GENETICS: FROM MENDEL TO GENOMES

Biological Sciences 101/Molecular and Cellular Biology 198, Summer Abroad 2013
Dr. Mark F. Sanders (mfsanders@ucdavis.edu)

WELCOME

Welcome to Genetics: From Mendel to Genomes, I’m glad you are interested in the course. Your experience in this course will be unique. It is rare to be able to complete an essential prerequisite course in the biological science while studying abroad, but we will do that in just four weeks. As we do it, we’ll take advantage of the two locales that are most closely associated with the two most important paradigm-shifting events in genetics history – the identification of Mendel’s principles of heredity and to determination of the structure of DNA. In Brno, Czech Republic you’ll study Mendelian genetics at the location and in the city where Gregor Mendel lived and worked his entire life, and in Cambridge England you’ll live and study at Clare College, University of Cambridge, the site of Watson and Crick’s work on DNA structure. Throughout the course you’ll be in the hands of one of the most experienced genetics instructors in North America, you’ll have a well-trained tutor to assist you, as well the help of an on-site coordinator who has extensive experience working with and advising UC Davis undergraduates.

COURSES AND CREDIT

You will receive 8 units credit for completion of this course. Four units will be awarded by letter grade for BIS 101 (Genes and Gene Expression) and four units will be awarded by pass/not pass for completion of MCB 198. Essays and a journal activity are the basis for MCB 198 grading. Details are provided in this course packet, which is designed to give you a full picture of the course.

BIS 101 is an information filled course that is typically taught over a 10-week academic quarter. This is a course that has changed substantially over time to keep pace with the field, but it is one I have taught multiple times each year over the span of my 27 year teaching career at UC Davis. I am experienced at teaching this course during the 6 week summer session, where lectures take place four days a week. Reducing the course length to 4 weeks in Summer Abroad means that the same information covered over 10 weeks in an academic quarter, or 6 weeks in a summer session, is instead covered in 4 weeks in Summer Abroad. This is required because as you know, BIS 101 is a critical prerequisite course to numerous follow-on courses in the biological sciences. As you’ll see from our schedule, lecture takes place five mornings a week, and the class includes planned afternoon activities four days a week.

All-in-all, you’ll get a deeper, richer and broader experience in this course than you could possibly get in any other BIS 101 course. I say that based on the more than 130 genetics courses I have taught to almost 35,000 students in my UC career – that’s more courses and more students than any other person at a major research university in North America!
THE TEXTBOOK

The textbook for the course is Genetic Analysis: An Integrated Approach, a new book I wrote based on my course and teaching experience. In addition to the textbook, the accompanying Study Guide and Solutions Manual by Peter Mirabito is also required.

Given our rapid pace and the wide range of material covered, my best advice is to begin textbook reading and problem solving well before our course begins. The reading requirements and recommended end-of-chapter problems are found in the course syllabus which you’ll find in a separate folder on the Summer Abroad website. The more reading and problem solving you are able to do ahead of the start of the course, the easier time you will have during the course. The required textbook and the Student Study Guide and Solutions manual are available now, so my advice is to plan to begin studying once you’ve complete your spring classes.

As an additional study aid, I will be posting PowerPoint files for each of the textbook chapters we’ll use on a course Smart Site. These files will be posted at about the time of our May Summer Abroad orientation meeting at UC Davis. My lectures will not use these Power Point files, but these files will assist you with your reading and comprehension prior to the start of the course.

COURSE GRADING

BIS 101 is a 4-unit component of this program that will be letter graded. Your grade is based on your performance on three graded assignments. The first assignment is a pre-departure quiz worth 10% of your course grade. This quiz will be submitted to me as an email attachment prior to the start of our course. The second assignment is a midterm exam on Friday August 23 and the last assignment is the final exam on Friday September 6. Details of the topics and chapters covered by each exam are found in the course syllabus.

The MCB 198 component of the course is also worth 4 units. MCB 198 is graded on a pass/not pass basis. Assignments for this portion of the course are written work in the form of two essays and two journaling activities. Details of these assignments are found below. The essays are to be submitted to me as email attachments as are summaries of your journaling activities.
Essay and Journaling Assignments

THE ESSAYS

You will complete two essays as part of the MCB 198 portion of Genetics: From Mendel to Genomes course. Each essay will be approximately 700-1000 words, submitted as Word document.

Prepare the content of each essay as though I am not your audience. Instead, presume that your essays are intended for an interested, but non-scientific audience, i.e. prospective undergraduates interested in the biological sciences or college graduates who want to know more about the biological sciences. Specialized scientific terms should be defined, complex concepts fully explained, and necessary technical details described in a manner understandable by your audience. Your essays are to be designed to convey a scientific perspective to your audience. Spelling, punctuation, and proper sentence and paragraph structure are important components of the grading.

