BISC 406L: Biotechnology

4 Units
Fall 2022
Lecture:
Tu and Th 9:00-9:50 a.m.
Lab:
Th 10:00-1:00 p.m. (sometimes 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

Ian Ehrenreich, Ph.D.
Office: RRI 319a
Office Hours: By appointment
Contact Info:
Email: ian.ehrenreich@usc.edu
Phone number: 213-821-5349
We will typically reply to emails within 24 hours during the workweek and 48 hours over the weekend.

Laboratory Director: Celeste Chong-Cerrillo, Ph.D.
Office: ZHS 450
Office Hours: By appointment
Contact Info: chongcer@usc.edu (best choice). Subject line should state: “BISC 406”

Teaching Assistant: Daniel Lusk
Office:
Office Hours:
Contact Info:

Course Description
BISC 406L is the capstone course for the BS in Biological Sciences with Emphasis in Biotechnology. It is also the capstone course and the Minor in Biotechnology 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](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 or Ehrenreich 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. Ehrenreich 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.
Final project report: Students will be expected to provide a single-spaced, 10-page paper describing the problem, methods to address the problem, and the potential range of outcomes for the proposed experiments. The paper should be written in Arial font with a font size of 12 and 1-inch margins on each side of the page. Primary literature should be used to reference salient points, and at least 25 papers should be referenced.
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>
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</thead>
<tbody>
<tr>
<td>Midterm Exam</td>
<td>120</td>
<td>17.8</td>
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</tbody>
</table>
Final Exam 120 17.8
Classroom Discussion 60 8.9
Final Project Report & Presentation 120 17.8
Laboratory 255 37.8

**TOTAL 675 100**

**Course letter grades:**
Course final grades will be determined using the following scale:
- A 90-100
- A- 87-89.9
- B+ 84-86.9
- B 80-83.9
- B- 76-79.9
- C+ 72-75.9
- C 68-71.9
- C- 64-67.9
- D+ 60-63.9
- D 56-59.9
- D- 52-55.9
- F below 52

**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: green
Ehrenreich lecture/discussion: blue
Both: black

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<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 23</td>
<td>Intro to Biotechnology (CREATE program)</td>
<td>1 and 1a</td>
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<td></td>
<td>Lect.</td>
<td>Aug 25</td>
<td>Cloning and synthesizing DNA molecules</td>
<td>2</td>
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<tr>
<td>2</td>
<td>Lect.</td>
<td>Aug 30</td>
<td>Assembling DNA molecules into chromosomes and genomes</td>
<td>3</td>
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<tr>
<td></td>
<td>Disc.</td>
<td>Sept 1</td>
<td>Bacterial genome synthesis and transplantation</td>
<td>4 and 5</td>
</tr>
<tr>
<td>3</td>
<td>Disc.</td>
<td>Sept 6</td>
<td>Eukaryotic chromosome synthesis and transplantation</td>
<td>6 and 7</td>
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<td></td>
<td>Lect.</td>
<td>Sept 8</td>
<td>CRISPR/Cas technology and applications</td>
<td>8</td>
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<tr>
<td>4</td>
<td>Disc.</td>
<td>Sept 13</td>
<td>CRISPR-based diagnostics</td>
<td>9</td>
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<tr>
<td></td>
<td>Lect.</td>
<td>Sept 15</td>
<td>CRISPR therapies in humans</td>
<td>10 and 11</td>
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<tr>
<td>5</td>
<td>Disc.</td>
<td>Sept 20</td>
<td>CRISPR therapy clinical trials</td>
<td>12</td>
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<tr>
<td></td>
<td>Lect.</td>
<td>Sept 22</td>
<td>DNA sequencing technologies</td>
<td>13</td>
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<tr>
<td>6</td>
<td>Disc.</td>
<td>Sept 27</td>
<td>Telomere-to-telomere genome sequences</td>
<td>14</td>
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<tr>
<td></td>
<td>Disc.</td>
<td>Sept 29</td>
<td>Single cell sequencing</td>
<td>15</td>
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<tr>
<td>7</td>
<td>Lect.</td>
<td>Oct 4</td>
<td>Plant Biotechnology</td>
<td>16</td>
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<tr>
<td></td>
<td>Disc.</td>
<td>Oct 6</td>
<td>Plant Biotechnology</td>
<td>17</td>
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<td>8</td>
<td>Oct 11</td>
<td>Midterm Exam</td>
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<td></td>
<td>Oct 13</td>
<td>Fall Break, no classes</td>
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<tr>
<td>9</td>
<td>Lect.</td>
<td>Oct 18</td>
<td>Immunology</td>
<td>18</td>
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<td></td>
<td>Disc.</td>
<td>Oct 20</td>
<td>Vaccine Development</td>
<td>19 and 20</td>
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<tr>
<td>10</td>
<td>Disc.</td>
<td>Oct 25</td>
<td>Cancer Vaccines</td>
<td>21</td>
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<td></td>
<td>Disc.</td>
<td>Oct 27</td>
<td>Techniques in Diagnostics</td>
<td>22</td>
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<tr>
<td>11</td>
<td>Lect.</td>
<td>Nov 1</td>
<td>Drug Development</td>
<td>23</td>
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<tr>
<td></td>
<td>Disc.</td>
<td>Nov 3</td>
<td>Monoclonal Antibodies as Drugs</td>
<td>24</td>
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<tr>
<td>12</td>
<td>Disc.</td>
<td>Nov 8</td>
<td>Tissue Engineering</td>
<td>25</td>
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<tr>
<td></td>
<td>Disc.</td>
<td>Nov 10</td>
<td>Animal Engineering</td>
<td>26 and 27</td>
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<tr>
<td>13</td>
<td>Disc.</td>
<td>Nov 15</td>
<td>Microbial Engineering</td>
<td>28</td>
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<td></td>
<td>Nov 17</td>
<td>Student Presentations</td>
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<tr>
<td>14</td>
<td>Nov 22</td>
<td>Student Presentations</td>
<td></td>
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<td></td>
<td>Nov 24</td>
<td>Thanksgiving Break, no classes</td>
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<tr>
<td>15</td>
<td>Nov 29</td>
<td>Student Presentations</td>
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<tr>
<td></td>
<td>Dec 1</td>
<td>Student Presentations</td>
<td></td>
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<tr>
<td>17</td>
<td>Dec. 8</td>
<td>FINAL EXAM: 11 a.m. to 12 p.m. (60 min.)</td>
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Readings:

**Statement on Academic Conduct and Support Systems**

**Academic Conduct:**

Plagiarism - presenting someone else’s ideas as your own, either verbatim or recast in your own words - is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

**Support Systems:**

*Student Health Counseling Services* - (213) 740-7711 - 24/7 on call
[engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline* - 1 (800) 273-8255 - 24/7 on call
[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP)* - (213) 740-4900 - 24/7 on call
[engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) | Title IX* - (213) 740-5086
[equity.usc.edu, titleix.usc.edu](http://equity.usc.edu, titleix.usc.edu)
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.
Bias Assessment Response and Support - (213) 740-2421  
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776  
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710  
studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101  
diversity.usc.edu
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  
dps.usc.edu, emergency.usc.edu
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) 442-120 - 24/7 on call  
dps.usc.edu
Non-emergency assistance or information.