Fixing Intro Bio: Integrating Concepts in Biology

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Gettysburg College
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Outline of Presentation

What did Vision & Change Propose?

What is the AP Biology Redesign?

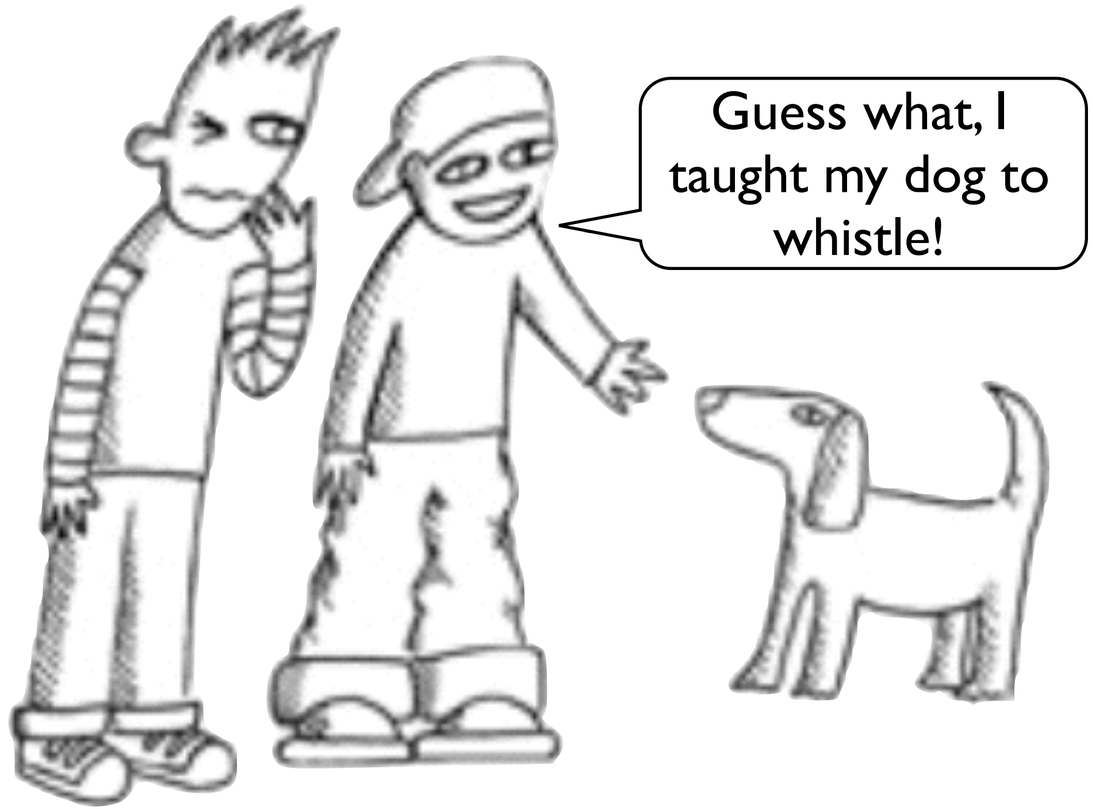
How does *ICB* fit with these curricula (+ GRE and MCAT)?

Students meet learning objectives (content and attitude).

How do we run our classrooms? Write tests?

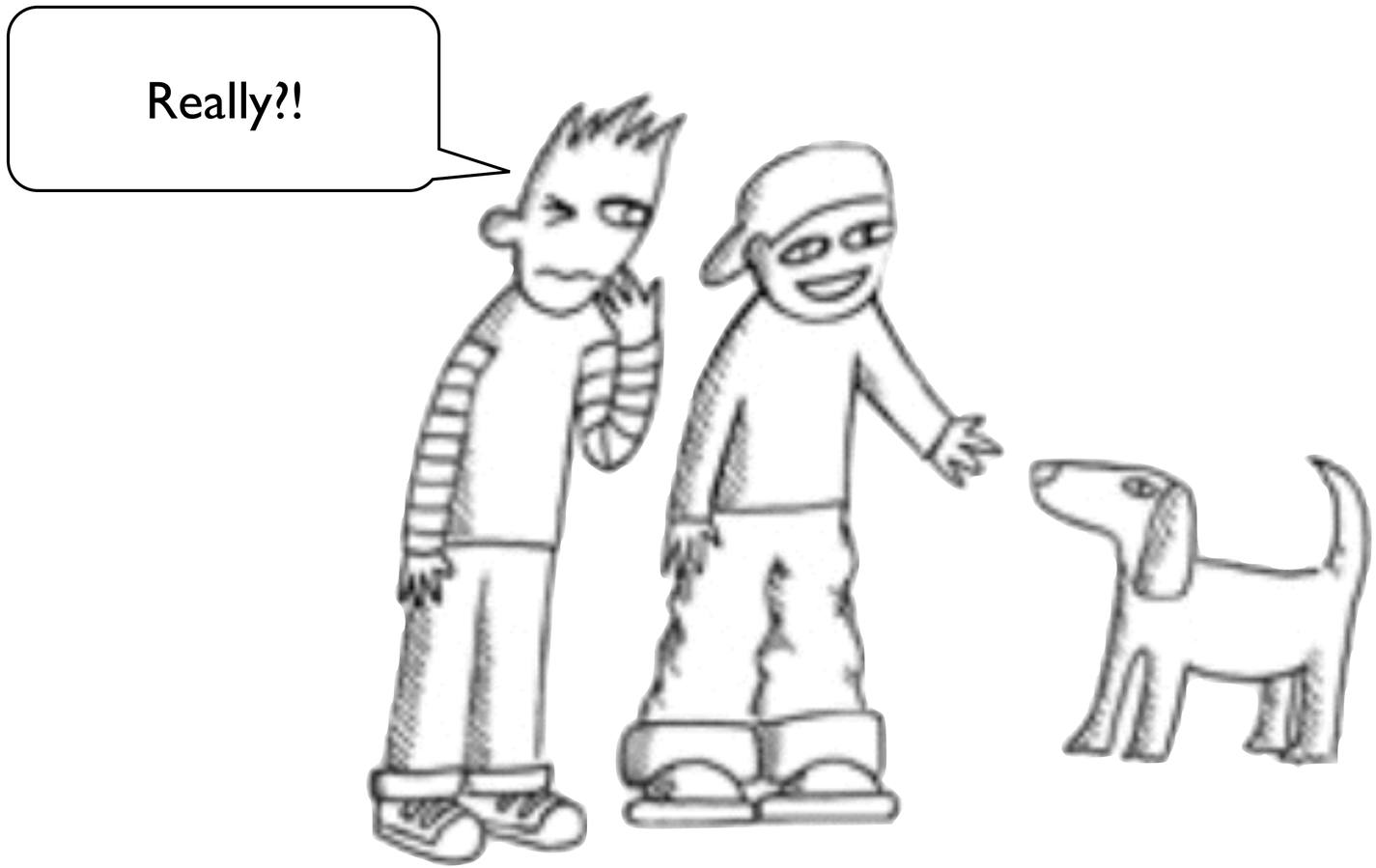
Let’s tour the book.

