Use of Supplemental Instructional Material for the ULM-HHMI NGRI Laboratory Class

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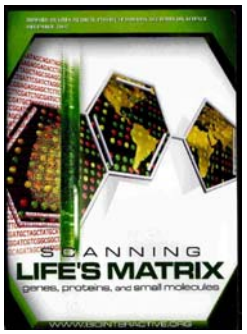
Abstract

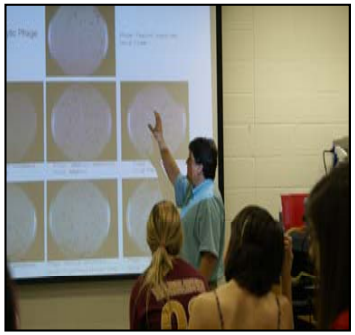
Throughout the two semester NGRI laboratory course sequence, a variety of supplemental instructional approaches were implemented to provide students with content tutorials, to summarize data collection efforts and provide guidance for next-step decisions, to explain the mechanics of computer algorithms, and to explore ethical issues associated with the biotechnology used during the course of the project. Brief introductions of phage life cycle biology, genome organization and experimental protocol flowcharts were followed by content quizzes that probed student understanding and encouraged follow-up questions. The DNA sequencing video was presented multiple times to generate a step-by-step understanding of pertinent procedural information and engender an appreciation for the biotechnology employed in modern sequencing protocols. MathBench modules (www.mathbench.umd.edu) exploring probability calculations through BLAST ("BLAST and (lm)probability") and restriction enzymes and gel electrophoresis through plasmid structure ("Chopping Up Plasmids") were employed as interactive tutorial exercises to enrich student understanding of important program tools. Since *Mycobacterium* sp. Peaches was only cut with *Hae*III during restriction digestion, NEBcutter V2.0 (New England BioLabs) was used to determine restriction enzymes that would cut the Peaches genome and generate gel outcomes from such digestions. The topic of comparative genomics was explored with students by introducing the Human Genome Project and the importance of model organisms ("Scanning Life's Matrix: Genes, Proteins, and Small Molecules" – HHMI-Holiday Lectures on Science series). Finally, the ethical, legal, and social implications of the Human Genome Project were probed by student viewing and critical assessment of *GATTACA*. The success of our combined approaches as reflected by student assessment instruments and performance measures in the introductory biology lecture and laboratory course sequence will be presented.

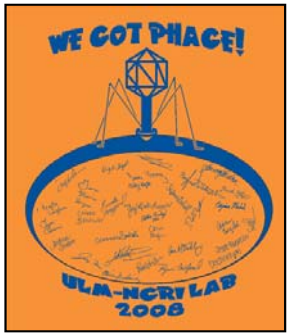


HHMI Holiday Lecture: Importance of comparative genomics; paper simulation of HGP

GATTACA: exploring ethical consequences of biotechnology

Project Status Reports





- How far have we taken each isolate?
- Where do we stand in the isolation/purification protocol?

Development of procedural flowcharts

SPOT TEST
Circle possible plaques on your plates (1, 2, 3)
↓
Add 100 µl phage buffer (PB) to µcentrifuge tubes
(You will need as many tubes as you have possible plaques.)
↓
Pick up possible plaque with end of pipette tip, tap into PB tube & vortex
↓
Draw grid on bottom of agar plate; label with possible plaque designations
↓
Add 4.5ml TA to 0.5 ml *M. smegmatis* culture, vortex & spread over bottom agar
↓
Add 5 µl of phage-containing PB to its labeled grid area (don't splatter!)
↓
Add 5 µl of PB only for – control grid area
↓
Add 5 µl of known phage sample for + control grid area
↓
Invert plate, incubate at 37°C for 24 hr.

