

Comparison of Student Performance in Bio110 (The Cell) at UC Merced: to Flip or not to Flip.



Marcos García-Ojeda, PhD
Associate Teaching Professor
School of Natural Sciences

Course Description

- **Bio110 covers the biology of the cell**
 - The course examines fundamental principles of cell biology in eukaryotic cells.
 - The material is covered in weekly formal lectures, discussion sections, and laboratory exercises.
- **Topics covered include:**
 - structure and function of the plasma membrane
 - transport of small molecules, ions and macromolecular complexes across membranes
 - protein trafficking
 - the cytoskeleton
 - signal transduction pathways
 - the control of cell division and cellular proliferation

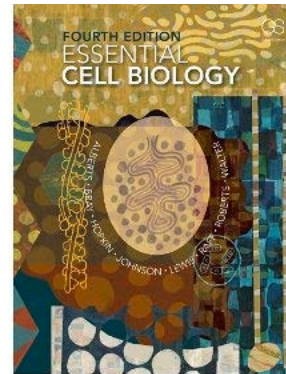
Course Description

➤ This course is a prerequisite, and therefore the foundation, for the majority of the Upper Division Biology courses.

➤ This course is required for students in the Microbiology and Immunology, Developmental Biology, Cell and Molecular Biology and Human Biology tracks. It is not required for students in the Ecology and Evolution track.

➤ Textbook

➤ Alberts et al., Essential Cell Biology (ECB), 4th edition.



➤ Prerequisites

➤ Bio001, General Biology

➤ Bio002, Molecular Biology

➤ Chem008, Organic Chemistry

Comparison of Bio110 taught in Spring 2013 and Fall 2014

	Spring 2013	Fall 2014
Classroom style	Traditional	Flipped
Number of Students	97	164
Teaching assistants	2	3
Student Level	Junior and Seniors	Juniors and Seniors
Educational History	Both homegrown and transfer students	Both homegrown and transfer students

Course Assessment Components for Bio110

	Spring 2013	Fall 2014
Midterm I	15%	15%
Midterm II	15%	15%
Midterm III	15%	15%
Final Exam	20%	20%
Laboratory	15%	15%
Participation	10%	15%
Quizzes via Clicker	10%	5%