Essay 1 – Due on or before Friday August 23

During the 20th century, the first century of modern genetics, two paradigm-shifting events that strongly influenced the direction of genetics research were the articulation and expansion of Mendel’s hereditary principles and the description of DNA structure. Some scientists and historians of science have identified genome sequencing and genomics as the first paradigm-shifting event in the second century of modern genetics.

Essay 1 addresses this view and is linked to the visits to the Institute of Experimental Botany in Olomouc, and course information. At the Institute of Experimental Botany and in your current and past course experience you have heard about the uses of genomic information in research and have seen scientific presentations based on those kinds of data. The essay assignment is to 1) describe what genomics is, 2) give an example or two of how genomic data is used in the interpretation of a trait, condition, or evolutionary problem and, 3) speculate about what the next decade will hold in terms of applications of genomics. For this last item you can include speculation about any of the other “omic” enterprises (for example, proteomics, metabolomics, or transcriptomics) if you like.

Essay 2 – Due on or before Saturday September 7

The second essay is based on your visits to the Museum of Zoology and the Whipple Museum, and you have a choice of topics A or B as described below. To gather the information for this assignment you will undertake self-guided tours of the Museum of Zoology (MoZ) and the Whipple Museum (WM). Tour the entire MoZ, but focus special
attention on the Darwin artifacts and displays, and on exhibit displays concerning the
evolution of organisms. Tour the entire WM as well, but focus attention on the display
concerning microscopy and on the display concerning hand held calculators (you’ll find
these in the drawers of the large wooden case in the WM).

**Essay 2, Choice A** is to discuss how knowledge and understanding of DNA structure and
variation has bolstered the traditional view of morphological evolution. Describe how
molecular information is used in evolutionary studies and how molecular variation is
related to morphological variation.

**Essay 2, Choice B** is to discuss how advancements in scientific instrumentation,
exemplified by microscopy, computational devices, and laboratory instrumentation have
contributed to the scope and pace of scientific advancement in the last 100-150 years.
Compare and contrast capabilities 50 and 100 years ago to today’s capabilities in
discussing this issue.

**THE JOURNAL**

You are to keep a journal of your activities, observations, and thoughts for the duration of
the course. You can begin your journaling activity at any time, but at a minimum, you
must commence with your arrival in Vienna. Maintain the journal through your
departure from the University of Cambridge at the end of our course. The journal is
yours, and you need not share its contents with anyone. What I am looking for is a
separate summary of your observations and thoughts on two topics that will be part of the
MCB 198 portion of Genetics: From Mendel to Genomes

**Journaling Activity 1 – Due on or before Friday August 23**

In a short written narrative, summarize your observations and thoughts about the
academic and scientific settings, facilities and activities in the Czech Republic. Describe
a) what you expected to see and what you actually saw and b) if what you saw changed
your perspective on the level of scientific research being conducted in other parts of the
world.

**Journaling Activity 2 – Due on or before Saturday September 7**

The University of Cambridge was established over 800 years ago, and from its inception
it has maintained a strong tradition of inquiry and display in the arts and sciences.
During your time in Cambridge you will have visited all eight of the (free admission)
campus museums, as well as visits to other museums, gardens and displays (some
requiring admission fees) in town as you are able.

Part 2 of the journaling activity is to be completed once you have finished your visits.
For this part of the assignment, devise your own personal “Top 10 List” of individual
locales, sites, or exhibits. The items on your list could be a large as “dinosaur exhibit in
the MoZ”, as small as the “Portrait of a young girl with pearl earrings by Rembrandt in
the Fitzsimmons Gallery”, or it can be a location such as “the Scholars Garden”. Itemize each of your top 10 choices and for each one provide a statement explaining why it's on your list and what impressed you so much about the item.
Your Daily Schedule – Brno

Mornings Monday through Friday (8/11-8/15)*
- 8:00-9:00  Breakfast (at dorm facility)
- 9:00-9:20  Transit to classroom (Mendel U)
- 9:40-11:00  Lecture A
- 11:00-11:20  Break
- 11:20-12:30  Lecture B
- 12:40-2:00  Lunch (on your own)

*Monday 8/12 will be include a morning lecture at the Mendel Museum, followed by a hosted lunch and then a tour the Mendel Museum, the former St. Thomas monastery and church.

*Friday 8/15 is an all day trip to Olomouc and Hynice.

