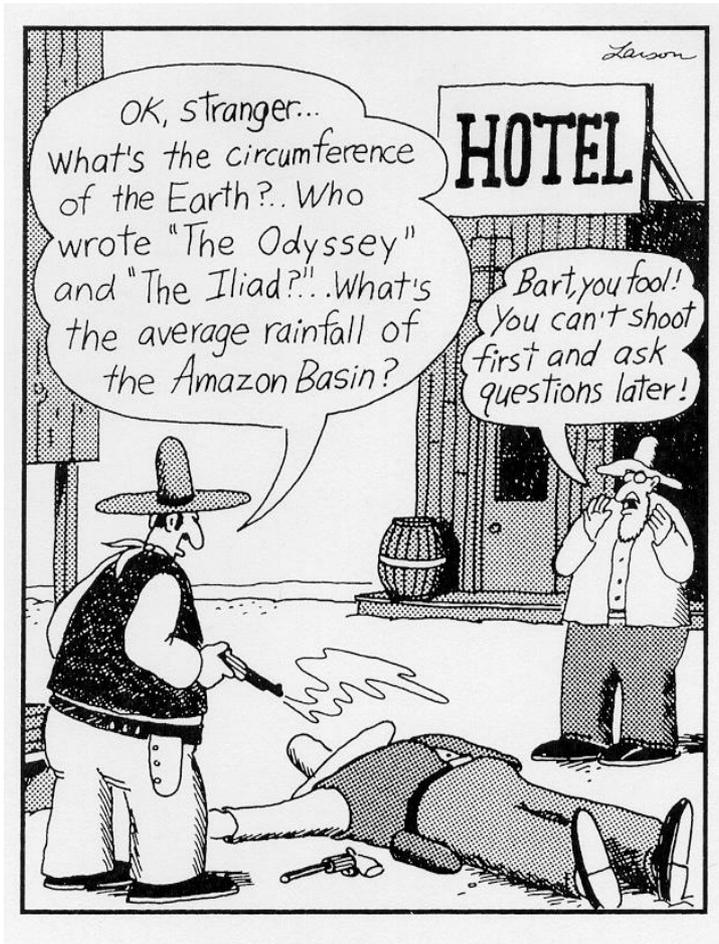


# Linking goals, assessment and teaching strategies to promote effective learning





# Linking goals, assessment and teaching strategies to promote effective learning

1. Introduction
2. How learning informs the teaching process
3. Creating effective assessments to match learning goals
4. Assessing assessments



Three instructors taught a University science course during the same semester.

Prof. A emphasized concepts, careful, logical;

Prof. B used demonstrations and took extra prep time;

Prof. C had a problem solving emphasis.

All used the same textbook and covered the same chapters. All professors received similar evaluations.

Pre-test scores for each class were almost identical.

*Predict which professor's class showed the greatest gain in post-test score.*

- A. A
- B. B
- C. C
- D. No difference



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**D. No difference**



Three instructors taught a University science course during the same semester.

## Observation #1

How the instructor delivers information may have little direct impact on learning

Corollary: What the student does is more important than what the instructor does

**D.** No difference



# Cognitive Science and Course Design

*A traditional science instructor concentrates on teaching factual knowledge, with the implicit assumption that expert-like ways of thinking about the subject come along for free or are already present.*

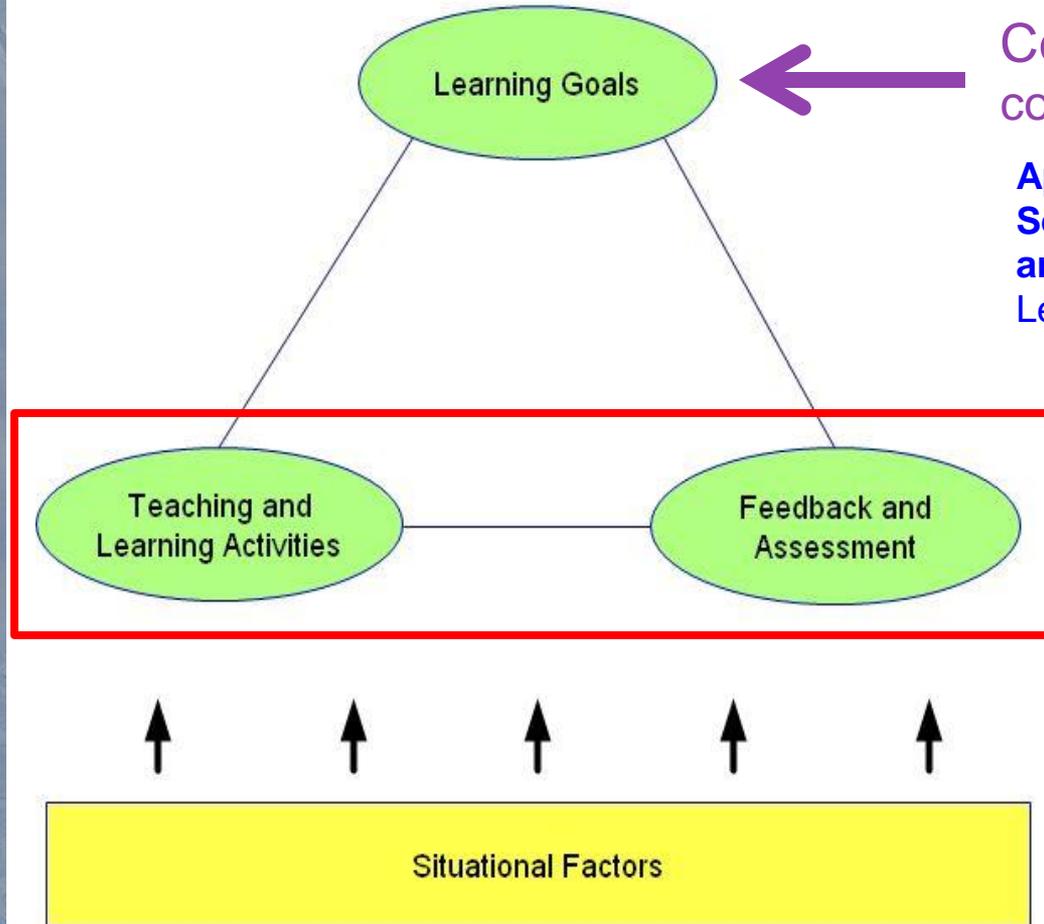
*But that is not what cognitive science tells us. It tells us instead that students need to develop these different ways of thinking by means of extended, focused, mental effort.*

Carl Wieman,

Assoc. Director, White House Office of  
Science and Technology Policy  
and Nobel Prize winner



# Linking goals, assessment and teaching strategies to promote effective learning



Context specific:  
content, skills

April 10, 2012 (Tuesday):  
Setting goals for effective  
and innovative courses  
Leader: Barbara Tewksbury,



