

backchan.nl

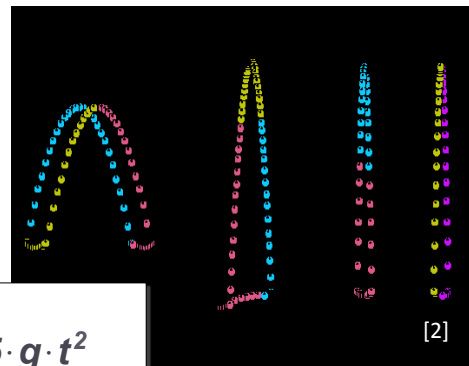
Backchan.nl is a simple, Web-based tool that allows audience members to identify themselves, post questions, and vote on other people's questions.

1

Juggling: as easy as...

$$(F+D)H=(V+D)N \quad [1]$$

F = time ball's in the air
 D = time ball's in a hand
 V = time a hand is vacant
 N = # balls
 H = # hands.



$$\begin{aligned} x(t) &= x(0) + v_x(0) \cdot t \\ y(t) &= y(0) + v_y(0) \cdot t - 0.5 \cdot g \cdot t^2 \end{aligned}$$

[1] Scientific Aspects of Juggling. In *Claude Elwood Shannon: Collected Papers*. Edited by N.J.A. Sloane and A. D. Wyner. IEEE Press, 1993.

[2] The Science of Juggling, by Peter J. Beek and Arthur Lewbel, *Scientific American*, November, 1995, Volume 273, Number 5, pages 92-97.

Faculty Meeting – 8 October 2015
STEM Department - Oh-So-Prestigious University

For Debate:

The STEM Department should commit funds to train professors and develop resources necessary for the adoption and ongoing use of active learning techniques in all courses in the Department by 2017.

▶ 3

Intended Learning Outcomes

By the end of the session, you will be able to:

- **Explain** the impact of active learning exercises in the classroom.
- **Identify/develop** active learning exercises that will help students achieve the desired learning outcomes.

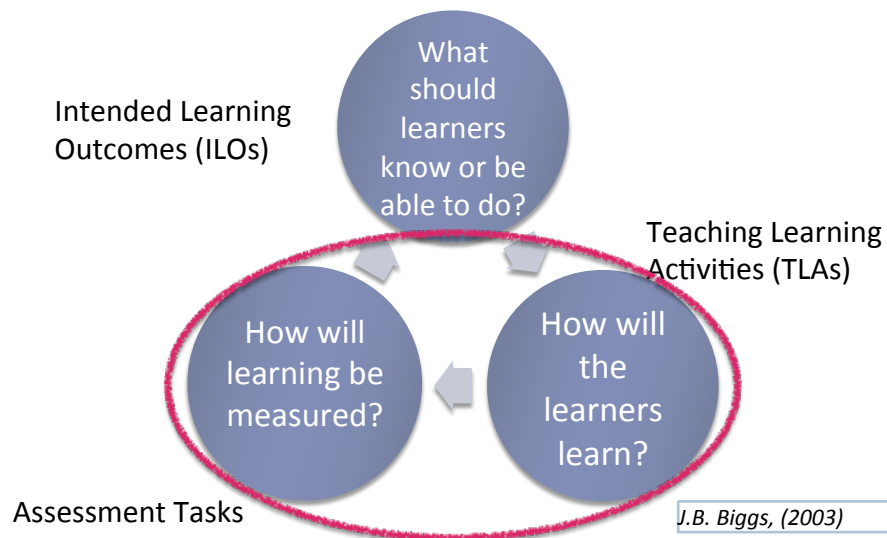
Lightning Round: Active Learning-Pros & Cons

Based on your reading and your experiences what do you think are the pros & cons of using active learning in your classes?

Group A – Pros (1 or 2)

Group B – Cons (1 or 2)

Constructive Alignment



Hake's 6000 student study of interactive engagement

Fig 3b: % Gain vs. % Pretest score removed due to copyright restrictions. See: Hake, Richard R. "Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses." Am. J. Phys. 66, no. 4(1998): 338-352 .

