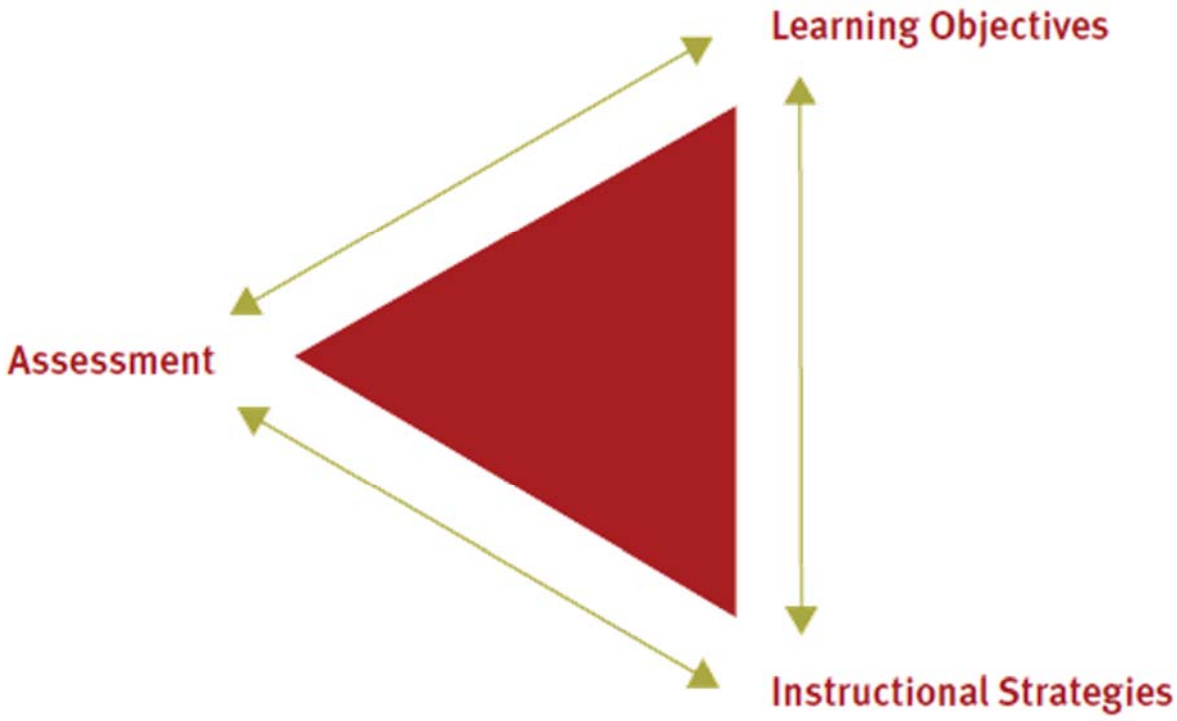
ASSESSING STUDENT LEARNING



"If the purpose of assessment is to ensure that course goals are met, and if students do well on the final exam, then students should be able to remember important course content after the course is over." – Anonymous

Do you agree or disagree with this quote? Why?

Types of Assessment Tools

Type of Assessment	Pros	Cons
Multiple-Choice Exams		
Free-Response Exams		
Essays		
Oral Exams		
Practical Exams		
Open-Book/Notes Exams		
Presentations		
Written Reports		
Portfolios		

Developing Questions

Which is the best exam question?

A. What was the date of the battle of the Spanish Armada?
B. Give the date of the battle of the Spanish Armada, and provide some historical evidence that supports your answer.

A. List three distinctive characteristics for each country in the region.
B. Imagine you are working for an international company that wants to establish a commercia presence in this region. The company sells a product that requires a modest per capita income for people to purchase it. The corporate executives understand that they wil not realize a significant income during the first five years or so, but they want to establish a foothold in the region with hopes of financial success in the not-too-distant future. The key to success is being in a country that will have enough political stability to allow economic growth and sufficient other factors to support at least moderately high earning power among the general population. The company had asked you to serve on an advisory board that will recommend the country in which they should open a new branch operation. Given what you have learned about the countries in this region, what country would you recommend as best meeting the needs of the company?

What purposes are these questions most suited to?