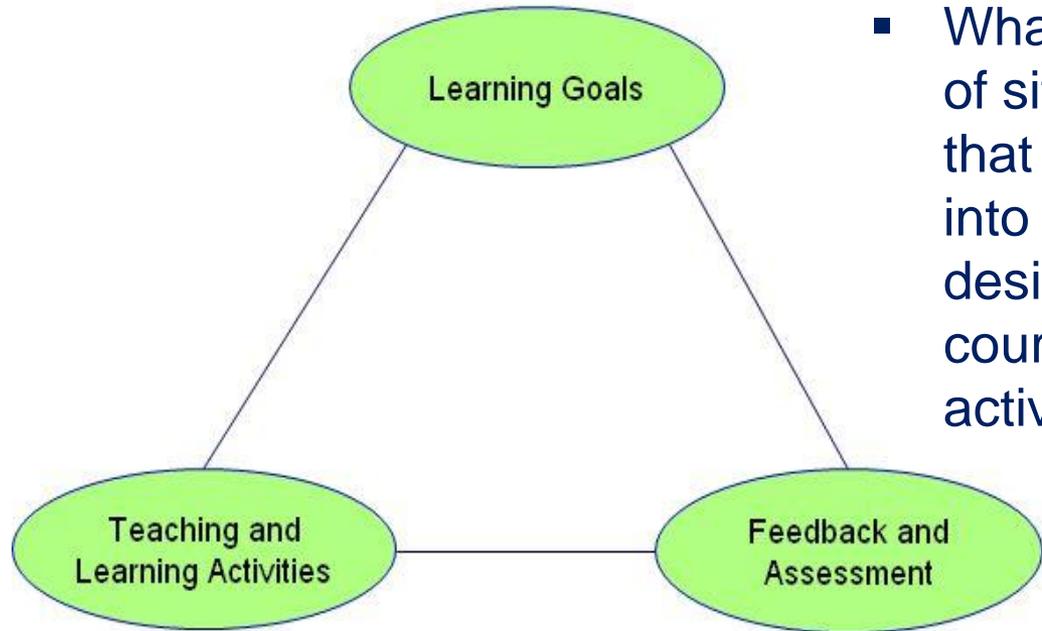
Our focus:

- What the student does.
- How to assess student learning.

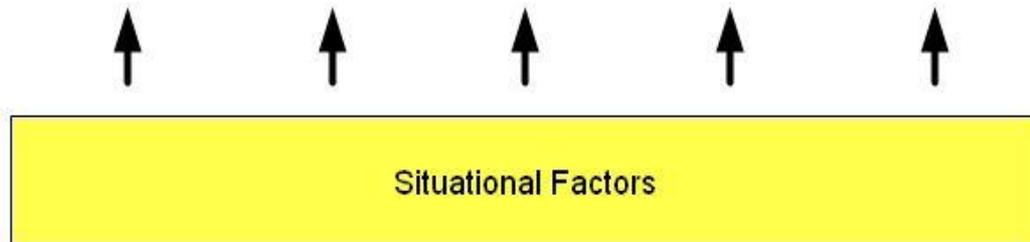
*Examples: class size, student motivation*

Fink, 2003, Creating significant learning experiences

# Goals, Assessment, and Teaching



- What are examples of situational factors that you have to take into account when designing your course, lesson, or activity?



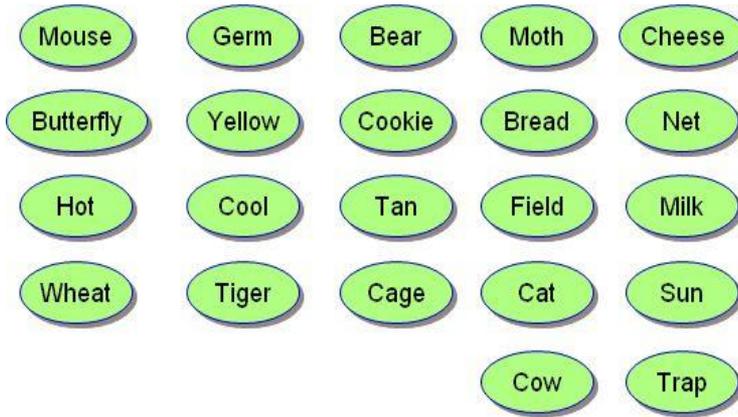
content misconceptions    class size    student degree program    classroom environment    academic rank of students    lecture vs. lab    student affect (motivation)

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# Learning Practice (implications for teaching)

- Attention – the more attention we give to a stimulus, the more strongly it is retained by our brain
  - We remember novel or emotional events best
  - We are better at seeing patterns than recording details
- Student memory of class information is improved by making associations among items
  - Outlines
  - Labeled diagrams

