I. Abstract

This past academic year (2008-09) Hope College of Holland, Michigan, offered a phage genomics research laboratory course to 20 first-year college students as part of a new science education experiment, designed and supported by the HHMI and SEA, to test the hypothesis that educational instruction, in the context of an authentic scientific research project, will lead to improved student learning and interest in science. Students were selected from a restricted pool of applicants existing high scores on the ACT and SAT college entrance exams. Lab sessions ran twice a week for a total of 5 hours in the fall (Phage/DNA isolation) and 3 hours in the spring (bioinformatics work). The essential content of the course was delivered, largely in sequence and as described in the manual, and all major goals of the course were achieved. We used the timely shift in course content from phage/DNA isolation in the fall to bioinformatics-based genomic analysis in the spring to introduce students to new techniques and the course was delivered, largely in sequence and as described in the manual, and all major goals of the course were achieved.

III. Course Implementation, Logistics

A. Course implementation strategy

- Students met for two scheduled laboratory sessions per week
  - Fall semester - Tues. 3 hour lab, Thurs. 2 hour lab
  - Spring semester - Tues. and Thurs. both 1.5 hour sessions
- Phage/DNA isolation work conducted in college teaching laboratory;
  bioinformatic work performed in computer teaching laboratory
- Established flexible target dates for completion of defined research program goals
- Flexible schedule (see example below) provided opportunities for enhanced coverage of some topics based on time availability

B. Course logistics

- Two student TAs assisted in lab preparations
- Fresh 1X top agar prepared on Monday for use that week or up to 10 days
- Agar base plates dried at room temperature minimum of 3 days prior to use (eliminated problem of incompletely solidified top agar)
- One P1FF M. smegmatis stock used to seed all P2FF cultures during semester; each P2FF culture used for up to 2 weeks (fresh cultures may have yielded higher titer counts)

B. Classroom dynamics

- Fall - 4 teams of 5 students, each analyzed ≈ 10 phage DNA preparations
- Spring - 4 teams of 5 students, each analyzed ≈ 20 phage DNA preparations
- Students contributed finishing data on Pumpkin genomic DNA sequence

C. Student assessment

- Fall - emphasized written presentation with laboratory notebook and journal article-style final report
- Spring - emphasized oral presentations with group journal discussions and final seminar-style report

V. Student Recruitment and Retention Outcomes

A. Supplementary course content

- Topics of interdisciplinary coverage
  - chemical of DNA polymerization and sequencing reactions; DNA sequencing operation
  - chemical specificity of nucleases and restriction enzymes
- physics of phage DNA packaging
- Additional laboratory methods covered
  - students contributed finishing data on Pumpkin genomic DNA sequence
- Skills covered to prepare students for subsequent core courses
  - statistical analysis and graphic representation of plaque size data
- Student-directed journal discussion topics relevant to Pumpkin genome findings
  - Pinck and RNA repair; Zhu et al., J. Biol. Chem. 279:26358 (2004)
  - Lsr2 and bacterial growth, lysogen stability; Arora et al., J. Bact. 190:4291 (2008)
  - Phamily 62 nuclease and phage DNA replication; Giri et al., J. Bact. 191:859 (2009)

- Things we would like to try in the future
  - include a cell staining and microscopy lab, examine M. smegmatis host strain
  - cover bioinformatic algorithm principles in greater detail
  - introduce students to basic programming

C. Student assessment

- Fall - emphasized written presentation with laboratory notebook and journal article-style final report
- Spring - emphasized oral presentations with group journal discussions and final seminar-style report

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2008/09 PGR Course - The Year in Review