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

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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.

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 to other students and instructors:
  - 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 provide a 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.

- 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.