (other textbooks, handouts)
12	Cell cycle, replication of DNA
13	Details at the replication fork, topoisomerase, helicase
14	Conversion of DNA to RNA, co-linearity, mRNA (tRNA, rRNA) synthesis, physical structure of a gene
15	RNA polymerase reactions
16	Breaking the genetic code, RNA to protein co-linearity
17	Transfer RNA as the adapter, RNA synthetases
18	Polyribosomes, rRNA and translation
19	Nucleus - RNA processing, macromolecular movement in and out of the nucleus
20	Histones and gene regulation
21	Elaboration on gene regulation in Eukaryotes or other guest lecture
22	Post-translational gene expression regulation by proteolysis
T4	Introduction to DNA, Central dogma
T5	The operon concept and gene regulation
T6	Review, questions & answers
T7	Intro to mitochondrion, glycolysis, TCA cycle
T8	Review session, discussion of graduate work, financing research, careers

**GENETICALLY SEMI-AUTONOMOUS “energy” ORGANELLES
YOU NEED TO KNOW MATERIAL FROM THE FIRST PART OF THE
COURSE TO UNDERSTAND THESE CHAPTERS!!!**

Fat 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
24	Mitochondrion as a genetically semi-autonomous organelle
25	Photosynthetic reaction centers and electron transport
26	Dark reactions and chloroplast genome

- 27 *Chlamydomonas* as an experimental system or other topic on my research
- 28 DNA transgenic technology
- T9 Chloroplast structure

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 Import of proteins into chloroplasts and mitochondria
- 29 Peroxisomes
- 30 Golgi Body and exocytosis
- 31 Endocytosis and lysosomes
- 32 Cytoskeleton

EXERCISES IN WRITING, READING AND CRITICAL EVALUATION of **primary scientific cell biology literature** (i.e. scientific articles, NOT reviews, books, websites and dictionaries). Completed assignments are to be placed in the box outside CB 3010A. Due to the size of the class, relative simplicity of the assignments, late returns (beyond 2 days, i.e. after 40% grade has been deducted) will not be accepted except for medical or compassionate reasons. **ELECTRONIC SUBMISSIONS WILL NOT BE ACCEPTED** - make arrangements with a friend or the Learning Assistance Center to get a **hard copy** into the assignment box or to my Biology office mailbox IF LATE. Since I prefer brevity, a separate title page is NOT required. Simply put on the top of the page: your full name, title of the assignment and number of the assignment – any additional information is superfluous.

PRIVACY ISSUES – assignment binder

Lakehead University privacy policy in a misguided and unworkable way demands that we return assignments to students on an individual basis. To get around this unworkable policy, I ask that, **if you are concerned about your grade privacy**, you place your assignments CUMULATIVELY (i.e. keep adding new assignments) into a **thin** binder or re-sealable envelope, which I will SEAL after grading, and return with the rest of the assignments in class. Those not attending classes will not be able to get their assignments back, as we are not permitted to leave them unguarded outside of our offices. If database grade entry corrections need to be made due to marking or entry errors, these have to be brought to my attention within 2 weeks of receiving the grade, NOT at the end of term!

FOCUS ON CELL BIOLOGY

All assignments will be based on information obtained from **cell biology journals**, or journals using molecular biology to answer questions pertaining to cell structure and function. In other words assignments based on microbiology, physiology, kinesiology, ecology or any other unrelated discipline will automatically receive a grade of only 10% of total. DO NOT ask or e-mail me or the teaching assistant regarding the suitability of a particular article. Use the course content as a guide to what I consider relevant topics for this course.

Exercise 1. LIBRARY ORIENTATION and Gillen pages 6-7, Section 2 exercises 1 to 7. (January 15th, due Jan 20) NOTE: The Monday deadlines imply that I have to be able to find the report in the assignment box (outside CB 3010) by morning the following Tuesday. You may have some grace time until whenever I remember to empty the box, usually later in the day.

Attend library orientation sessions on Wednesday, Jan. 15th, 2013 in the regularly scheduled time slot. 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.

Answer Section 2 exercises in Gillen. 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.

Exercise 2a. Read Gillen Section 3: “The Anatomy of a paper” (page 7 onwards) and answer Section 3 Exercises (on pages 14-15). **WRITING A “LITERATURE CITED” SECTION.** (DUE January 27th)

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.