<http://scitation.aip.org/content/aapt/journal/ajp/66/1/10.1119/1.18809>

Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses
Richard Hake, American Journal of Physics v66 p64-74 (1998)

7

A 2014 meta-analysis of 225 studies shows a 12% decrease in the failure rate when active learning was used instead of traditional lecture

Figure 1: Failure rates and concept test results removed due to copyright restrictions. See: Wieman, C. "Large-scale comparison of science teaching methods sends clear message." PNAS 111, no. 23(2014): 8319–8320.

<http://www.pnas.org/content/111/23/8319.full.pdf>

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Active and Interactive

What's the difference?

There many active learning techniques

- Summarize
- 5 minute free write/response
- Answer a question (clickers or no clickers)
- Pass the chalk/pointer (image or graph)
- Beach ball
- Mud cards
- Think-pair-share
- Lightning round
- Jigsaw
- Students *are* the demo
- ...and others...

I – 5 minute active learning techniques

- Ask a content question
- Ask : What questions do *you* have?

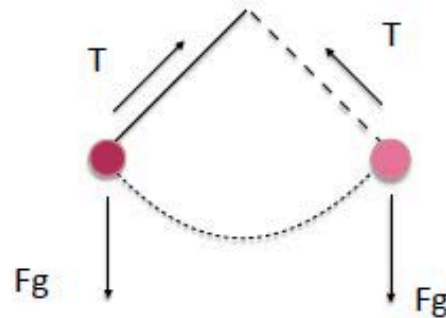
Give students enough time to actually formulate an answer or question



Soliciting and utilizing student responses to questions can be very effective

- Dedicated clickers (\$\$\$)
 - purchased by students
 - borrowed by students
- Other devices (kind of free)
 - b.socrative.com : go to room #745356
 - poll everywhere
- Plickers (almost free, but...)
- Index cards/A - B - C - D (just about free)
- Fingers (really free)

Misconceptions persist in traditional lecture classes



© AIP Publishing LLC. Clement, J. "Students' preconceptions in introductory mechanics." *The American Journal of Physics*, 50, no.1(1982): 66-71.
http://people.umass.edu/~clement/pdf/students_preconceptions_in_introduutory_mechanics.pdf

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Use concept questions to check for (mis)understanding

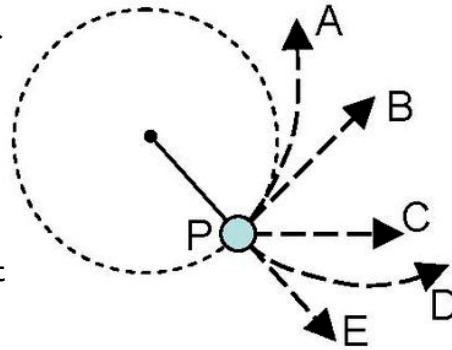
Which of the following statements is *false*?

- A. There are data to support that active learning increases student learning.
- B. Active learning always involves group work.
- C. Active learning techniques help students engage with material in a minds-on way.
- D. Lecturing and active learning can have a cooperative relationship.

Use concept questions to check for (mis)understanding

A steel ball is attached to a string and is swung in a circular path in a horizontal plane. At the point P shown, the string suddenly breaks near the ball.

Viewed from above above, which path would the ball most closely follow after the string breaks?