Teaching *vs* Learning

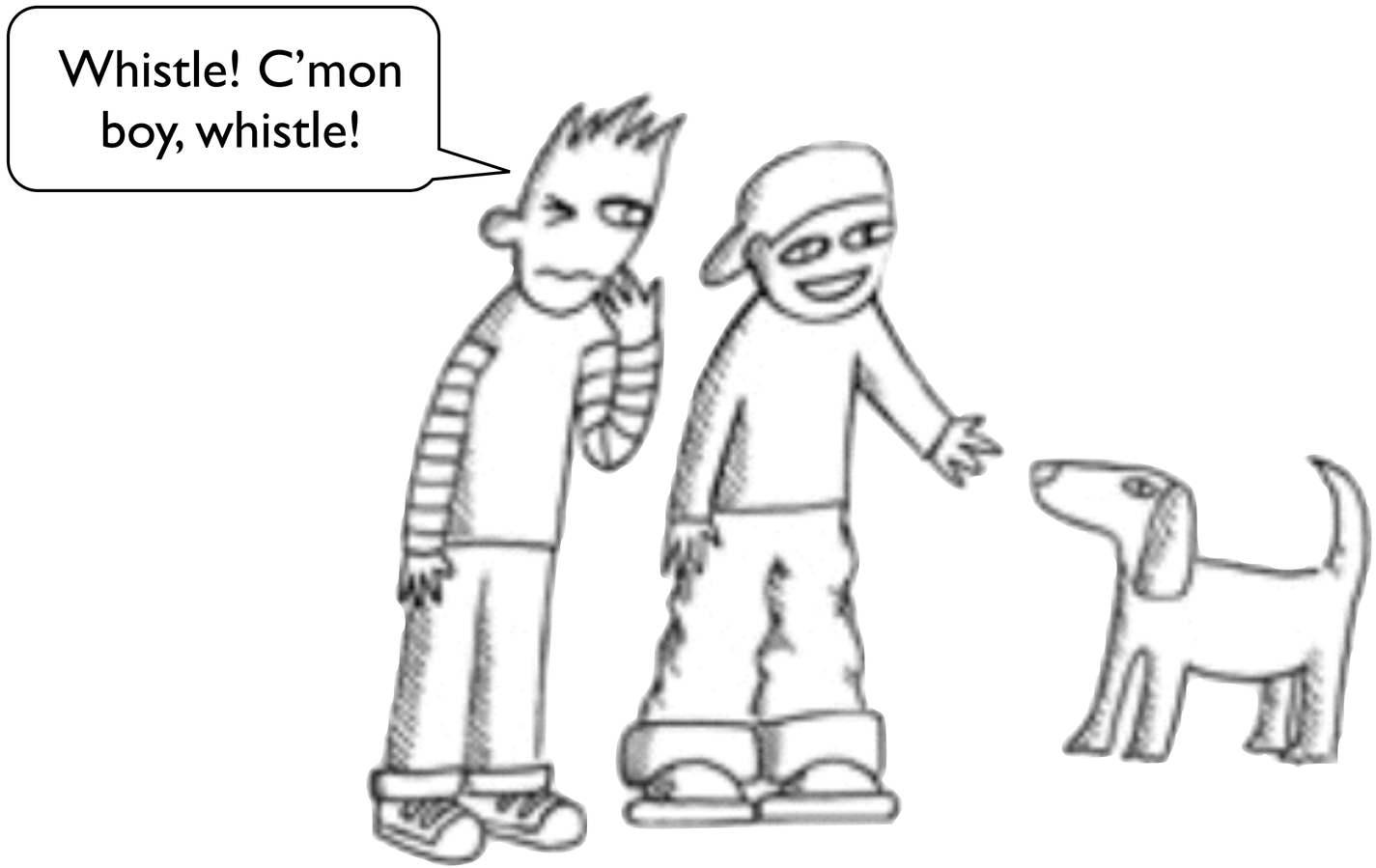


http://thegoodpeople.se/blog/?p=208

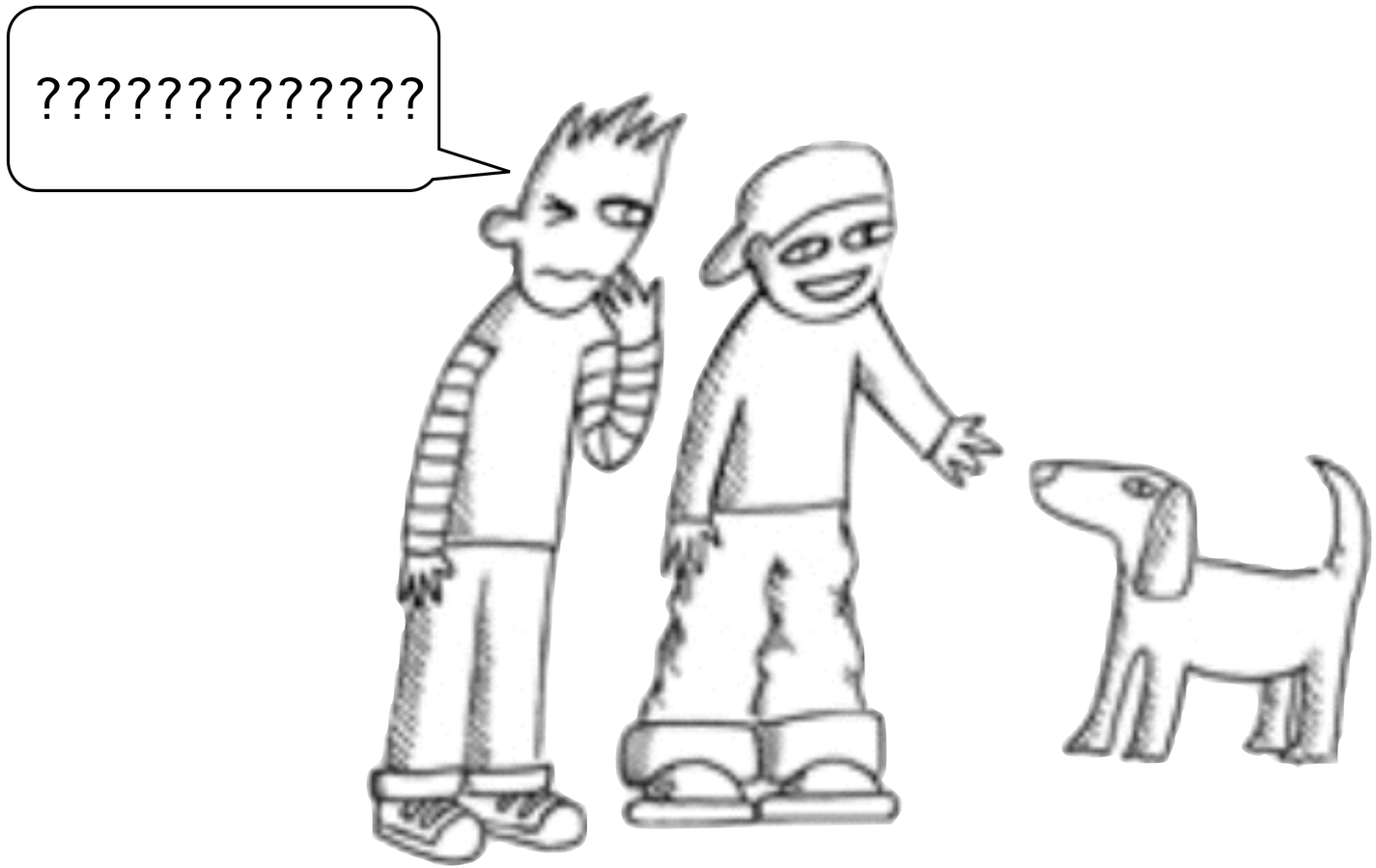
Teaching *vs* Learning



Teaching *vs* Learning



Teaching *vs* Learning



Teaching *vs* Learning

Teaching *vs* Learning

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

Vision & Change	**AP Biology**
Evolution	Evolution
Structure and Function	
Information	Information
Energy and Matter	Homeostasis
Systems Biology	Emergent Properties

