

**General Course Information for
BIMM 194/BGGN 283: A CRISPR Perspective – Spring 2024**

Class Time & Location: Wednesdays at 1:00-2:20 PM, York Room 3010

Instructor: Professor Jill Wildonger

Contact: jwildonger@ucsd.edu

*Please include "BISP 194" or "BGGN 285" in the subject line of your email.

Office Hours: Tuesdays (April 16 - June 4), 1:00-2:00 PM, Bonner 2140

Course Website: <https://canvas.ucsd.edu/courses/54422>

Course Description: CRISPR has revolutionized gene editing and opened up new possibilities in research, food production, disease treatment, and disease detection, to name a few. We will discuss the emergence of gene editing technologies as well as the expansion of approaches made possible by CRISPR-Cas9 and other CRISPR-based systems. Throughout the course, you will also acquire the skills to interpret, evaluate, and present primary literature.

Prerequisite: BIMM100 (Molecular Biology). Success in the course will be aided by a strong foundation in molecular biology fundamentals.

Course Format: Each class is centered on a topic and will include a presentation and discussion of a primary research paper. Starting in Week 3 (April 17), classes will be led by student groups presenting a primary research paper and leading the discussion; Prof. Wildonger will provide a brief introduction as needed; there will be a short in-class quiz.

Grading: Your grade will reflect a combination of your engagement with and participation in the class (50 points), weekly on-line quizzes in Canvas (20 points), and a written assignment (30 points). There is no final exam. Any mistake made in grading must be brought to the attention of Prof. Wildonger within a week of the result being posted. The grading mistake should be obvious, and you should clearly and briefly describe the mistake. Points will be awarded as described below (100 points total). **I enthusiastically want every student to do well in the course and enjoy the class.** The assignments are intended to aid and enrich your learning.

30 points...In-class participation; 1 quiz per week starting Week 3 (April 17), 6 points per quiz

- Quizzes will be a mix of ~3-6 multiple-choice and/or short-answer questions
- Some questions may be answered with a partner
- 5 quizzes (top scores) are tallied; 3 quizzes (lowest scores) are dropped.
- No make-up quizzes, no exceptions. Missed quizzes receive zero points. If you miss class and/or the in-class quiz, the missed quiz will receive zero points and will be dropped, counting as one of the dropped quizzes.

- 20 points.....Group presentation (1 presentation); guidelines below
- 5 points.....Develop one quiz question about the paper that you present (1 question)
- The question should be a thoughtful multiple-choice or short-answer question (not an open-ended question; not an opinion question).
 - The question should be generated independently by you.
 - The question is due within 10 days of your presentation
- 20 points.....Quizzes on Canvas; 10 quizzes total; 1 quiz per week, 2 points per quiz
- 4 questions per week/class (0.5 points per question)
 - Two chances to answer each multiple-choice question correctly
 - Points are only awarded for correctly answered questions
- 25 points.....Essay (1 essay); guidelines below
- Essays can be submitted anytime between May 3 - June 10.
 - If you submit your essay before May 17, you may request the opportunity to revise and resubmit your work before June 10.

There is no extra credit.

There is no option for extra work for extra points.

Revised work is only allowed for one assignment under one condition: essays submitted before May 17 (revised essays must be resubmitted by June 10); essays submitted after May 17 may not be revised and will be graded once at the end of the quarter, no exceptions. All other assignments (in-class participation quizzes, group presentation, student-developed quiz question, Canvas quizzes) may not be revised or re-taken for additional points.

Letter grades will be assigned as follows based on the points achieved:

87-100: A (A-, A, or A+)

77-86: B (B-, B, or B+)

67-76: C (C-, C, or C+)

57-66: D

Below 57: F

Course Assignments (description, dates & deadlines, and points awarded)

In-class Participation – multiple-choice and short-answer questions (30 points total)
Starting Week 3 (April 17) there will be a short in-class quiz each week on the material covered in the class. The quizzes are intended to encourage class participation and to provide an opportunity to engage with the paper being presented. The quizzes will be a mix of multiple-choice and short-answer questions; some questions can be completed with a partner. Each quiz will have ~3-6 questions to answer in ~15 minutes. There will be a total of 8 quizzes, and the 5 top-scoring quizzes will be tallied (6 points per quiz). Three quizzes will be dropped. There will be no make-up quizzes (no exceptions). A missed quiz will receive zero points and will count as one of the dropped quizzes. Only three quizzes are dropped, so please attend class regularly.