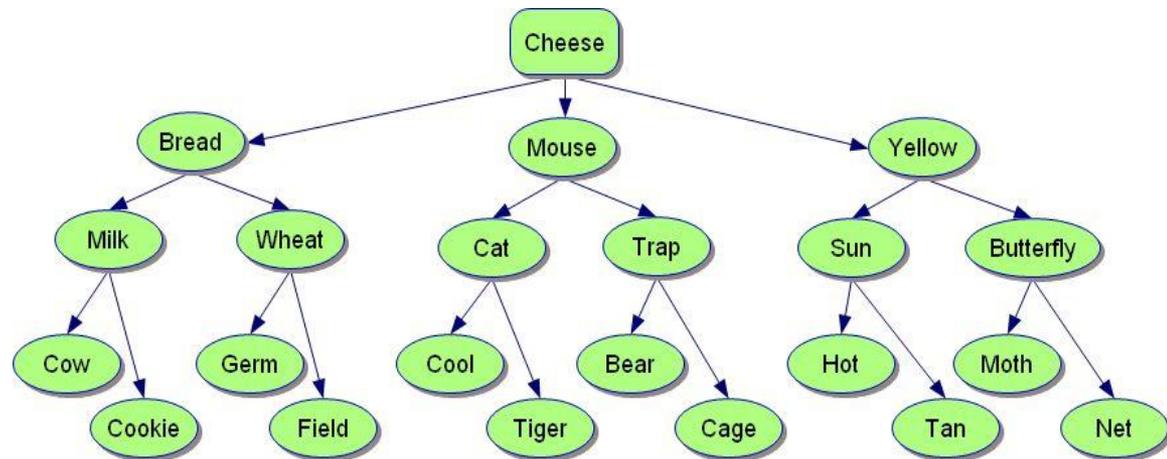


### Group A

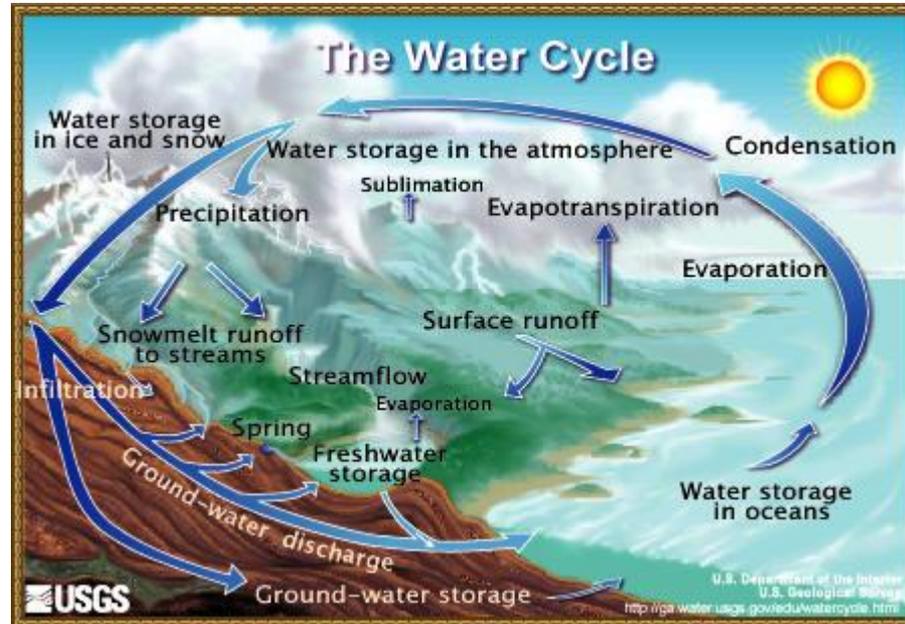
- Students examined a list of these 22 items for one minute and tried to remember as many as possible.

### Group B

- Students examined a diagram of these 22 items for one minute and tried to remember as many as possible.



# Visualizing information in “chunks”

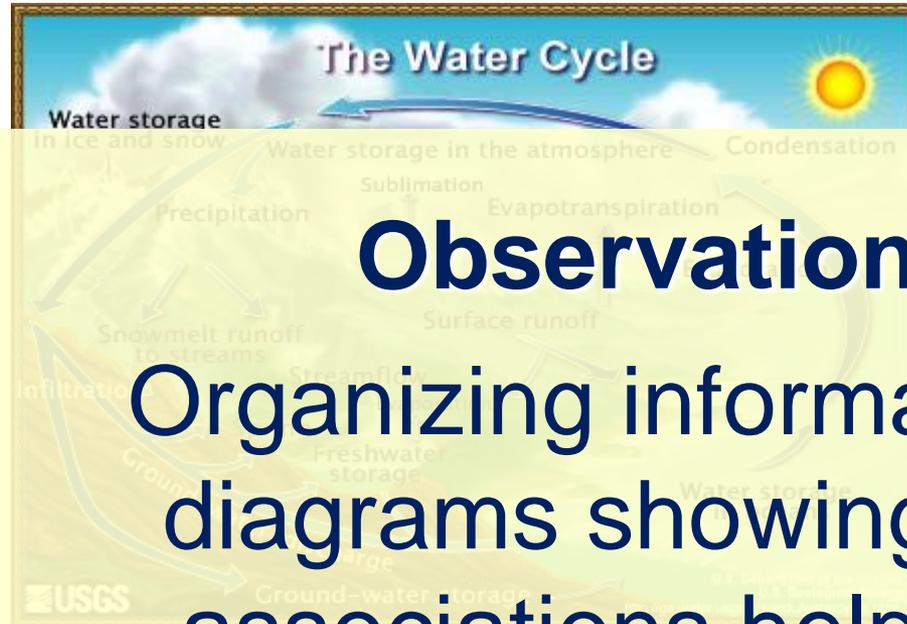


“Chunking” of information is similar to expert thought patterns

Training students to use labeled sketches or other graphic organizers can make it easier to recall related information later

Caveat: Students must understand the constituent parts separately

# Visualizing information in “chunks”



## Observation #2

Organizing information into diagrams showing simple associations helps recall

Training students to use labeled sketches or other graphic organizers can make it easier to recall related information later

Caveat: Students must understand the constituent parts separately



# The Value of Peer/Self Reflection

**Experimental Group:** Three 2-minute pauses per lecture, student discussion of lecture content with peer.

**Control Group:** No pauses for discussion in lecture.

Students completed a delayed multiple choice test 12 days later

# The Value of Peer/Self Reflection

Students completed a delayed multiple choice test 12 days later



- Experimental Group – average test score : **84.4\***
- Control Group – average test score : **76.3**



## Repeat to Remember

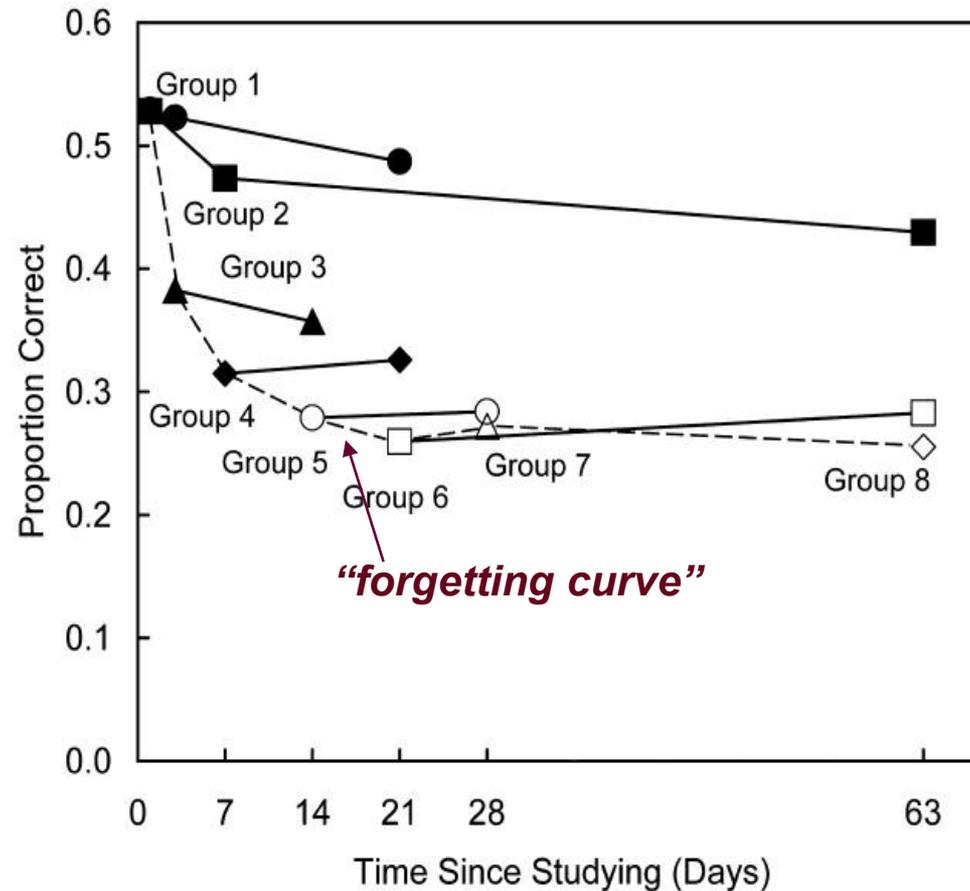
- Short-term memory
  - The more effort we put into encoding information at the moment of learning, the more we remember
  - **Listening → writing → drawing/organizing**



