Restructuring Microbiology 325: Microbial Genetics

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Recently Microbiology 325, a third year microbial genetics course, was completely restructured. Previously the course used a traditional lecture and tutorial based learning model, but now incorporates an active learning model. This new version of the course employs clearly defined learning objectives, pre-class readings, in-class group oriented clicker-based problem solving, and very little lecturing. A concept inventory was used to measure the learning gains achieved by the students in the restructured course, with an average learning gain of 50% being observed.

Microbiology 325: Microbial Genetics

Microbiology 325 is a third year microbial genetics course that was added to the curriculum in 2010. The course covers, in depth, a range of concepts in microbial genetics including plasmid, phage and cloning vectors, gene transfer, genetic maps, genetic analysis, and microbeal gene expression. In particular students spend a great deal of time with the concepts involved in gene expression, and the analyses related to these concepts.

The initial iteration of Microbiology 325 primarily involved a traditional lecture-based learning model.

- Students spent two hours a week listening to the instructor summarizing or expanding upon the salient points covered in the course readings.
- An additional hour each week was used for a tutorial-type session during which students would work on practice problems and receive varying amounts of feedback. These tutorials often used a combination of worksheets and clicker questions.

The Restructured Microbiology 325

For the January 2012 semester Microbiology 325 was completely restructured to employ a learning model based heavily on active learning within the classroom with minimal lecturing from the instructor. In particular, the new version of the course relies upon:

- Detailed learning objectives that were provided to the students.
- Just-in-Time-Teaching methods involving pre-class reading and homework to prepare the students for each week’s material.
- In-class group work and discussion based on solving challenging problems, often using clickers.

Measuring Learning Gains in Microbiology 325

The Operon Concept Inventory (developed at UBC) was used as a pre-test in January and as a post-test in March. This inventory comprises 22 questions regarding bacterial gene regulation and expression.

- The learning gain was calculated for each student as (post-pre)/(22-pre).
- The average learning gain for the class was found to be 0.50 or 50%.
- With other inventories, typical learning gains for traditional lecture courses fall in the range of 10-30%, whereas active learning based courses have typical learning gains of 20-70%.

The following questions are based on the diagram shown below. The diagram shows the region of a bacterial genome containing the rimine operon and the rimW and rimX genes. The rim operon encodes proteins that allow bacterial cells to break down a carbon/energy source called rimine. All of the genes are indicated by a solid colored box and gene name in the diagram. The locations of the promoters are indicated by bent arrows. The transcription of the rim operon is controlled by the presence of rimine and another food molecule known as lonate. When both lonate and rimine are available, bacterial cells will use lonate as a carbon/energy source instead of rimine. For each of the questions assume all other essential nutrients are always present.