Natural Science II: Genomes and Diversity
V55.0314
Spring 2011
Mondays and Wednesdays, 2:00 p.m. – 3:15 p.m.
Silver 207

Professor Mark Siegal
Department of Biology
12 Waverly Place, Room 306
Phone: 998-7908
E-mail: mark.siegel@nyu.edu
Office Hours: By e-mail appointment

Course Description

Millions of species of animals, plants and microbes inhabit our planet. Genomics, the study of all the genes in an organism, is providing new insights into this amazing diversity of life on Earth. We begin with the fundamentals of DNA, genes and genomes. We then explore microbial diversity, with an emphasis on how genomics can reveal many aspects of organisms, from their ancient history to their physiological and ecological habits. We follow with examinations of animal and plant diversity, focusing on domesticated species, such as dogs and tomatoes, as examples of how genomic methods can be used to identify genes that underlie new or otherwise interesting traits. Genomics has also transformed the study of human diversity and human disease. We examine the use of DNA to trace human ancestry, as well as the use of genomics as a diagnostic tool in medicine. With the powerful new technologies to study genomes has come an increased power to manipulate them. We conclude by considering the societal implications of this ability to alter the genomes of crop plants, livestock and potentially humans.

Course Objectives

• To gain an appreciation of the diversity and unity of life on Earth
• To acquire a foundation of knowledge of how organisms store and process information encoded in DNA
• To understand technological advances that will shape the future of our world
• To develop skills in problem solving and interpreting scientific information
• To engage in various methods of scientific investigation in the laboratory
• To critically evaluate popular media reports on the latest developments in biological research
• To become adept at conveying scientific concepts to others
• To address the complex ethical, social and legal consequences of genetic information

Course Texts and Readings

Required Text

Required Multimedia DVD
DNA Interactive (Cold Spring Harbor Laboratory Press, 2003).

Required Articles
Articles about recent discoveries in genomics from The New York Times, Scientific American or other sources will be assigned throughout the semester as part of the required readings and are available online through the course Blackboard site.
# Lecture and Laboratory Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading*</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 M Jan 24</td>
<td>Introduction and Overview</td>
<td>D&amp;Y Intro</td>
<td>No laboratory</td>
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## GENES AND GENOMES

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading*</th>
<th>Laboratory</th>
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<tbody>
<tr>
<td>2 W Jan 26</td>
<td>DNA</td>
<td>D&amp;Y Ch. 1</td>
<td></td>
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<tr>
<td>3 M Jan 31</td>
<td>DNA Replication &amp; The Genetic Code</td>
<td>D&amp;Y p. 27-34</td>
<td></td>
</tr>
<tr>
<td>4 W Feb 2</td>
<td>Splicing, Translation &amp; Recombinant DNA</td>
<td>D&amp;Y p. 35-39</td>
<td>Lab 1: Chromosomes</td>
</tr>
<tr>
<td>5 M Feb 7</td>
<td>DNA Sequencing &amp; Genome Projects</td>
<td>D&amp;Y p. 40, Ch. 3</td>
<td>Lab 2: DNA isolation</td>
</tr>
<tr>
<td>6 W Feb 9</td>
<td>Genomics</td>
<td>D&amp;Y p. 119-124; [1]</td>
<td></td>
</tr>
<tr>
<td>7 M Feb 14</td>
<td>Dialogue: Genes &amp; Genomes</td>
<td>[TBA]</td>
<td>Lab 3: Genetic code; form working groups</td>
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</tbody>
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## GENOME DIVERSITY: MICROBES

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading*</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 W Feb 16</td>
<td>Bacterial Genes and Genomes</td>
<td>[2]</td>
<td>Lab 4: Bacterial transformation and gene regulation I</td>
</tr>
<tr>
<td>M Feb 21</td>
<td>No class: Presidents’ Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 W Feb 23</td>
<td>Bacterial Genomes and Diversity</td>
<td>[3-5]</td>
<td></td>
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<tr>
<td>10 M Feb 28</td>
<td>Universal Tree of Life &amp; Ecological Genomics</td>
<td>D&amp;Y Ch. 6; [6-9]</td>
<td>Lab 5: Bacterial transformation and gene regulation II; meet with working groups; review for midterm</td>
</tr>
</tbody>
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## GENOME DIVERSITY: ANIMALS