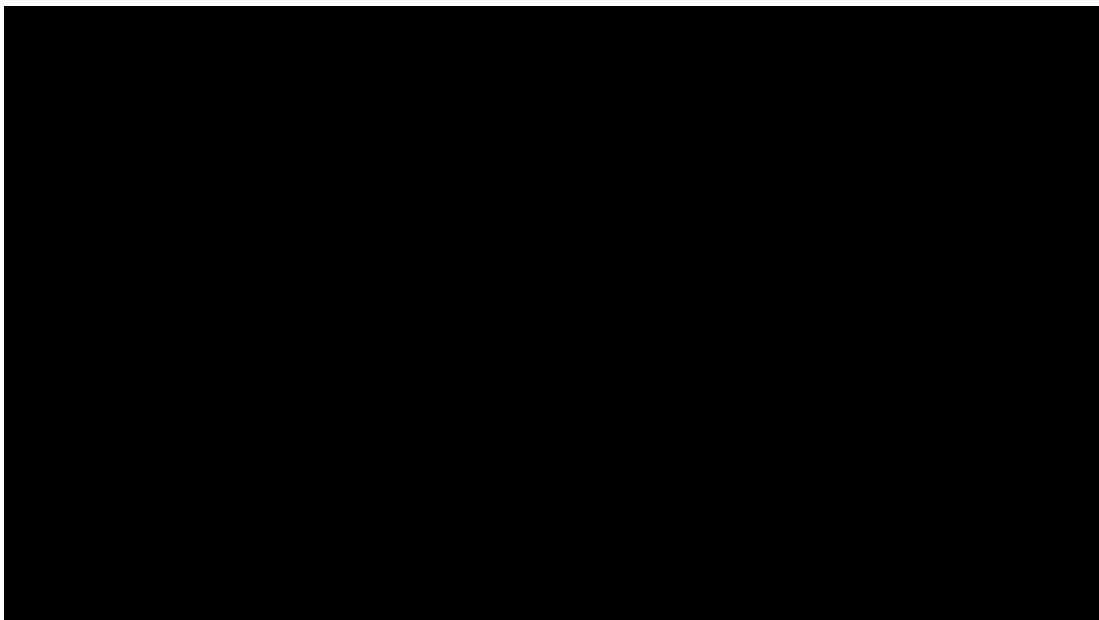
Flipping Classroom

- I wanted to improve the educational experience of UC Merced Biology Students
 - 45.6% Hispanic students
 - 25.2% Asian/Pacific Islander
 - 5.7% African American
 - 14.1% White
 - 64.8% of the total student population have First Generation Status.
- Why Flip the classroom?
 - It helps busy student with learning.
 - Struggling students can revisit lecture material at their own pace.
 - Flipping allow students to pause and rewind the professor.
 - Flipping increases student-professor interaction
 - Flipping increases student-student interaction and peer-learning.
 - Flipping changes the classroom dynamics in a positive

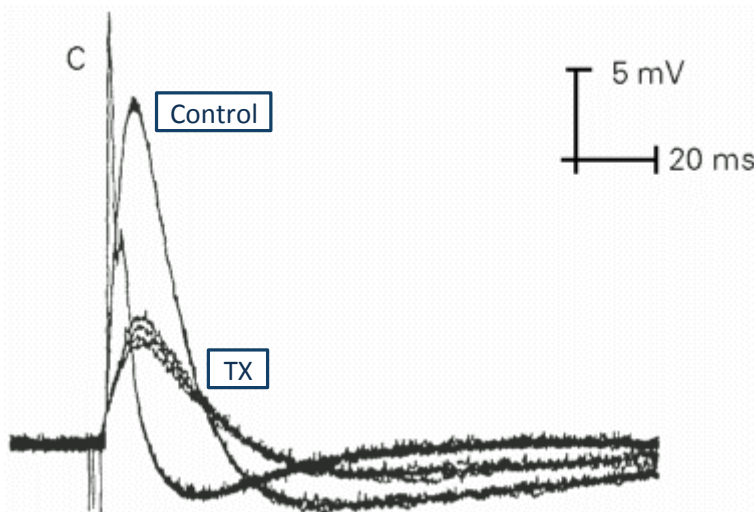
How I flipped my classroom...

- Bio110 video lectures were posted in the class YouTube Channel
 - Video lectures were generated and edited using Camtasia 2 Software.
 - Video lecture length ranged from 30-60 mins.
 - Lecture production is a time consuming process upfront, but the lectures are then done and usable for 2-3 years, saving time!
- Students were expected to watch the video lecture before attending the flipped class.
 - Students were also expected to read the appropriate book chapter before attending the flipped class.
- The flipped lecture was conducted using clicker questions, case studies, conceptual and thought questions as well as games.
 - Students worked in small groups to answer questions, encouraging discussion and peer-learning.

Sample Video Lecture: Action Potential



Sample Conceptual Question: Neurotoxin



This plot shows the effects of a toxin on neuronal action potential.

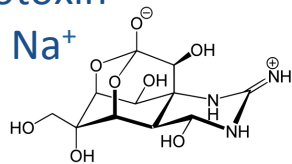
Based on the data, what is the most likely mechanism of action of this toxin?

Effect of 1 μM toxin (TX) on action potential in a Bcg-3 (100 $\mu\text{g}/\text{ml}$)-pretreated nerve.

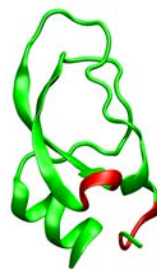
<http://www.scielo.br/img/fbpe/bjmr/v34n7/html/3946i05.htm>

Sample Lecture Slide: Toxins

- Tetrodotoxin (TTX), found in Fugu fish, is a deadly neurotoxin that inhibits voltage-gated Na^+ channels in muscle cells.

