UF | UNIVERSITY of FLORIDA
College of Medicine

AAPM 2021
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63RD ANNUAL MEETING & EXHIBITION

It only took a pandemic: Engaging online students with active learning strategies

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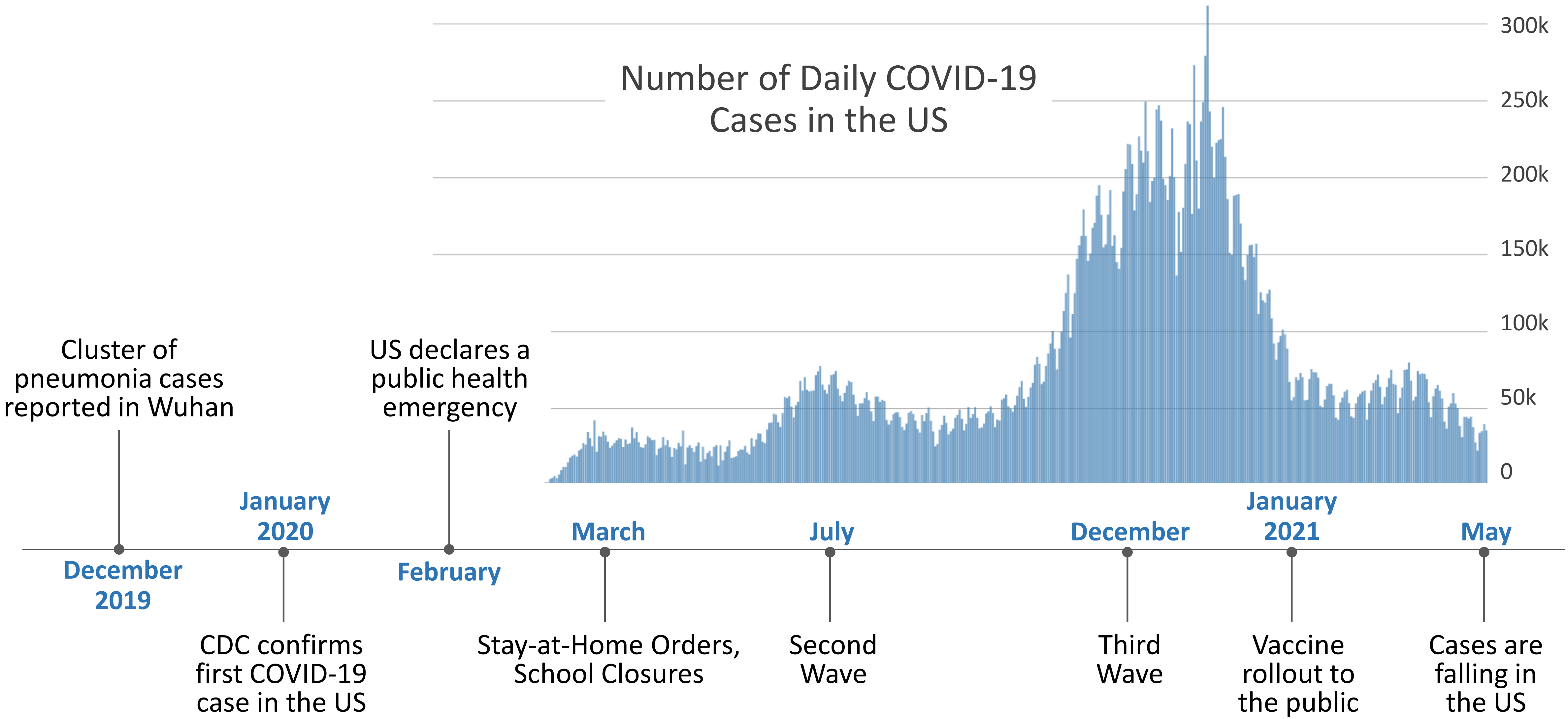
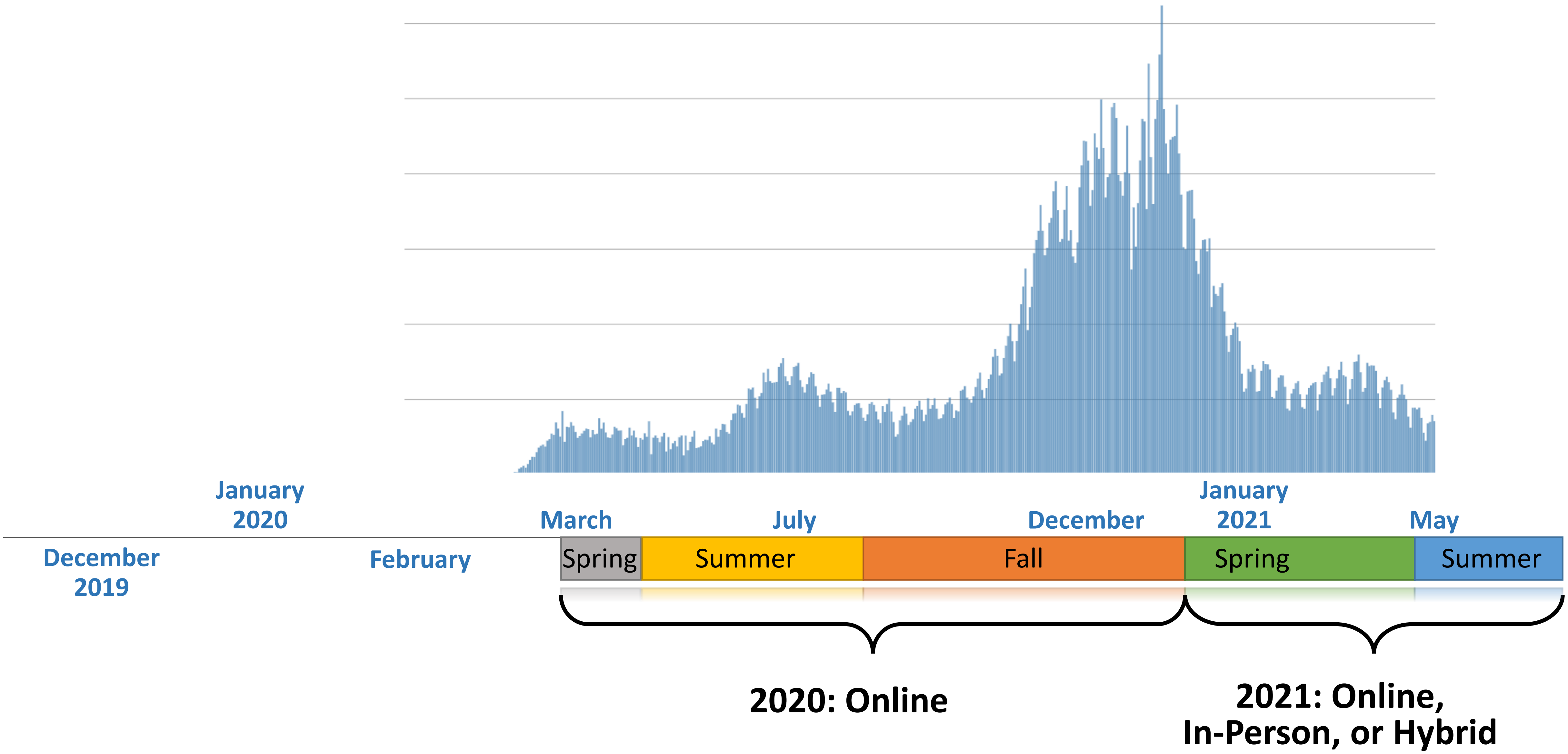
Disclosures

