Assessment in STEM
Teaching Science Like a Scientist

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Hunter College
Key Points for Today

- Teaching as scholarship
- Examples of my assessment
- Change is needed
- Design course with assessment included
- Your turn to generate a plan for your course
Introductions

Malcolm Campbell
Biology and Genomics (24 years)
• Introductory Biology
• Genomics
• Lab Method in Genomics
Two Types of Assessment

Imposed from Above

Do It for Yourself


Scholarship of Teaching

Would you write a paper without collecting data?

Would you start a new area of research without reading literature first?

Why do so many do both of these in their careers?
Would you write a paper without collecting data?

Would you start a new area of research without reading literature first?

Why do so many do both of these in their careers?
Example of Helpful Assessment

Echo360 records all classes (audio and slides)
## Example of Helpful Assessment

<table>
<thead>
<tr>
<th>Name</th>
<th>Engagement</th>
<th>Attendance</th>
<th>Video views</th>
<th>Presentation views</th>
<th>Questions</th>
<th>Activity part. / correct</th>
<th>Notes word count</th>
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Example of Helpful Assessment

I thought all students would use it equally – not true.
Who do you think uses it the most?
Example of Helpful Assessment

\[ y = -0.437x + 52.041 \]
\[ R^2 = 0.20826 \]
Example of Helpful Assessment

Exam Average (n = 4)

Students (sorted by grade)

- F2012: 47% (pre-Echo)
- F2013: 26% (1st year)
- F2014: 9% (2nd year)
Example of Helpful Assessment

after changing intro biology textbook
Definition of Insanity

Insanity: doing the same thing over and over again and expecting different results.

- Albert Einstein
This year it will be different!

How many of you teach upper level classes and marvel at how little students retain?

How many of you have gotten course evaluations that say class and lab are not aligned?
This year it will be different!

How many of you teach upper level classes and marvel at how little students retain?

How many of you have gotten course evaluations that say class and lab are not aligned?
Summation of Education Reform

Who wants change?
Summation of Education Reform

Who wants to change?
Backwards Design of Curriculum

1. What will your students be able to do after this lesson/activity/course? (learning objectives)

2. How will you know if they can do this?

3. How will your students gain this ability?
Bloom’s Taxonomy of Learning
Your Turn

Think of one class to focus on today.

Look at Bloom’s taxonomy & pick the level to target.

Write one learning objective using Bloom’s verbs.
Would you want your child/niece/nephew to perform in a piano recital without practicing?

How is this analogous to assessing your students?
If you want to change student behavior, you have to structure your class and your assessment to match your learning objectives.
Do you want students to read before class?
Then don’t tell them what they should have read.

If you don’t expect them to read before class, why have a textbook in the first place?

Do you want students to see the big picture?
Then don’t test them on minutia.

Do you want your student to interpret data?
Then give them real data for lots of practice.
“Students live up to our expectations, so don’t set them too low.”

https://www.ibiology.org/scientific-teaching/active-learning.html
Goal: I want my students to think and act like scientists.
LO: Students will be able to analyze and interpret experimental data.
Types of Assessment

Formative assessment gauges how well students learned in short run. (quiz, clicker questions, think/pair/share, minute paper)

Summative assessment most common, final measurement to see what they retained. (exams, lab reports, term papers, etc).

No matter what type of assessment, connect them to learning objectives (what will students be able to do?)
Types of Assessment
LO: Students will be able to analyze and interpret experimental data.

$p = 0.043$
LO: Students will be able to analyze and interpret experimental data.
Criticisms Became My Learning Objective
“Your students won’t learn core concepts.”

\[ p = 0.06 \]

\[ p = 0.97 \]

Percent correct

Fall 2010

ICB
traditional

+- SEM
"Your students won’t learn core concepts."

- ICB: 83% response rate (new)
- Traditional: 63% response rate (traditional)

Fall 2010:
- ICB: 62% correct
- Traditional: 60% correct
- *p* = 0.97

Spring 2011:
- ICB: 74% correct
- Traditional: 58% correct
- *p* = 0.06

SEM: +/- SEM
Your Turn

Formative

• Minute papers
  ‣ What is major lesson today?
  ‣ What is still confusing to you?
• Skim these to see what worked and what did not.
• Spend more class time, give as homework, or move on??
• What are your learning objectives?
• Do you have too many learning objectives?
• Definition of insanity…
Your Turn

Summative

- Draw experimental design for a critical experiment
  - cannot BS a drawing
  - I learned that students have no sense of size scale when I asked them to draw a picture of IDH
- Assemble evidence that supports our understanding of…
- Interpret data taken from relevant literature.
Your Turn

Generate one assessment piece that could measure whether your students accomplished the LO.
Teaching Should Be Fun!