Concepts

Vision & Change
Evolution
Structure and Function
Information
Energy and Matter
Systems Biology

AP Biology
Evolution
Information
Homeostasis
Emergent Properties

ICB
Evolution
Cells
Information
Homeostasis
Emergent Properties

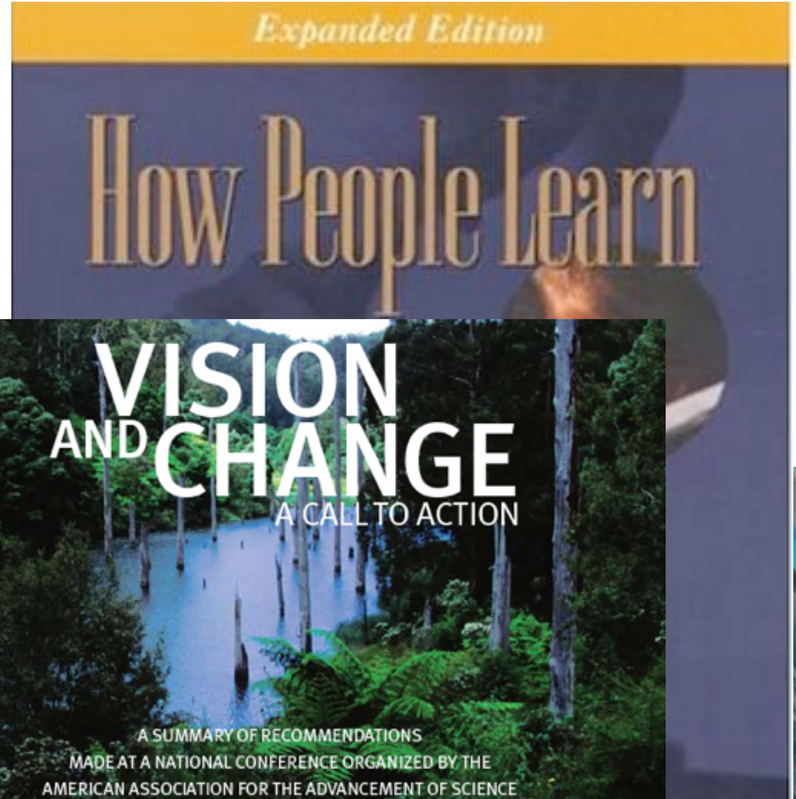
V&C Competencies

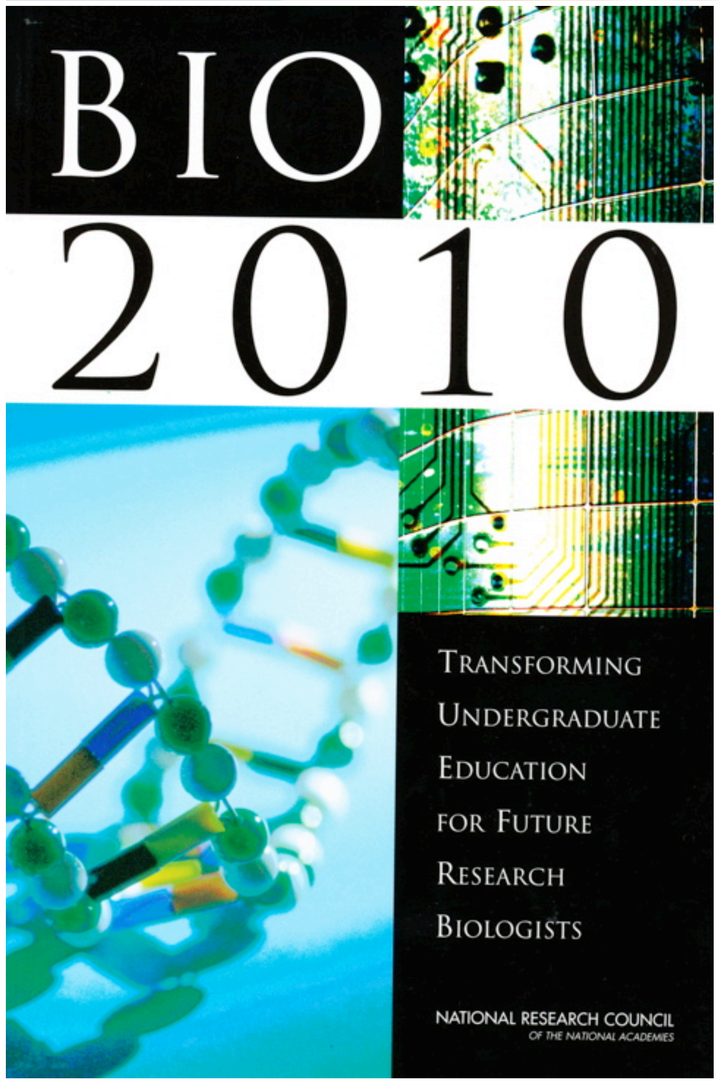
- Apply the process of science
- Use quantitative reasoning
- Use modeling and simulations
- Integrate different disciplines
- Communicate & collaborate
- Connect science & society

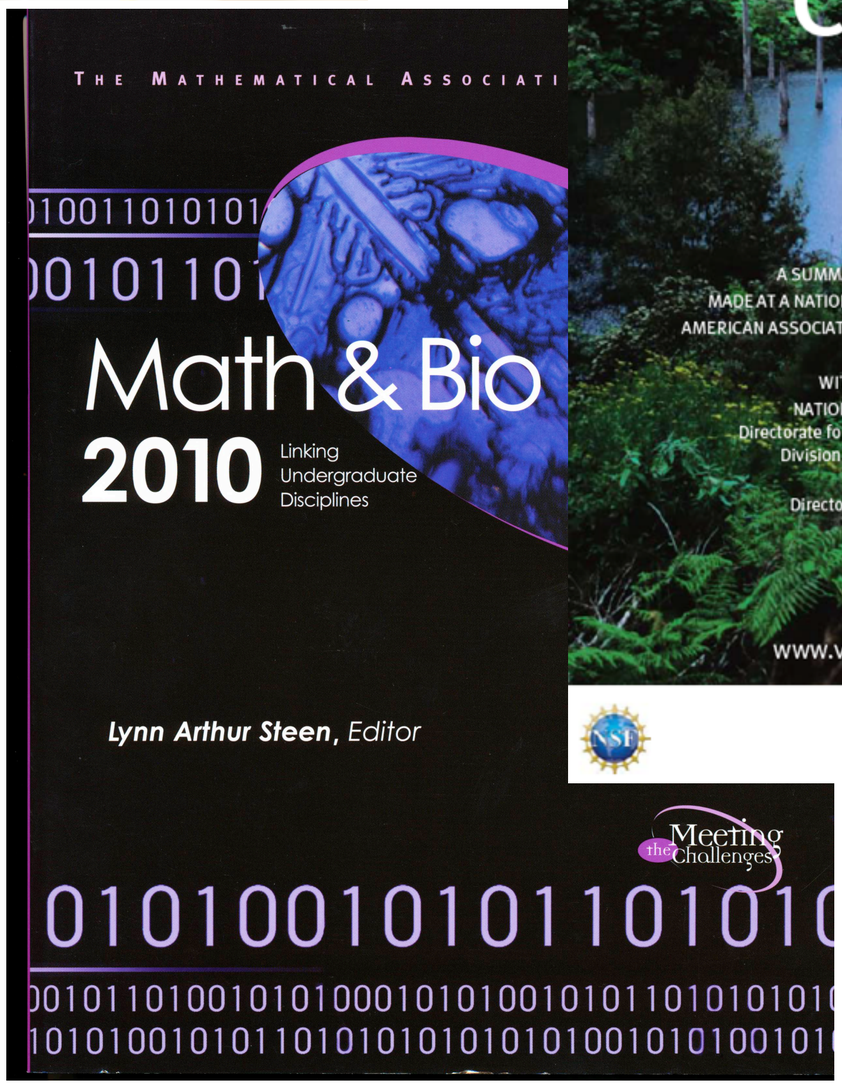
AP Competencies

- use models to communicate and solve problems
- apply mathematics appropriately
- scientific thinking to extend thinking and guide experiments
- plan and emplement 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