# Repeat to Remember, Remember to Repeat

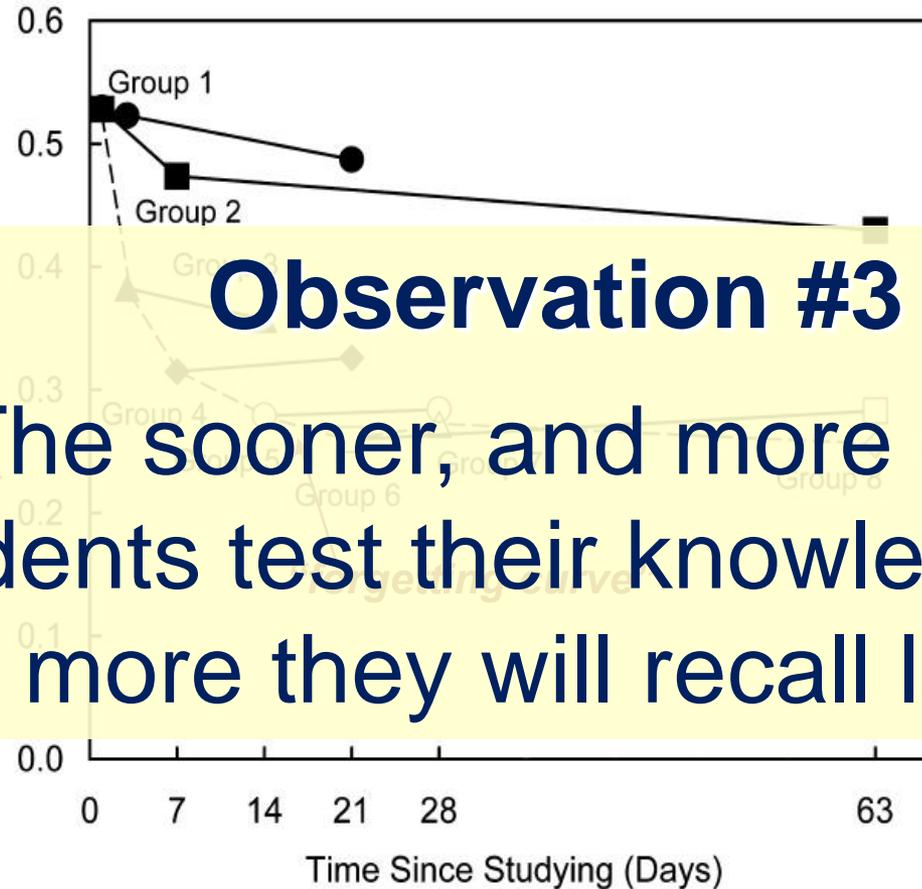
- **Short-term memory**
  - The more effort we put into encoding information at the moment of learning, the more we remember
  - **Listening → writing → drawing/organizing**
  
- **Long-term memory**
  - Thinking or talking about an event immediately after it occurs enhances memory of the event
  - Reviewing material at fixed, spaced intervals enhances memory (after class reflection, online quizzes, recitations, tutorials, study groups, etc.)

## The Forgetting Curve



- The sooner, **and more frequently** that testing occurs, the more information students can retrieve weeks later

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# Conceptests and Peer Interaction

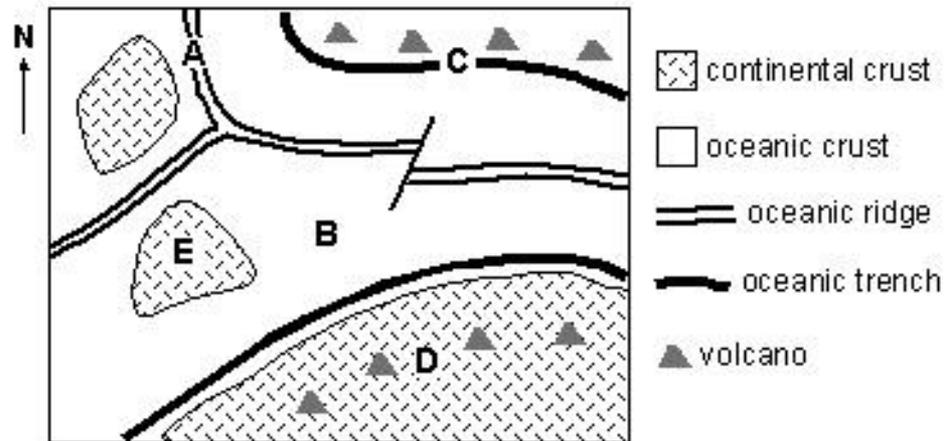
Examine the map and answer the question that follows. How many plates are present?

a. 3 (26%)

c. 5 (44%)

b. 4 (19%)

d. 6 (11%)

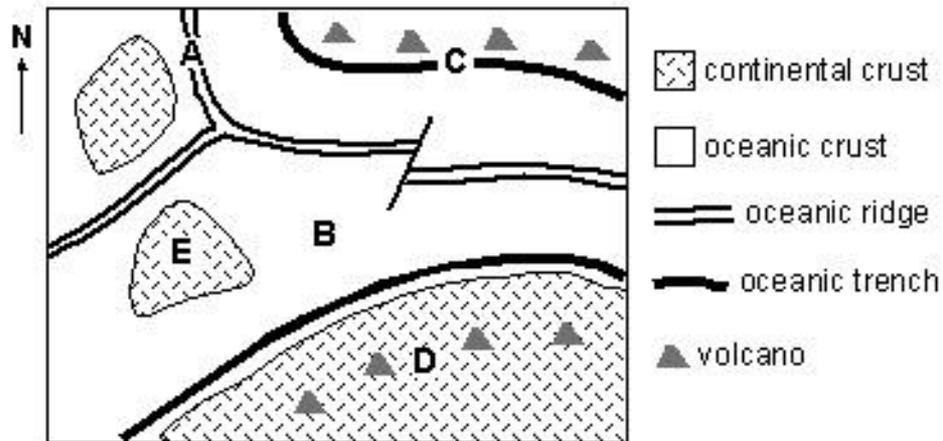




# Conceptests and Peer Interaction

Examine the map and answer the question that follows. How many plates are present?

