How do you know your students are learning what you are teaching?
What did it feel like to be the student?

This is really boring.

How is this relevant?

I don’t have time to do all this.

Can’t they just tell me this information in class?

What is all this jargon?
### The Flipped Classroom

<table>
<thead>
<tr>
<th>What is it?</th>
<th>What are the disadvantages?</th>
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**Overview of Assessment, Formative, Summative, & Attitudinal Survey**

<table>
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<tr>
<th>CATs</th>
<th>Attitudinal Survey</th>
<th>Diversity</th>
<th>Resources</th>
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**COTTRELL SCHOLARS COLLABORATIVE**

*Integrating Discovery and Education to Advance Science*
<table>
<thead>
<tr>
<th>Task</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Look at test results, see distribution, standard deviation, etc. Monitor trends and the time evolution of these data</td>
<td>1) homework + midterm exam 2) active participation in discussions/questions during class</td>
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<td>I grade the midterm exam questions to see if the students correctly answered the question and if they took the correct approach to solving the problem</td>
<td>I want my students to understand the major concepts of physical chemistry and be able to relate those concepts to broader biochemical and biological problems. I almost exclusively utilize targeted questions on exams (midterms) to determine if they learned these concepts</td>
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<tr>
<td>Randomly call on students to see if they can answer questions, break class into small discussion groups and monitor whether the discussions are on track, exams and homework assignments to track retention</td>
<td>Homework assignments, exams, asking the class a question</td>
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<td>Reading and grading lab reports and exams</td>
<td>Lab reports, written exams</td>
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<tr>
<td>set out measurable instructions, and compare students' response to my instructions</td>
<td>Short quiz Homework exams</td>
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<tr>
<td>If the students solve the problems correctly, then it is likely they are learning the material. If the students are not solving problems correctly, then it is not likely they are learning the material.</td>
<td>Various possibilities include quizzes, problem sets, and exams. Also if the students are engaged during lectures and asking relevant questions.</td>
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<td>I will analyze their ability to apply concepts I have taught them in order to solve unfamiliar problems on problem sets and exams.</td>
<td>I want my students to learn organic chemistry reactions and mechanisms and I will use tools such as problem sets and exams to determine if they learned it.</td>
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<td>Assess the scores on each question/point, and determine if the class performance is markedly lower on one or more skills/concepts relative to others.</td>
<td>An exam or homework assignment</td>
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<td>By using online homework, I can analyze which problems gave the students the most difficulty, and see which topics they successfully mastered.</td>
<td>I will primarily rely on the results of weekly homework assignments, which are administered through Blackboard.</td>
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<td>Go over student responses to questions, in class discussion, determine whether there are still misconceptions, see if students can apply their knowledge to a differently presented question</td>
<td>In class discussion, tests, clicker questions</td>
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<tr>
<td>I will try to ask questions and follow-ups that probe their train of thought that leads to the final answer. I’m interested in “how” they arrive at their answer as in the answer itself, so I will write homework and exam questions in a way that requires them to think and apply these concepts.</td>
<td>There are several means I plan to use for this: in-class participation, homework solutions, answers to questions for Live Domes, a mid-term and final exam, and so on.</td>
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Why not just exams and problem sets?

Timing – instant feedback to professor and student within 24 hours of delivery of content

Grades – practice before being graded

Easy evaluation of one specific learning gain rather than breaking down each question of an exam or problem set and not diluted by all the other concepts typically in problem sets and exams
1) When should you assess your students learning?

- Every day of lecture
- Every week
- When you and the students want to know if they have learned a concept outlined in the learning goals of the course
- A few times a semester with midterms, finals, and quizzes

Right Answer: 3  ✔
Feedback:

When do you learn if your students learn?: Question 1 (N = 58)

![Bar chart showing percentage of students learning at different times]

- A: 24.1%
- B: 8.6%
- C: 56.9%
- D: 10.3%
3) What would improve the rubric to better match and allow the learning gains to be assessed?

Scoring of a written description on the experiment (such as would be found in a lab report)

The rubric could list the learning goals and group each of the assessment topics above into the appropriate goal. Then, provide more description about how points are assigned to the lab report based on how well the report reflects the goals outlined.

The learning gains that the instructor identified should be clearly outlined in the Rubric, and the categories of the rubric should reflect these learning gains. More emphasis should be placed on understanding, instead of just getting the right answer, to ensure that the learning gains of students whose experiment goes poorly can still be properly assessed.

A rubric incorporating some student input to make certain students understand the learning goals.

Although the rubric can certainly still include grades for error, accuracy, and yield calculations (etc.), the rubric should also directly incorporate the goals the teacher has indicated. For example, the teacher could require (and include in the rubric) that the students write out a short explanation of the goals of the experiment and why they chose to design them in a particular way, and this would be graded for correctness and clarity.

To include additional points based on students' ability to design an experiment.

Specific reasons and examples for each possible point value.

Work with students to better outline learning goals and inspire them to come up with additional goals.

