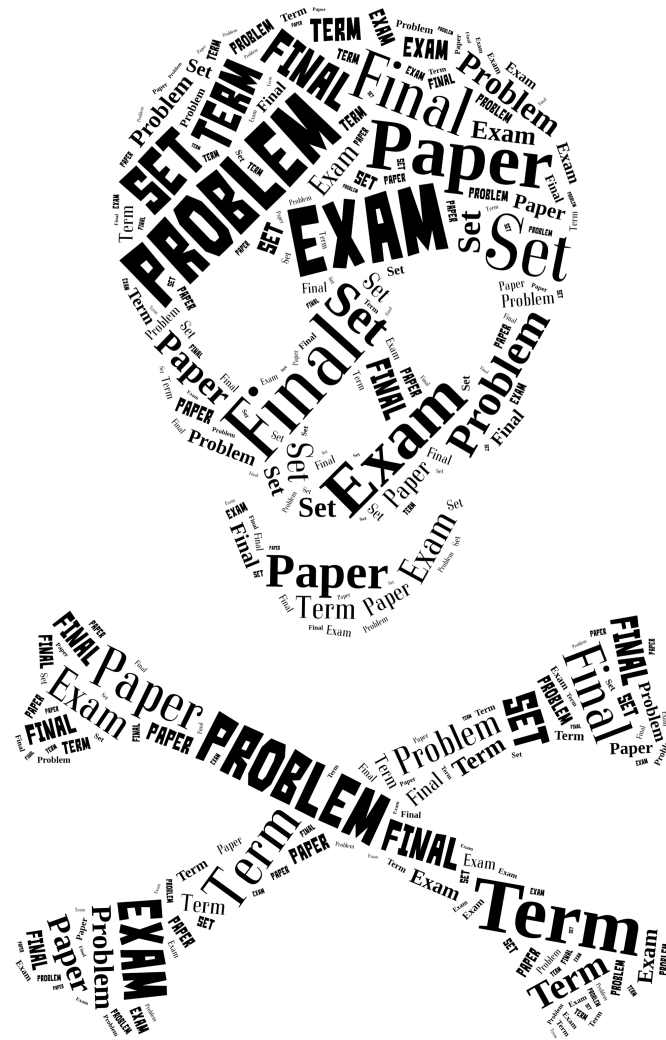# Best Practices to Evaluate Student Learning

Preceptor in Biological Chemistry | Marty Samuels
Lecturer in Biological Sciences at Northwestern University | Stanley Lo
Lecturer in Neurobiology | Ryan Draft

Best Practices to Evaluate Student Learning

**GOAL:** Teach you to use assessment to teach better.

OBJECTIVES:

1. To understand how feedback and reflection can increase self-learning.

2. To employ group learning to help students evaluate themselves.

3. To be able to write questions that evaluate different levels of understanding.

4. To understand your role in connecting lecture with graded assignments.

Active Learning <u>Can</u> Increase Learning

62 courses, **6452** physics students testing interactive strategies *vs.* traditional lecture
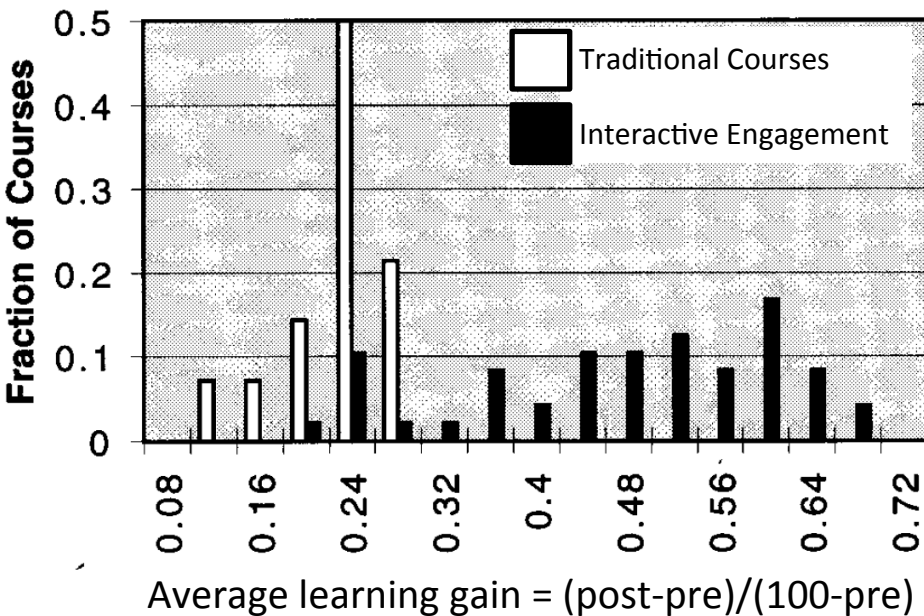
538 students split into a traditional lecture group and a deliberative practice group.