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading*</th>
<th>Laboratory</th>
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</thead>
<tbody>
<tr>
<td>11 W Mar 2</td>
<td>Review: Genes, Genomes &amp; Microbes</td>
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<tr>
<td>M Mar 7</td>
<td>Midterm Exam 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 W Mar 9</td>
<td>Animal Genomics &amp; Origin of Domestic Dogs</td>
<td>[10-12]</td>
<td>Lab 6: Restriction enzymes and plasmids</td>
</tr>
<tr>
<td>M Mar 14</td>
<td>No class: Spring Recess</td>
<td></td>
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<tr>
<td>Date</td>
<td>Day</td>
<td>Topic</td>
<td>Notes</td>
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<tr>
<td>W Mar 16</td>
<td></td>
<td>No class: Spring Recess</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>Breed Discrimination &amp; Genotypes and Phenotypes</td>
<td>[13-19]</td>
</tr>
<tr>
<td>14</td>
<td>W</td>
<td>Other Animal Genomes: Similarities and Differences</td>
<td>[10]</td>
</tr>
<tr>
<td>15</td>
<td>M</td>
<td>Plant Genes and Genomes &amp; Breeding</td>
<td>[20,21]</td>
</tr>
<tr>
<td>16</td>
<td>W</td>
<td>Genome-wide Mapping of Traits</td>
<td>[22]</td>
</tr>
<tr>
<td>17</td>
<td>M</td>
<td>Agricultural Traits: Rice, Tomatoes, Corn</td>
<td>[23]</td>
</tr>
<tr>
<td>18</td>
<td>W</td>
<td>Review: Animal &amp; Plant Genomics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td><strong>Midterm Exam 2</strong></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>W</td>
<td>Genetics of Human Disease</td>
<td>D&amp;Y Ch. 7; [24,25]</td>
</tr>
<tr>
<td>20</td>
<td>M</td>
<td>Genomics for Diagnosis</td>
<td>[26-29]</td>
</tr>
<tr>
<td>21</td>
<td>W</td>
<td>Human History and Diversity</td>
<td>D&amp;Y Ch. 5; [30-37]</td>
</tr>
<tr>
<td>22</td>
<td>M</td>
<td>Dialogue: Personal Genomics</td>
<td>D&amp;Y p. 41-42, 161-164; [TBA]</td>
</tr>
<tr>
<td>23</td>
<td>W</td>
<td>Transgenic Plants and Animals</td>
<td>D&amp;Y p. 135-139, Ch. 8; [38]</td>
</tr>
<tr>
<td>24</td>
<td>M</td>
<td>GMOs and Society</td>
<td>[39,40]</td>
</tr>
<tr>
<td>25</td>
<td>W</td>
<td>Cloning, Gene Therapy &amp; Complex Human Traits</td>
<td>D&amp;Y Ch. 4, 9; [41-47]</td>
</tr>
<tr>
<td>26</td>
<td>M</td>
<td>Conclusion: Genomics &amp; The Future</td>
<td>[48-51]</td>
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*Readings will be supplemented with assignments from the *DNA Interactive* DVD. Numbered readings are given below, and are available through links on Blackboard. [TBA] = to be assigned.
Readings


Laboratory Sessions (Silver 203)

<table>
<thead>
<tr>
<th>Lab Section</th>
<th>Day and Time</th>
<th>Lab Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 002</td>
<td>Tuesday, 3:00 pm – 4:40 pm</td>
<td>Joshua Richardson</td>
</tr>
<tr>
<td>Section 003</td>
<td>Tuesday, 5:00 pm – 6:40 pm</td>
<td>Joshua Richardson</td>
</tr>
<tr>
<td>Section 004</td>
<td>Wednesday, 9:00 am – 10:40 am</td>
<td>Michael Raftree</td>
</tr>
<tr>
<td>Section 005</td>
<td>Wednesday, 11:00 am – 12:40 pm</td>
<td>Michael Raftree</td>
</tr>
</tbody>
</table>