Learning gain: "ability to design an experiment". If student obtains a low yield, ask student to hypothesize why and propose a change in procedure that would test the hypothesis.

Base it less on the empirical "right answer" numbers and more on the ability of the students to understand what they did, why, and what the numbers mean.

Outline scoring criteria that seek to better assess the student's understanding of the lab and its aims, and not just their presentation of the data. For example, including a section titled "Explanation of Results" where the students rationalize why their experiment yielded the results that they obtained. In situations where the experiment gave unexpected results, the students will have to think critically of reasons for why this is the case, showing that they have some understanding of both the goals of the lab and the means by which they were meant to achieve those goals.

Added points for explanation of each concept.

Lab report that details the exact aims. It doesn't need to be a full report, but one where the students are asked specific questions (essay style) and they must respond.

Explicit link between goals and grading. Example: have a "Presentation of scientific results" section (corresponding to a stated goal) and then have the individual components of that presentation under that heading.
**Student Log for the following question:**

2) What is confusing you about the implementation of CATs?

---

My main concern is how much time they can potentially take away from lecture and in-class work. For instance, when clickers were used in a general chemistry course for which I was a TA, approximately 10 minutes of each class period were used for clicker questions, and the students in my section told me that they did not find these questions very useful. If the clicker questions had been more useful, the time they took would have been fine, but I found this to be a clear case of poor execution of a CAT.

I believe I understand.

The muddiest point and one minutes test are straightforward. I am confused about how to implement the concept map.

deciding which one to use

I don’t understand why CAT’s like concept mapping have to be used in the classroom/lecture. Could be used on the course website, for example, without taking away valuable classroom time.

How often do you use CATs?

Some of the ideas, such a concept mapping, seem like they may be difficult to implement in a course on thermodynamics. This may be a useful exercise for the students to try on their own or during recitation, but I suspect it will take up too much time during lecture.

How often should we implement CATs

It is very clear.

How can you effectively implement CATS when you have 300 students?

Are they actually useful for assessing students?

How to use them for classes where the topics are very linear/math based.

Since I’ve always learned in a traditional classroom, the mix of content delivery, assessment, etc. is confusing. When do the students get presented with info that they are conceptually mapping etc.?

It is normally time consuming. How should we make it more time effective?

It’s confusing to me how implement this to a graduate level chemical biology class because I’ll be going through a lot of information and might not have time to stop to implement these strategies?

The best way to incorporate CATs with a traditional lecture without breaking up the flow of the class.

It is not clear to me how to use the collected information to improve my teaching.

The implementation of CATs is not confusing. I found it a great strategy and would like to use it but I believe for
“My main concern is how much time they can potentially take away from lecture and in-class work. For instance, when clickers were used in a general chemistry course for which I was a TA, approximately 10 minutes of each class period were used for clicker questions, and the students in my section told me that they did not find these questions very useful. If the clicker questions had been more useful, the time they took would have been fine, but I found this to be a clear case of poor execution of a CAT.”
“I don't understand why CAT's like concept mapping have to be used in the classroom/lecture. Could be used on the course website, for example, without taking away valuable classroom time.”
“Are they actually useful for assessing students?”
Discussion – take 1

I have just gone over ionic equilibria and pH titrations in class. This is typically a topic the students struggle with and I see a lot of confused faces in the audience.

What should I consider before I choose an assessment method?

What should you consider before you choose an assessment method?

How do you go about it?
Discussion – take 2

• Here is an assessment question that I can put in many different CAT formats.

• Draw a beaker of HCl and a separate beaker of CH₃COOH. Your drawings do not need to be qualitatively correct, but the differences between the two beakers should be clear.

• What do your students need to know to answer this question?
Another one…or two

• Write an exam question that would test your knowledge of ion equilibria and pH.

• Write one sentence summarizing the concept of equilibrium.
Some tips…

• Don’t make classroom assessment a chore.
• If a CAT doesn’t appeal to your professional judgment, then don’t use it.
• Try the CAT activity out on yourself.
• Allow for more time than you think.
• Close the loop. Give the students feedback on the results – the information is useful to you and them
Attitudinal

- Student’s experiences in learning significantly influence their performance.
- Student’s enjoy the course more if they think you care about their learning and experiences.
- After three weeks, administer a three – five question attitudinal survey, discuss the results with your students, and make some changes.
Example

• Give one or two examples of specific things your instructor does that really helps you to learn organic chemistry

• one or two examples of specific things your instructor does that makes it more difficult for you to learn organic chemistry

• Suggest one or two specific, practical changes your instructor can make that would help you improve your learning in class
Incorporate an assessment into your Teachable Tidbit

How to get started…
1. Think about a clearly defined topic of your active learning tidbit
2. What is the most important learning gain that you have targeted with your teachable tidbit?
3. Do you want your students to synthesize the material in a specific way?
4. Play around with some different questions or statements that you would want your students to answer and be sure they are at a learning level that you expect them to have for an exam.
5. Put your best formulation from 4 in the context of one of the CATs described in your handout or at http://www.flaguide.org/; examples are in the CATs book.