

Critical Thinking in Science

Summer 2021

1:00-2:30 PM Wednesday, Zoom

Instructors:

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Course Goals:

Encourage a constructively critical approach to the evaluation of science research papers, proposals and other presentations.

Familiarize students with the peer review process and its importance.

Improve student understanding of the how to design rigorous and reproducible experimental studies.

Provide an opportunity to add elements of rigor to the student's research projects and receive peer feedback.

Format:

Virtual class discussion of assigned reading and writing assignments. Some sessions will include lecture material from the instructors.

Grading: (Pass/Fail)

Because the success of this class depends on active student participation, the grading system is intended to encourage students to regularly contribute to discussions and to complete in-class exercises.

Preparation for and participation in class discussions (12 points total)

In-class participation at each virtual session is worth 1 point. Active participation requires that the student complete any pre-class assignments and meaningfully participate in the discussions. Students are also expected to turn on their cameras for the duration of the class period.

Class assignments (12 points total)

Three short, written assignments and one oral presentation assignment are planned for the class. The course instructors will grade each these exercises on a 0-3 pt scale. In general, full credit will be given in all cases where students complete these assignments in a thoughtful manner that is directed at the intended objective.

Final Grade: A passing grade requires that students earn at least 20 of 24 possible points during the semester.

Missed Classes: Students who are unable to attend one class can earn credit for one missed session during the semester by contacting the instructor within 3 days and then satisfactorily completing a short written assignment before the next class. Make up credit will not be available for additional missed sessions.

Canvas Access: All registered students should regularly check the course website on Canvas where assignments will be posted.

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May 19 Course Orientation/What is "Critical Thinking"

May 26 Hypothesis, Bias and Dogma

Reading assignments

1. Scientific Summary - 2012 Nobel Prize in Physiology and Medicine

"Mature Cells can be reprogrammed to become pluripotent" John Gurdon and Shinya

Yamanaka

2. Select and read one of the three additional summaries provided (see Canvas)

June 2 Rigor and Reproducibility – Problems

Reading assignment to be discussed in class:

Nuzzo et al, *Nature* 2015 – "Fooling Ourselves"

Munafo et al, *Nature Hum Behav* 2017 – "A Manifesto for Reproducible Science"

Baker, *Nature* 2016 – "Quality Time"

June 9 Rigor and Reproducibility– Solutions

June 16 Evaluating data and conclusions

Written assignment #1 (3 points) due in class: Identifying assumptions

June 23 The Peer-Review Process

Reading for discussion at this class: To Be Determined

June 30 Discussion of Student Manuscript Reviews

Written assignment #2 (3 points) due in class: Review of assigned article

July 7 Origins and impact of a science controversy

Reading Assignment to be discussed in class:

Eliyahu, D. et al. Overproduction of p53 antigen makes established cells highly tumorigenic. *Nature* 316, 158-60 (1985).

Eliyahu, D., et al. Wild-type p53 can inhibit oncogene-mediated focus formation. *Proc Natl Acad Sci USA* 86, 8763-7 (1989).

July 14 Project planning - Adopting a rigorous approach

July 21 Discussion of mini-project plans

Written Assignment #3 (3 points) due in class– Draft mini project outline due in class

July 28 Student mini-project plan presentations #1

Assignment #4 (3 points)- Oral presentations by first half of students

Aug 4 Student mini-project plan presentations #2

Assignment #4 continued - Oral presentations by second half of students