Teaching For Learning Sake

Session Overview

An overview of today's session

The focus of this session is to explore how the basic principles of teaching and learning need to be applied to modern college science teaching. We will operate in three sessions. In session one we will explore the basics of teaching and learning and learn about modern research that has verified best instructional practices. Second, we will explore how technology can maximize your instructional efficiency. Third, we will spend workshop time learning to plan lessons using the techniques discussed.

LEARNING	TEACHING	COGNITION
• **Passive learning** = sitting and listening: It is the least efficient mode of learning	• Talking does NOT produce learning.	• Students will retain context when they explain it.
• Explaining ideas produces understanding.	•Creating opportunities for students to explain maximizes their learning	• Students cannot remember all of the content without ample opportunities to explain.
• Explaining things that apply to your life directly will maximize leanring.	•Multimedia, including video and Smartphone enhanced interaction can improve engagement.	• Assessment can change to alter cognitive roles.
• Timed recall will maximize learning		

SESSION 1: TEACHING HOW LEARNING HAPPENS

Introduction

Objective 1: The goals of this session are to help science professors and administrators gain a clear understanding of the relationship between science teaching and the basic cognitive limitations of learning.

Objective 2: The session intends to provide professors with an understanding of Pedagogy. Pedagogy is the idea that teaching actions are designed to promote learning. This session will focus on self-explanation, transfer, and cognitive load.

Objective 3: The session intends to provide professors and students with an understanding of how technology can improve their instruction by producing greater opportunities for students to participate and see themselves as a part of the science community.

Logging In To Nearpod

To participate in the smartphone enhancement simply use a smartphone, tablet, or laptop to visit www.nearpod.com

STEP 1: Visit the website: http://www.nearpod.com

STEP 2: Type in the code

STEP 3: Enter your name and press submit

How Does Learning Work

What do you think? How does learning happen?

How does learning work?

