*Draft*

USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences

# BISC 406L: Biotechnology

**4 Units**
**Fall 2019**
**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


**Instructor: 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
I 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
**Contact Info:** chongcer@usc.edu
Subject line should state: "BISC 406"

**Teaching Assistant: TBD**
**Office:**
**Office Hours:**
**Contact Info:**


## Course Description

BISC406L is the capstone course for the Minor in Biotechnology offered by the 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; (2) Genomics and Proteomics; (3) Manipulating Prokaryotic and Eukaryotic gene expression; (4) Molecular Diagnostics and Therapeutics; (5) Vaccines and Gene Therapy; (6) Genetic Engineering of Plants and Animals and; (7) 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 recombinant DNA 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.
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.
Name important regulatory divisions of government and demonstrate explain types of oversee that they administer.
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 lectures 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 a week ahead of 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 group 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 625 possible points:

| Assignment | Points | % of Grade |
|---|---|---|
| Midterm Exam | 150 | 22.9 |
| Final Exam | 150 | 22.9 |
| Classroom Discussion | 70 | 10.7 |
| Student Presentations | 30 | 4.6 |
| Laboratory | 255 | 38.9 |
| **TOTAL** | 655 | 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:

| Wk | Type | Date | Lecture Topic | Reading |
|---|---|---|---|---|
| 1 | Lect. | Aug 27 | Intro to Biotechnology (CREATE program) | 1 |
| | Lect. | Aug 29 | DNA Technology | 2 |
| 2 | **Disc.** | Sept 3 | **DNA Techniques in pathogen ID** | **3** |
| | Lect. | Sept 5 | Plant Biotechnology | 4 |
| 3 | **Disc.** | Sept 10 | **Plant Biotechnology** | **5** |
| | Lect. | Sept 12 | Immunology | 6 |
| 4 | Lect. | Sept 17 | Recombinant Proteins | 7 |
| | **Disc.** | Sept 19 | **Vaccine Development** | **8** |
| 5 | **Disc.** | Sept 24 | **Cancer Vaccines** | **9** |
| | | Sept 26 | **No Lecture, Lab only** | |
| 6 | **Disc.** | Oct 1 | **Techniques in diagnostics** | **10** |
| | **Disc.** | Oct 3 | **Grant proposal exercise** | |
| 7 | **Disc.** | Oct 8 | Drug Development | **11** |
| | **Disc.** | Oct 10 | **Monoclonal Antibodies as Drugs** | **12** |
| 8 | | Oct 15 | **Midterm Exam** | |
| | | Oct 17 | Fall Break, no classes | |
| 9 | **Disc.** | Oct 22 | **Grant proposal exercise** | |
| | **Disc.** | Oct 24 | **Drugs for Genetic Diseases** | **13** |
| 10 | Lect. | Oct 29 | Animal Biotechnology/Cell Therapy | 14 and 15 |
| | **Disc.** | Oct 31 | **Tissue Engineering** | **16 and 17** |
| 11 | **Disc.** | Nov 5 | **Stem Cell Therapy/Gene Editing** | **18 and 19** |
| | **Disc.** | Nov 7 | **Gene Therapy/Gene Editing** | **20 and 21** |
| 12 | **Disc.** | Nov 12 | **Animal Engineering** | **22 and 23** |
| | **Disc.** | Nov 14 | **Microbial Biotechnology** | **24 and 25** |
| 13 | Lect. | Nov 19 | Student Presentations | |
| | Lect. | Nov 21 | Student Presentations | |
| 14 | **Disc.** | Nov 26 | **Biotechnology Ethics and Author Discussion** | **26** |
| | | Nov 28 | Thanksgiving Break, no classes | |
| 15 | Lect. | Dec 3 | Student Presentations | |
| | Lect. | Dec 5 | Student Presentations | |
| 17 | | **Dec. 12** | **FINAL EXAM: 11 to 11:50 a.m. (60 min.)** | |

Readings:

1. **Clark, D. P., and N. J. Pazdernik**. 2015. Basics of Biotechnology. In Clark, D. P., and N. J. Pazdernik. (Authors), Biotechnology: Applying the genetic revolution, p. 1-32. Elsevier Academic Press, San Diego, CA.
2. **Clark, D. P., and N. J. Pazdernik**. 2015. Genomics and Gene Expression. In Clark, D. P., and N. J. Pazdernik. (Authors), Biotechnology: Applying the genetic revolution, p. 231-268. Elsevier Academic Press, San Diego, CA.
3. **Mahmudunnabi et. al.** 2018. Molecular detection and PCR-RFLP analysis using Pst1 and Alu1 of multidrug resistant Klebsiella pneumoniae causing urinary tract infection in women in the eastern part of Bangladesh. Journal of Genetic Engineering and Biotechnology. 16:77-82.
4. **Clark, D. P., and N. J. Pazdernik**. 2015. Transgenic plants and plant biotechnology. In Clark, D. P., and N. J. Pazdernik. (Authors), Biotechnology: Applying the genetic revolution, p. 397-424. Elsevier Academic Press, San Diego, CA.
5. **Xu et al.** 2018. Characterization of transgenic rice expressing fusion protein Cry1Ab/Vip3A for insect resistance. Scientific Reports **8** Article number: 15788.
6. **Clark, M.** 2001. Immunochemical applications. In C. Ratledge and B. Kristiansen (ed.), Basic Biotechnology, 2nd ed., p. 503-530. Cambridge University Press, Cambridge, U.K.
7. **Clark, D. P., and N. J. Pazdernik**. 2015. Recombinant Proteins. In Clark, D. P., and N. J. Pazdernik. (Authors), Biotechnology: Applying the genetic revolution, p. 305-328. Elsevier Academic Press, San Diego, CA.
8. **Pauthner, M. et al.** 2019. Vaccine-Induced Protection from Homologous Tier 2 SHIV Challenge in Nonhuman Primates Depends on Serum-Neutralizing Antibody Titers. Immunity. **50**: 241-252.
9. **Cooper, M. et al.** 2018. An 'off-the-shelf' fratricide-resistant CAR-T for the treatment of T cell hematologic malignancies. Leukemia. **32 (9)** : 1970-1983.
10. **Gootenberg, J., et al.** 2017. Nucleic acid detection with CRISPR-Cas13a/C2c2. Science **359 (6336):**438-442.
11. **Berg, J. M., J. L. Tymoczko, and L. Stryer.** 2015. Drug development. In Berg, J. M., J. L. Tymoczko, and L. Stryer (Authors), Biochemistry, 8th ed., p. 1033-1056. W. H. Freeman and Company, New York.
12. **Bardia, A. et al.** 2019. Sacituzumab Govitecan-hziy in Refractory Metastatic Triple-Negative Breast Cancer. NEJM. **380 (8)** : 741-751.
13. **Welch, E. M., et al.** 2007. PTC124 targets genetic disorders caused by nonsense mutations. Nature 447:87-91.
14. **Clark, D. P., and N. J. Pazdernik**. 2015. Transgenic Animals. In Clark, D. P., and N. J. Pazdernik. (Authors), Biotechnology: Applying the genetic revolution, p. 425-456. Elsevier Academic Press, San Diego, CA.
15. **Thieman, W. J. and Palladino, M.A.** 2014. Medical Biotechnology, p. 263-305. In W. J. Thieman & M. A. Palladino (Authors), Introduction to biotechnology. Harlow etc.: Pearson Education Limited.
16. **Belmonte, J. C. I.** 2016. Human Organs from Animal Bodies. Sci. Am. **315 (5)** : 32-37.

17. **Yamaguchi, T. et al.** 2017. Interspecies organogenesis generates autologous functional islets. Nature. **524** : 191-196.
18. **Hall, S. S.** 2016. The First Tinkering with Human Heredity May Happen in the Infertility Clinic. Sci. Am. **315 (3)** : 54-61.
19. **Zhou, Q. et al.** 2016. Complete Meiosis from Embryonic Stem Cell-Derived Germ Cells In Vitro. Cell Stem Cell. 18 (3) 330-340.
20. CRISPR identifies genes that might be targeted to hobble HIV infection Sharon Begley - https://www.statnews.com/2016/10/25/crispr-identifies-hiv-genes/
21. **Hultquist, J. F. et al.** 2016. Platform for Functional Genetic Studies of HIV-Host Interactions in Primary Human T Cells. Cell Reports. **17 (5)** : 1438-1452.
22. Using Gene Drives to Limit the Spread of Malaria. https://www.the-scientist.com/?articles.view/articleNo/47755/title/Using-Gene-Drives-to-Limit-the-Spread-of-Malaria/
23. **Hammond, A. et al.** 2016. A CRISPR-Cas9 gene drive system targeting female reproduction in the malaria mosquito vector *Anopheles gambiae*. Nature Biotechnology. **34** : 78-83.
24. **Lu, T. K. and Purcell, O.** 2016. Machine Life. Sci. Am. **314 (4)** : 58-63.
25. **Mimee, K. et al.** 2018. An ingestible bacterial-electronic system to monitor gastrointestinal health. Science, **360**, 915-918.
26. **Clark, D. P., and N. J. Pazdernik**. 2015. Bioethics in biotechnology. In Clark, D. P., and N. J. Pazdernik. (Authors), Biotechnology: Applying the genetic revolution, p. 665-693. Elsevier Academic Press, San Diego, CA.

## 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. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

**Support Systems:**

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*
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

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
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
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.