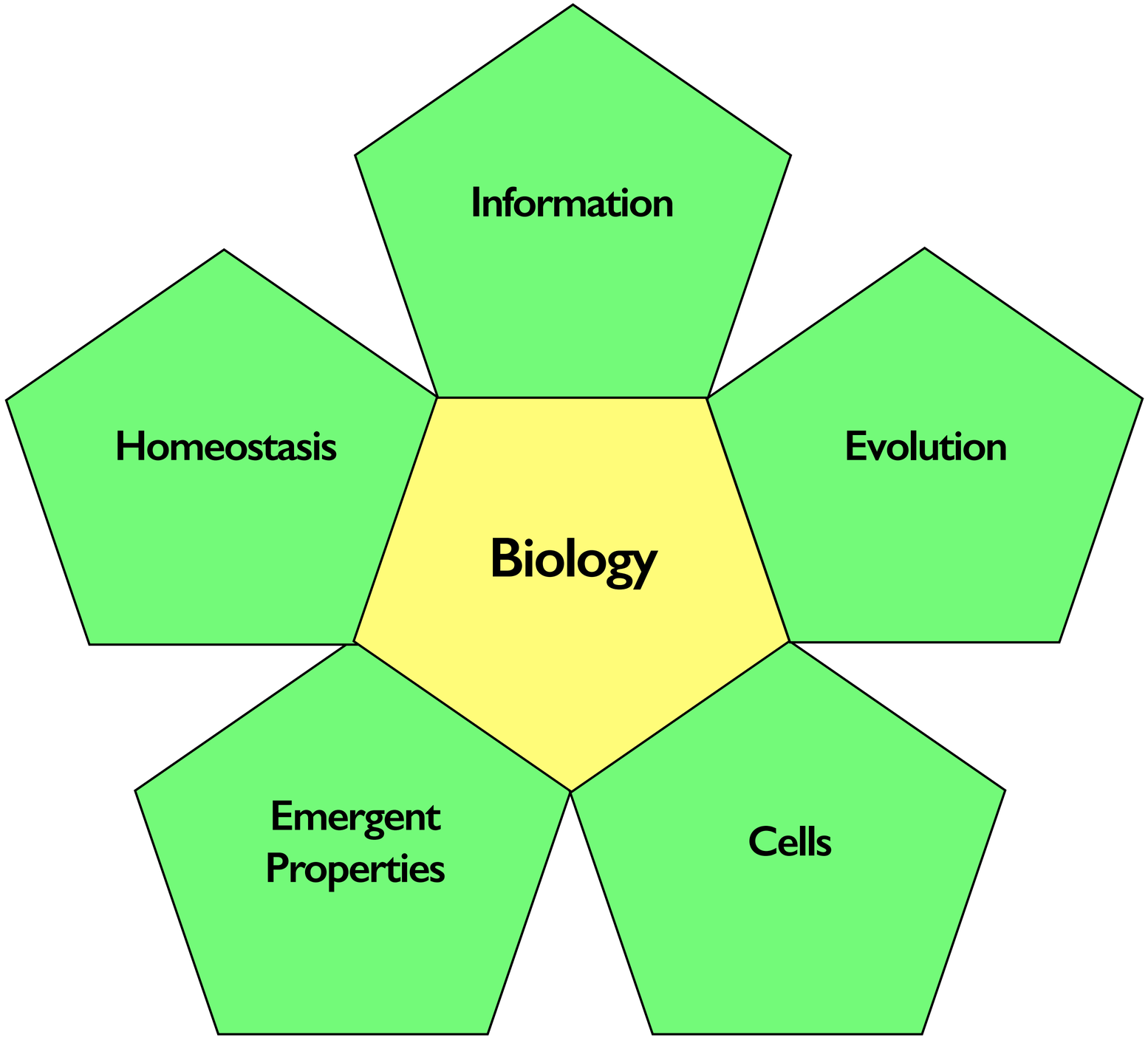
Cellular

Organismal

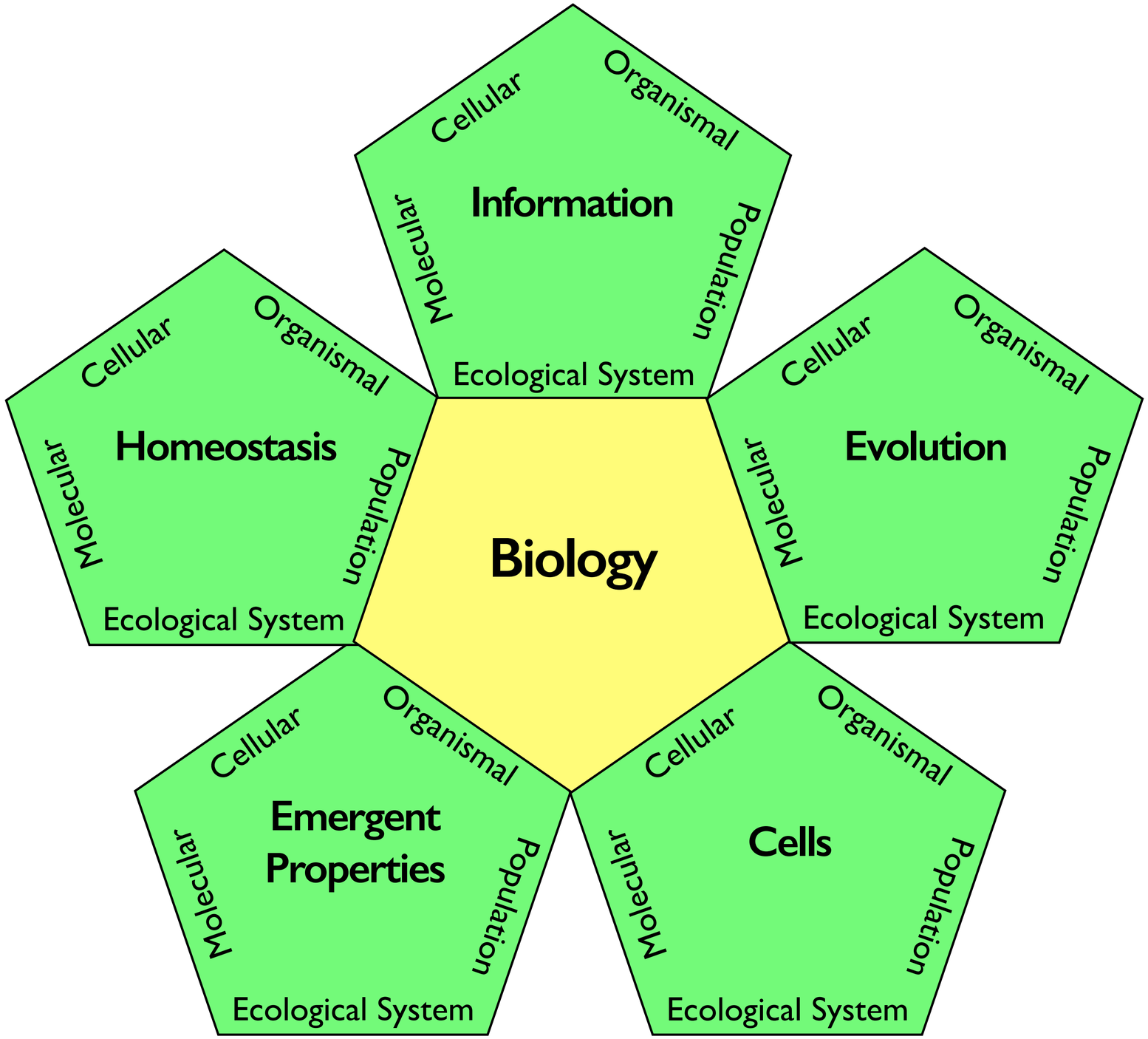
Population

Ecological System

Five Big Ideas of Biology



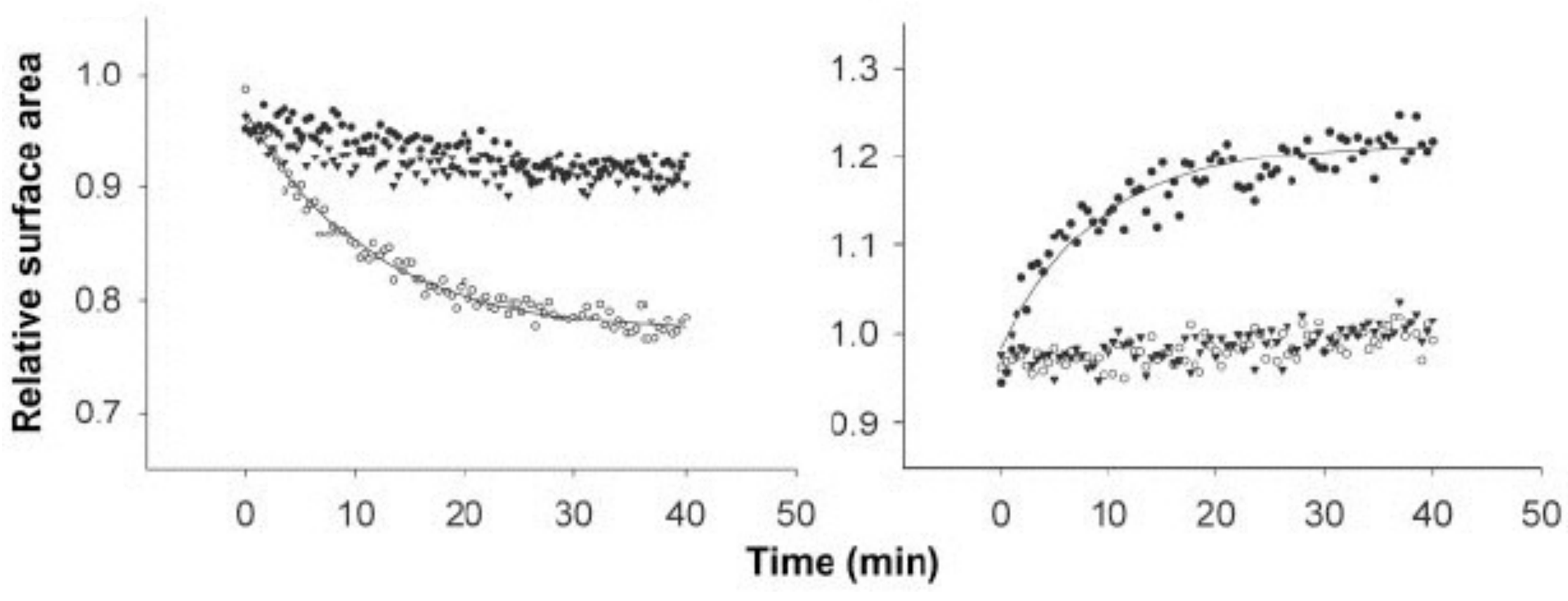
Five by Five Matrix of Biology