Directions: Use the space below to write notes about teach of the key ideas

The Death of Behaviorism

BIG IDEA	DETAILS

The Self-Explanation Effect

BIG IDEA	DETAILS

Acquisition vs. Learning

BIG IDEA	DETAILS

Cognitive Apprenticeship

BIG IDEA	DETAILS

Cognitive Load

BIG IDEA	DETAILS

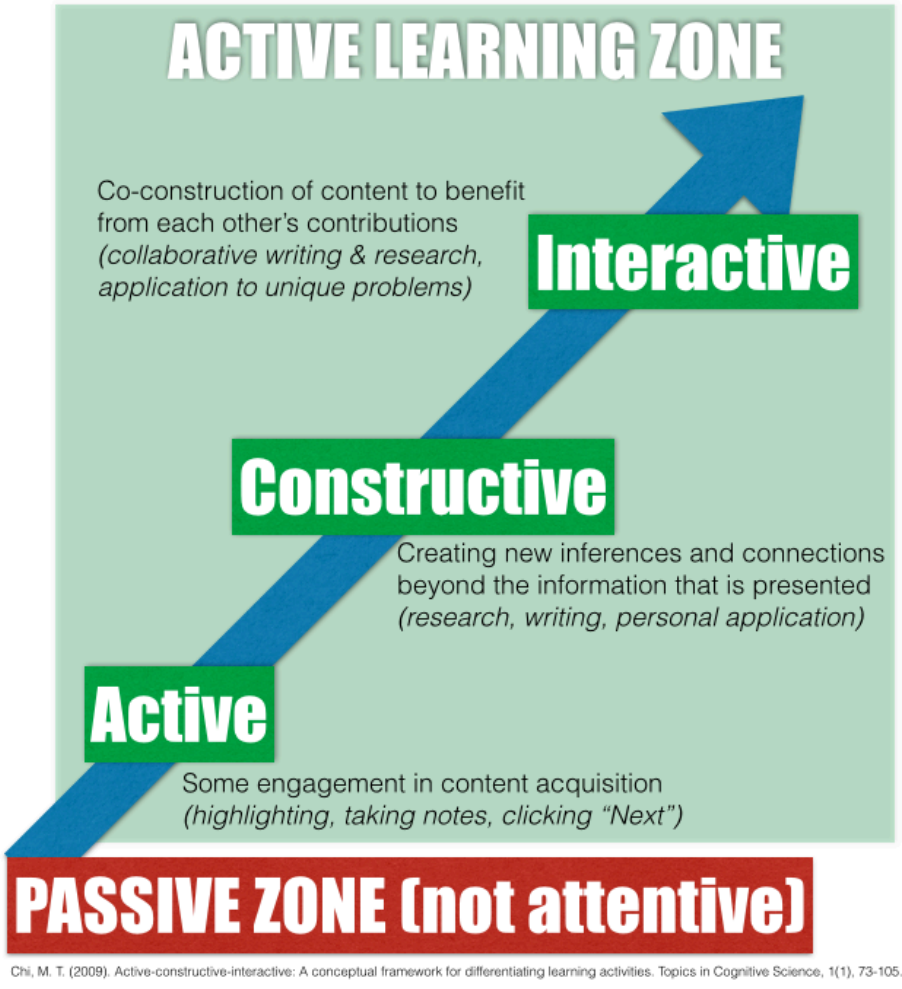
The Generativity Principle

BIG IDEA	DETAILS

The Futility of Trying To Remember Everything

Cognitive Load

- Our cognitive function is limited and makes adjustments when there is information overload.
- A combination of working memory and language complexity impact students' classroom learning
- The [PASI] Framework



Chi, M. T. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. Topics in Cognitive Science, 1(1), 73-105.

The Power of a Question

Cued Attentiveness: When we discuss questions, our attention is drawn to the details of the topic. Starting Instruction with an exploration of the question helps the learner become more attuned to the details of the concepts.

Cognitive scientist Andrea diSessa called this P-PRIMS

P-PRIMS = A Phenomenolical Primitive

The basic idea is that developing a primitive understanding of the concept will help students master the details of a concept as they become more attuned.

*** To Read the research explore:

Disessa, A. A. (2002). Why “conceptual ecology” is a good idea. In *Reconsidering conceptual change: Issues in theory and practice* (pp. 28–60). Springer.

DiSessa, A. A., & Sherin, B. L. (1998). What changes in conceptual change? *International Journal of Science Education*, *20*(10), 1155–1191.

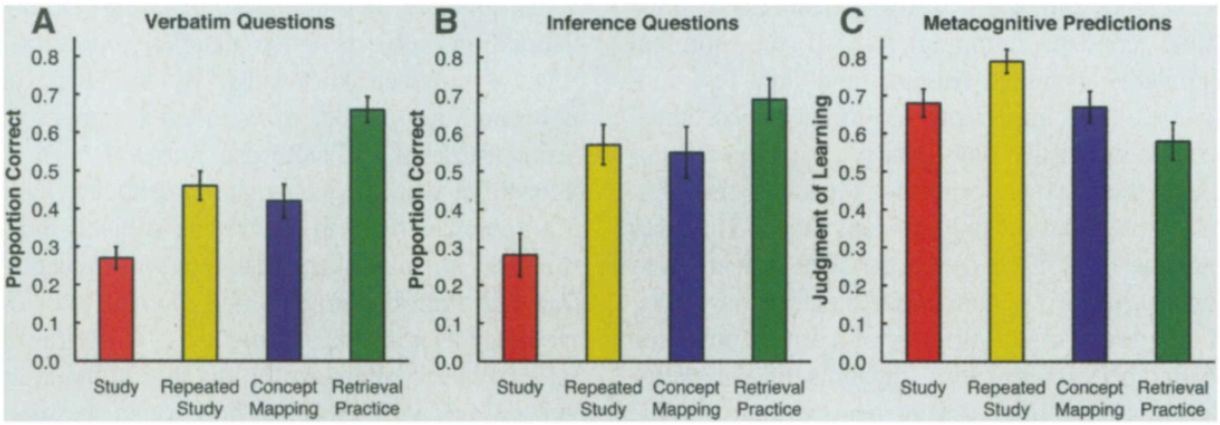
Cued recall

- There is a science to memory
- Just like computers our brains have a maximum capacity and the ability to delete unneeded information.
- Scholars of Cognitive Science (e.g. Cal Newport, & Jeff Karpicke) study the most efficient way for students to remember things.
- Two big findings emerge:

(1) Students must have opportunities to **PRACTICE** retrieving information

(2) They must be spaced out. Doing it over and over is not efficient.

Jeffrey Karpicke et al (2011)



- As you practice retrieving information or explanation, it improves the retention rate for students. Jeff Karpicke's work outlines how providing students opportunities to "Practice" retrieving information maximizes their learning.

Things to read:

Karpicke, J.; Blunt, J. (2011) Retrieval practice produces more learning than elaborative studying with concept mapping. Science, 331, 772-775.

Karpicke, J.; & Roediger, H.; (2008) The critical important of retrieval for learning. Science, 319, 996-968.

