



Implementing a Freshman Honors Lab in Phage Genomics at UC Santa Cruz

Lourdes Valenzuela, Manuel Ares, Jr., **Grant A. Hartzog**. Department of Molecular, Cell & Developmental Biology, University of California, Santa Cruz, CA, 95064.

Motivation for Teaching an Honors Course in Phage Genomics

- UC Santa Cruz is a research I university with ~14,500 undergraduates, ~2500 of whom are majoring in the biological sciences
- The campus has many programs aimed at recruiting, supporting and retaining students from educationally disadvantaged backgrounds
- However, few efforts are made to support or retain the most motivated and talented students

Bio21L: Environmental Phage Genomics

- To address the needs of our better students, we implemented our phage course, Bio21L, as a 2 unit honors lab that is taken in addition to the normal load of freshman courses
- Students begin this year long course before their first introductory biology course in the spring of their freshman year
- Our goals in this course:
 - provide an active learning opportunity in a small size class distinct from the passive learning typical of large enrollment lower division courses
 - give students a real research experience
 - prepare students for research experiences in faculty labs

Selecting Students for Bio21L

- Students were recruited by targeted emails to entering freshmen with AP Biology scores of ≥ 4 , and by making presentations at all summer orientation events
- We developed an online application system. In addition to asking students to describe their intended major, previous academic experiences and performance, we asked the following questions:

• Please describe your "career goals" such as you have formulated them at this time. What do you see yourself doing after you graduate? Five years after graduation? Ten years?

• What do you find most attractive about the possibility of doing research and why?

• How do you deal with failure?

• Have you had any experience teaching (formal or informal)? If so, please describe.

• Have you ever volunteered at a medical or health facility? How did this experience affect you?



- Of ~50 applicants, 7 students were directly admitted to the class, another 8 were selected following interviews. The 15 students selected were diverse, both in their backgrounds and their academic interests.
- We selected against students who were strongly fixated on a career in healthcare, but did select several students who were considering medical school as one of several possibilities.

Implementing Bio21L

- Class held in a dedicated lab, allowing students 24 hour access to their experiments
- 2 class meetings per week, 1 hour and 45 minutes each
- We provided an experience distinct from typical large-enrollment (>300 student) introductory lecture courses. We:
 - expected students to take responsibility for their learning
 - emphasized process over content
 - avoided lectures
 - focused discussions on hypotheses, data interpretation and experimental goals

Challenges

- Bio21L was taken in addition to a normal load of freshman-level courses. We had to be careful to not overload students with work that might harm their performance in other courses.
- UCSC operates on the quarter system. Because classes only start in late September, we were hard pressed to have DNA ready for sequencing.
- Bio21L students don't take their first introductory biology class until the Spring quarter, thus they are operating with a limited knowledge set.

Solutions

- We kept tabs on student's exam schedules and were sensitive to impacts of out of class work assignments
- We overcame time constraints imposed by the late start of our Fall quarter at two critical points:
 - enrichment procedure was used to speed the initial isolation of phages
 - we trouble shot the DNA isolation procedure and worked closely with students who ran into troubles to insure their successful isolation of DNA
- 5-10 minute mini lectures were occasionally used to provide necessary background information in basic biology

Observations

- Once students started their introductory biology course in the Spring quarter, they became much more engaged in their project
- Students clearly appreciated the contrast to their other courses and the unique opportunity they were afforded

Out of Class Activities

- Students toured the sequencing facility at Roche Biosciences
- Helped students identify summer internship opportunities and provided letters of recommendation
- Arranged for a special discussion section for Bio21L students in the introductory biology course
- Counseled students on future research opportunities
- Student presented a poster at end of year undergraduate research symposium

Evangelism

- We are making several efforts to use our experiences in Bio21L useful to other students and instructors:
 - we are sequencing the other 13 phages collected by Bio21L students in the campus sequencing facility
 - one goal of this exercise is to provide raw data for existing and future courses in bioinformatics that will involve an authentic research experience
 - we will help a high school teacher implement a phage-hunting exercise in the coming year
 - we aim to recruit other faculty into the course in future years