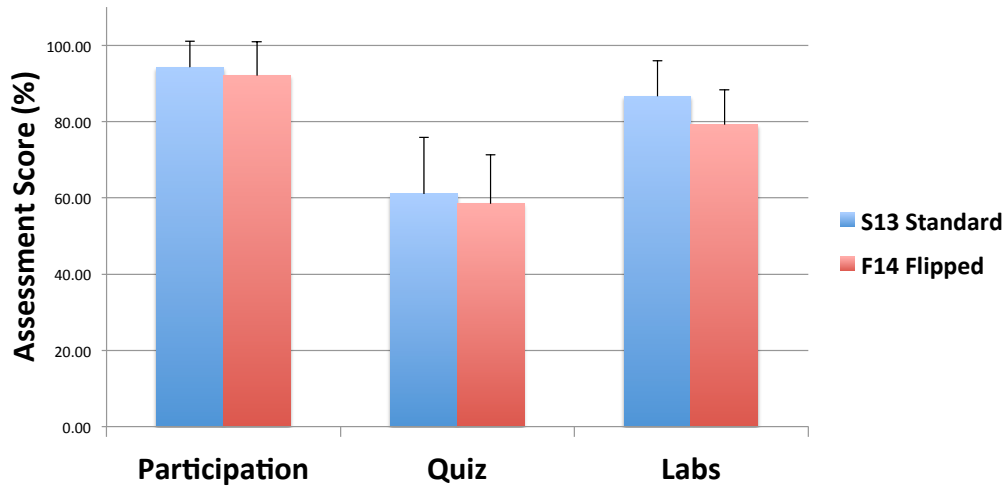


- Dendrotoxin (DTX), produced in mamba snakes, is a protein toxin that blocks subtypes of voltage-gated K^+ channels in neurons (second example).



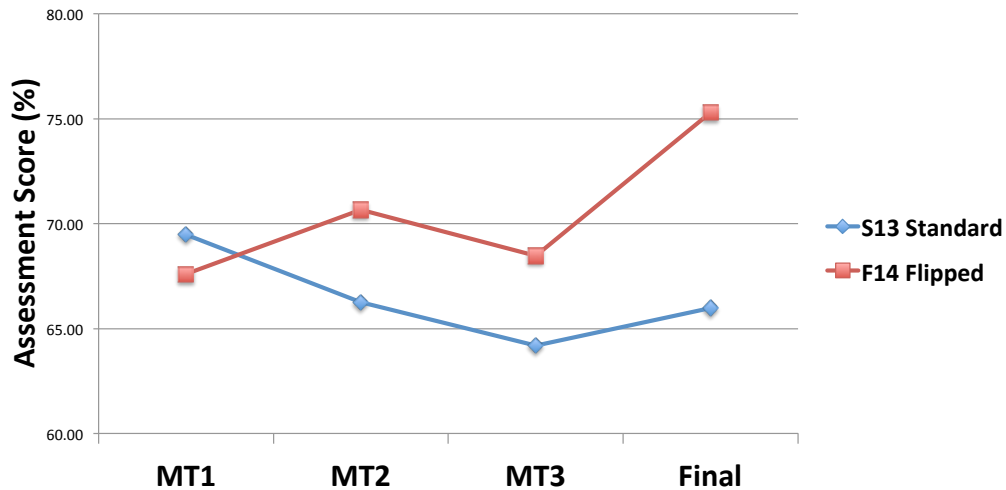
Comparison of Assessment Scores

Comparison of End of Term Assessment Scores



Comparison of Assessment Scores

Comparison of Exam Performance



Conclusions

- In exams, students in the flipped classroom outperformed a similar cohort of students taught in the traditional Socratic method.
- Student participation, quiz scores and lab scores did not differ between the flipped classroom and the standard classroom.
- Overwhelming positive student response to the flipped lecture class.
 - Students enjoy the freedom to view the lectures at their own leisure.
 - Students express that they learned more having to discuss the material in greater detail with the case studies.
- Shorter lectures were favored over longer lectures.
- I got a more direct interaction with my students during class discussion.

Future Directions

- Increase class structure
 - Students understand the language of points. They will come better prepared for lecture if they have a post-lecture quiz or post-lecture assignment.
 - Shorten longer lectures, so they are easier for the students to view.
 - Supplementation with lectures from iBiology.
- Ensure the class is held in a classroom that allows better interaction.
 - Walking around the room answering questions is challenging in the theatre style lecture halls.
- Increase the amount of student-centered content.

Acknowledgements

- Spring 2013 Teaching Assistants
 - Mohamed Aboukilila
 - David Lu
- Fall 2014 Teaching Assistants
 - Mufadhal Al-Kuhlani, PhD.
 - Asa Gardner
 - Keedrian Olmstead
- Prof. Jennifer Manilay
- James Whalen, PhD
 - BIO Instructional Laboratory Coordinator

