BISC 406L: Biotechnology
4 Units
Fall 2024
Lecture:
Tu and Th 9:00-9:50 a.m.
Lab:
Th 10:00-1:00 p.m. (usually we will begin lab at 9:00 a.m. and start lecture after)
Room: ZHS 472

Instructors:
Christa Bancroft, Ph.D.
Office: ZHS 470
Office Hours: By appointment
Contact Info:
Email: cbancrof@usc.edu (best choice). Subject line should state: “BISC 406”
Phone number: 213-740-5553

Laboratory Director: Celeste Chong-Cerrillo, Ph.D.
Office: ZHS 450
Office Hours: By appointment or open door policy
Contact Info: chongcer@usc.edu. Subject line should state: “BISC 406”

Laboratory Instructor:
Office Hours:
Contact Info:

Course Description
BISC406L is the capstone course for the BS in Biological Sciences with Emphasis in Biotechnology. It is also the capstone course and the Minor in Biology and Business offered by the Dornsife College of Letters, Arts and Sciences and the Marshall School of Business. The course will focus on the impact of the biotechnology revolution on health care in this age of molecular medicine. Topics to be covered include: (1) Recombinant DNA technology from plasmids to genomes; (2) CRISPR applications including genome editing; (3) Modern DNA sequencing technologies; (4) Genomics and Proteomics; (5) Manipulating Prokaryotic and Eukaryotic gene expression; (6) Molecular Diagnostics and Therapeutics; (7) Vaccines and Gene Therapy; (8) Genetic Engineering of Plants and Animals and; (9) Biotechnology regulation. We will address the ethical, legal and social implications of advances in biotechnology and will discuss governmental regulation of food, drugs and biotechnology itself. The laboratory exercises will focus on synthetic biology and other techniques, which have played a fundamental role in the “new” biotechnology revolution.

Learning Objectives
Explain the difference between historical biotechnology and modern biotechnology.
Know how to synthesize genes and to build plasmids, chromosomes, and genomes.
Have an understanding of how CRISPR/Cas systems work and can be utilized in diverse ways for human benefit, including as therapies.
Develop knowledge of the history of DNA sequencing technologies, especially modern short and long read approaches and their applications.
Provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products.
Explain the concept and application of monoclonal antibody technology and the development of vaccines.
Explain the general principles of using DNA technology to generate transgenic plants, animals and microbes.
Provide examples of current applications of biotechnology and advances in different areas: medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic science.
Discuss ethical implications of biotechnology research and development.
Design an experiment with step-by-step instructions to address a research problem.
Demonstrate proficiency of technical skills in a variety of biotechnology methods.
Explain relevant background content, interpret data and critically evaluate conclusions of a scientific research paper. Effectively communicate the information to peers in a classroom setting during discussions and presentations.

Prerequisite: BISC 320L
Recommended Preparation: BISC 313 or BISC 325

Course Notes
Lectures: The lecture slides will be posted on the course Blackboard internet site as .ppt and .pdf files (https://blackboard.usc.edu). All course materials, information, announcements and grades will be posted on Blackboard until the end of the semester.
Class lecture periods will either be lectures given by the instructor (labeled Lect. on syllabus calendar) or discussions of reading assignments by students (labeled Disc. in bold red on syllabus calendar). Participation in these discussions is an important part of the course. A TENTATIVE reading list is given in the course syllabus below the topic calendar. If we deviate from this version of the reading list, a new, dated version of this syllabus will be posted on Blackboard. You should be prepared to discuss reading assignments on the days specified as discussions. Questions will be assigned ahead of time that each student will answer and discuss during the discussion period.

It is important to attend all of the lectures during the course and to take good notes for study. Prior to attending each lecture, it is important to have read the appropriate papers. However, many of the lectures will contain new and additional information that is not in those readings. Examinations will be based on information in lecture slides, communicated during lecture, discussed during class discussions and presented in assigned readings. In studying for examinations, complete and accurate lecture and discussion notes are of prime importance.

Lecture and Discussion Absences:
Attendance at all lecture and discussion sections is expected. If you must miss a discussion due to illness or valid USC travel, please present Dr. Bancroft with evidence of the reason for absence and you will be allowed to make-up the discussion assignment within 1 week of the missed lecture period.

Exams:
In case the midterm exam must be missed for legitimate reasons, discuss the situation with the course instructor prior to the exam, if possible. If the midterm is missed for an emergency or for a valid health reason (with written documentation), the score of the final exam will be used to comprise your total point score for course exams.
Regrades:
In the event an error is made in the grading of your exam, written submittal a description of the error, using the regrade form posted on Blackboard, with the exam should be returned to Dr. Bancroft within a week after receiving your graded exam. After this time period, exams will not be regraded.

Email Communication:
To ensure privacy, only student’s USC email accounts may be used for email communications. Students are responsible for understanding the content of email messages that the instructor sends to their USC accounts. Therefore, each student must check their USC email regularly and make sure their account is not over quota, so new messages can be received.

Required Readings and Supplementary Materials
There is no textbook for the course. All reading assignments will be posted on Blackboard in .pdf format for you to access.

Description and Assessment of Assignments
Midterm and Final Exams will include multiple choice, short answer and mathematical problems that can be done without a calculator.
Classroom discussion questions will be assigned to each lab partner group during the class meeting prior to the class discussion. Pairs will present relevant data and figures to answer the questions during class discussion time. Points will be awarded based on participation of each member and correctness of answer.
Student presentations will occur during the last four weeks of class. Presentation dates will be assigned at least 3 weeks ahead of the first scheduled presentation. Detailed information about this assignment is posted on Blackboard under Course Documents. During student presentations attendance is mandatory and all students are expected to listen attentively and ask questions of other groups. Missing another group’s presentation without a valid excuse will result in a 5 pt. deduction from your own presentation score.
Laboratory work assignments are discussed in more detail in the laboratory manual.