A Time for Telling

There is a diversity of ways that people 'remember' things

TABLE 1
The Content of Instruction: The Eight Target Concepts and Their Operationalizations

Concept Type	*Operationalization*
Schema concepts	
Stereotypical recall	People remember events of high stereotypy
Script intrusions	People falsely remember events from own script
Ordered recall	People remember events in chronological sequence
Obstacle recall	People remember obstacles to goal completion
Encoding concepts	
Total recall	People remember more if material is meaningful
Primacy and recency	People remember first and last items of a stimulus list
Gist and verbatim	Meaning leads to gist recall; nonsense leads to verbatim recall
Inference intrusions	People remember inferences made while reading a passage

Shwartz & Bransford (1998) A Time for Telling

- The value of the different types of recall frames how they will remember things.
- In school, we are best suited to find things that live in their scripts because it will trigger their 'time to recall.'
- Your "telling" is most useful under two conditions:
  a. It explains things that are **pertinent to their lives**… is become more useful
  b. It occurs **AFTER** students have recognized they have come to the limits of their understanding.

The direct application to your science teaching is that your teaching should:

(a) Create opportunities for all students to explain

(b) Do NOT Evaluate their explanations

(c) Provide an Explanation

(d) Apply concepts to things they will experience.

Using Technology to Build

- Technology provides an opportunity to create 35 explanations at the same time.
- Technology allow you to provide students with a 0-consequence opportunity to practice retrieving information.
- If you choose to use multiple choice questions, you will be able to get a real-time assessment of what students know as a starting point.
- You can produce your “time for telling.”
-

A Professor's Chance To Produce Learning

A Professor's Brainstorming Activity

Directions: Given each of these potential activity types, create 3 ways you can build activities to address each type of learning based task.

Category (definition)	List 3 Things you might do in your class to create this opportunity
Building Contextual Memory: This means asking students to explain the concept, but in context they are familiar with.	1.
	2.
	3.

Category (definition)	List 3 Things you might do in your class to create this opportunity
In-Class Generative Opportunities This means asking students to explain the concept in class to promote retrieval practice	1.
	2.
	3.

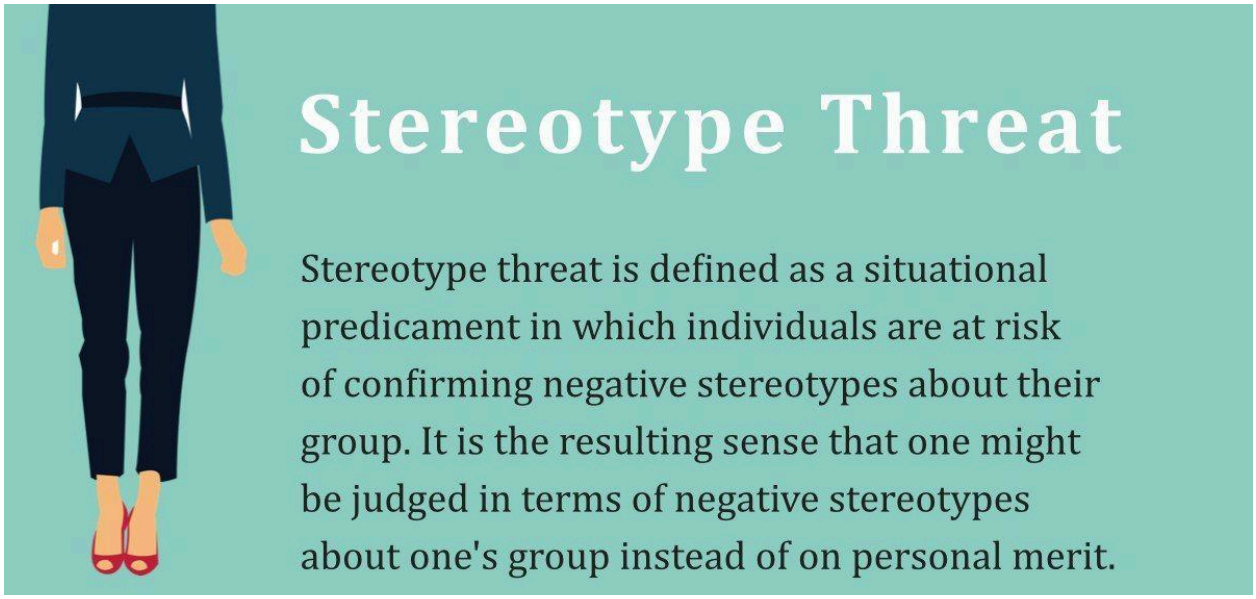
Category (definition)	List 3 Things you might do in your class to create this opportunity
Out-Of-School Assessments This means asking students to explain the concept for homework or out of class to promote retrieval.	1.
	2.
	3.

