The Original Course & Curriculum

Cell Biology Lab: Biosc 462 (Lecture Biosc 461)
- 6-9 sections/semester
- ~16 students/section (juniors and seniors)
- 1 GTA/section

- Twelve 3-hour labs/semester
- Each lab was a self-contained (non-inquiry):
  - Molecular biology
  - Cell division
  - Vesicle traffic
  - Cytoskeleton
  - Subcellular fractionation
  - Cell Motility
  - Microscopy

- Mid-term and final, quizzes, lab reports
Given the enormous quantity of factual scientific knowledge and given the rapid rate at which information is added to this pool of knowledge undergraduate educators [should] engage students in the methods and processes of scientific inquiry rather than requiring student to memorize science facts

-National Research Council
The Evolution of the Course

Inquiry & Critical Thinking Skills

Sunberg et al., 1993
Anderson, 2002
Griffith, 2007
Howard & Miskowski, 2005
The Evolution of the Course

Inquiry & Critical Thinking Skills

Science-Related Attitudes

TOSRA (Fraser & Butts, 1982)
- Career interest in science
- Attitude to scientific inquiry
- Social implications of science
- Normality of scientists

Dirks & Cunningham, 2006
The Evolution of the Course

Quitadamo & Kurtz, 2007

Inquiry & Critical Thinking Skills

Communication

Science-Related Attitudes

Steglich, 2000
Lusk et al., 2007
The Goal

To develop inquiry-based cell biology laboratory course that included instruction in communication (writing)
The Team

Faculty
• Lesly Temesvari (Alumni Distinguished Prof., Biological Sciences)
• Kimberly Paul (Assoc. Prof., Genetics and Biochemistry)
• Deborah Switzer (Prof., Education)
• Steven Katz (Pearce Prof. of Professional Comm., English)

Graduate Students
• Terri Bruce (Biological Sciences→Director CLIF)
• John Dinolfo (RCID→Research Faculty MUSC)
• Elizabeth Hughes (Education→Asst. Prof. Duquesne University)

National Science Foundation
(Division of Undergraduate Education)
• Course Curriculum Laboratory Improvement (CCLI) Program
  →TUES, Widening Implementation & Demonstration of Evidence-Based Reforms (WIDER)
• Equipment Upgrades, Non recurring supplies, Grad student salaries
The New Course & Curriculum

• 2 weeks on methods and techniques

• Project 1 (~4-5 weeks):
  Ø Testing 3 unknown drugs for their anti-cancer properties
  Ø Cell cycle regulation, apoptosis, necrosis, and mol. biology
  Ø Poster presentation (specific instruction/ethics)

• Project 2 (~4-5 weeks):
  Ø Testing drug delivery mechanisms
  Ø Vesicle trafficking, cytoskeleton, cell surface receptors
  Ø Manuscript (specific instruction/ethics)

• Quizzes, Assignments, Poster (Group), Manuscript(Individual)
Assessment of Critical Thinking Skills
TIPS I, II

I: Identify Variables
O: Operationally Define
H: State Hypothesis
G: Interpret Graphs
D: Design Experiments

n=96 ('08), 64 ('09)

Dillashaw & Okey, 1980; Burns et al., 1985
Assessment of Critical Thinking Skills

CAT

Pre-Test

Mean: 21.83±5.37

Post-Test

Mean: 23.70±4.206

n=46; P<0.01
<table>
<thead>
<tr>
<th>Evaluate and Interpret Info</th>
<th>Problem Solving</th>
<th>Creative Thinking</th>
<th>Effective Comm.</th>
<th>Skill Assessed by CAT Question</th>
<th>Institution</th>
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**CAT Total Score**

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<th>Probability of difference</th>
<th>Effect Size</th>
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<td>23.70</td>
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Conclusions

Inquiry & Critical Thinking Skills

Communication

Science-Related Attitudes

New assessment tool for scientific communication and communication ethics
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<tr>
<th>Evaluate and Interpret Info</th>
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<td>Q1</td>
<td>Summarize the pattern of results in a graph without making inappropriate inferences.</td>
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<td>Evaluate how strongly correlational-type data supports a hypothesis.</td>
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<td>Provide alternative explanations for a pattern of results that has many possible causes.</td>
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<td>Separate relevant from irrelevant information when solving a real-world problem.</td>
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<td>Use and apply relevant information to evaluate a problem.</td>
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<td>Identify suitable solutions for a real-world problem using relevant information.</td>
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<td>Q14</td>
<td>Identify and explain the best solution for a real-world problem using relevant information.</td>
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<td>Q15</td>
<td>Explain how changes in a real-world problem situation might affect the solution.</td>
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</tbody>
</table>

**Overall CAT Total Score**: 21.83 | 23.70 | ** | +.19
Conclusions

Inquiry & Critical Thinking Skills

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Mixed results
Acknowledgements

Team Members
• Kimberly Paul
• Deborah Switzer
• Steven Katz
• Terri Bruce
• John Dinolfo
• Elizabeth Hughes

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