Grades*
15% Midterm Exam 1
15% Midterm Exam 2
25% Final Exam
25% Laboratory and Quizzes
15% Group Presentation and Project
5% Homework

* see also Altruism Points below

Coursework and Policies

Exams
The exams will contain questions covering the lectures, readings and laboratory projects. The final exam will be cumulative, covering topics throughout the course. In most aspects of science, researchers faced with a problem have many resources at their fingertips to aid in finding a solution. In this spirit, you may use any book and/or notes you wish during the midterm and final exams (for fairness to those without laptops, and to avoid distraction, computers and other electronic devices will not be allowed). As you might guess, open book/notes exams are less likely to test you on recall of facts and more likely to test you on your ability to integrate and think critically about new information. Study questions provided at the end of each lecture will provide practice with some types of questions that will appear on the exams.

If you will miss one midterm exam because of illness, you must contact Professor Siegal by e-mail before the start of the exam and provide a doctor's note explaining your absence. No make-up exams will be given for the course. Instead, the final exam will count as 40% of your course total. If you miss two midterm exams you will be required to withdraw from the course.

A make-up will be given for the final exam only under exceptional circumstances that must be discussed with Professor Siegal prior to the exam. In this case a grade of incomplete will be given for the course and the make-up will be scheduled for the Fall 2011 semester. No alternative date for the final exam will be offered at the end of the spring semester so avoid making travel plans to leave NYU before the date of the final exam.

Working Groups
The transmission of scientific knowledge to the general public is a difficult and under-appreciated task. In this course, you will not only be responsible for increasing your own knowledge of genomics, but will also contribute to broader dissemination of this knowledge. You will work in small groups to develop creative ways of conveying key concepts and discoveries to a general audience. Each working group will form during the laboratory (week of Feb 14), and will be responsible for communicating information related to one of the four main themes of the course: 1) how genes and genomes work, 2) how genes and genomes reveal the history of life, 3) how genes and genomes reveal the unity and diversity of life, and 4) how technological advances in genomics impact scientific discovery and society. There will be two main forums for communication: postings to individual weblogs throughout the course, and a group presentation toward the end of the semester. These are described below.
Homework (Blogs)
Each student will maintain a weblog, and homework credit will be given for contributions to these blogs. Postings will be related to the topic of the student’s working group and should either explain pertinent material covered in class or comment on relevant current events or news stories. The goal is to create an online community resource for students to share information about the course and the topics it raises. The blogs will also serve as repositories of information that each working group will use in crafting its presentation. More details and instructions for posting to blogs will be given in class and posted on Blackboard.

Group Presentations and Final Projects
Group presentations will take place in the laboratory (week of Apr 25). The presentation should convey specific scientific information related to the group’s topic. Each member of a team must participate in the presentation, and each member will submit a separate final project related to his or her group’s presentation. More details on the format of the group presentations and projects are available on Blackboard.

Altruism Points
Contrary to the popular image of the lonely scientist toiling away in isolation, science is a collective activity that depends on the sharing of ideas. Typical college courses, especially college science courses, actively discourage such sharing and engender a competitive environment by grading students almost entirely by exams and quizzes. In this course, you will be rewarded for helping your peers increase their knowledge. These “altruism points” are earned by online contributions that go beyond what is required for homework credit. Three types of posts will be considered, each worth up to 15 points:

- answers to other students’ questions about lecture or lab material
- lecture notes or explanations of material covered in class
- commentary on relevant current events related to the course (but not directly covered in the course)

Altruism points will be tallied and posted to the Blackboard gradebook at 3 times during the course (at the time of each exam). Earning full altruism points requires regular contributions — points not earned by the time of tallying cannot be made up later in the course.

Altruism points will be used to adjust your final course grade by the formula:

\[
\text{adjusted course grade} = \text{course grade} \times \frac{100 - \text{altruism points}}{100} + \text{altruism points}
\]

For example, a student with a course grade of 60 can increase his grade to 70 by earning 25 altruism points; a student with a course grade of 80 can increase her grade to 89 by earning 45 altruism points. Altruism can easily make a difference in your final letter grade. The lower your course grade the more altruism helps!
Statement on Academic Integrity
Morse Academic Plan, College of Arts and Science

As a student at New York University, you have been admitted to a community of scholars who value free and open inquiry. Our work depends on honest assessment of ideas and their sources; and we expect you, as a member of our community, likewise to maintain the highest integrity in your academic work. Because of the central importance of these values to our intellectual life together, those who fail to maintain them will be subject to severe sanction, which may include dismissal from the University.