Developing Questions

For each pair of items, decide which is better, and why:[1]

1-A. The promiscuous use of sprays, oils, and antiseptics in the nose during acute colds is a pernicious practice because it may have a deleterious effect on: A. the olfactory nerve B. red blood cells C. the sinuses [✓] D. white blood cells	**1-B.** Frequent use of sprays, oils, and antiseptics in the nose during a bad cold may result in: A. congestion of the mucous membrane in the nose B. damage to the olfactory nerve C. destruction of white blood cells D. the spreading of the infection to the sinuses [✓]
2-A. In 1965, the death rate from accidents of all types per 100,000 population in the 15-24 age group was: A. 59.0 B. 59.1 C. 59.2 [✓] D. 59.3	**2-B.** In 1965, the leading cause of death per 100,000 population in the 15-24 age group was from: A. accidents [✓] B. cancer C. respiratory disease D. rheumatic heart disease
3-A. About how many calories are recommended daily for a 14-year-old who is 62" tall, weighs 103 lbs., and is moderately active? A. 1,500 B. 2,000 C. 2,500 [✓] D. 3,000	**3-B.** About how many calories are recommended daily for a 14-year-old who is 62" tall, weighs 103 lbs., and is moderately active? A. 0 B. 2,000 C. 2,500 [✓] D. 3,000
4-A. Which of the following is a category in Bloom's cognitive domain taxonomy? A. Critical thinking B. Reasoning ability C. Rote Learning D. All of the above E. None of the above [✓]	**4-B.** What is the most complex level in Bloom's cognitive domain taxonomy? A. Analysis B. Comprehension C. Evaluation [✓] D. Knowledge E. Synthesis

[1] Stolen from Zimmero, D. (2004). *Writing Good Multiple-Choice Exams*, pp. 27-28.

The Case of the Frustrated Student

This semester I enrolled in an introductory biology course hoping to go into medicine. I made an easy A in my high school AP Biology class, so I figured I would be well-prepared for this course. I approach this class like most others: I attend lecture (I've only missed two this semester), read the textbook (usually before class, if I have time), and turn in the homework if it's going to be graded. Prof. Lopez is great; she's really well organized and follows the book closely. The homework has been helpful for learning terms and information.

The first exam in this course was NOT what I expected. None of the questions were short answer or essay. It was all multiple choice—100 of them and I barely finished them in the 75-minute exam period. Some of the questions were easy, just simple recall. But about a third of the questions tested us on things we never learned and skipped stuff we had covered in class. For example, we learned about the *lac* operon last week, and it wasn't even on the test. But there was this question asking us to "select the best description of a strategy bacteria use to regulate gene expression" followed by all these convoluted descriptions of possible strategies. How am I supposed to know about that? I got a 72% on that test and Prof. Lopez didn't even explain any of the more difficult questions. What a crock!

Forget biology and medicine; it's not for me.

Questions for Discussion:

- What issues might be contributing to this situation?
- What impact did the exam have on this student's motivation to learn?
- What suggestions do you have for the professor?

Adapted from Handelsman, J, S. Miller & C. Pfund (2007). *Scientific Teaching*, p. 145. New York: W.H. Freeman & Company.

Incentivizing Learning and Challenging Students

Professor Charlie Kemp (Biomedical Engineering) incorporates novel problems into exams, preparing students to perform well with clear communication, structured scaffolding, and well-grounded motivation techniques. His students respond by rising to the challenge and generally accepting their grade as the grade they have earned.

Course Assessment Structure

Item	Portion of final grade	Content
Homework problems	0%	
Homework quizzes (x10)	30%	In-class quizzes containing questions that mirror assigned homework problems
Exam #1	20%	3 questions: • 1 basic skills & concepts question • 1 related to hw but appears new • 1 "novel problem"
Exam #2	20%	
Final Exam	30%	5 questions (2 basic; 2 related; 1 novel)

What makes a good "novel problem" (for a test)?

- Real world
- Interesting
- Not like anything students have seen so far
- Has a simple solution
- Presented without subparts or structuring: students are on their own

See page 8 for an example!

Georgia Tech students care a lot about grades. They need and want to pass the class, and as high achievers they have been trained to respond to grades as a reward signal. By tying grades to evidence of their learning, I can leverage their mindset to help achieve my goals for them.