Category (definition)	List 3 Things you might do in your class to create this opportunity
Transfer Tasks: This means asking students to explain the concept, but in context that is new to maximize understanding.	1.
	2.
	3.

Category (definition)	List 3 Things you might do in your class to create this opportunity
Multiple Modes of Representation This means providing students multiple ways to understand a concept, video, simulation, lecture (etc.).	1.
	2.
	3.

The Psychology of Classroom Learning

Stereotype Threat



- What are the implications for your teaching?
- How can you counter this in your instruction?

Identity & Failure

- Repurposing failure as a part of your instruction.
- Using your assessment for learning purposes and measurement purposes.

An Acquisition Approach to Science Teaching

We struggle to retain information that is not needed regularly. However, when knowledge becomes vital to our everyday interactions the information is retained and retrieved more readily.

Acquisition = When doing requires learning.

> An example would be carpenters becoming skilled at measurement and adding fractions.

Learning = Gaining understanding of information without necessity

Learning Based Teaching Practices

4 Lesson Options

4 Phases: a. See it b. Do it. c. Read it. d. Explain it

See It
To help students get a sense of what the phenomenon is, we will look forward videos that show students the concepts. Instruction should allow students opportunity to **see the concept.**

Do It
Applying the concept to an experience will help to solidify the concept. Conducting a lab or a model building activity will allow students a chance to apply the concept. Allow the students to **do it**, so they can understand the application of the content.

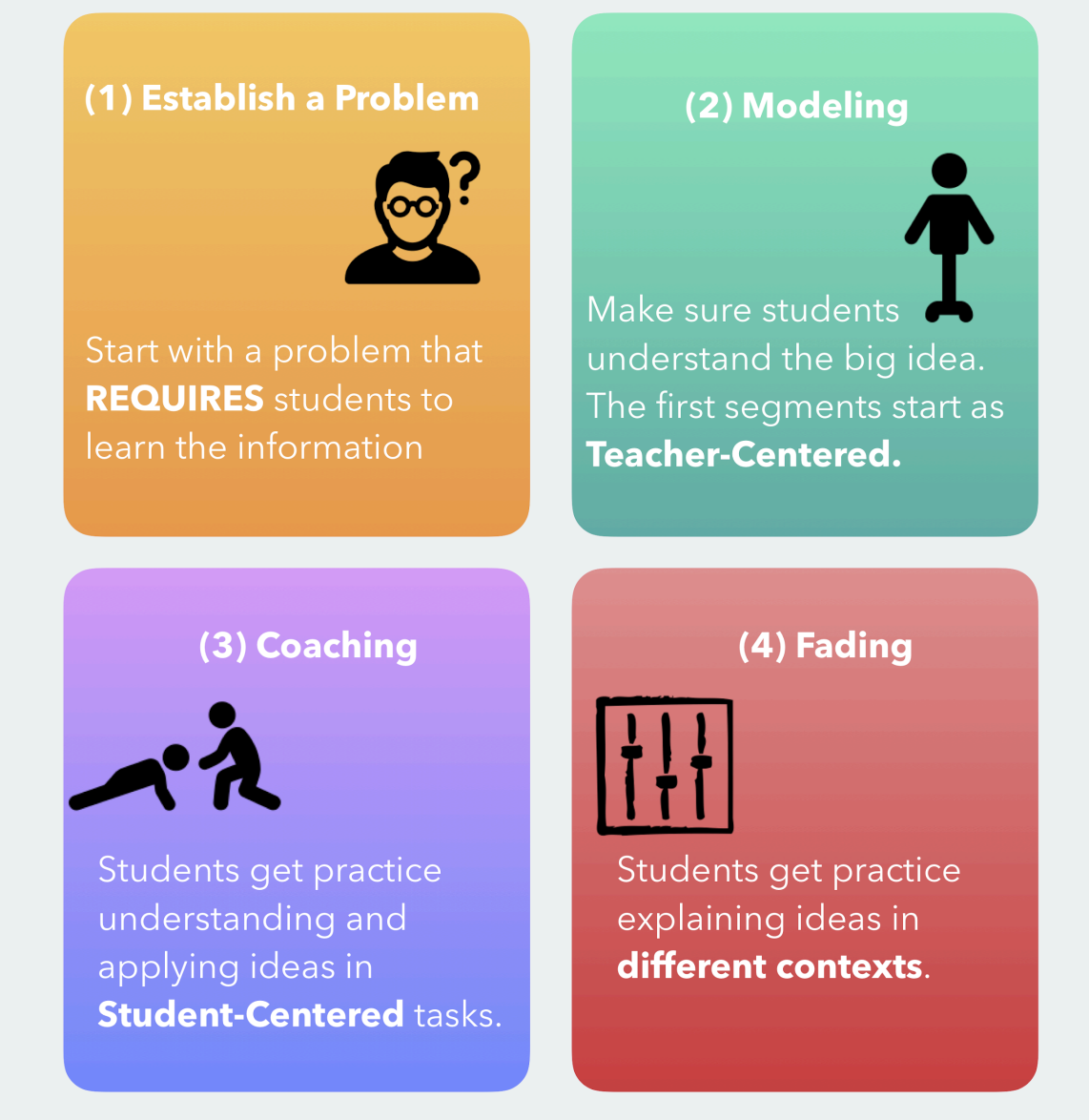
Read It
To affirm what students are learning, they should also allow students a chance to read about the concept. To further support students learning, they need to read it.