Use concept questions to check for (mis)understanding

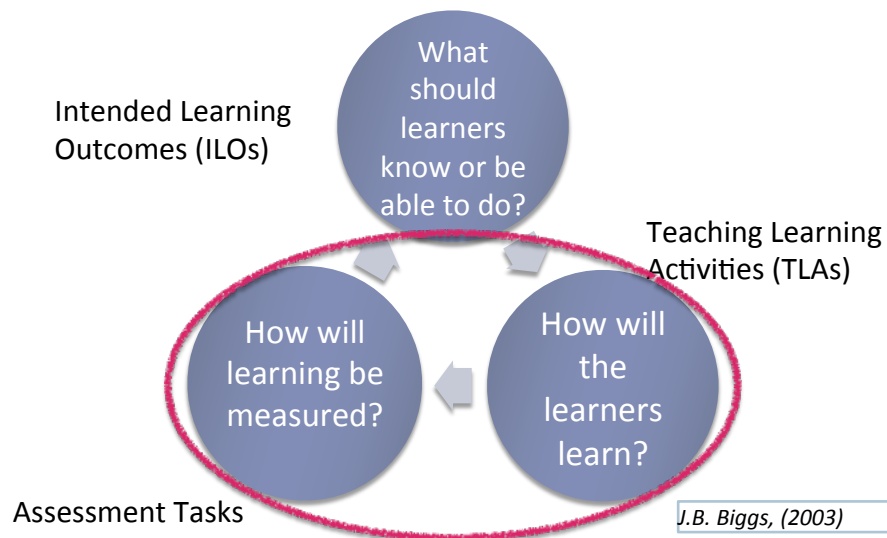
The majority of actual weight (dry biomass) gained by plants as they grow from seed to an adult plant comes from which of the following substances?

- Nutrients in the soil that are taken up by plant roots.
- Molecules in the air that enter through pores in the plant leaves.
- Water taken up directly by plant roots.
- Energy from the sun.

3 Stages of Clicker Use

1. Simple, primary factual questions
2. More challenging conceptual questions, answer is not obvious, can be argued
3. Lecture is structured around a set of challenging clicker questions that embody the material

Constructive Alignment



Engage Students with Thoughtful & Targeted Questions

Socrative: go to: [socrative.com](https://www.socrative.com) - room Number: 745356

If living cells similar to those found on earth were found on another planet where there was no molecular oxygen, which cell part would most likely be absent?

- a. Cell membrane
- b. Nucleus
- c. Mitochondria
- d. Ribosome
- e. Chromosomes

It's important to be thoughtful about what questions you ask, and why

*Based on research at NASA, what was the approximate net global change in temperature between 1880 and 1975?**

- a) + 2 °C
- b) + 0.4 °C
- c) + 0.08 °C
- d) - 0.08 °C
- e) - 0.4 °C
- f) - 2 °C

Hansen, J., et al. "Global temperature change." Proc. Natl. Acad. Sci., 103(2006): 14288-14293.
<http://pubs.giss.nasa.gov/abs/ha07110b.html>

**Hansen J et al. PNAS 2006;103:14288-14293*

How you use clickers makes a difference!

	Fall '09 (N = 171)	'10,'11 (N = 314)
<i>Answering clicker questions helped me to identify weaknesses in my understanding.</i>	51%	82%
<i>Clicker questions stimulated me to think conceptually during lecture.</i>	36%	82%
<i>I enjoyed using the clickers</i>	35%	67%
<i>I made an effort to answer clicker questions as well as I could.</i>	77%	92%

Study conducted with Dr. Rudy Mitchell in the Teaching and Learning Laboratory

Backchan.nl Break: -3 Minutes

What questions do you still have about implementing clicker-type response /concept questions in your courses?

Lightning Round

*Based on research at NASA, what was the approximate net global change in temperature between 1880 and 1975?**

- a) + 2 °C
- b) + 0.4 °C
- c) + 0.08 °C
- d) - 0.08 °C
- e) - 0.4 °C
- f) - 2 °C

- Consider your choice and your reasoning
- Line up for the Lightning Round
- You & your partner have 2 MINUTES to discuss your answers
- Switch
- Repeat
- When all pairings are complete, revisit your answer & reasoning
- If you changed your answer, articulate, why



Lightning Round

What is the equation of the line tangent to the function $f(x) = |x|$ at the point (0,0)?

- a. There is one tangent line with an equation $y = 0$
- b. There are two tangent lines, with equations $y = -x$ and $y=x$
- c. There are an infinite number of tangent at this point
- d. There is no tangent line at this point

- Consider your choice and your reasoning
- Line up for the Lightning Round
- You have 1 MINUTE to explain your reasoning to your
- Your partner has 1 MINUTE to explain her/his reasoning to you
- Switch
- Repeat
- When all pairings are complete, revisit your answer & reasoning. If you changed your answer, articulate, why.