Exercise 2b (Also due Jan 27th). Pretend you are preparing an article on one of the topics listed below, go to the library or use computer to search for **PRIMARY** literature on **ONE** of the topics and prepare a Literature Cited section in the current style of the journal **Plant Physiology**

(<http://www.plantphysiol.org/site/misc/ifora.xhtml#TEXT%20REQUIREMENTS>) containing five to six (6) references only (i.e. make sure you use an article from a recent **printed issue** of *Plant Physiology* as your model (or **pdf format** if you use electronic version of the article, **HTML format looks DIFFERENT!**), watch for: capitalization, **bolding of Author names and Journal volume**, punctuation and of course spelling - this is critical, particularly in the computer age. Incorrect spelling will not later retrieve appropriate information from computer databases).

NOTE: To save space, scientific articles use abbreviated names of journals, usually in the Bibliography section. For example the Canadian Journal of Botany has a standard abbreviation Can. J. Bot. (even the periods are sometimes deleted to save space - Can J Bot). I don't insist at this stage that you use the correct "approved" standard abbreviations. Either spell out the full journal name, or make up your own abbreviation. But, for future reference, the standard abbreviations can be found on the Internet. The Web of Science list may be the most relevant to use, since many of your literature searches will be based on their system: http://images.webofknowledge.com/WOK46/help/WOS/A_abrvjt.html

TOPICS: 1) Cell cycle regulation; 2) protein degradation via the ubiquitin and proteasome system; 3) DNA replication (NOT repair); 4) protein structure - any protein.

The following is an example of the ludicrous variety of ways to format the citation of THE SAME RESEARCH PAPER in different scientific journals (name of journal requiring this format is in brackets at the end of each citation). The example is based on a letter from S. Sperti *et al.*, Nature 393:301, 1998. The present and future generation of scientists will have to work on standardization of bibliographic citations. For the moment you will have to conform, accept the system and recognize the subtle differences in preparing your own reports. The operative word in writing report bibliographies is **CONSISTENCY** required by the specific journal you are submitting an article to. The following example is as inconsistent as can be. If you look at each citation closely, you will see it is set up differently from all the others (order of items, punctuation, bolding, italics, placement of initials, etc.):

Scott,T.A., White, B. & Nero,C. Money and Nature. *J. Biol. Chem.* **500**, 600-612 (1998). (Nature)
Scott TA, White B, Nero C. 1998. Money and Nature. *J. Biol. Chem.* **500**, 600-612. (J. Exp. Bot.)

Scott TA, White B, Nero C (1998) Money and Nature. *J Biol Chem* 500: 600-612 (Planta)

Scott TA, White B, Nero C. 1998. Money and Nature. *J Biol Chem* 500: 600-612. (RNA)

Scott, T.A., White, B. and Nero, C., Money and Nature. *J. Biol. Chem.* **500**: 600-612. (Eur. J. Immunol.)

Scott,T.A., White,B. and Nero,C. (1998) Money and Nature. *J. Biol. Chem.,* **500**, 600-612. (Embo J.)

Scott, T.A., White, B. and Nero, C. (1998) Money and Nature. *Journal of Biological Chemistry,* **500**, 600-612. (Toxicon)

Scott, T.A., B. White. and C. Nero. 1998. Money and Nature. *J. Biol. Chem.* 500:600-612. (J. Exp. Med.)

Scott, T. A., B. White, and C. Nero. 1998 Money and Nature. *J. Biol. Chem.* 500: 600. (J. Immunol.)

Scott TA, White B, Nero C. Money and Nature. *J Biol Chem* 1998, **500**, 600-612. (Eur. J. Cancer)

Scott TA, White B, Nero C. Money and Nature. *J Biol Chem* 1998, **500**:600-612. (Clin. Exp. Immunol.)

Scott, T. A., White, B., and Nero C. (1998) *J. Biol. Chem.* **500**, 600-612 (J. Biol. Chem.)

Scott, T. A., White, B. and Nero C. (1998) *J. Biol. Chem.* **500**, 600-612 (Biochem. J.)

Scott, T.A., White, B. and Nero, C. (1998) *J. Biol. Chem.* 500, 600-612. (FEBS Lett.)

Scott,T.A., White,B. and Nero,C. (1998) *J. Biol. Chem.* **500**, 600-612. (Nucl. Acids Res.)