- |                        |                        |                             |
|------------------------|------------------------|-----------------------------|
| <b>a.</b> 3 (26%; 0%)  | <b>c.</b> 5 (44%; 75%) | <i>Individual responses</i> |
| <b>b.</b> 4 (19%; 18%) | <b>d.</b> 6 (11%; 7%)  |                             |



# The Value of Peer Interaction

**Control Group:** Students took physics test individually.

**Experimental Group:** Students took physics test individually, then again as a pair.

Proportion of pairs of students who both got the question wrong on the first test but correct on “paired” test: **29%**

Students in both groups answered similar questions on a second exam two weeks later.

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Mean score on second exam for control group: **64%**

Mean score on second exam for experimental group: **74%**

# The Value of Peer Interaction

**Control Group:** Students took physics test individually.

**Experimental Group:** Students took physics test individually, then again as a pair.

**Observation #4**  
Knowledge is socially constructed  
and students learn best in  
supportive social settings

Proposition: Students who got a question wrong on the first test but correct on "paired" test: 29%

Students in both groups answered similar questions on a second exam two weeks later.

Mean score on second exam for control group: 64%

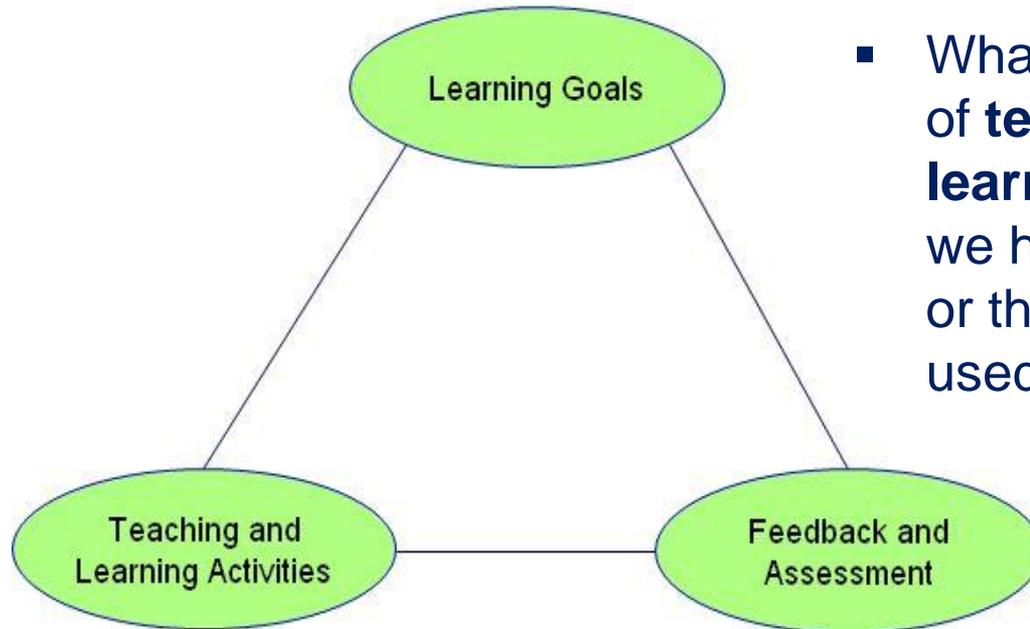
Mean score on second exam for experimental group: 74%



**Any Questions So Far?**



# Linking goals, assessment and teaching strategies to promote effective learning



- What are examples of **teaching and learning activities** we have recognized or that you have used before?



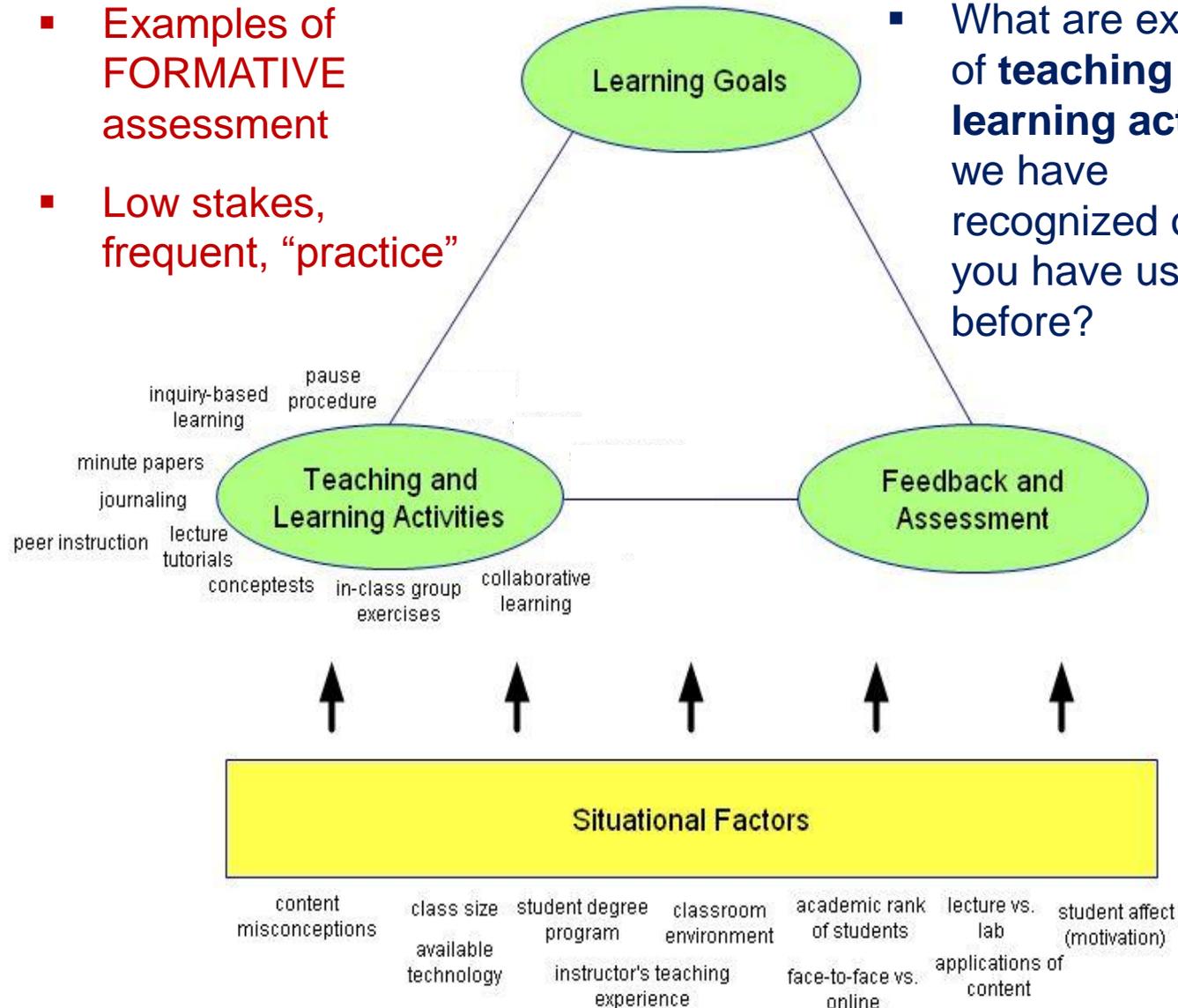
content misconceptions    class size    student degree program    classroom environment    academic rank of students    lecture vs. lab    student affect (motivation)

available technology    instructor's teaching experience    face-to-face vs. online    applications of content

