BC 378 MOLECULAR BIOLOGY SPRING 2008

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The goal of this course is to familiarize you with the exciting and rapidly advancing field of molecular biology and with some of the techniques that are used by molecular biologists. We will focus our attention primarily on eukaryotic organisms but will also consider some of the ways in which bacteria differ from us in their molecular mechanisms.

It is assumed that students in BC378 will have a good background in basic cell biology and genetics. If you have forgotten what you learned about these topics in BI163/164 and in BI279 it would be a good idea to go back and review them before the class begins.

COURSE REQUIREMENTS

Readings - Assignments from the textbook (Molecular Biology of the Gene [sixth edition] by J.D. Watson et al.) should be read before the corresponding class period. In addition to readings from the textbook, a few articles from the scientific literature will be assigned throughout the semester.

Class sessions - M, W, F at 10:00 in Olin 234 - Class periods will consist of lectures and discussion roughly following the schedule shown on page 4. For the exams you will be responsible for all material covered in class. If you miss a class period, be sure to find out what we covered by getting notes from another student.

Labs – Tuesday/Wednesday at 1:00 in Olin 213 - The length of the lab period will depend on how long it takes to finish each experiment and we will not always finish at the same time. We may also need to do a limited amount of lab work on other days. You are expected to keep a well-organized lab notebook while doing the experiments. You will also be responsible for turning in a research paper reporting the results of your experiment on *RBCS* gene expression.

Exams - There will be two exams during the semester and one final exam during exam week.
Exam I - 6/7 March
Exam II - 17/18 April
Pick up these exams in the box outside the Biology Dept. office.
Complete the exam in the Science library.
These are closed book exams - no books or notes may be used.
When finished, place them in my mailbox (by 5:00).
Final Exam - (exam period #1)
This will be a comprehensive exam over all material covered during the semester.
This is a closed book exam - no books or notes may be used.

Material available on the course web site – The syllabus, laboratory handouts, problem sets and other important materials for this course will be available electronically from the BC378 web site. Please be sure that you access the necessary documents and print them out by the time that you need them.

http://.colby.edu/academics_cs/courses/BC378/index.cfm

Papers - You will be responsible for turning in one lab research paper and one literature review paper during the semester.

Lab research paper - due 4 April. Requirements for the research paper are described in detail on page 6.

Literature review - due 7 May. Requirements for the literature review are described in detail on page 7. (don't wait until the last minute to get started on this)

Lab notebook - Your lab notebook should include a complete, well-organized, and legible record of the work that you did. Requirements for the lab notebook are described in detail on p7. Each section of your lab notebook must be completed and turned in by 5 pm on the indicated due date.

ATTENDANCE

You are expected to attend all classes and labs as we will be doing something important every day. If illness or other extenuating circumstances cause you to be absent you will be responsible for making up the work missed.

OFFICE HOURS

A schedule of office hours will be posted outside of my office door. Please come and talk to me if you have any questions regarding the material in this course or any issue of concern to you.

GRADING

Exam I	16% of total semester grade
Exam II	16%
Final Exam	28%
Review paper	15%
Lab paper	13%
Lab notebook	12%
	100%

Grades will be determined based on the following scale. Other less quantifiable factors such as class participation, laboratory performance etc. may also be taken into account, especially in the case of students whose final percentages fall on the borderline between two letter grades.

94 - 100	A
90 - 93	A-
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 69	D+
63 - 66	D
60 - 62	D-
00 - 59	F

Plagiarism, cheating, and other forms of academic dishonesty are serious offences. The instructor may dismiss the offender from the course with a mark of F and will report the case to the department chair and the dean of students, who may impose other or additional penalties including suspension or expulsion. (Colby College Catalog)