Grading Breakdown
The course grade will be based upon 675 possible points:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm Exam</td>
<td>150</td>
<td>22.2</td>
</tr>
<tr>
<td>Final Exam</td>
<td>150</td>
<td>22.2</td>
</tr>
<tr>
<td>Classroom Discussions</td>
<td>100</td>
<td>14.8</td>
</tr>
<tr>
<td>Student Presentations</td>
<td>75</td>
<td>11.1</td>
</tr>
<tr>
<td>Laboratory</td>
<td>200</td>
<td>29.6</td>
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</tbody>
</table>

**TOTAL** 675 100

Course letter grades:
Course final grades will be determined using the following scale. If necessary, course grades will be adjusted at the end of the semester such that the average will be the lowest “B-” for the class.

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>Corresponding numerical point range</th>
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<tbody>
<tr>
<td>A</td>
<td>93-100</td>
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</tbody>
</table>
Student Presentation Guidelines and Rubric
Will be posted to Blackboard website under Content and “Student Presentations”.

Grading Timeline
Grades for Midterm Exams will be posted within one calendar week following the exam date.

Course Schedule:
Bancroft lecture/discussion: black
Student presentations: Green

<table>
<thead>
<tr>
<th>Wk</th>
<th>Type</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lect.</td>
<td>Aug 27</td>
<td>Intro to Biotechnology</td>
<td>1 and 1a</td>
</tr>
<tr>
<td></td>
<td>Disc.</td>
<td>Aug 29</td>
<td>Synthesizing DNA molecules and Assembling DNA into chromosomes and genomes</td>
<td>2 and 3</td>
</tr>
<tr>
<td>2</td>
<td>Disc.</td>
<td>Sept 3</td>
<td>Bacterial genome synthesis and transplantation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Disc.</td>
<td>Sept 5</td>
<td>Bacterial genome synthesis and transplantation</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Disc.</td>
<td>Sept 10</td>
<td>Eukaryotic chromosome synthesis and transplantation</td>
<td>6 and 7</td>
</tr>
<tr>
<td></td>
<td>Disc.</td>
<td>Sept 12</td>
<td>CRISPR therapies in humans</td>
<td>8 and 9</td>
</tr>
<tr>
<td>4</td>
<td>Disc.</td>
<td>Sept 17</td>
<td>CRISPR/Cas technology and applications</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Disc.</td>
<td>Sept 19</td>
<td>CRISPR-based diagnostics</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>Disc.</td>
<td>Sept 24</td>
<td>CRISPR therapy clinical trials</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Disc.</td>
<td>Sept 26</td>
<td>DNA sequencing technologies</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Disc.</td>
<td>Oct 1</td>
<td>Telomere-to-telomere genome sequences</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Disc.</td>
<td>Oct 3</td>
<td>Single cell sequencing</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Lect.</td>
<td>Oct 8</td>
<td>Plant Biotechnology</td>
<td>16</td>
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<td></td>
<td></td>
<td>Oct 10</td>
<td>Fall Break, no classes</td>
<td></td>
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<tr>
<td>8</td>
<td></td>
<td>Oct 15</td>
<td>Midterm Exam</td>
<td></td>
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<tr>
<td></td>
<td>Disc.</td>
<td>Oct 17</td>
<td>Plant Biotechnology</td>
<td>17</td>
</tr>
<tr>
<td>No.</td>
<td>Date</td>
<td>Topic</td>
<td>Lecture/Class</td>
<td>Reads</td>
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<tr>
<td>9</td>
<td>Oct 22</td>
<td>Immunology</td>
<td>Lect.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Oct 24</td>
<td>Vaccine Development</td>
<td>Disc.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Oct 29</td>
<td>Cancer Vaccines</td>
<td>Disc.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Nov 5</td>
<td>Monoclonal Antibodies as Drugs</td>
<td>Disc.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Nov 7</td>
<td>Tissue Engineering</td>
<td>Disc.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Nov 12</td>
<td>Animal Engineering</td>
<td>Disc.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Nov 14</td>
<td>Microbial Engineering</td>
<td>Disc.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Nov 19</td>
<td>Student Presentations</td>
<td>Nov 19</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Nov 21</td>
<td>Student Presentations</td>
<td>Nov 21</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Nov 26</td>
<td>Drug Development</td>
<td>Lect.</td>
<td></td>
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<tr>
<td>20</td>
<td>Nov 28</td>
<td>Thanksgiving Break, no classes</td>
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<td></td>
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<tr>
<td>21</td>
<td>Dec 3</td>
<td>Student Presentations</td>
<td>Dec 3</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Dec 5</td>
<td>Student Presentations</td>
<td>Dec 5</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Dec 12</td>
<td>FINAL EXAM: 11 a.m. to 12 p.m. (60 min.)</td>
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</tbody>
</table>

Readings:


Statement on Academic Conduct and Support Systems

Academic Integrity:
The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university’s mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit
work written by others or “recycle” work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity’s website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.
**Reporting Incidents of Bias or Harassment** - (213) 740-5086 or (213) 821-8298
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

**The Office of Student Accessibility Services (OSAS)** - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

**USC Campus Support and Intervention** - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

**Diversity, Equity and Inclusion** - (213) 740-2101
Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

**USC Emergency** - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

**USC Department of Public Safety** - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
Non-emergency assistance or information.

**Office of the Ombuds** - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

**Occupational Therapy Faculty Practice** - (323) 442-2850 or otpf@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.