Key Components of Charlie's Approach

We know that motivation arises when students (a) value the goal being pursued, (b) believe they can do what is being asked of them, and (c) believe they will be rewarded appropriately, if they put the work in.[1]

How Charlie Motivates His Students

This matters to me!	I can do this!	This will get me an A!
• Makes an explicit connection between working on homework and performing on exams. • Clearly explains that to receive an A in the class you have to solve novel problems. • Shares student comments from previous years' CIOS, about the importance of working outside of class.	• Discusses how to approach homework problems in a way that will contribute to quiz and exam performance. • Provides a heuristic for solving novel problems. • Provides information about how past students have performed in the course (breakdown of letter grades).	• Transparency about % of grade connected with assigned homework problems (e.g., 1/3 of exam will be a homework-like problem). • Transparency about % of grade connected to novel problems (e.g., 1/5 * 30% = 6% from final exam). • Explicitly explains how performance on three problem types translates to a specific letter grade in the course.

[1] See Ambrose *et al* (2010). *How Learning Works: Seven Research-Based Principles for Smart Teaching*. Jossey-Bass.

Problem #3 (33 points)

Monitoring a person as he or she sleeps can provide valuable information about the person's health. Researchers have demonstrated that force sensors (i.e., load cells) located between each of the bed supports and the floor can be used to estimate sleep quality, breathing rate, and other phenomena [1] [2]. For example, the bed pictured below has four legs, so a force sensor would be placed under each of its four legs. In order to facilitate sleep monitoring, you wish to estimate the position of the person's center of mass on the bed using force sensors placed in this manner.

To better understand this estimation problem, you have decided to create a simplified planar model of a bed with a person on top of it. Since you expect the position of the person's body with respect to the narrow dimension of the bed (i.e., the extent to which the person has moved to his or her side) to be especially informative, your planar model represents the position of the person's center of mass, x_p, along this direction, corresponding to the x-axis. $x_p = 0\ m$ means that the person's center of mass is at the left edge of the bed when looking at the bed from the foot of the bed, which is the edge of the bed that is typically closest to the person's feet (person would be against the wall in the bed pictured below). $x_p = L\ m$ would mean that the person's center of mass is at the right edge of the bed when looking from the foot of the bed. You also want to understand how to estimate x_p with beds that have supports at locations other than the corners, so you have decided to use a total of three supports for your planar bed model each with a force sensor, as described in the following table. You may assume any moments applied by the bed supports to the sensors are negligible. As noted in the table, prior to the person being in bed, each sensor records its force measurement. By subtracting these forces from the forces measured when the person is in bed, you can treat the bed and bedding as being massless.

Force Sensor #	***Position of Sensor (m)***	***Force Before Person in Bed (N)***	***Force After Person in Bed (N)***	***Difference in Force Due to Person Being in Bed (N)***
#1	$x = 0\ m$	f_{1b}	f_{1a}	$F_1 = f_{1a} - f_{1b}$
#2	$x = \frac{1}{2}L\ m$	f_{2b}	f_{2a}	$F_2 = f_{2a} - f_{2b}$
#3	$x = L\ m$	f_{3b}	f_{3a}	$F_3 = f_{3a} - f_{3b}$

Using this planar model, you must derive an equation that estimates the unknown position of the body's center of mass, x_p, using only the known values L, F_1, F_2, and F_3.

For full credit, you must show your work, state your assumptions, and clearly communicate your reasoning using diagrams, equations, and text. Correct equations will result in no credit unless you also clearly communicate how you arrived at them.

The image of the bed is from http://commons.wikimedia.org/wiki/File:3399_-_Fiescheralp_-_Hotel_Eggishorn.JPG
It was taken by Andrew Bossi and has a date of July 14, 2007.

[1] Adami, A.M.; Pavel, M.; Hayes T.L.; Singer, C.M., "Detection of Movement in Bed Using Unobtrusive Load Cell Sensors," IEEE Transactions on Information Technology in Biomedicine, vol.14, no.2, pp.481,490, March 2010.

[2] Beattie, Z.T.; Hagen, C.C.; Hayes, T.L., "Classification of lying position using load cells under the bed," Conf Proc IEEE Engineering in Medicine & Biology Society, 2011.