Student attitudes towards using physics in biology

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Introduction

Biology education

Kristi Hall (Graduate Student)

Dr. Todd Cooke

Physics education

Dr. Edward “Joe” Redish

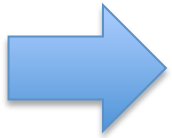
Jessica Watkins (Research Associate)

Why physics?

physics

chemistry

mathematics



biology

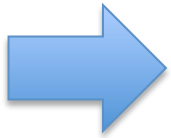
*National Research Council, Bio 2010: Transforming Undergraduate Education for Future Research Biologists (The National Academies Press, 2003).

Why physics?

physics

chemistry

mathematics



biology

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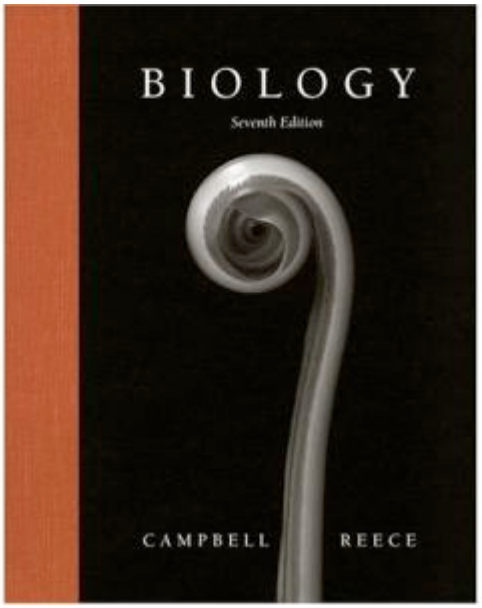
Why (not) physics?

Disciplinary cues



*Campbell, N. A., & Reece, J. B. (2008). Biology Eighth Edition (8th ed.). Benjamin Cummings.

Curricular cues

Sample course plan for biology majors

Firstsemester
BSCI 106
CHEM131
ENGL 101
UNIV 100

Second semester
BSCI 105
CHEM 231
MATH 131
CORE

Third semester
BSCI 207
CHEM 241
CORE
CORE

Fourth semester
BSCI 222
CHEM 271
CORE
CORE

Introduction

BSCI 207: Organismal biology

Diversity, structure, and function of organisms

Introduction

BSCI 207: Organismal biology

Focus on fundamental principles

Integration of physics, math, and chemistry

Pedagogical reforms

What the students have to say…

Surveys

M-BEX

Maryland Biology Expectations Survey

Here are a number of statements that may or may not describe your beliefs about learning biology. You are asked to rate each statement by selecting a number between 1 and 5 where the numbers mean the following:

1 - strongly disagree 2 - disagree 3 - neutral 4 - agree 5 - strongly agree

1. Biology courses should focus on biological subjects and should not present much chemistry and/or physics.

1 - strongly disagree

Student interviews

#1: Disciplines are distinct

Students see these biology, chemistry, math, and physics as distinct from each other

#1: Disciplines are distinct

"let the chemistry and the physics teachers teach you the chemistry and physics and assume the kids know it… but it's not a biology class's job to teach about the properties of carbon."

#2: Physics is unnecessary

Students state that physics is unnecessary to learn biology

#2: Physics is unnecessary

"I don't think [physics equations are] necessary to help explain biology… I think its just an extra step that isn't isn't really necessary, um. I mean, I think if people understand it, its helpful, but I don't feel like its necessary at all."

#2: Unnecessary physics

(on Hagen-Poiseuille equation)

I think it's intuitive. If something gets too large and you have a really tiny, like say a tree, if a tree gets really large and your trunk is half a foot wide, it's not gonna work, it's too big. It's intuitive.

So you don't feel like the math actually…

…illuminates something anymore than just your intuition would.

#3: Different expectations

Students report a fairly sophisticated view of the discipline and a more naïve view of acquiring knowledge (in courses)

#3: Different expectations

"And that's part of studying… in biology I would look over my lecture notes, but that's the nature of biology.

I may not do that with the chemistry course [or] with Dr. Redish's [physics] course."

Where do we go from here?

Changing content is *not* enough!

Goals

- Identify the main issues
- Open a dialogue
- Develop a common language
- Better integrate physics in biology courses