Afternoons of T 8/13, W 8/14 and R 8/15
- 2:10-3:30  Research presentation or tutoring session, (Mendel U)
- 3:30 on  Free (study) time, dinner is on your own

Your Daily Schedule – Cambridge

Mornings Monday through Friday (8/19-9/5)* and **
- 8:00-9:00  Breakfast (the Buttery)
- 9:10-10:30  Lecture A (Latimer Room or Bennett Room)
- 10:30-11:00  Tea (Great Hall or Library Common Room)
- 11:10-12:20  Lecture B (same location as lecture A)
- 12:30-1:30  Lunch (Great Hall, the Buttery or another location)

*Friday 8/23 is the midterm exam and Friday 9/6 is the final exam. Both will consist of two parts divided by tea time.

**Following the completion of the midterm exam on Friday 8/23 and the completion of lecture on Friday 8/30, you are free for the remainder of the day and the weekend. You may stay in Cambridge or travel. You must return on Sunday and be in class and on time on Monday morning. Note: On weekends only breakfast is available.

Afternoons of M 8/19, W 8/21, R 8/22, M 8/26, M 9/2 and W 9/4
- 1:40-3:00  Tutoring session, mandatory (same room as lecture)
- 3:00-5:30  Free (study) time
- 5:30-7:00  Dinner (the Buttery or as assigned)

**Afternoons of T 8/20, T 8/27, W 8/28, R 8/29, T 9/3 and R 9/5
Research presentations or off-site visit, start and end times will vary
Chapter Problems for Solution
The list of end of chapter problems is representative of most of the topics we will discuss in lecture. This is a “minimal list” of problems for solution that will help you practice problem solving and solidify your knowledge of genetic principles and their application. For topics that are difficult for you, work additional problems to be sure your knowledge and skills are sufficient for success. Use the “evaluate-deduce-solve” problem solving framework illustrated in the Genetic Analysis worked examples to guide your solutions. Complete answers with explanations and problem solving guidance are available in the Student Study Guide and Solutions Manual.

Chapter 1 – 8, 9, 10, 11, 15, 17, 19, 20, 23
Chapter 2 – 5, 6, 7, 8, 11, 12, 13, 15, 18, 20, 24, 28, 30, 39, 41, 42, 44
Chapter 3 – 2, 5, 6, 12, 13, 14, 17, 19, 22, 25, 29, 32
Chapter 4 – 3, 4, 6, 8, 10, 11, 17, 18, 21, 22, 23, 24, 25, 27, 28, 33
Chapter 5 – 2, 5, 6, 7, 12, 14, 16, 17, 18, 24, 26, 28, 29, 32
Chapter 6 – 2, 9, 12, 16, 17, 19, 20, 21, 22, 24, 25, 26
Chapter 7 – 2, 5, 8, 11, 15, 19, 20, 24, 25, 27, 29, 33
Chapter 8 – 1, 3, 4, 7, 15, 16, 17, 22, 25, 26
Chapter 9 – 2, 5, 9, 12, 16, 17, 18, 23, 28, 32
Chapter 10 – 1, 6, 8, 12, 14, 15, 21, 23, 24, 26, 27
Chapter 11 – 4, 7, 15, 16, 18, 22, 26
Chapter 12 – 4, 8, 9, 17, 21, 27, 28, 31, 32, 34
Chapter 13 – 4, 5, 11, 12, 16, 18, 20, 24, 26, 31
Chapter 14 – 2, 4, 6, 7, 8, 16, 17, 18, 19, 22, 23, 24, 31
Chapter 15 – 1, 2, 3, 4, 5, 7, 9, 11, 13, 17, 18
Chapter 16-18 – Problems are TBA, depending on lecture and reading schedule

Problems for Tutoring Sessions
Each tutoring session is mandatory. I have built time into lectures to answer general questions and undertake some extra problem solving. Your tutors will build on our in-class problem solving in his tutoring sessions to help you work through difficulties with the problems assigned for each session. The problems designated for each discussion are from your textbook and are included in the lists of chapter problems above. The problems are listed below as chapter-problem number, i.e. 2-5 is Chapter 2, problem 5. All tutoring session problem are to be completed BEFORE the session so that the time in the session can be devoted to overcoming difficulties.

Session B1 – 2-5, 2-12, 2-20, 2-30, 2-44
Session B2 – 3-6, 3-12, 3-14, 3-29, 3-32, 4-4, 4-23, 4-28
Session C1 – 5-7, 5-12, 5-14, 5-18, 5-26
Session C2 – 6-12, 6-16, 6-22, 6-25
Session C3 - 7-8, 7-20, 7-29, 8-17, 8-26
Session C4 –9-5, 9-12, 9-17, 9-28, 10-15, 10-23
Session C5 – 11-15, 11-16, 11-18, 12-4, 12-9, 12-27, 12-32, 12-34
Session C6 – 13-12, 13-18, 13-24, 14-18, 14-19, 15-17, 15-18, and TBA questions