Plagiarism consists in presenting ideas and words without acknowledging their source and is an offense against academic integrity. Any of the following acts constitutes a crime of plagiarism.

- Using a phrase, sentence, or passage from another person's work without quotation marks and attribution of the source.
- Paraphrasing words or ideas from another's work without attribution.
- Reporting as your own research or knowledge any data or facts gathered or reported by another person.
- Submitting in your own name papers or reports completed by another.
- Submitting your own original work toward requirements in more than one class without the prior permission of the instructors.

Other offenses against academic integrity include the following.

- Collaborating with other students on assignments without the express permission of the instructor.
- Giving your work to another student to submit as his or her own.
- Copying answers from other students during examinations.
- Using notes or other sources to answer exam questions without the instructor's permission.
- Secreting or destroying library or reference materials.
- Submitting as your own work a paper or results of research that you have purchased from a commercial firm or another person.

Particular emphasis is placed on the use of papers and other materials to be found on the World-Wide Web, whether purchased or freely available. In addition to having access to the same search engines as students, faculty also have at their disposal a number of special websites devoted to detecting plagiarism from the web.

Plagiarism and other cases of academic fraud are matters of fact, not intention. It is therefore crucial that you be diligent in assuring the integrity of your work.

- Use quotation marks to set off words that are not your own.
- Learn to use proper forms of attribution for source materials.
- Do your own original work in each class, without collaboration, unless otherwise instructed.
- Don't use published sources, the work of others, or material from the web without attribution.
- For further information, consult the Bulletin of the College of Arts and Science, the CAS Academic Handbook, and the Student's Guide to NYU.

revised 11/2005
Academic Guidelines for Students
Morse Academic Plan, College of Arts and Science

To help foster common academic expectations among students and instructors, the following
guidelines for MAP courses are offered to students. While these represent minimum expectations
across the curriculum, individual faculty members may set additional course requirements.
Students should therefore consult the course syllabus for details of policies in each class.

Attendance
Inasmuch as students have voluntarily sought admission to the University, they are expected to
attend all class meetings, including all lectures and all meetings of associated recitation, workshop,
or laboratory sections. Students may be excused for documented medical or personal emergency
and will receive reasonable accommodation for the observance of religious holidays. In these
cases, they should contact their instructors in advance or, in cases of emergency, as soon as is
practicable. Students are responsible for making up any material or assignments they miss.

Classroom Decorum
The classroom is a space for free and open inquiry and for the critical evaluation of ideas, and it
should be free of personal prejudice. Students and instructors alike have an obligation to all
members of the class to create an educational atmosphere of mutual trust and respect in which
differences of opinion can be subjected to deliberate and reasonable examination without animus.

As a matter of courtesy to their fellow students and instructors, students should arrive at class
promptly, prepared and ready to participate. Students are reminded particularly to shut off all
cellular telephones and pagers and, except in cases of emergency, to remain in the classroom for
the duration of the lecture or section meeting. If it is necessary to leave or enter a room once class
has begun, students should do so quietly and with as little disruption as possible. Under
University policy, disruptive classroom behavior may be subject to faculty review and disciplinary
sanction.

Completion of Assignments
Students are expected to submit course work on time and to retain copies of their work until a
final grade has been received for the course. Instructors are not obliged to accept late work and
may assign a failing or reduced grade to such assignments.

Students who encounter sudden and incapacitating illness or an other comparably grave
circumstance that prevents them from completing the final examination or assignment in a
course may request a temporary mark of Incomplete from the course instructor. To receive an
Incomplete, students must have completed all other requirements for the course, including
satisfactory attendance, and there must be a strong likelihood they will pass the course when all
work is completed.