# Goals, Assessment, and Teaching

- Examples of **FORMATIVE** assessment
- Low stakes, frequent, "practice"

- What are examples of **teaching and learning activities** we have recognized or that you have used before?



content misconceptions    class size    student degree program    classroom environment    academic rank of students    lecture vs. lab    student affect (motivation)

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# Seven Principles of Good Practice

## The instructor . . .

1. Encourages student-faculty contact
2. Develops cooperation among students
3. Encourages active learning
4. Provides prompt feedback
5. Emphasizes time on task
6. Communicates high expectations
7. Respects diverse talents and ways of learning

***Which of these have we touched on so far?***



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# Avoid Shallow Learning

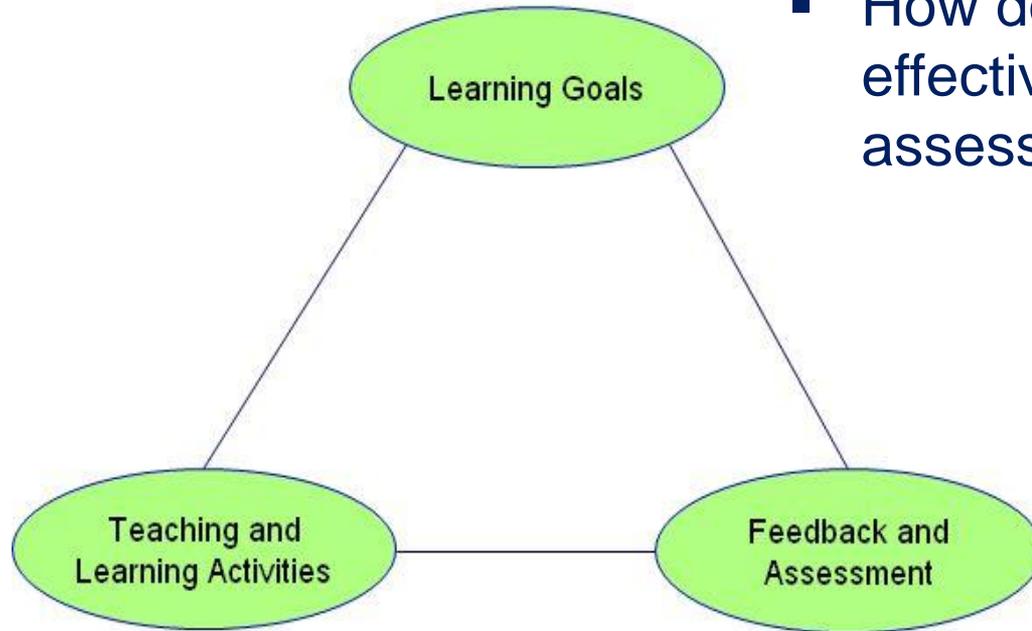
## The Montillation of Traxoline

Directions: Read the passage below and answer the questions that follow.

It is very important that you learn about traxoline. Traxoline is a new form of zionter. It is montilled in Ceristanna. The Ceristannians gristerlate large amounts of fevon and then brachter it to quasel traxoline. Traxoline may well be one of our most lukized snezlaus in the future because of our zionter lescelidge.

1. What is traxoline?
2. Where is traxoline montilled?
3. Why is it important to know about traxoline?

# Goals, Assessment, and Teaching



- How do we design effective **SUMMATIVE** assessments?

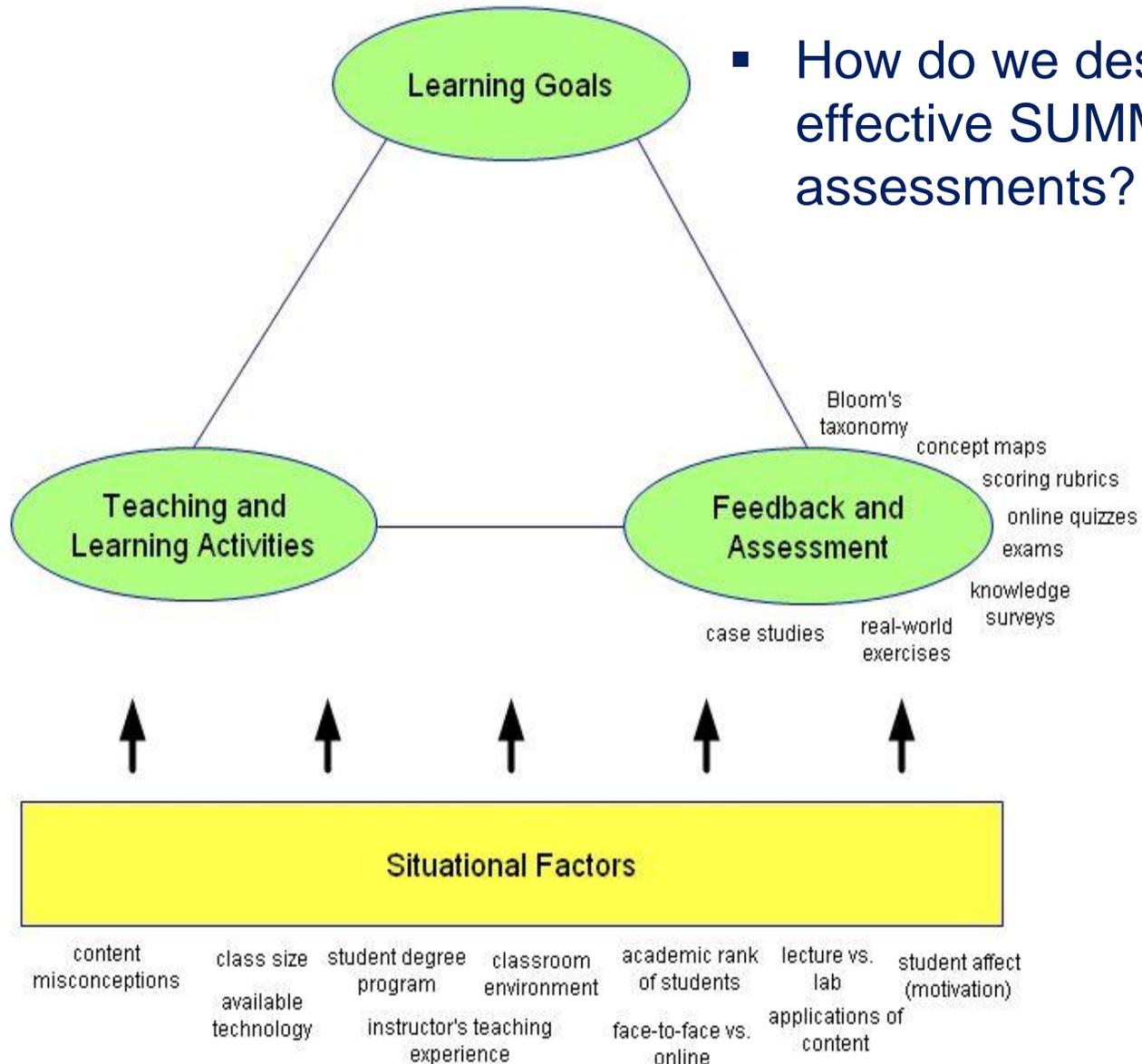
- Directly linked to learning goals
- Count significantly toward final grade



content misconceptions    class size    student degree program    classroom environment    academic rank of students    lecture vs. lab    student affect (motivation)

available technology    instructor's teaching experience    face-to-face vs. online    applications of content

# Goals, Assessment, and Teaching



- How do we design effective **SUMMATIVE** assessments?