T.A. Scott, B. White, C. Nero *J. Biol. Chem.* **500**, 600 (1998) (Science)

Exercise 3. “The Introduction” (Gillen, pages 15 - 20, answer questions on page 20, due Feb 3rd). Select a different article from that used for Exercise 2, provide the title page with the Abstract with your assignment.

Exercise 4. “The Materials and methods” (Gillen, pages 20 to 28, answer questions on pages 28 - 29, due Feb 10th). Select a different article from those used previously, provide the title page with the Abstract with your assignment.

Exercise 5. “The Results” Gillen Section 6, pages 29 to 37, answer questions on page 37, due March 3rd). Select a different article from those used previously, provide the title page with the Abstract with your assignment.

Exercise 6. CRITICAL ANALYSIS OF A SCIENTIFIC PAPER (NOTE: due March 3rd (same as exercise 5) – this gives you a chance to recover from the reading week!). Select a different article from those used previously, provide a copy of the article as instructed below.

General suggestions: use past tense when referring to work in the report, but present tense where appropriate, since you are evaluating the report NOW; don't forget to *italicize* foreign words, particularly Latin genus and species names - the convention is capital for genus name, lower case letter for species name, eq. *Drosophila melanogaster*. Use **active voice** (I, we will do such and such...), not passive voice (IT will be done)! This is a departure from the old fashioned way you were taught to write lab reports in high school and perhaps in other courses. The modern way is to take responsibility for your own work and use **ACTIVE VOICE!**

Assignment:

Search the internet for a SHORT primary research article on DNA replication, transcription or translation (i.e. any aspect of the central dogma). Long articles in top notch journals may be more difficult to deal with, so don't aim too high! **Submit a printed version of the article stapled to your report – you may correct specific mistakes in the printed version.**

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 (relative weight/importance - in % - given in brackets):

(20%) What is the scientific significance and originality of the findings – are the authors making (1) significant new contribution to the field, (2) only incremental, slight modification of previously made observation(s), or (3) something in between?

(10%) Is the approach and experimental design appropriate – i.e. do the methods serve to answer the question well? Are the methods appropriate?

(10%) Are the statistical methods applied valid – adequate – required?

(10%) Is correct scientific nomenclature adhered to? Use of platitudes/slang/excessive jargon?

(10%) Are the conclusions reached sound and borne out by the experimental data, Figures and Tables appropriate?

(10%) Is the paper organized well? Appropriate information in the appropriate sections? Is it repetitious? Is the discussion relevant to the topic?

(10%) Are there outright errors in calculations, spelling, grammar, sentence structure – if clarity is lacking point this out in the printed article (by underlining)?

(10%) Is the title appropriate and the abstract reflect well the article content?

(10%) 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. In third and fourth year, you will be expected to be critical when preparing essays, posters, lab reports and oral presentations.

Exercise 7. “The Discussion” Gillen section 7, pages 38-41, answer Section 7 exercises, due March 10th). Select a different article from those used previously, provide the title page with the Abstract with your assignment.

Exercise 8. APPLICATIONS OF SINGLE CELL or SMALL COLONIAL ORGANISMS. (Due March 17th)

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. 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*

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.

Exercise 9. CELL TYPES and DIVERSITY - (due March 24th)

Part 1. LABELED TRANSMISSION ELECTRON MICROGRAPH AND CAPTION (Figure legend). Perform a library (not Google) search for images and primary information on a cell type of your choice (use Fat Alberts as your initial inspiration), selected from any multicellular organism. Use scanned images from library books or journals. Or use the image search capability of Google on the Internet, but **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**. On a separate page or the back of the image, 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 (NOT just 5000x or similar, i.e. even approximate scale bar if this is missing in the original) 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, using knowledge you gained in the rest of the course. 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 (and used!) **primary** references and the image/legend page are additional to the allowed 2 page text limit).

DO NOT repeat the above statements of the assignment as opening sentences – just plunge into 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. In other words apply the skills you have learned in the tutorial part of the course. 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.

Submit a hard copy of the essay by Wednesday, the 28th of March (If plagiarism is suspected, you will be asked to submit an electronic version of your essay to lada.malek@gmail.com). Standard rules for late submissions apply.

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	20pts (10% of final grade)

ADDITIONAL USEFUL MATERIALS.