Group presentation (20 points)

The class will be divided into eight groups, and each group will be assigned to present a research paper and lead a discussion of the paper (guidelines below).

Points awarded for succinctly and clearly summarizing the overall significance of the project and motivation (3 points), experimental goals and approach (3 points), results (3 points), interpretation of the results (3 points), conclusion (3 points), and your opinion on whether the data in the paper support the authors' conclusions (3 points). Teamwork and an overall well-organized presentation will also be evaluated (2 points). The same number of points will be awarded to all members of the group. Presentations should be the result of collaboration between all group members.

Quiz question about the paper that you present (5 points)

Please create a thoughtful multiple-choice or short-answer quiz question based on the paper that you present as a group. While the presentation is a group effort, the question should be generated independently by you (no group work). The question should NOT be open-ended (e.g., there should a correct answer). The question should not solicit an opinion. The question is due within 10 days of your presentation. Points awarded for thoughtfulness (1 point), correctness (3 points), and clarity (1 points).

Quizzes on Canvas – multiple-choice and short-answer questions (20 points total)

There will be an on-line quiz in Canvas each week on the material covered in each class. Each quiz will be available the Tuesday before class and should be completed within a week by the following Tuesday (e.g., the quiz for the first class will be available on Tuesday April 2 and should be completed by the end of the day Tuesday April 9). Each quiz has four questions, and you will have two chances to answer each question correctly. Some questions are short-answer and open-ended; for questions soliciting your opinion, any well-reasoned answer will be marked as "correct." You are welcome to work on the quizzes together in a small group. Your answers should reflect your individual effort or your contribution to an interactive small-group effort. Points awarded for correctly answered questions (incorrect answers receive no points).

Essay (25 points)

Please select any of the research articles in the course syllabus other than the paper that you presented (you CANNOT write about the paper you presented). Please write an essay (1,000-1,200 words) for a non-scientist audience, such as friends or family, explaining the scientific advance (additional guidelines below). You may submit your essay anytime between May 3 - June 10. If you submit your essay before May 17, you may request the opportunity to revise and resubmit your work before June 10. Please email Prof. Wildonger to request the option to resubmit if you submit before May 17. Only essays submitted before May 17 may be revised and resubmitted. All essays submitted after May 17 will be graded once, at the end of the quarter, with no opportunity for revision (no exceptions).

Points awarded for succinctly and clearly summarizing the overall significance of the paper and the motivation (5 points), and main take-aways (5 points); summary of the data that the authors use to support their conclusion (5 points); your opinion on whether the data support the authors' conclusion (5 points), and your thoughts on a potential future direction or application (5 points).

Academic Integrity: Academic dishonesty will not be tolerated in this course.

According to UCSD policy, academic dishonesty includes:

- completing assignments for another student
- allowing another student to complete an assignment for you
- copying another student's work on an assignment
- allowing another student to copy your work on an assignment
- incorporating plagiarized material into an assignment

Any issues with academic dishonesty will be reported to the UCSD Academic Integrity Coordinator and the Dean of the student's college. Confirmed cases of academic dishonesty will result in the student receiving an F as their final grade and other disciplinary actions determined appropriate by the Academic Integrity Coordinator.

Group Presentation Guidelines

All members of the group will contribute to the presentation and discussion. All members should participate in either/both the presentation and discussion.

Your group will be assigned a primary research paper to present (see class syllabus)
You will have a total time of ~45 minutes of class time for your presentation.
Prepare a ~35 minute presentation, which will allow time (~10 minutes) for questions.

The presentation should cover:

The overall significance of the project and motivation (3 points)

What is the problem, or what is the unanswered question?

Why is this important? Provide enough background so the class can understand the rationale behind the study. This may require reading additional papers.

What has already been done, and what do the authors hope to accomplish?

What impact will the work have?

The experimental goals and approach (3 points)

For example, the authors want to determine whether DNA is cleaved by Cas9 (the goal). To do this, they use X assay (approach).