DATE	TOPIC	READING
FEB 06 W	introduction	1-5
08 F	the concept of genes	1-5 Pearson*
11 M	nucleic acid chemistry	6 (101-110)
13 W	nucleic acid structure	6 (110-116, 127-131)
15 F	nucleic acid analysis	21 (739-745, 753-760)
18 M	genomes	7 (135-144)
20 W	chromosomes	7 (144-147, 156-162)
22 F	chromosomes	7 (169-174, 182-187)
25 M	DNA replication	8 (247-254)
27 W	transposons	11 (334-343, 347-348)
29 F	transposons	11 (354-358, 363-364) Pennisi♠
MAR 03 M	retroviruses	11 (349-350)
05 W	gene expression-overview	
07 F	gene structure (**EXAM I**)	
10 M	transcription	12 (377-382)
12 W	transcription	12 (396-410)
14 F	RNA processing	13 (415-422, 430-445)
17 M	mRNA and tRNA	14 (457-469)
19 W	translation	14 (469-487)
21 F	translation	14 (487-499, 511, 516-517)
SPRING BREAK ----------		
31 M	the genetic code	15 (all)
APR 02 W	protein localization	
04 F	protein localization	(Lab research paper due)
07 M	gene regulation	16 (553-555) 17 (589-597)
09 W	gene regulation	17 (597-606) 21 (776-777)
11 F	gene regulation	17 (620-625) 18 (641-649, 654-655)
14 M	gene regulation	Mathonnet et al.@
16 W	gene cloning	21 (746-751)
18 F	gene cloning (**EXAM II**)	
21 M	sequence analysis	20 (703-707, 711-714) Brent♦
23 W	measuring gene expression	
25 F	measuring gene expression	19 (662) 21 (778-780) 20 (708-711)
28 M	transgenic plants	22 (798-800)
30 W	transgenic animals	22 (810-816)
MAY 02 F	use of transgenic organisms	
05 M	gene expression/research techniques	Tyagi et al.#
07 W	the cell cycle	(Literature review paper due)
09 F	oncogenes	

*__Pearson H__ (2006) What is a gene? Nature 441:399-401

♠__Pennisi E__ (2007) Jumping genes hop into the evolutionary limelight. Science 317:894-895

@__Mathonnet G et al.__ (2007) MicroRNA inhibition of translation initiation in vitro by targeting the cap-binding complex eIF4F. Science 317:1764-1767

♦__Brent MR__ (2007) How does eukaryotic gene prediction work? Nature Biotech. 25:883-885

#__Tyagi M and Karn J__ (2007) CBF-1 promotes transcriptional silencing during the establishment of HIV latency. EMBO J. 26:4985-4995

LAB SCHEDULE

12 Feb	**1) Arabidopsis transformation – I** **Gene expression - planning**
19 Feb	**2) Gene expression - treatment and sample collection**
26 Feb	**3) Gene expression - RNA isolation**
04 March	**4) Gene expression - RNA gel**
11 March	**5) Gene expression – qRT-PCR**
18 March	**6) Gene expression - analysis of qRT-PCR data**

---------- SPRING BREAK ----------

01 April	**7) DNA sequencing – sequencing reactions** **Arabidopsis transformation – II**
08 April	**8) DNA sequencing – electrophoresis and data collection**
15 April	**9) Computer sequence analysis - I**
22 April	**10) Computer sequence analysis – II**
29 April	**11) Bioinformatics – analysis of large data sets**
06 May	**12) Presentations**

LAB RESEARCH PAPER

This paper is to be written in a format similar to that used for papers that are submitted to the EMBO Journal. Your manuscript should be typed, double-spaced, and printed (preferably on both sides) on 21.5 x 28 cm paper.

TITLE PAGE - (p1) Title of article, author's name

ABSTRACT - (p2) a summary of the work you did, the results obtained, and the significance of those results (100 - 150 words). It is best to write the manuscript first and then the abstract so you will know what it is you are summarizing.

INTRODUCTION - This should be about one page long and should give the reader a bit of background about the subject under study and the relevance of the experiment(s) you did.

RESULTS - In this section you will describe the results you obtained in your experiments. This will generally require the use of at least two or three figures (see below) and an explanation of what conclusions can be draw from them. This section should usually be divided into subsections with subheadings. (about 2 pages depending on the complexity and amount of data)

DISCUSSION - Here you should discuss the significance of your results in a broader sense. Do your results agree or disagree with previous work (if any) that has been done? Are there any doubts about the reliability of your results that the reader should be cautioned about? Are there any further avenues of study that are suggested by the results you obtained? (about 1 - 2 pages)

MATERIALS AND METHODS - Here you should briefly describe the experimental techniques that you used and how you obtained any important (or unusual) materials. The purpose of this section is to allow another scientist to be able to repeat your experiments if there are any doubts about the results. You can divide this section into subsections with subheadings if necessary. In order to avoid including an excessive amount of boring detail in this section you may want to refer to existing descriptions in the literature. For example, you might want to write something like "RNA was prepared from Arabidopsis seeds using the method of Jones et al (2004) except that the solutions were incubated at 40° for 20 minutes instead of 10 minutes".
(about 2 pages depending on the complexity of the methods used)

REFERENCES - Here you should list any references that you referred to in your paper. Your references may be books, journal articles, book chapters, theses etc. You must use at least two real journal articles (in addition to any articles you use from the Col. J. Res. Meth.) in the preparation of your paper. Look at a recent issue of EMBO J. in the library for the appropriate reference format.