Average learning gain = (post-pre)/(100-pre)
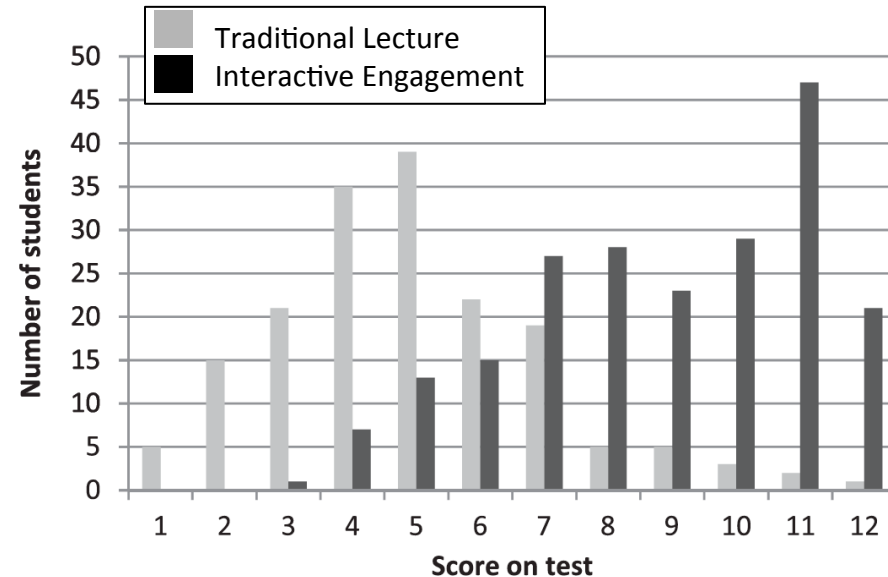
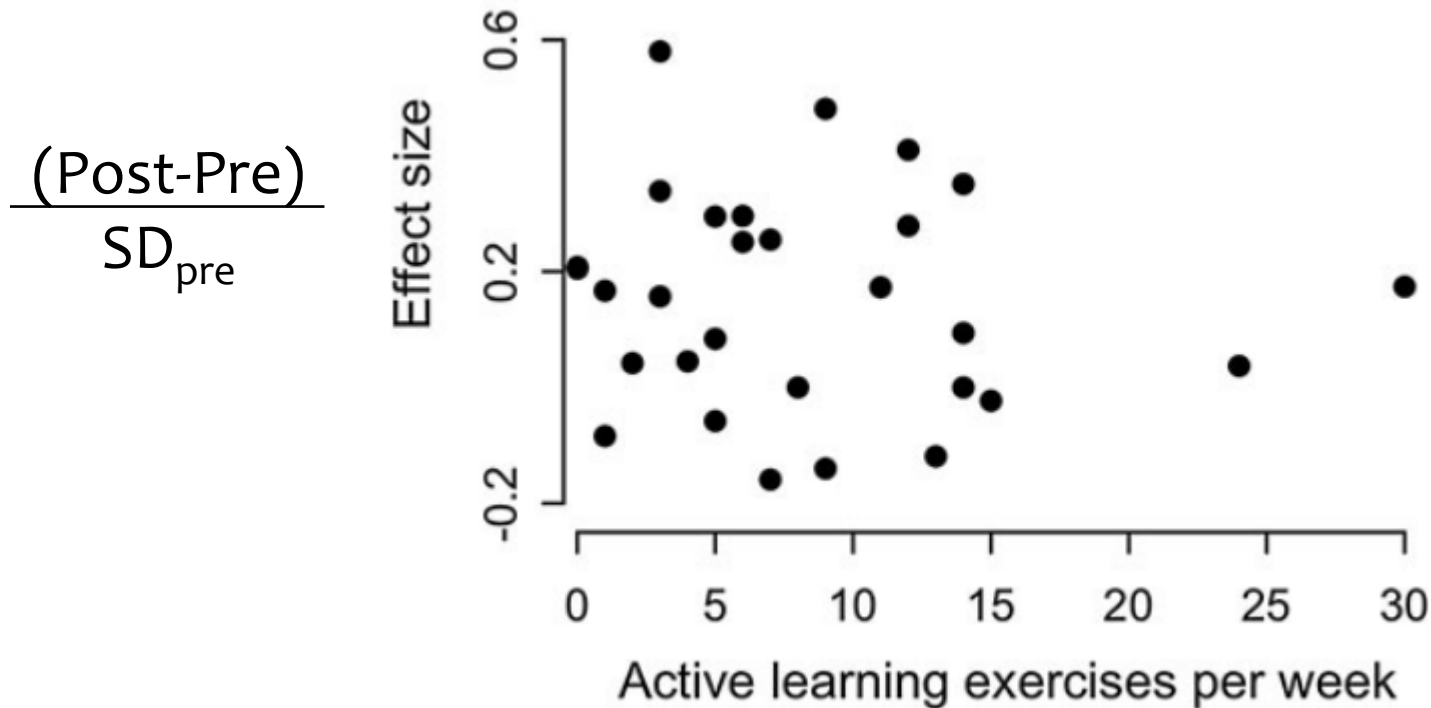Hake et al, *Am. J. Phys*. 1998.
Deslariers et al, *Science* 2011.