# Assessment for Intellectual Growth

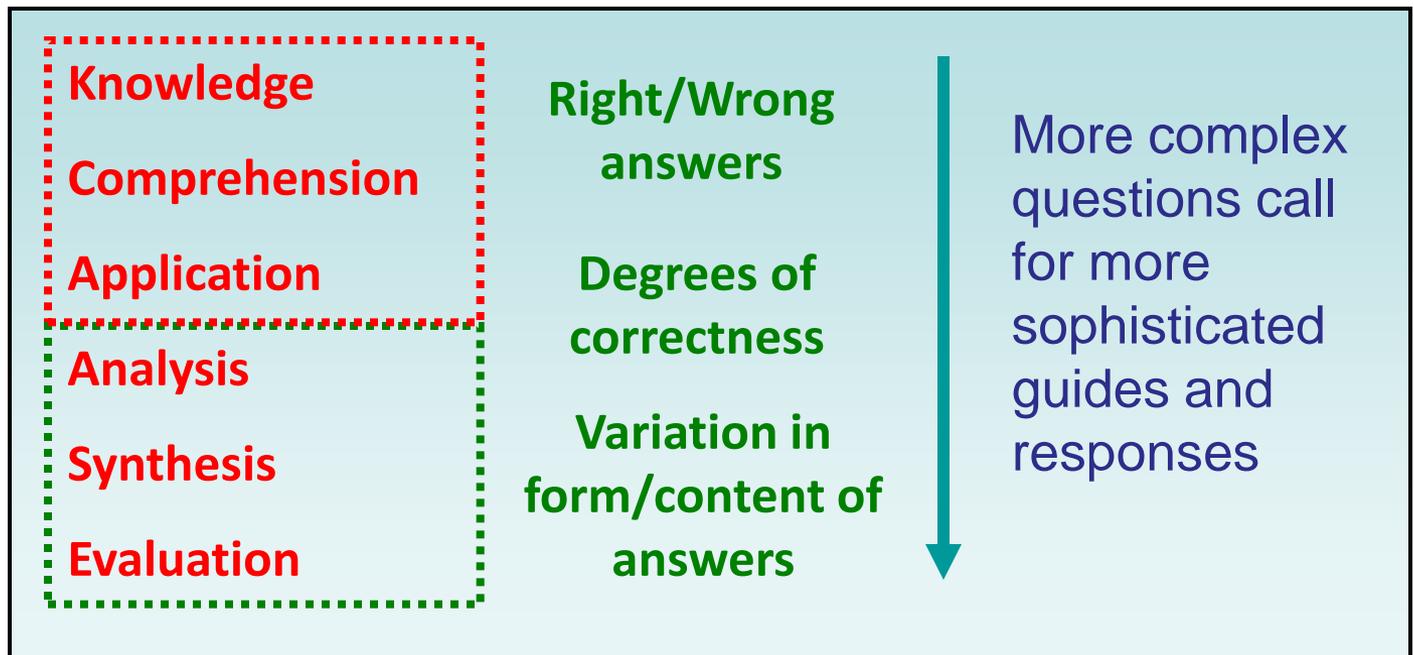
Teaching and learning goals can be ordered using **Bloom's Taxonomy**

## Bloom's Taxonomy Comprehension Survey

- A. I have never heard of BT
- B. I have heard of BT but can't explain much about it.
- C. I can name the six categories of BT.
- D. I can classify exercises into the six BT categories.
- E. I can make up questions representative of the six categories of BT.

# Setting Learning Goals

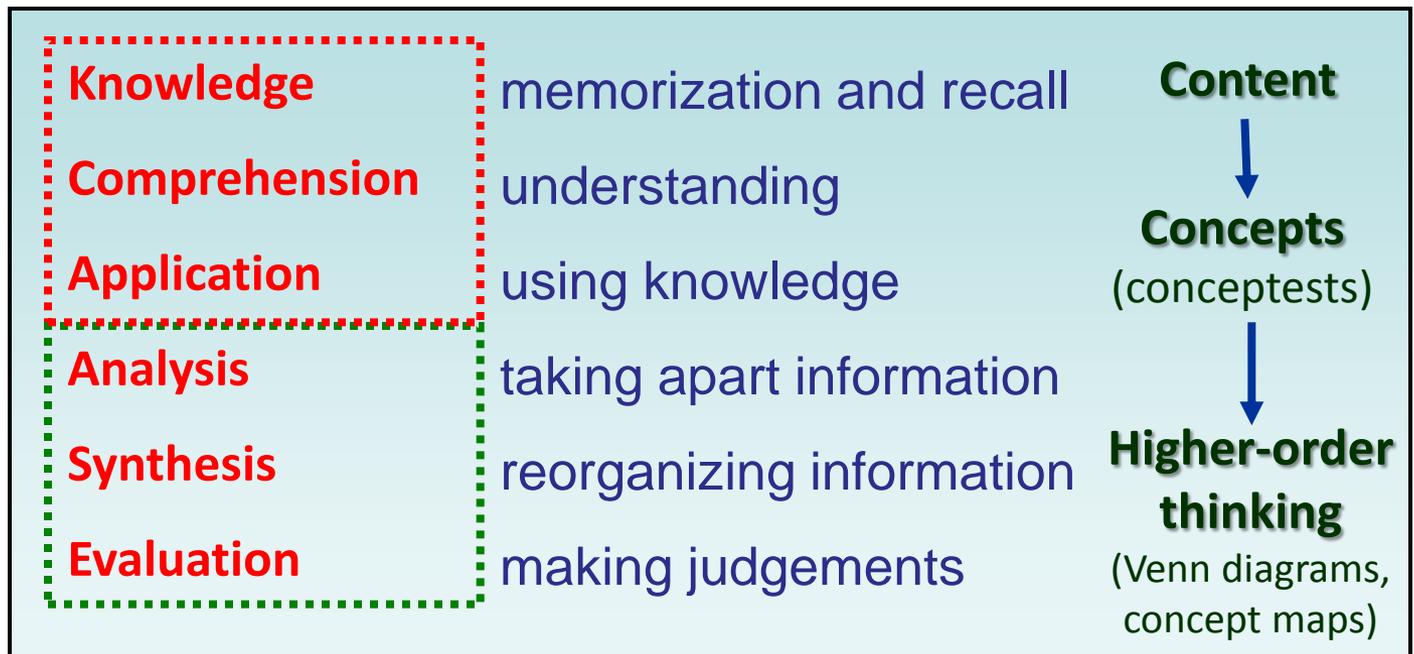
Learning goals can be ordered using **Bloom's Taxonomy** – but how do you assess student work?