The key results/data* (3 points) and the authors' interpretation of the results (3 points)

*Identify the results/data that are most important to the authors' main conclusions.

Important: It is likely that not all the results/data will be included in the presentation.

Conclusions and the authors' main takeaway (3 points)

Whether you think the data in the paper support the authors' conclusions (3 points)

What you think would be the future direction(s) for this study?

Teamwork and the overall organization of the presentation will be evaluated (2 points).

Essay Guidelines

The essay can be submitted anytime between May 3 and June 10. If you submit your essay before May 17, you can request the option to revise and resubmit before June 10. Please email Prof. Wildonger to request the option to resubmit if you submit before May 17. Only essays submitted before May 17 can be revised and resubmitted. All essays submitted after May 17 will be graded once, at the end of the quarter, with no opportunity for revision (no exceptions).

Select a research paper covered in the course other than the paper that you presented (you CANNOT write about the paper you presented). If you would like to cover an article not in the course syllabus but related to material that we covered, you must obtain prior approval from Prof. Wildonger (otherwise the essay on the outside paper will receive zero points).

Describe the scientific advance reported in the research paper for a science novice.

Your writing should be in essay form and be 1,000-1,200 words (~1,200 words max, please).

The essay should describe the following:

What is the overall significance of the project and motivation for doing the work? (5 points)

Consider what you think is generally significant, not just what is significant for a scientist or a scientific field. Consider why a non-scientist would be interested in this study.

What are the authors' main take-aways (5 points), and how do the authors support their conclusions (5 points)?

Describe the experiments and conclusions for a non-expert. Highlight the key experiment(s) and describe how these experiments lead to the authors' conclusion(s).

Do you think the data do indeed support the authors' conclusion, why or why not? (5 points)

Give your opinion on what the authors show and whether you feel the data provide strong evidence for their conclusion.

What do you think is a potential future direction or application? (5 points)

BIMM 194/BGGN 283 A CRISPR Perspective on Gene Editing - Spring 2024 – Syllabus

Week	Theme	Date	Topic and primary research paper
1	Introduction to Gene Editing	April 3	Milestones in the history of gene editing <i>Site-directed mutagenesis by gene targeting in mouse embryo-derived stem cells.</i> Thomas et al. PMID: 2822260
2		April 10	CRISPR-Cas9 transforms gene editing <i>A Programmable Dual-RNA-Guided DNA Endonuclease in Adaptive Bacterial Immunity.</i> Jinek et al. PMID: 22745249
3	Broad Applications of CRISPR-Cas9	April 17	Editing the foods we eat <i>Enhancing grain-yield-related traits by CRISPR-Cas9 promoter editing of maize CLE genes.</i> Liu et al. PMID: 33619356
4		April 24	Breaking the genome to cure disease: sickle cell disease <i>CRISPR-Cas9 Gene Editing for Sickle Cell Disease and β-Thalassemia.</i> Frangoul et al. PMID: 33283989
5		May 1	All about the base: CRISPR meets nucleotide base editors <i>Programmable base editing of A•T to G•C in genomic DNA without DNA cleavage.</i> Gaudelli et al. PMID: 29160308
6		May 8	Treating sickle cell disease by changing the DNA base <i>Base editing of haematopoietic stem cells rescues sickle cell disease in mice.</i> Newby et al. PMID: 34079130
7		May 15	Gene editing hits its "prime" with prime editing <i>Search-and-replace genome editing without double-strand breaks or donor DNA.</i> Anzalone et al. PMID: 31634902
8		May 22	Modifying the epigenome to combat pain <i>Long-lasting analgesia via targeted in situ repression of NaV1.7 in mice.</i> Moreno et al. PMID: 33692134
9	CRISPR Beyond Cas9	May 29	Cas enzymes that cleave RNA and single-stranded DNA <i>C2c2 is a single-component programmable RNA-guided RNA-targeting CRISPR effector.</i> Abudayyeh et al. PMID: 27256883
10		June 5	Back to bacteria: CRISPR as a tool to selectively eliminates harmful bacteria <i>Development of CRISPR-Cas13a-based antimicrobials capable of sequence-specific killing of target bacteria.</i> Kiga et al. PMID: 32523110