Stepwise rationale for all isolation/characterization procedures

Content quizzes assess student understanding of research objectives

Activity #2 Name_____

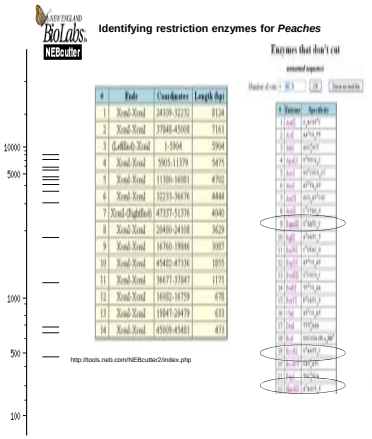
1. Each plaque originates from a single infectious particle. (true, false)
2. In the spot test, why do we sample the plaque region of our sample plates?
   _____
3. _____ adsorption a) release of viral particles from the host cell
   _____ assembly b) viral genome enters host cell
   _____ induction c) viral nucleic acid covered with protein coat
   _____ lysis d) attachment of virus to host cell
   _____ penetration e) lysogenic → lytic cycle conversion
4. Production of new viral particles requires: a) viral nucleic acid replication; b) early/late protein synthesis; c) both a & b
5. Induction can occur naturally or can be promoted by environmental factors such as as ultraviolet radiation. (true, false)
6. Turbid plaques are an indication of ___ (lytic, lysogenic) viral growth.
7. In the phage titer assay, the 10-2 plate yielded 25 plaques. Calculate the pfu/ml.

In-class activities stress important phage biology and quantitative concepts.

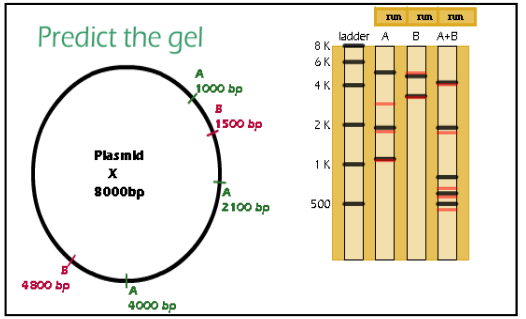
Biology 123-07
Phamerator Activity
Names_____

What is the GC content of the Peaches genome? _____
List the **orphams** found in the Peaches genome.
_____
Which member of the A2 cluster has the largest number of orphams present?
_____
Find an example of a **moron** within the A2 cluster phages.
_____
Give an example of a **phamily** that represents probable gene duplication.
_____
Construct phamily circles for S integrase and Y integrase. (List phages found in each phamily.)
S int -_____
Y int -_____

Exploring the A2 cluster and Peaches with Phamerator



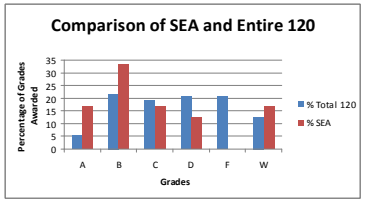
NEBcutter: Simulation of restriction digestions



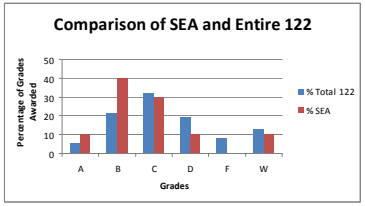
MathBench - Use of simulations to explore quantitative aspects of restriction digestion and BLAST probability results (www.mathbench.umd.edu)

Assessment

Comparison of SEA and Entire 120		
Grade	% Total 120	% SEA
A	5.4	16.6
B	21.6	33.3
C	18.9	16.6
D	20.7	12.5
F	20.7	0
W	12.6	16.6



Comparison of SEA and Entire 122		
Grade	% Total 122	% SEA
A	5.7	10
B	21.4	40
C	32.1	30
D	19.3	10
F	8.6	0
W	12.9	10



Does NGRI lab participation translate into improved biology lecture performance?

Reporting to the community

SEA / ULM site visit

South Central and Texas branches, Annual ASM Meeting, November 2008