Explain It
Expertise comes as students have the opportunity explain what they know. Several learning segments must focus on teachers having the chance to **explain it.**

A Planning Formula

Stage 1 allows us to get a sense of what we want to do and what resources we will use. This session will allow us to identify how we want to organize our activities to maximize the students' learning.

What is Cognitive Apprenticeship Lesson Planning?



Session 2 : Centering technology

Introduction to Technology Enhancements

We need to think critically about how technology can be in improve the learning experience in modern classrooms. As you move forward, we would like to explore the **3 Benefits of Technology:**

1. **Technology is reusable**
    i. One of the big challenges in teaching science involves collecting lesson plan materials for laboratory experiences. They can be costly and are generally good for just one use.

    ii. Using STEM technology resources can be easy because they are reusable.

    iii. Your laptop or phones can be microscopes, telescopes, and experimental devices

2. **Diversifying images and sounds can tell the students they BELONG to Science**

    i. Science videos and software that is designed by women and students of color can let students know they belong.

    ii. If resources do not exist in the way you want, you can build them and have your students build them.

3. **Technology can serve as a great formative and assessment resources**

    i. A way to make sure students are producing good learning information is to make them share it publicly. Technology can help students produce sharable science materials

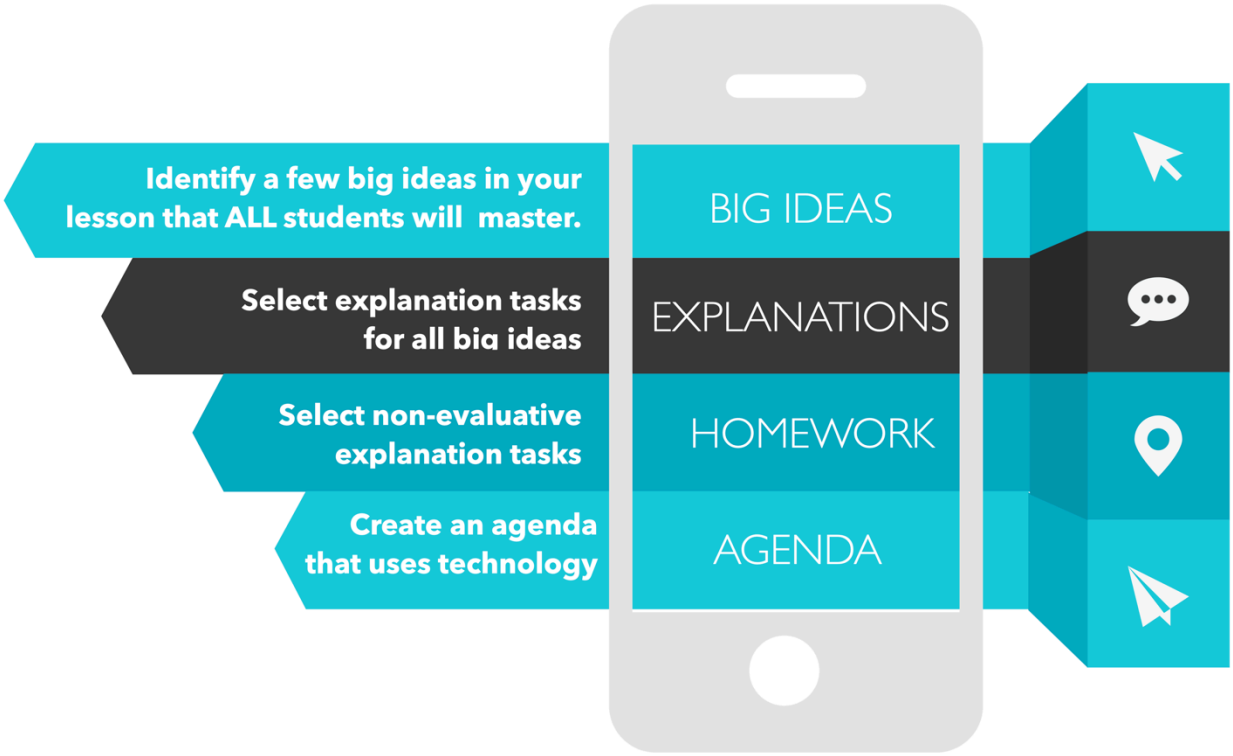
    ii. Twitter Science Account

        1. Students can short descriptions of phenomenon with images
        2. Students can create discussions based on content.