Active Learning Exercise 1: Reflection and Feedback

pH Strip/Titration activity

Active Learning Can Increase learning … maybe?

33 instructors and courses
pre/post assessment on evolution concepts
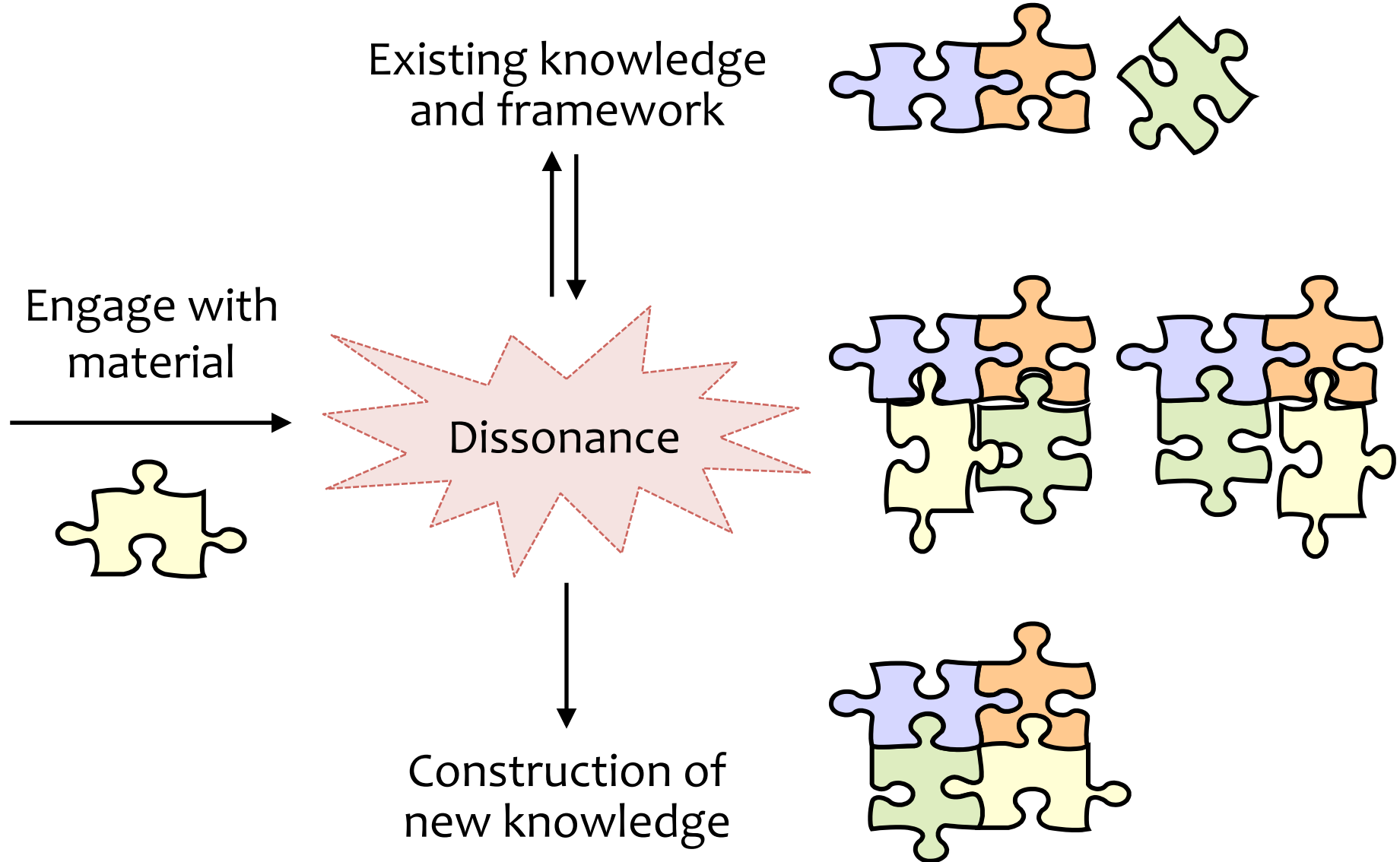
$$\frac{(\text{Post-Pre})}{\text{SD}_{pre}}$$

