

## **BGGN285 & BISP194 – Inbreeding Depression and Heterosis**

**Spring 2022**

**Tuesday, 9:30-10:50am**

**Muir Biology 1138**

**Instructor: Prof. Steven Briggs ([sbriggs@ucsd.edu](mailto:sbriggs@ucsd.edu))**

**Office location and hours: 6115 NSB; Tuesday 11:00am-12:00pm**

### **COURSE DESCRIPTION**

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**BGGN285/BISP194** – *Inbreeding Depression and Heterosis* is designed to convey current knowledge regarding the consequences of inbreeding and outcrossing in plants, animals, and humans. The scope of effect on health caused by inbreeding and outcrossing exceeds all other known forms of genetic variation. Hybridization produces such a remarkable boost in fitness that nearly all crops and livestock are now produced as hybrids, even though the time and effort required to breed hybrids is much greater than to breed varieties. The consequences of inbreeding on human health are only beginning to be appreciated. Despite its importance in nature, agriculture, and medicine, there is little understanding of inbreeding depression/heterosis. By reading the literature, participating in classroom discussions, and taking quizzes each student will learn the principles of this field of study.

Most of you are seniors/masters and you will be entering the biotechnology industry or graduate school within the next few months. Your abilities to analyze research publications and verbally present scientific results in group meetings will be crucial to your success. This course is organized to help you strengthen these skills.

The format of the course is one classroom workshop weekly. Participation is graded for all workshops. Workshops are guided explorations of the biological meanings in the research articles. Each workshop will begin with a 10-15 minute slide presentation by student Presenters who will explain the reason that the research was done (WHY) and the key methods that were used (HOW). At the end, Presenters will offer their conclusions and perspectives on the article. The remaining period of the workshop will engage all students in analysis of the figures from the papers (WHAT). WHY-HOW-WHAT is the standard format for scientific presentations and articles. Preceding the discussion of each figure, students will confer with each other for 2-3 minutes to refine their understanding and to prepare for their presentation if they are called upon. Then students will be called upon randomly to present figures from the article under consideration. Each figure will be shown on the screen and the designated students will describe what was measured, how it was measured, how the figure should be interpreted, what conclusions were drawn by the authors, and how the results fit into the narrative of the article. You can think of this as a verbal quiz, and you will be graded on the accuracy of your answers. Preparation before class is essential for success!

Please make a point of participating in every class. I know that this can be hard for shy people or if English is your second language. Participation is a requirement for this course and it will be required in your professional life. Fully participating in group efforts helps the group and it helps you.

Presenters must submit their slides as a PPT or PDF file before the beginning of class as an email to Prof. Briggs.

A quiz on each article will be open on Canvas from Thursday at 2:00pm to Friday at 2:00pm. You may use any resources you wish to help you answer the questions. Please do your own work, so that you learn the subject matter. The quizzes won't be difficult and they will require that you have read the articles.

Some articles are accompanied by a review/commentary which is offered to you as an aid to understanding the article. Articles have a number and the review/commentary has the same number plus a letter. The class discussion and quiz will not cover the review/commentary.

Additional course information can be found on our class website on Canvas, including PDFs of the articles in Files.

## **COURSE REQUIREMENTS**

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### **Participation**

Class participation, presentations, and quizzes are used to determine your grade.

### **Integrity**

I will give and I expect in return an honest, fair, responsible, respectful, trustworthy, and courageous effort on all academic work and collaboration.

Please read UC San Diego's Policy on Integrity of Scholarship. Then, take the integrity pledge!

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**BGGN285/BISP194** – *Inbreeding Depression and Heterosis* SP22 Syllabus

Week 1 (Mar 29) – Inbreeding depression

Articles:

1 Darwin, C. R. 1876. The effects of cross-fertilization in the vegetable kingdom. London\_ John Murray  
(You are only required to read chapters I and XII)  
1a Darwin on fertilization Dyer Nature 77

Week 2 (Apr 5) – Inbreeding depression

Articles:

2 Associations of autozygosity with a broad range of human phenotypes Clark Nat Comms 19

2a The genetics of inbreeding depression Charlesworth Nat Rev Genet 09

Week 3 (Apr 12) – Inbreeding depression

Articles:

3 Ancestral Inbreeding Only Minimally Affects Inbreeding Depression in Mammalian Populations Ballou J Hered 97

3a Plant Biotechnology Journal - 2020 - Mackay - Understanding the classics the unifying concepts of transgressive

Week 4 (Apr 19) – Inbreeding depression

Articles:

4 An epigenetic basis of inbreeding depression in maize Han Sci Adv 21

4a Inbreeding depression, it's not just for population biologists Kariyat Am J Noy 19

Week 5 (Apr 26) - Heterosis

Articles:

5 The Role of Hybrid Vigor in the Replacement of Pecos Pupfish by Its Hybrids with Sheepshead Minnow Rosenfield Conservation Biol 04

Week 6 (May 3) – Heterosis

Articles:

6 Diurnal down-regulation of ethylene biosynthesis mediates biomass heterosis Song PNAS 18

6a Mechanism of heterosis Review Fujimoto Breeding Sci 18

Week 7 (May 10) – Heterosis

Articles:

7 Parental DNA Methylation States Are Associated with Heterosis in Epigenetic Hybrids Lauss Plant Physiol 18

Week 8 (May 17) – Heterosis

Articles:

8 Transcriptomic, miRNA and Proteomic Changes of a Novel Hybrid Yellow Catfish Zhang Mol Cell Prot 19

Week 9 (May 24) – Heterosis

Articles:

9 Plant height heterosis is quantitatively associated with expression of plastid ribosomal proteins Birdseye PNAS 21

Week 10 (May 31) - Heterosis

Articles:

10 Microbe-dependent heterosis in maize Wagner PNAS 21

## **Grades**

Quizzes (10) = 50 points (5 points per quiz).

Class participation = 50 points. One shared presentation plus opportunities every class period to present figures and contribute comments (answers/explanations).

Shared presentations = 10 points. Sign up on the Google sheet for the Presentation you wish to make. The Presenters will take 10 minutes (5 slides maximum) for an Introduction to describe the WHY and HOW of the paper (goals and strategies) using slides from other articles or from Supplementary figures of the article. Then they will display the figures from the paper in order. It will sometimes be best to display only one or a few panels from each figure at one time. After the discussion of WHAT for each figure (data and conclusions), the Presenters will offer their comments, to complete or clarify matters. After the discussions are over, the Presenters will provide a Summary of the findings of the article and offer their comments on its strengths and weaknesses; they should use a few slides for this and may include Supplementary figures from the article. Emphasize correlation vs causality; necessary or sufficient?

Figure presentations/comments = 40 points. Prior to the discussion of each figure, students will confer in small groups for 2-3 minutes to finalize their preparation. Then the Presenters will choose a student randomly to describe and interpret the next figure. We will only discuss the figures in the main body of the article. However, it is a good idea to look at Supplementary figures for clarifying descriptions and other helpful information; you can find that information on the journal website. All students should add to the discussion with questions and comments. Credit of up to 4 points per class will be given for accurate presentations/explanations of the figures. This part of the class is where many students fall behind in their grade because they are shy or have not prepared ahead of time. Don't be that student! Credit of up to 4 points doesn't sound like much yet it adds up. Get your 4 points every class!

There are no make-ups.

## **Grading Scale**

**A = 90-100**

**B = 80-89**

**C = 70-79**

**D = 60-69**

**F = 59-below**