    iii. Instagram/Tic Toc

1. Images and videos can be used to demonstrate understanding

University Teaching For Engagement Framework

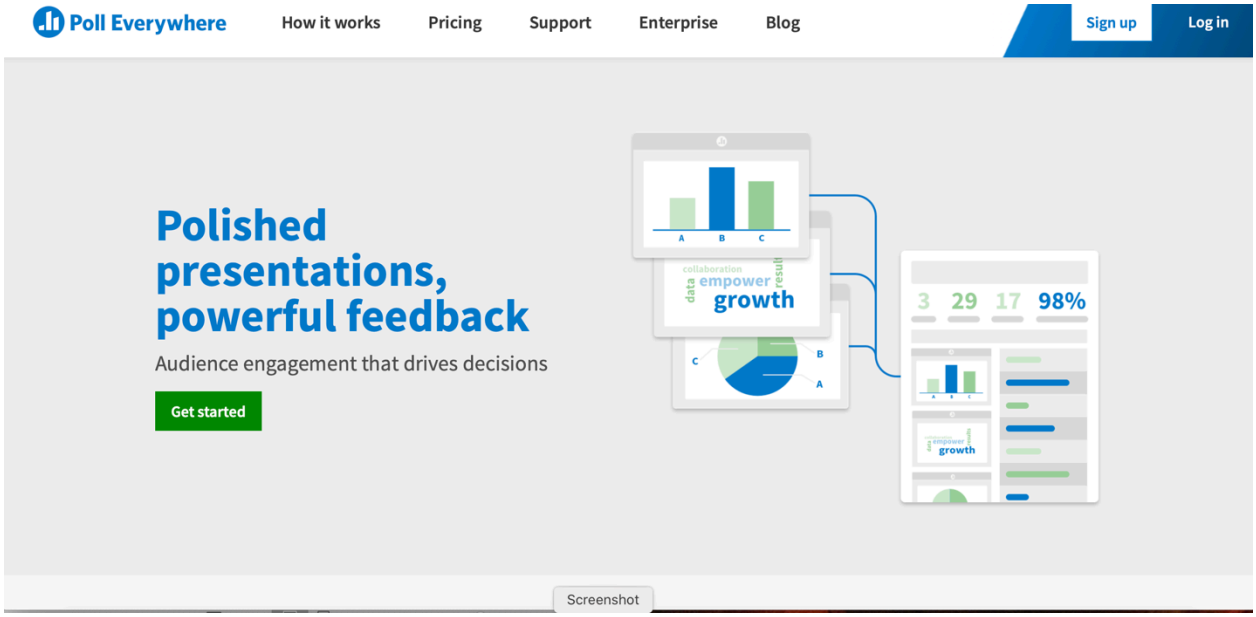