What Makes Active Learning Work (or not)?

In your group, think about what factors might underlie the variation in active learning gains.

How People Learn

Existing knowledge
and framework

Engage with
material

Dissonance

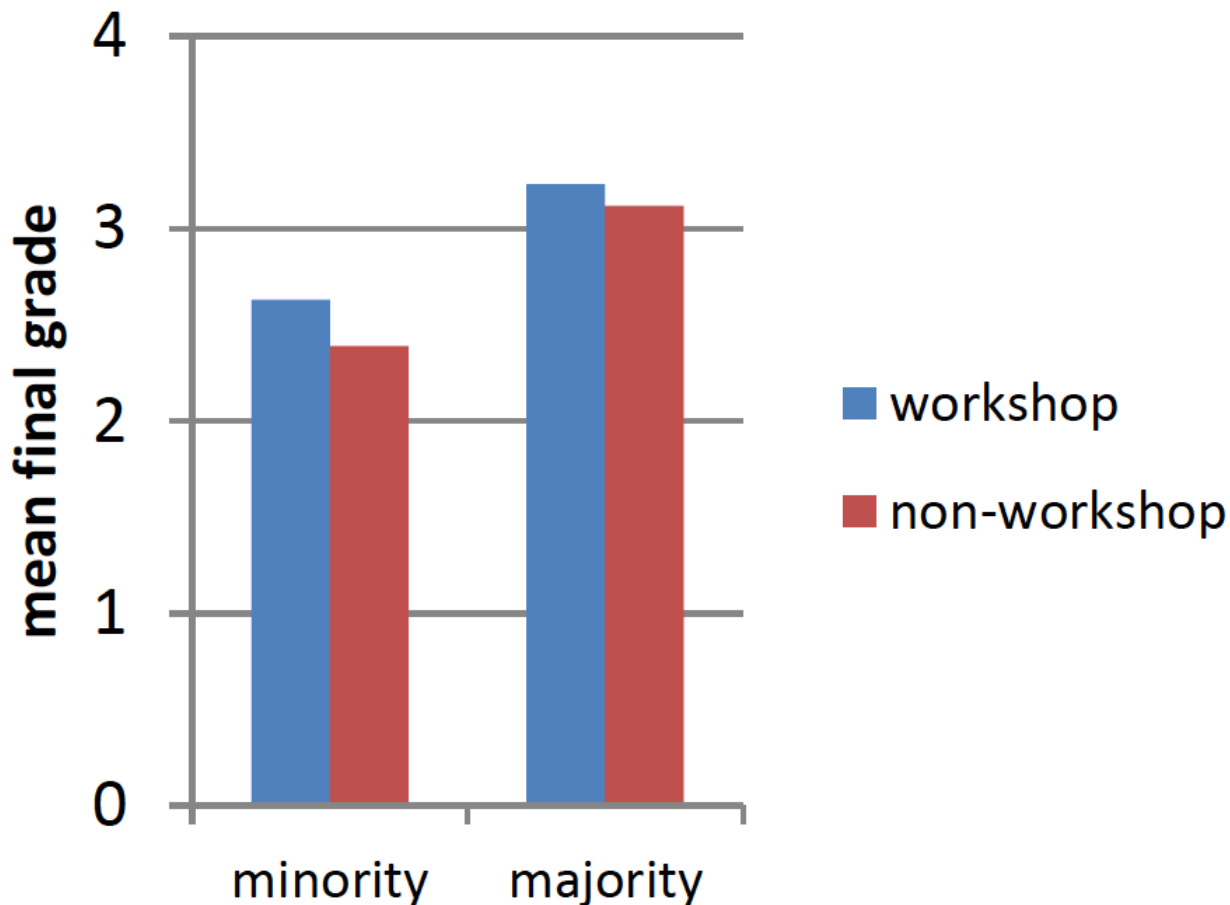Construction of
new knowledge

Active Learning Exercise 2

Amino Acid Statement Correction

- Work 2 minutes alone
- Then work with your group

Group Feedback is Crucial for Learning

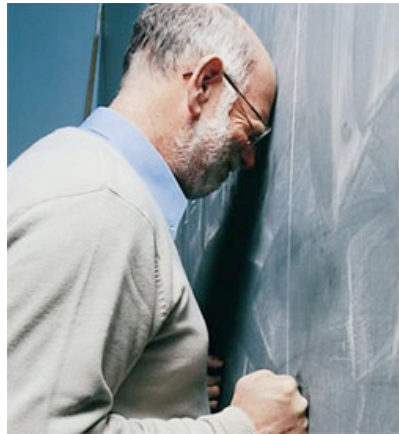## Study of small group learning

- 10 year study across STEM disciplines

Activity 2 Debrief: Using Feedback

In your groups, please discuss the following question:

How did this activity allow for evaluation?

Teacher:
- Identify student knowledge/skill deficiencies
- Modify subsequent learning activities
- Focus away from grading ☹ and onto learning ☺

Student:
- Clarify what good performance is (goals, expected standards)
- Assess their own knowledge/skills
- Assess their peers' knowledge/readiness
- Promotes the development of self-assessment

The Montillation and Use of Traxoline

It is very important to learn about traxoline. Traxoline is a new form of zionter. It is montilled in Ceristanna. The Ceristannians found that they could gristerlate large amounts of fervon and then bracter it to quasel traxoline. This new, more efficient bracterillation process has the potential to make traxoline one of the most useful products within the molecular family of lukizes snezlaus.

1. What is traxoline?
2. Where is it montilled?
3. How is traxoline quaseled?
4. Why is traxoline important?

What Types of Thinking are Involved?

A. The function of the GTPase activity of G-proteins is: _____

B. Cholera toxin modifies the G-protein by transferring ADP-ribose to an arginine residue in the GTPase active site. What is the most likely outcome?