Bibliography and library call numbers of useful guides to effective scientific writing:
Barrass, R., Scientists must write. Chapman and Hall, London, 1978. (T11 B37)

Fassler Walvoord, B.E., Helping students write well. A guide for teachers in all disciplines. The Modern Language Association of America, N.Y., 1982 (PE 1408 W31336)

Heffernan J.A.W. and J.E. Lincoln, Writing; A College Handbook, 2nd Ed., W.W. Norton & Co., N.Y., London, 1986. (PE 1408 H438, 1986)

Hughes, K. and J. Vinall-Cox, The report writer's manual, Mosaic Press, Oakville, ON, 1985 (PE 1478 H84)

Tichy, H.J., Effective writing for Engineers, Managers and Scientists, 2nd Ed., J. Wiley & Sons, N.Y., Chichester, Brisbane, Toronto, Singapore, 1988. (PE1475, T53, 1988)

THIS BOOK IS NOW A REQUIRED STANDARD IN THE BIOLOGY DEPARTMENT:

Moore, R., Writing to learn biology, Saunders College Publishing, 1992. You may consider buying it and reading it early.

As a future professional biologist, you should make it a habit to read regularly some scientific journals. The weeklies **Nature** or **Science** are good sources of information on science policy and international science news. They also contain top quality research reports in various scientific disciplines (you can only scan the abstracts of these very specialized articles - Nature has a section which summarizes in a popular writing form the contents of the detailed reports). Regularly scan a few journals of immediate interest to you.

UNNECESSARY WORDS (FYI)

Student writers are notorious for using piles of unnecessary verbiage (perhaps in an attempt to sound “scientific”?). Good scientific writing is quite simple, making its point in a forceful language limited in the use of technical terms.

The following pages give samples of two or more word sequences in which at least one word can be eliminated. Go through this list and **CROSS OUT NEEDLESS WORDS**. The edited word list will be posted so you can verify your choices. Keep this list when writing papers and reports in the future.

Unnecessary words which can be deleted:

separate entities	entirely eliminated	two different methods
currently being	few in number	absolutely essential
had done previously	personal opinion	each and every
none at all	reduce down	10 a.m. in the morning
joint cooperation	separate out	advance notice
any and all	disappear from sight	general consensus
completely finish	come to an end	absolutely complete
future plans	for the purpose of	assembled together
unexpected surprise	duly noted	exactly the same
bisect into two parts	mutual cooperation	in close proximity
one and the same	red in colour	after the conclusion of
blame it on	already existing	due to the fact that
actual facts	currently underway	in order to
basic essentials	never before	near the place of
definite decision	continue to remain	completely unanimous
usual custom	first began	cooperate together
subject matter	mix together	endorse on the back
equally as effective	private industry	final outcome
two equal halves	the question as to whether	personal friend
have need for	basic and fundamental	combine together
any and all	various differences	consensus of opinion
full and complete	each individual	end product
various different	if at all possible	hurry up
near the vicinity of	perform a study	by means of
unusual in nature	join together	advance planning

active consideration
baffling enigma
conclusive proof
advance reservation
close proximity
brief in duration
merge together
repeat the same
until such time as
the actual number
conclusive proof
stunted in growth
hard evidence
assemble together
during the course of
revert back
advance plan
current status
repeat again
balance against one another
during the course of
because of the fact that
absolutely essential
quite impossible
past experience
combine into one
first and foremost
all of
necessary requisite
in between
file away
close scrutiny
enclosed herewith
by means of
equal halves
at a later date
join/blend together
for the purpose of
new initiatives
close proximity

slow up
hectares of land
all throughout
large in size
exactly identical
underlying purpose
viable solution
past experience
joint partnership
while at the same time
at the time when
and so on and so forth
completely finish
each individual
initial preparation
absolute necessity
basic fundamentals/essentials
honest truth
this particular instance
range all the way from
excess verbiage
nominated for the position of
completely surround
wholly new
rarely ever
final outcome
refer back to
uniformly consistent
debate about
still remain
protrude out
consequent results
entirely eliminate
serious crisis
end result
smaller in size
is defined as
continue on
mix together
completely eliminate

previously found
total of 30 people
ask the question
period of time
authentic replica
young juvenile
past medical history
ultimate outcome
viable alternative
introduce a new
most unique
wish to thank
plan ahead for the future
science of biology
spherical in shape
in connection with
resume again
overall plan
whether or not
by means of
refer back
make a study of
deliberately chose
customary practice
any and all
one and the same
different species
cancel out
repeat again
circulate around
write up
definite proof
in conjunction with
subject matter
if it is assumed that
in between
completely full
early beginnings
recur again