Introducing Technology

NearPod

Screenshot

Poll Everywhere



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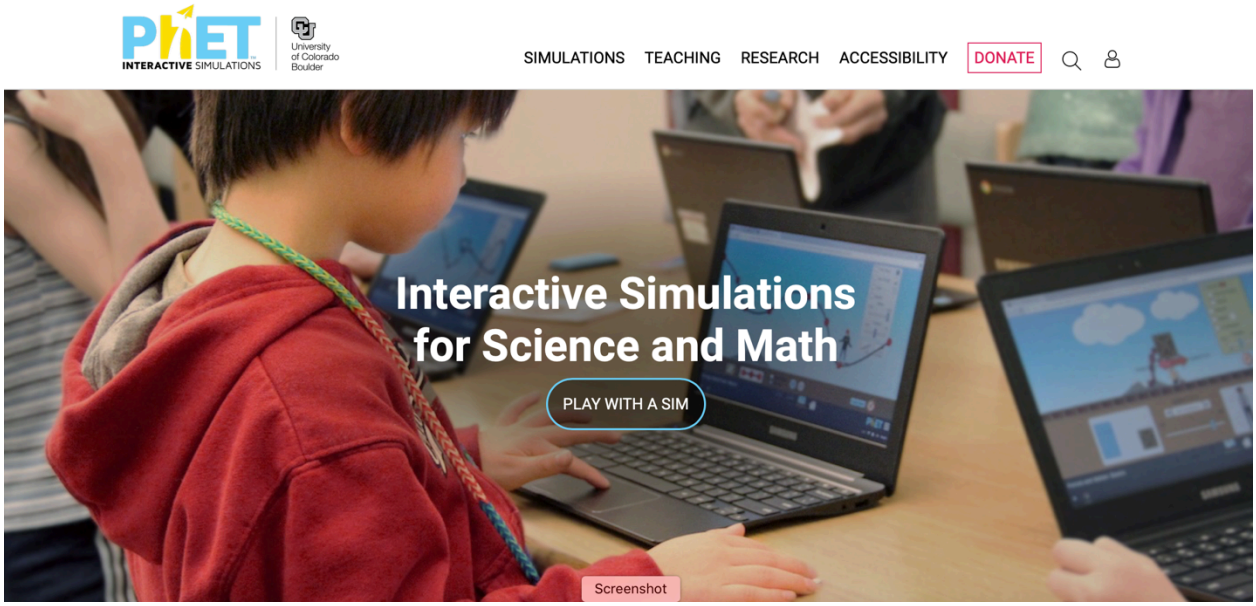
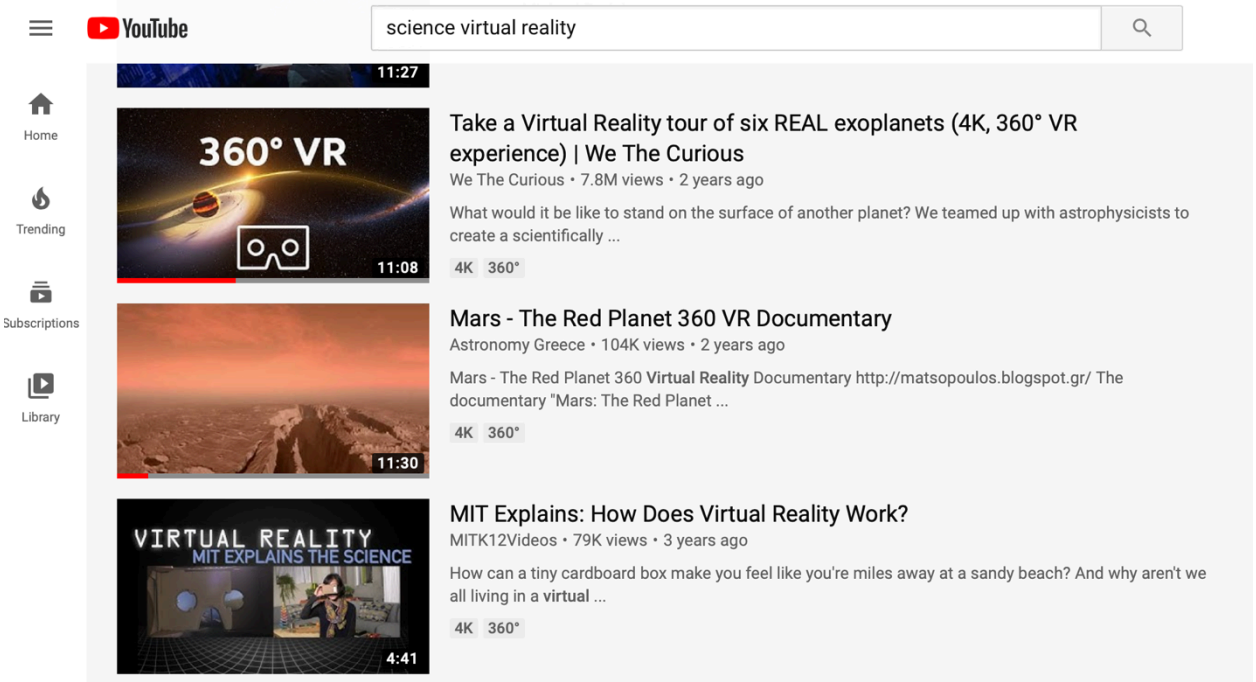