FIGURES - You should generate good quality, easy to understand figures that will communicate to the reader the results you have obtained. These can be line graphs, bar graphs, drawings etc. Use whatever is most appropriate for the type of data you have. Each figure should be numbered (Figure 1, Figure 2, etc.) and should be accompanied by a brief legend explaining what type of experiment the results are from and defining any symbols used. Please include each figure (with its legend) at the point where you first refer to it in the text.

While you may discuss the results of your experiments with you lab partner (or anyone else), the paper that you write must be your own individual work.

LITERATURE REVIEW

A literature review summarizes and discusses the current state of knowledge in a particular field. It is usually written by an expert in that field so that other scientists can learn something about the field without having to search for and read all of the relevant original research papers. We will read some review papers in this class so you should have a general idea of how they are written.

You may choose any topic in Molecular Biology to write about for your review. If you are in doubt as to whether the topic you are thinking about is a good one, come and talk to me.

Your paper is to be written in a format similar to that used for papers that are submitted to the series of "Annual Reviews". You may use as a model any article from the 2007 issue of the Annual Review of Plant Biology. Your paper, however, does not have to be as long as some of the rather exhaustive (and exhausting for the author) reviews you will see there.

Your manuscripts should be typed, double-spaced, and printed (preferably on both sides) on 21.5 x 28 cm paper.

TITLE PAGE - (p1) Title of article, author's name

ABSTRACT - (p2) a one-paragraph summary of your paper (100 - 200 words). It is best to write the review first and then the abstract so you will know what it is you are summarizing.

TABLE OF CONTENTS - See a recent issue of the Annual Review of Plant Biology for the appropriate format.

INTRODUCTION - This should be about one page long and should give the reader a bit of background about the subject under study.

The main body of your review should be divided into whatever subheadings are appropriate for your topic. Overall, this section should include about 4 - 5 pages of text.

FIGURES - Depending on your topic it will probably be helpful to have a figure or two. See a recent issue of Annual Review of Plant Biology for the appropriate format.

CONCLUSIONS - Wrap up your review with a paragraph or two of concluding remarks.

LITERATURE CITED - The number of references that you need will depend on your topic, but you must have at least 10. While you may refer to other review articles, books etc. when necessary, the majority of the references you use should be original research articles.

LAB NOTEBOOK

Your lab notebook should be a complete, well organized, and legible record of the work you have done. Keep your lab notes in a bound notebook, write all of your entries in pen, and be sure to date each entry. Your notebook should be divided into sections, as described below.

LAB WRITE-UP	POINTS	due date
#1A Transformation I	5	13/14 Feb
#2 GE - plan exp. & collect samples	6	27/28 Feb
#3 GE - RNA isolation	6	27/28 Feb
#4 GE - RNA gel	7	05/06 March
#5 GE – qRTPCR	4	12/13 March
#6 GE - analysis of qRTPCR	10	19/20 March
#7 DNA seq. - reactions	4	02/03 April
#1B Transformation II	5	TBA
#8 DNA seq. – data	8	09/10 April
#9 Sequence analysis- part I	7	16/17 April
#10 Sequence analysis- part II	8	23/24 April
#11 Bioinformatics – datasets	10	30 April/01 May
(Presentation)	20	in lab
	100 total	

Each of your sections should include:

TITLE

OBJECTIVES - Include at least a couple of paragraphs explaining what you are going to do and describing the biological significance of your experiment. This should be written before coming to lab.

PROCEDURES - It is OK to just refer to the lab handout here if you followed a procedure that is clearly spelled out in the handout. Make sure to record any deviations from the established procedure and any procedures you used that are not described in the handout.

OBSERVATIONS - Write down everything of significance that happens during your experiment. Make your observations immediately while the experiment is in progress. Don't wait until later or you will forget. Don't just record the data but also include any notable observations you made. Calculations made from your data and graphs of your data can go at the end of this section.

INTERPRETATIONS - What conclusions can be reached from your results? What does it all mean? Why did you observe what you did?

Sections that are italicized in the lab handouts indicate items that MUST be included in the lab write-up. This does not mean that these are the only things that should be included.