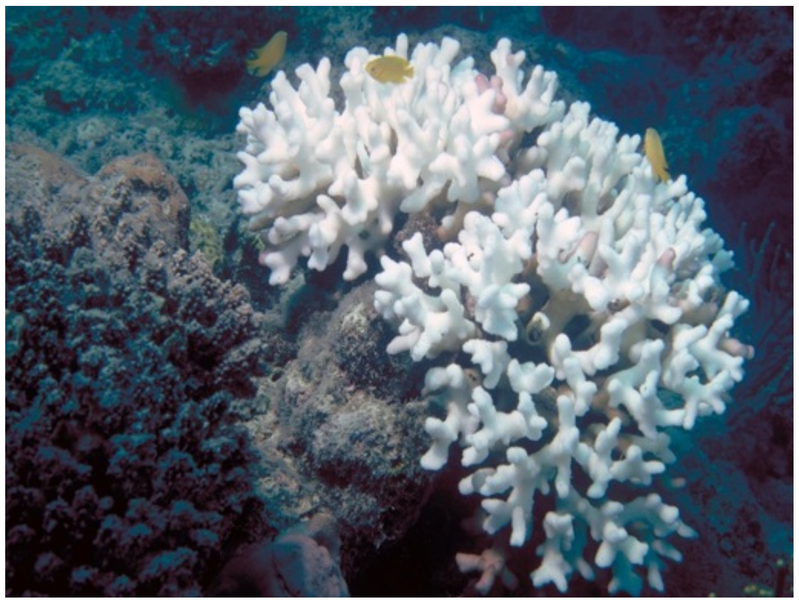
BioMath Explorations

BioMath Exploration 6.3

How can you fit exponential curves to data?



Ethical, Legal and Social Implications

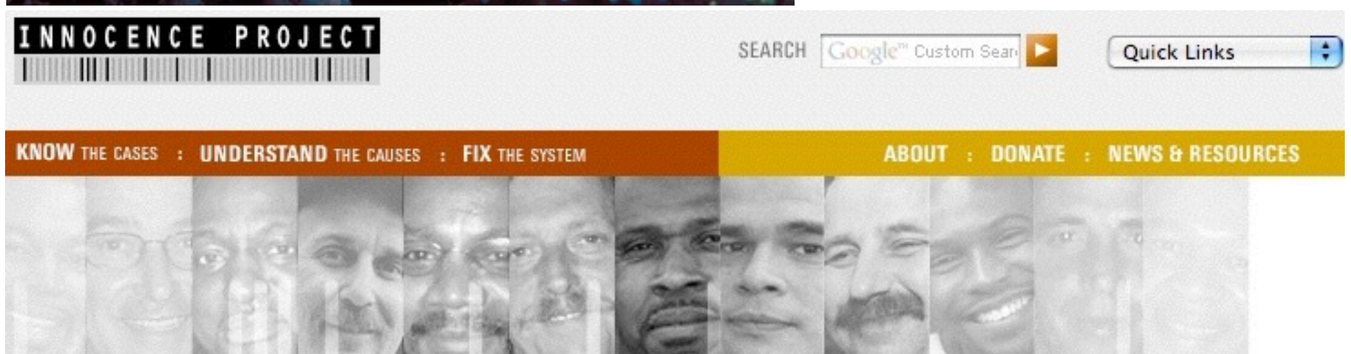


Are religion and evolution compatible?