Open-ended questions can be used for all categories.

# Setting Learning Goals

Learning goals can be ordered using **Bloom's Taxonomy** – but how do you assess student work?



Open-ended questions can be used for all categories.



# Scaffolding Student Learning

**Plate Tectonics Comprehension Survey:** Review the following statements and identify which best describe your understanding of the material in this section. Answer the corresponding questions

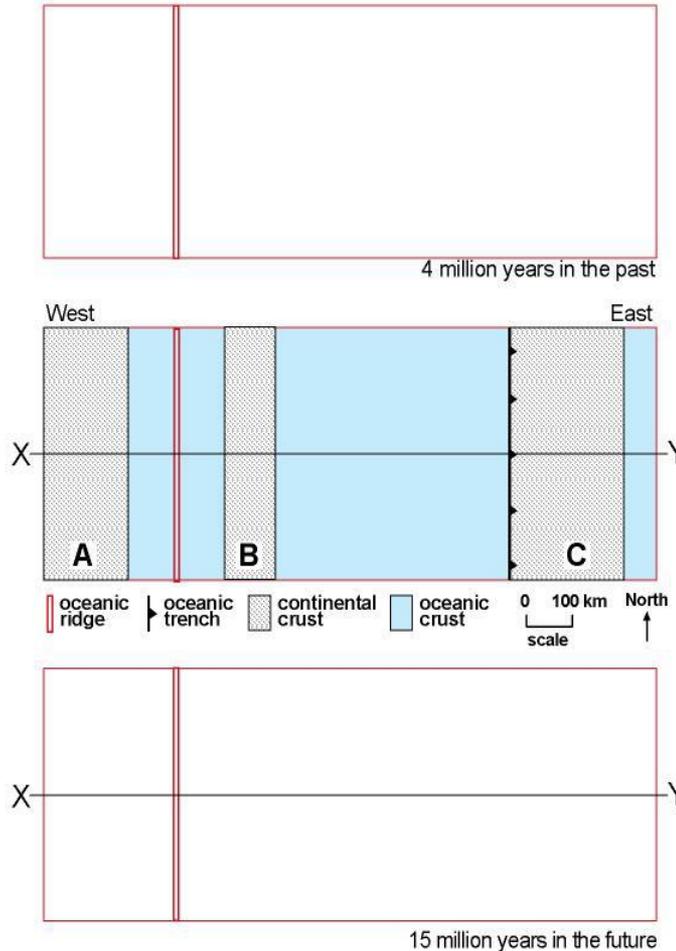
- Level 1: I can identify how many plates are present on a map showing plate boundaries. (Answer Checkpoint 4.17).
- Level 2: I can draw a cross section to illustrate the characteristics of plate boundaries. (Answer Checkpoint 4.18).
- Level 3: I can compare and contrast the features associated with divergent and convergent plate boundaries. (Answer Checkpoint 4.19).
- Level 4: I can interpret how plate configurations change over time. (Answer Checkpoint 4.20).



# Monitor Student Learning

## Synthesis

A and B are traveling at 5 cm/yr; C is traveling west at 2 cm/yr.



1. How many plates are present?
2. Sketch and label a cross section along X-Y.
3. Fill in the upper and lower templates to show the plate configurations.



# Open-ended Question Stems

Bloom's Level	Question Stems
1. Knowledge	What is . . . ? Who, what, when, where, ...? Describe . . .
2. Comprehension	What would happen if . . . ? What does . . . illustrate about . . .? What is analogous to . . . ?
3. Application	How could . . . be used to . . . ? What is another example of . . . ?
4. Analysis	How does . . . affect . . . ? What are the differences (similarities) between . . . ? How does . . . compare or contrast with . . . ?
5. Synthesis	What is a solution for the problem of . . . ? How would you plan a new . . . ? How does X relate to Y?
6. Evaluation	Why is . . . important? What is the best . . . , and why? Do you agree/disagree that . . . ?



# Writing Assessment with Rubrics

## A rubric is a scoring protocol that:

- Specifies criteria and a measurement scale for different levels of proficiency.
  - Establish criteria (e.g., presentation, reasoning) tied to exercise learning goals.
  - Determine categories (e.g., needs improvement, satisfactory, good, exemplary) and scoring scale for components of answer.
  - Provided to students prior to assignment.



# Sample Analytic Rubric: Homework

Level of Achievement	General Approach	Comprehension
<b>Exemplary (5 pts)</b>	<ul style="list-style-type: none"> <li>Addresses the question.</li> <li>States a relevant, justifiable answer.</li> <li>Presents arguments in a logical order.</li> <li>Uses acceptable style and grammar (no errors).</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates an accurate and complete understanding of the question.</li> <li>Backs conclusions with data and warrants.</li> <li>Uses 2 or more ideas, examples and/or arguments that support the answer.</li> </ul>
<b>Adequate (4 pts)</b>	<ul style="list-style-type: none"> <li>Does not address the question explicitly, although does so tangentially.</li> <li>States a relevant and justifiable answer.</li> <li>Presents arguments in a logical order.</li> <li>Uses acceptable style and grammar (one error)</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates accurate but only adequate understanding of question because does not back conclusions with warrants and data.</li> <li>Uses only one idea to support the answer.</li> <li>Less thorough than above</li> </ul>
<b>Needs Improvement (3 pts)</b>	<ul style="list-style-type: none"> <li>Does not address the question.</li> <li>States no relevant answers.</li> <li>Indicates misconceptions.</li> <li>Is not clearly or logically organized.</li> <li>Fails to use acceptable style and grammar (two or more errors).</li> </ul>	<ul style="list-style-type: none"> <li>Does not demonstrate accurate understanding of the question.</li> <li>Does not provide evidence to support their answer to the question.</li> </ul>
<b>No Answer (0 pts)</b>		



# Linking goals, assessment and teaching strategies to promote effective learning

## Summary

- Identify tasks associated with learning goals.
- Provide students opportunity to practice tasks or task components during lecture/lab (formative assessment).
- Ensure sufficient learning supports are in place.
- Scaffold activities in multiple steps to provide students opportunities to develop the necessary skills.
- Match summative assessments to learning goals as directly as possible.



**Any Questions?**