Questions and Concerns
Up-to-date course information is available on the MAP website: www.nyu.edu/cas/map.
Questions, concerns, comments, and feedback may be directed to the following members of the
MAP staff, located in 903 Silver Center, 212-998-8119. Complaints will remain confidential.

Director: Prof. Joy Connolly morse.plan@nyu.edu
Associate Director for the FCC: Prof. Vincent Renzi map.fcc@nyu.edu
Associate Director for the FSI: Prof. Trace Jordan map.fsi@nyu.edu
Department Administrator: Ms Janet Lebeda morse.plan@nyu.edu

revised 1/2010
Why MAP?
A Guide for Students

What is the MAP?

The Morse Academic Plan is the group of core courses that every student must complete in order to earn a degree from the College of Arts and Science. It represents the considered judgment of the faculty about what every College graduate should know as a part of his or her liberal arts education. In other undergraduate divisions at NYU, faculty of those schools have adopted parts of the MAP to provide a core experience in the liberal arts for their students as well. Because it is shared by students across different schools, majors, and programs, the MAP is also sometimes called the general education curriculum.

What's "liberal" about the liberal arts?

"Liberal" comes from the Latin word liber, meaning "free." In ancient Greece and Rome, liberal education was the pursuit of free men, that is, those with the means and leisure to be able to devote themselves to learning, rather than to labor.

Today when we speak of "liberal education," we mean an education in the "liberal arts," an education for men and women that frees intellectual capacities and the imagination through the study of human endeavor on a broad scale, from music, art, and philosophy, to encounters with nature and with cultures of other times and places.

What are the "liberal arts"?

Sometimes also called the "arts and sciences" or "liberal arts and sciences," in the medieval university curriculum they were seven in number: grammar, logic, rhetoric, arithmetic, geometry, astronomy, and music.

Today, the liberal arts encompass all the disciplines of the humanities and social sciences, mathematics, and the natural sciences—all those areas of inquiry that are pursued for the sake of expanding human knowledge, rather than as training for a particular profession.

(over)
What's the practical value of liberal education?

*Education in the liberal arts builds your critical, analytic, and communications skills,* giving you the preparation you need to flourish in the world of work and to become a productive member of society.

More than this, however, *education in the liberal arts is preparation for life as a responsible, actively engaged citizen,* equipping you with the open-mindedness and soundness of judgment necessary to reason, act, and lead. Indeed, this University—and the whole enterprise of higher education in the United States—was founded on the belief that college graduates have a special opportunity and responsibility to contribute to the common good.

What are the faculty's specific goals for the MAP?

In designing the MAP, the faculty sought to ensure that students would expand their capacity to communicate effectively, by *improving their writing and gaining proficiency in a foreign language.* This is why every undergraduate must complete *Writing the Essay* or its equivalent, and why the University maintains extensive opportunities for language study both in New York and at the global sites, as well as the non-credit Speaking Freely program.

The faculty also wanted to provide every student with opportunities to build his or her *quantitative skills* and to study the *natural sciences.* These studies give you the knowledge you need to be an independent-minded citizen in a world increasingly shaped by science and technology, where urgent questions of policy require prudent, well-informed judgments. We aim, too, to foster your appreciation of mathematics and the sciences as liberal pursuits.

We likewise believe that students should gain knowledge of the *social sciences,* which study how humans communicate, organize their communities, worship, use language, and engage in trade and diplomacy. Because the *fine and performing arts* connect us in unexpected ways, give pleasure, and reveal new perspectives on the world, the MAP also includes courses in *Expressive Culture.*

Finally, *students should come to think of themselves as citizens of a larger world by gaining the ability to comprehend how people remote from themselves understand, experience, and imagine their lives.* They should also come to *know themselves better by engaging critically with the significant ideas that have shaped contemporary culture.* For these reasons, all students in the MAP complete a course in *Cultures and Contexts* and a course in *Texts and Ideas.*

Does all this mean that you will take a few courses outside your main interests and comfort zone? That is our intention: Stretching the mind and rethinking old assumptions and beliefs are important preparation for your future. The MAP represents our commitment as a faculty to assuring you an undergraduate education that will equip you for success in your later careers and prepare you for a life of thinking critically and creatively about who you are, who you want to be, and how to better the world we live in.