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

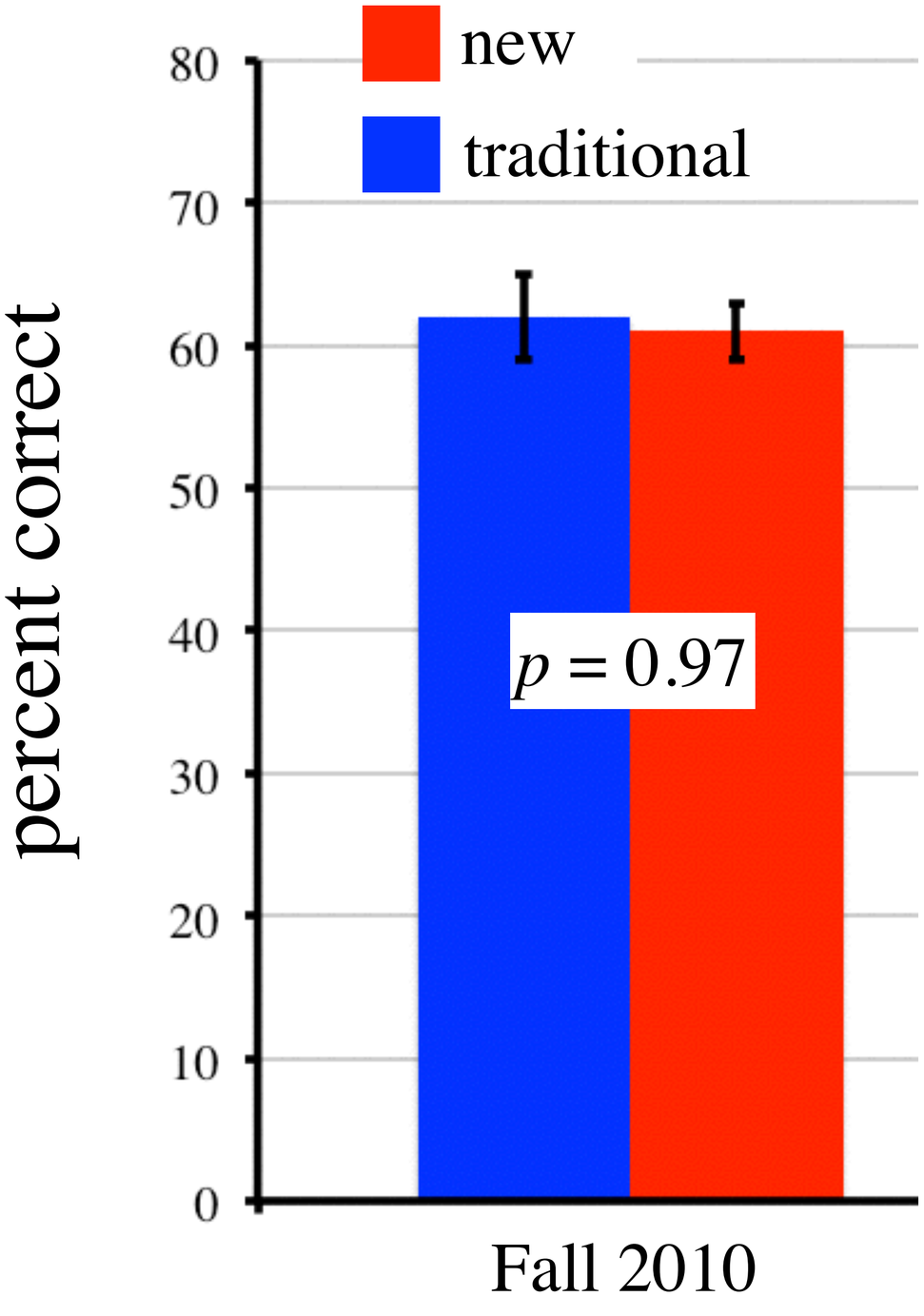
Does basic biology have any impact on the real world?

Who owns your DNA?



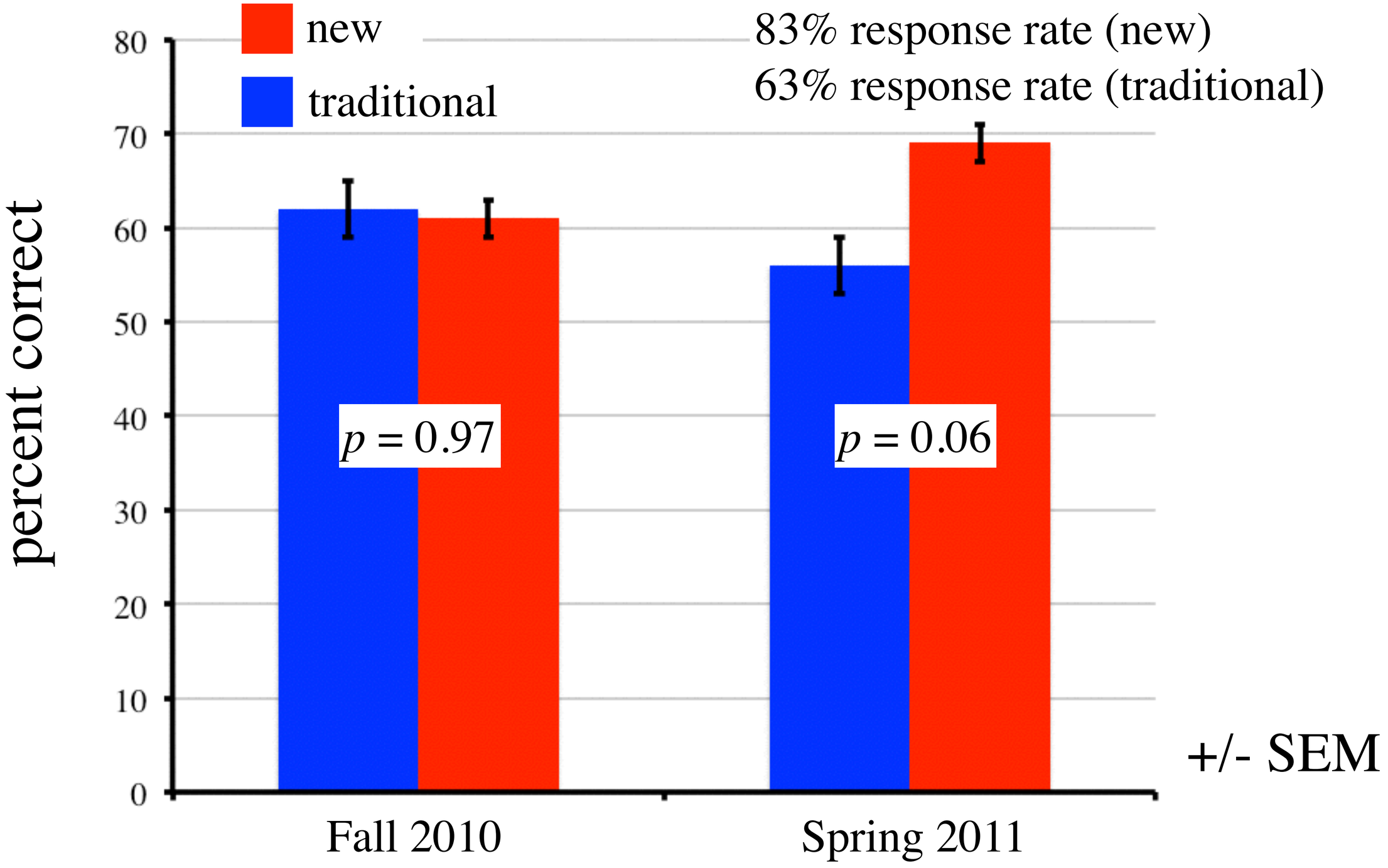
Did my students learn less content?