YouTube

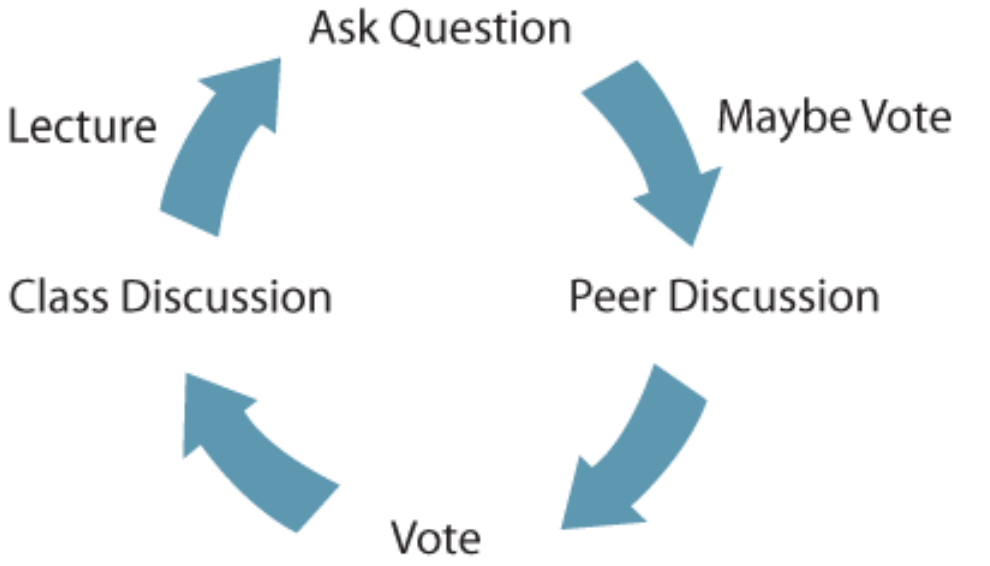


Session 3 : Translating To College Instruction

Session 3

Learning Segment Planning
Learning segments are the small components of a lesson. Each sub-segment can help enhance engagement and promote learning. University science lectures do not provide the freedom a K-12 classroom, but there are a number of practices you can use.

Peer Instruction



Peer Instruction Model by Eric Mazur

Embed A Non-Evaluative Explanation (In-Class)
To promote students' capacity to understand the concepts, provide them a few moments in class to explain the concept. This can be low tech by having individuals write on stickies, or technology based where answers are on public display.

Digital Recall/AKA Explanatory Homework
To promote students' understanding of the ideas, have them provide explanations of science ideas as homework. These explanations can promote students' capacity to understand. This can take the form of YouTube videos, written papers (pass/no pass), or surveys.

A Time To Tell- Inverting Lecture
After having students share their understanding of a concept, provide a short teacher lecture to clarify the concept.

Timing
Each session should be recrafted from a linear teacher only lecture, to a mixture of videos, small discussions, and teacher clarifications. To maximize students' learning consider keeping the pace of these small interactions between 5-10 minutes each.

Using Technology
To make sure you can maximize students' ability to participate in conversations by having an opportunity to explain consider using a technology like Nearpod to maximize who gets to participate.

Curriculum Building
The ultimate challenge is to build one lesson per week for your 14 week semester. However, working together, the team of professors could create an interactive curriculum based on the principles we are learning today.


Sc
RESOURCES
RESEARCH
COMMUNITY
ABOUT US
SEARCH
ACCOUNT
Science in the City
This website is designed to provide a community for teachers and educators to explore resources, exchange ideas and hear about our new research findings.
Screenshot

Race, Culture & Multimedia

- As issues of stereotype and doubt emerge, the technology the multimedia resources you can teach the content while sending implicit messages of belonging.

- Consider selecting multicultural and language dynamic video resources

- You may not be able to diversify your teaching force immediately, but your selection of videos and images

A STEP-Wise Approach To Building Curriculum

a. Identify resources
b. Organize them by type: - introduction, confirm
c. Plan your explanatory, *generative* tasks
d. Set gender, cultural cues
e. Construct agenda

Challenge

Challenge 1: Create 1 Lesson & Share a Lesson

Challenge 2: Build a Team & Build the First College Science Curriculum