C. Based on the data, what mutation(s) are possible in the variant cells? Explain your reasoning.
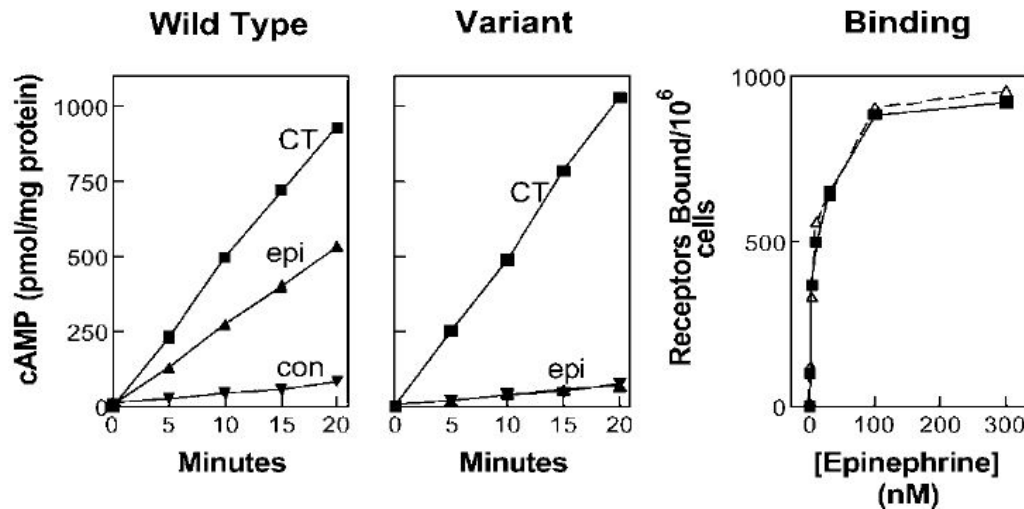
Left and Center: Wild-type and variant cells were incubated with only GTP (con), with epinephrine and GTP (epi), or with cholera toxin and GTP (CT). Right: Binding of radioactive epinephrine to wild-type (solid squares) and variant cells (triangles).

Bloom's Taxonomy of Cognitive Processes

Remember   Recalling information
Recognizing, listing, describing, retrieving, naming, finding

Understand   Explaining ideas or concepts
Interpreting, summarizing, paraphrasing, classifying, explaining

Apply   Using information in another familiar situation
Implementing, carrying out, using, executing

Analyze   Breaking information into parts to explore relationships
Comparing, organizing, deconstructing, interrogating, finding

Evaluate   Judging based on criteria
Experimenting, checking, hypothesizing, critiquing, justifying

Create   Generating new ideas, products, or ways of viewing things
Designing, constructing, planning, producing, inventing

Anderson and Krathwohl (2001) *A Taxonomy for Learning, Teaching, and Assessing*

Active Learning Exercise 3: Higher Order Questions

Ribosome Strip Sequence

Activity 3 Debrief: Higher Order Questions

Work with your group to design a question that could test higher-order concepts for this activity.

Higher Order Questions Lead to Deeper Student Understanding, which Lasts Longer

Study of long-term conceptual understanding after deep (vs. superficial) questions:

- Compare test scores given in the middle of the course and at 8 to 101 weeks later

Subtest	M	Difference	Pooled SD	Effect Size	p
Deep	2.43	3.24	9.30	0.35	.01
Surface	−0.81				

1/3 of a grade better

Your Role in Connecting to Lecture

Lecture Goals: We know the concepts and questions we want students to know and understand

Lecture → Objective 1 | Objective 2 | Objective 3

Section →
- Active Learning Activities
- Help create new knowledge

Grades →

- Tests, P-sets, Papers
- Demonstrate knowledge

Conclusion: Take Home Messages

1. Activities require **reflection/feedback** for maximal learning gains.

2. Group work provides essential feedback for the **student and teacher.**

3. Assessment questions should **span** higher and lower order levels of understanding.

4. You as a TF are crucial for **bridging and connecting** lecture with graded assignments.

Your Task for This Afternoon

1. Discuss your group's topic.
    - Agree on the context in which the activity could be taught.
    - What particular areas of the topic might be challenging?

2. Write learning goals and objectives for your topic.

3. Decide what you want the students to understand and be able to do to demonstrate their knowledge?

4. Develop a 15-minute teaching activity.

5. Teach the activity to another group:
    - 15 minutes of teaching
    - 15 minutes of feedback.

Every Activity Requires Reflection

- Explain answers and reasoning
- Discuss differing ideas
- Identify what was confusing
- Identify what you needed to know

How People Learn

PRIOR KNOWLEDGE

Engaging with the material

DISSONANCE

CONSTRUCTION OF NEW KNOWLEDGE

Foundations. Borasi and Fonzi, National Science Foundation.