Student Content Assessment



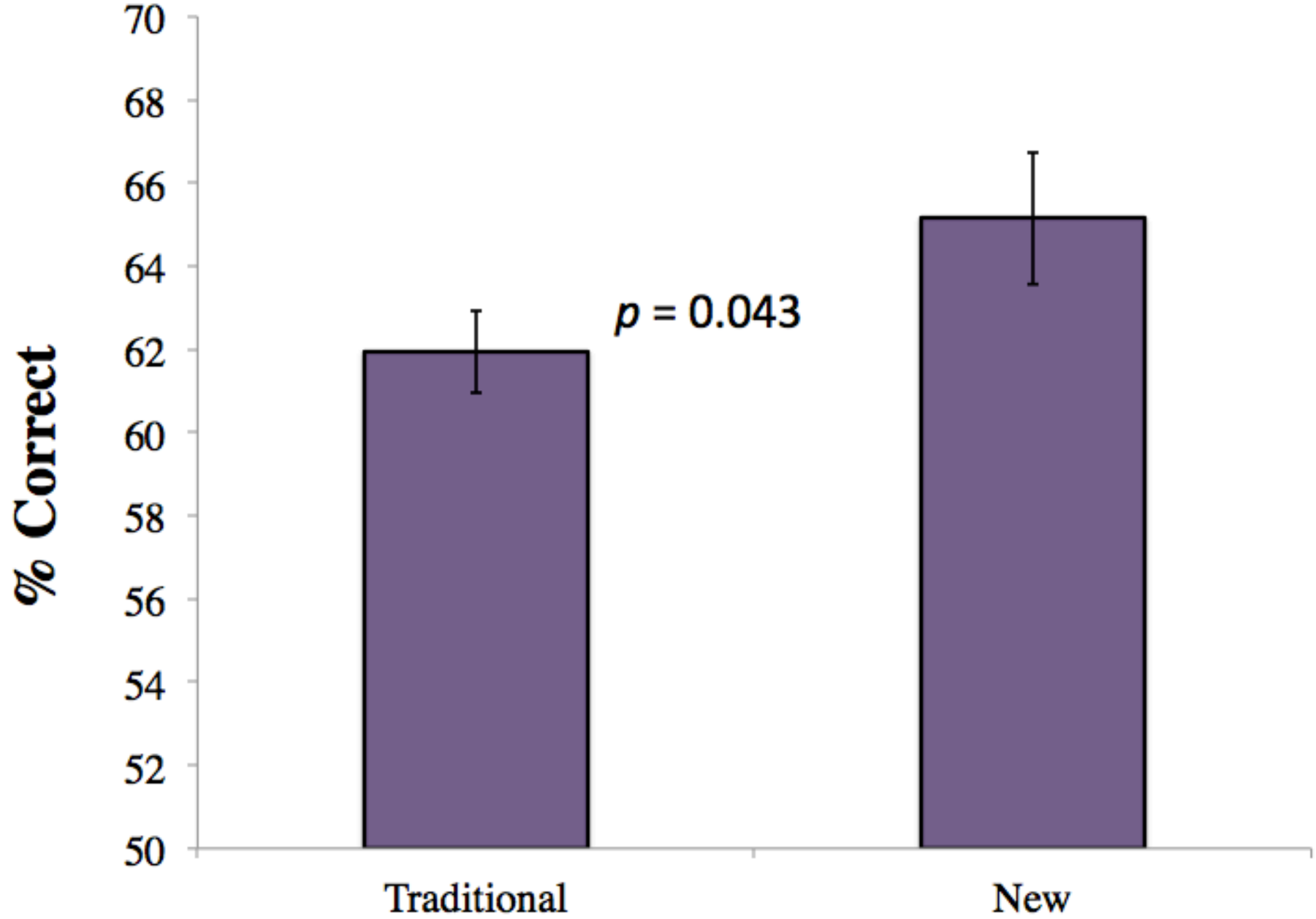
+/- SEM

Student Content Assessment

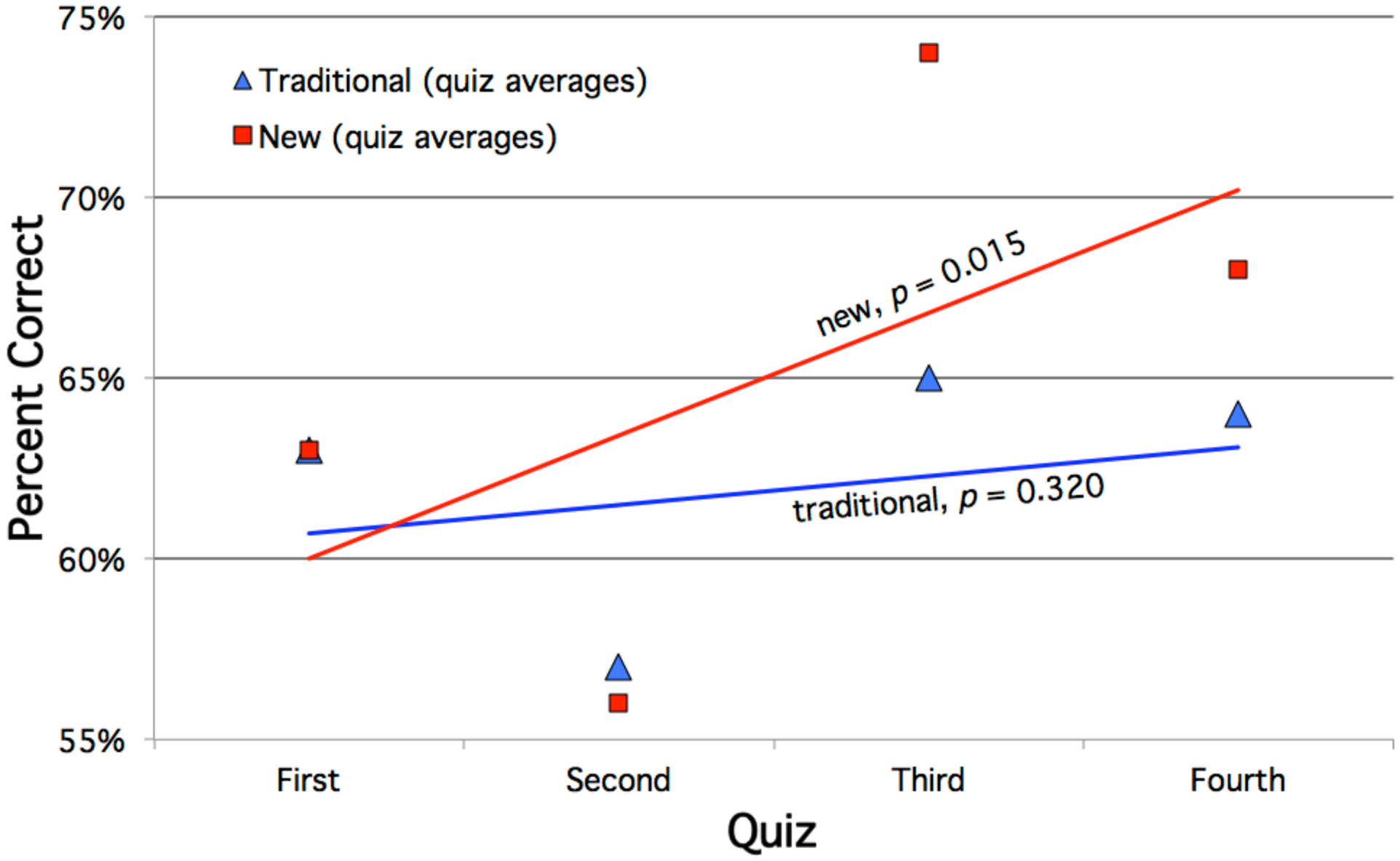


Can my students analyze data better?