Lightning-Round

- Consider your choice and your reasoning
- Line up for the Lightning Round
- You have 1 MINUTE to explain your reasoning to your
- Your partner has 1 MINUTE to explain her/his reasoning to you
- Switch partners
- Repeat
- When all pairings are complete, revisit your original response

Share out – with beach ball

Think - Pair - Share

When tapped, do you think the thicker block will display a note that is:

- I. higher than
- II. lower than
- III. the same as
the thinner block?

What (ground & atmospheric) conditions do you think are necessary to form these snow rollers?

Open-ended Question



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Open-ended, small group Brainstorm, or Jigsaw (5-20 minutes)

Students are divided into 3 groups of "experts":

- Group 1 - mechanical testing
- Group 2 - failure mechanisms
- Group 3 - processing

Groups are given *pre-class* readings on their areas of expertise

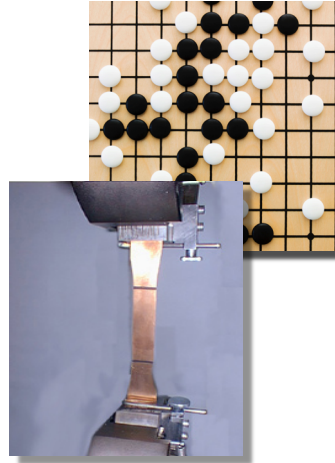
In class - students form heterogeneous groups to make holistic recommendations



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Students *are* the demo (5-20 minutes)

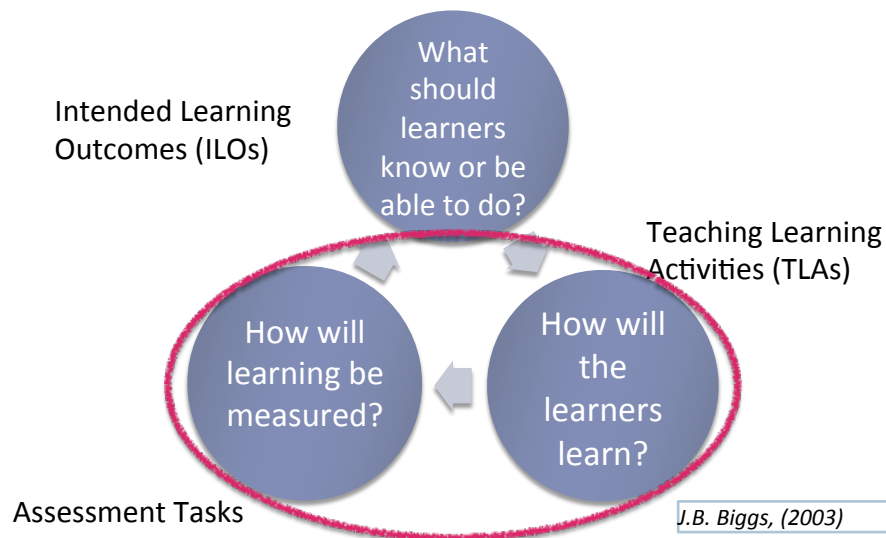
- *Vacancy diffusion*
<https://youtu.be/4dRamMVp25w?t=13m31s>
Students *are* the atoms on a 2-d lattice. Apply “jump” rules.
- *Tensile test*
Students *are* the atoms in a test specimen.
- *Bubble Sort*
Students *sort themselves by height using the BS algorithm*



Game board © source unknown. Photo of copper tensile test © Illinois Tool Works Inc.
<http://www.copper.org/applications/industrial/DesignGuide/props/ductility.html>

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Constructive Alignment



Think - Pair - Share

Active Learning Strategies for your class

THINK

- Pick two specific active learning activities.
- How will you integrate the activity into a course in in discipline to facilitate *a specific learning outcome*?
- What are the potential benefits or pitfalls of the activities?

PAIR - SHARE

- Discuss your ideas in small-groups
- Be prepared to share your ideas with the large group