## Meaningful Assessment in AP Biology: Testing in the Service of Learning

*A Presentation to the Biology Department At MIT*

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Thinking about meaningful assessment -- What do you want to know? What meaning o you want to derive from the test?

## Developing Depth of Knowledge

- Students need a deep foundation of factual knowledge
- They need to connect facts & ideas in the context of a conceptual framework
- They need to connect concepts to prior knowledge to facilitate recall and application for problem solving

Most of American education is based on recall.
Application for problem solving: e.g. rate calculation (9th grade) vs. calculating a tax on purchase w/out a cash register. ->
Humans don't transfer. The problem is that it is assumed that people transfer.

## The Role of Teachers

- Teachers have depth of subject-matter knowledge
- Connecting to students existing knowledge—becoming "learner centered"
- Teaching for understanding, rather than retrieval
- Assumptions about intelligence and transfer of learning

Role of teachers: becoming "learner-centered" rather than "teacher-centered."
Teaching for understanding rather than retrieval means taking the time for students to elaborate in the classroom.

## The Role of the Learner

- Learning is a "constructive" process, active not passive
- Students arrive with prior knowledge, often with incomplete understanding of the subject
- Knowing what you know, and what you don't know is key
- Views of one's "intelligence" are central

Role of learner.
Learning as a constructive process. E.g. "two out, two on, bottom of the seventh." To understand that, one needs to know something about baseball and the language of baseball.
Prior knowledge: 3&4 year olds have theories for why it's light and dark, etc. Theories exist, but are wrong. Not an "empty package."
Knowing what don't know: identify a point where knowledge breaks down. Have strategies for learning.
Views of oneself: learn slower if believe self (fixed vs. adaptive).

## Assessment in the Service of Learning

- Assessment is the art & science of knowing what students' know
- Assessments provide "evidence" of students' knowledge, skills & abilities
- Evidence supports teachers "inferences" of what students' know & can do
- Inferences guide and inform instruction

Assessment

Assessment for understanding is harder at start-up, but when the "pool" is created, it evens out. Need to develop rubrics.

Teachers "inferences" of what students know. If can't infer, assessment is of low value.

Inferences guide and inform instruction. -> have to insure that students learn key concepts. May have to go back and re-teach if students are not getting it.

Philosophy of transparency: Formative and summative assessment have to be separate.

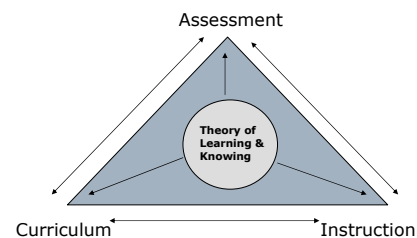What are the topics about which you want to make inferences?
What evidence are you going to use?

## 4 Key Concepts

- Making students' thinking visible
- Developing depth of knowledge, & connecting to prior knowledge
- Defining the roles of the Teacher & the Learner
- Assessing student learning, informing teaching

## Making Students' Thinking Visible

- Students approach new learning with complex, but often incomplete, views of the world
- If this initial understanding is not engaged, they often fail to grasp new concepts
- Teachers need to "make visible" students' pre-existing knowledge and incomplete understanding

Making Thinking Visible

Give out rubrics-criteria for success.

If a test is a valid criteria for learning, then announcing these criteria is fair.

Grading on a curve guarantees failure for some part of the class.

This defeats the goal of teaching a subject.

## The Curriculum-Instruction-Assessment Triad

Assessment Triad



Learning and understanding is an inherently psychological act.

### Advances in the Sciences of Thinking & Learning

Implications for C-I-A derived from study of expertise (computer science, cognitive science, educational psychology, linguistics & neuroscience)

- nature of expertise
- Influence of prior knowledge
- Metacognitive knowledge
- Learning with understanding
- Multiple paths to knowledge acquisition
- Situated knowledge & expertise

### Developing Depth of Knowledge

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### Overview of Cognitive Processes

- Remembering
  - Short-term memory
  - Long-term memory
- Reasoning & Thinking
  - Inductive, deductive, abductive
- Problem Solving
- Rule Making

### Why Cognitive Models of Content Knowledge are Critical

- Tell us what are the important aspects of knowledge that we should be assessing.
- Give deeper meaning and specificity to standards
- Give us strong clues as to how such knowledge can be assessed
- Suggest what can and should be assessed at points proximal or distal to instruction
- Can lead to assessments that yield more instructionally useful information -- within and across levels and contexts
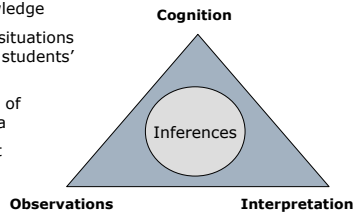- Can guide the development of systems of assessments

## Assessment: A Process of Reasoning from Evidence

**Cognition**-model of how students represent knowledge

**Observations**-tasks or situations that allow us to observe students' performance

**Interpretation**-method of making sense of the data

**Inference**-judging what students' know & can do

Cognition

Inferences

Observations          Interpretation

## Why Focus on Classroom Formative Assessment?

- As instruction is occurring, teachers need information to evaluate whether their teaching strategies are working.

- They also need information about the current understanding of individual students and groups of students so they can identify the most appropriate next steps for instruction.

- Students need feedback to monitor their own learning success and to know how to improve.

## Assessment Centered Elements

- There are frequent opportunities to make students' thinking visible through processes of formative assessment.

- Teachers try to grasp where students are in the development of their thinking and understanding of critical constructs.

## Translating Science into Engineering: Principles of Assessment Design

- Assessment design should be based upon a **model of student learning** and a clear sense of the **inferences about student competence** that are desired for the **particular context of use**.
- Design is recursive process – starting with the **Student Model**
- The student model suggests the most important aspects of student achievement that one would want to make inferences about and provides clues about the types of tasks that will elicit evidence of students' understanding.