Student Skills Assessment



Student Skills Assessment



Are *ICB* students overconfident?

* p<0.05, ** p<0.01, *** p<0.001	Average at Start	
1 - 5 scale, 1 = weak	**ICB**	**Traditional**
understand central concepts of biology	**4.11**	**3.76**
apply concepts to new situations	**3.89*** **	**3.09**
analyze new data	**3.68** **	**3.02**

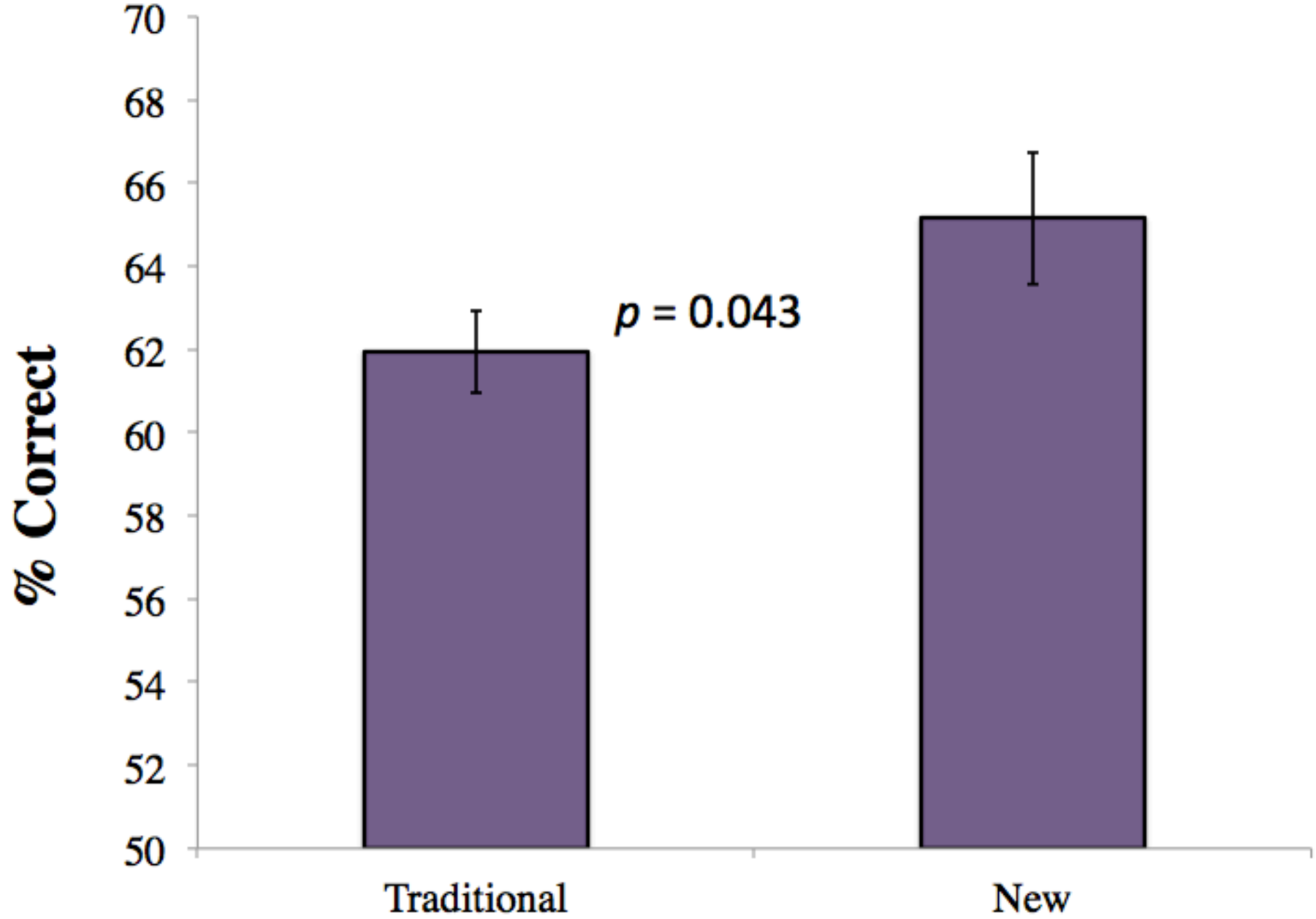
yes?

Are *ICB* students overconfident?

less so

* p<0.05, ** p<0.01, *** p<0.001	Average at Start		△ in Average at End	
1 - 5 scale, 1 = weak	**ICB**	**Traditional**	**ICB**	**Traditional**
understand central concepts of biology	**4.11**	**3.76**	**+0.12***	**+0.53**
apply concepts to new situations	**3.89*****	**3.09**	**-0.04****	**+0.67**
analyze new data	**3.68****	**3.02**	**-0.28****	**+0.56**

Student Skills Assessment



Do *ICB* students see biology differently?

1-5 scale 5 = extremely accurate	**Average at Start Fall**	
	ICB	**Traditional**
biology is definitions & processes	2.86	2.61
big questions of biology already answered	1.71	1.50
big/small division of biology describes nature	3.15	3.02
1-5 scale 5 = extremely important		
memorization	3.96	3.64

* p<0.05, ** p<0.01, *** p<0.001, ^ p= 0.06

no

Do *ICB* students see biology differently?

1-5 scale 5 = extremely accurate	Average at Start Fall		Δ in Average End of Fall	
	ICB	Traditional	ICB	Traditional
biology is definitions & processes	2.86	2.61	-0.58***	+0.50 yes!
big questions of biology already answered	1.71	1.50	-0.32*	+0.22 yes!
big/small division of biology describes nature	3.15	3.02	-1.08***	-0.06 yes!
1-5 scale 5 = extremely important				
memorization	3.96	3.64	-1.48***	-0.08 yes!

* p<0.05, ** p<0.01, *** p<0.001, ^ p= 0.06

Do *ICB* students see biology differently?

1-5 scale 5 = extremely accurate	Average at Start Fall		Δ in Average End of Fall		Δ in Average End of Spring	
	ICB	Traditional	ICB	Traditional	ICB	Traditional
biology is definitions & processes	2.86	2.61	-0.58***	+0.50	-0.46***	+0.45
big questions of biology already answered	1.71	1.50	-0.32*	+0.22	-0.33^	0.00
big/small division of biology describes nature	3.15	3.02	-1.08***	-0.06	-0.75**	-0.10
1-5 scale 5 = extremely important						
memorization	3.96	3.64	-1.48***	-0.08	-1.27***	+0.23

yes!

yes?

yes!

yes!

* p<0.05, ** p<0.01, *** p<0.001, ^ p= 0.06

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