Fixing Intro Bio: Integrating Concepts in Biology

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Biology Department and GCAT

Davidson

Gettysburg College
August 13, 2014
Outline of Presentation

What did Vision & Change Propose?

What is the AP Biology Redesign?

How does *ICB* fit with these curricula (+ GRE and MCAT)?

Students meet learning objectives (content and attitude).

How do we run our classrooms? Write tests?

Let’s tour the book.
Teaching vs Learning

Guess what, I taught my dog to whistle!
Teaching vs Learning

Really?!
Teaching vs Learning

Whistle! C’mon boy, whistle!
Teaching vs Learning

???????????????
Teaching vs Learning

I thought you said you taught your dog to whistle.
Teaching vs Learning

I did, but I didn’t say that he learned to whistle.
Our Current Challenge: Introductory Biology

Integrating Concepts in Biology

by

A. Malcolm Campbell, Laurie J. Heyer and Christopher J. Paradise
What’s Wrong with Biology Education Now?

- Vocabulary is emphasized (800-1000 vs 1400)
- Experimental approaches are minimized
- Math is absent
- Memorization is rewarded
- Critical thinking is discouraged
- Information is irrelevant to students
If we currently cover all the important stuff....

...how can we add more content?
Too much content for the containers
Too much content for the containers
“Never mistake activity for achievement.”
John Wooden
# Concepts

<table>
<thead>
<tr>
<th>Vision &amp; Change</th>
<th>AP Biology</th>
</tr>
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<tbody>
<tr>
<td>Evolution</td>
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</tr>
<tr>
<td>Structure and Function</td>
<td>Information</td>
</tr>
<tr>
<td>Information</td>
<td>Homeostasis</td>
</tr>
<tr>
<td>Energy and Matter</td>
<td>Emergent Properties</td>
</tr>
<tr>
<td>Systems Biology</td>
<td></td>
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</table>
V&C Competencies

• Apply the process of science
• Use quantitative reasoning
• Use modeling and simulations
• Integrate different disciplines
• Communicate & collaborate
• Connect science & society
AP Competencies

• use models to communicate and solve problems
• apply mathematics appropriately
• scientific thinking to extend thinking and guide experiments
• plan and implement data collection strategies
• data analysis and evaluation of evidence
• work with scientific explanations and theories
• connect information across scales, concepts and domains
Start with the literature…
Present information and data...
... in the context of the big picture.
Artificial Divide within Biology

Small Biology

Big Biology
Five Levels of Organization

- Molecular
- Cellular
- Organismal
- Population
- Ecological System
Five Big Ideas of Biology

- Information
- Homeostasis
- Emergent Properties
- Evolution
- Cells

Biology
Five by Five Matrix of Biology

- Molecular
- Ecological System
- Population
- Organismal
- Cellular
- Molecular

- Information
- Ecological System
- Population
- Organismal
- Cellular
- Molecular

- Homeostasis
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- Cells
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- Molecular
BioMath Explorations
BioMath Exploration 6.3

How can you fit exponential curves to data?
Ethical, Legal and Social Implications

Are religion and evolution compatible?

Is science possible if you are uncertain about what is true?

Does basic biology have any impact on the real world?

Who owns your DNA?
Did my students learn less content?
Student Content Assessment

- 83% response rate (new)
- 63% response rate (traditional)

$p = 0.06$

Spring

Fall 2010

percent correct

$p = 0.97$

+/- SEM
Student Content Assessment

- 83% response rate (new)
- 63% response rate (traditional)

$p = 0.06$

Fall 2010

$p = 0.97$

Spring 2011

$+/-. SEM$
Can my students analyze data better?
Student Skills Assessment

% Correct

Traditional  New

$p = 0.043$
Student Skills Assessment

- **Traditional (quiz averages)**
- **New (quiz averages)**

- **new, p = 0.015**
- **traditional, p = 0.320**

**Percent Correct**

- First
- Second
- Third
- Fourth
Are *ICB* students overconfident?

<table>
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<tr>
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<th>Average at Start</th>
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<td>* p&lt;0.05, ** p&lt;0.01, *** p&lt;0.001</td>
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<td>ICB</td>
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yes?
Are *ICB* students overconfident?

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Student Skills Assessment

% Correct

Traditional: 62
New: 66

$p = 0.043$
**Do ICB students see biology differently?**

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**yes!**

**yes?**

**yes!**

**yes!**
How do I run my class?

• Assume they have read before class.
• Go through reading like a journal club.
• Cold call on students to answer questions.
• It is ok to be wrong.
• Students ask more than just clarifying questions.
• Try to answer Integrating Questions on their own.
• I do not collect IQ answers, but will review some in office.
• I cover key points but do not present the information to them.
• Remember learning is not the same thing as teaching.
• Value added by coming to class.
How do I assess student learning?

- 10% of questions come from lab
- questions are based on Integrating Questions (not identical)
- questions are based on Review Questions (not identical)
- support their answers with data!!!
- focus on learning objectives and Bloom’s terms
- they draw some answers
- design experiments with controls
- could be multiple choice format
Touring ICB

- eBook website
- PPT for teachers
- Excel from BME 3.1
- sample test