- None



US Centers for Disease Control COVID-19 Case Surveillance Public Use Data


January 2020
March
July
December
January 2021
May
December 2019
February
Spring
Summer
Fall
Spring
Summer
2020: Online
2021: Online, In-Person, or Hybrid

Challenges of Online Learning

Technical Challenges

- Computer access
- Internet connectivity
- Computer literacy

Lack of Structure

- Organization
- Self-discipline
- Time management

Social limitations

- Feelings of Isolation
- Lack of interaction
- Reduced motivation

Loss of social life during college

Academic success in an online environment

Isolation

Loneliness

Family conflicts at home

Increased workloads

Computer accessibility

Economic hardships

Internet connectivity

Future employment

Vulnerability of family members to Covid-19 infection

Stress

Unmotivated

Depression

Anger

Anxiety

Substance Abuse

Eating Disorders

Fear

Suicide

Browning MH et al (2021) PLOS ONE; Ihm L, et al (2021) Int J Health Plan Mgmt; Li X, et al (2021) Int J Env Res Public Health

The Online Environment

- Reduced focus
- Home environment
- Distractions
- Zoom fatigue
- Few interactions
- Passive learning

The Online Environment

- Online learning is more tiring on concentration
- We cannot transfer online the same approaches used in face to face learning

Traditional Learning	Active Learning
Passive, lecture-heavy, one-way transmission of information	Student actively participates in the learning process
Instructor talks and students listen with few interruptions	Instructor talks with regular breaks for structured activities
Student concentration drops after 10 minutes	When student concentration begins to wane, a short in-class activity is assigned
The instructor is unaware of student comprehension during the lecture	Student comprehension is assessed directly during the lecture

Adapted from Eison J (2010) Active Learning Books 2(1)

Benefits of Active Learning

Activities promote high-order thinking skills, improving understanding and learning

Interaction improves human connection, engagement, motivation, and participation

Collaboration forces students to actively contextualize meaning among a group

Community supports collaborative learning and helps students feel comfortable and valued

Course Description

3-Credit
Graduate Course
Fall semester

Two 75-minute
lectures per week
(Tues/Thurs)

Radiation Biology

Incoming
Medical Physics
Graduate Students

Course size
Range: 4 - 14
students

How to Do It

Prepare Students for Success

1. Define measurable student learning objectives
2. Align educational content and assessments to meet them
3. Use a Learning Management System

Motivate students with Active Learning Strategies

4. Humanize course with interactions
5. Create engaging lectures & interactive activities
6. Promote a strong collaborative learning community

Define Learning Objectives
Prepare Content & Assessments

Topic	Student Learning Objectives	Bloom's Learning Level	Assessments	Activities	Text Readings	PowerPoint Slides
Radiation-induced damage to cells	1. Identify the 5 major types of radiation-induced chromosome aberrations	Remembering	Short answer	Teamwork in Jamboard	Radiation biology for the radiologist Chapters 1-3	Radiation damage to DNA and Chromosomes
	2. Differentiate the 3 techniques for identifying DNA damage, quantifying chromosomal aberrations, and graphing cell survival curves	Analyzing	Essay	Padlet activity		Evaluating chromosomal damage & cell survival
	3. Calculate cell survival fractions given an irradiation scenario	Applying	Solve	Homework		Cell survival curves
	4. Predict how modifying radiation type, dose rate, or oxygen concentration will affect cell killing to normal cells and tumor cells	Evaluating	Short answer	Discussion in breakout room		Cell survival curves
	5. Recommend an irradiation treatment plan for a specific type of tumor	Creating	Discussion	Discussion board in Canvas		Factors that affect cell survival

Create a Structured Course in Canvas

- Each lecture had its own:
  - ***Linked page***
  - ***Instructional materials***
  - ***Activities & Assignments***
- Frequently sent students messages, reminders, feedback
- Synchronous lectures in Zoom
  - Recorded for review

How I taught a 75-minute Course

2019: In-Person

- *Some* Planning
- 30 min Lecture
- 10 min Example Problem
- 5 min Social Break
- 30 min Lecture

2020: Online

- ***More*** Planning
- 5 min Social Activity
- 10 min Lecture
- 10 min Interactive Activity
- 10 min Lecture
- 10 min Example problem
- 10 min Lecture
- 10 min Group Activity
- 10 min Lecture

Humanize the Course

- Introductions, ice breakers, virtual backgrounds, show & tell, games
- Opportunities to discuss class material
  - Join class early or stay late
  - Provide a space outside class
- Scheduled social hours outside of class
- Instructor presence, enthusiasm, humor
- Campus announcements and resources

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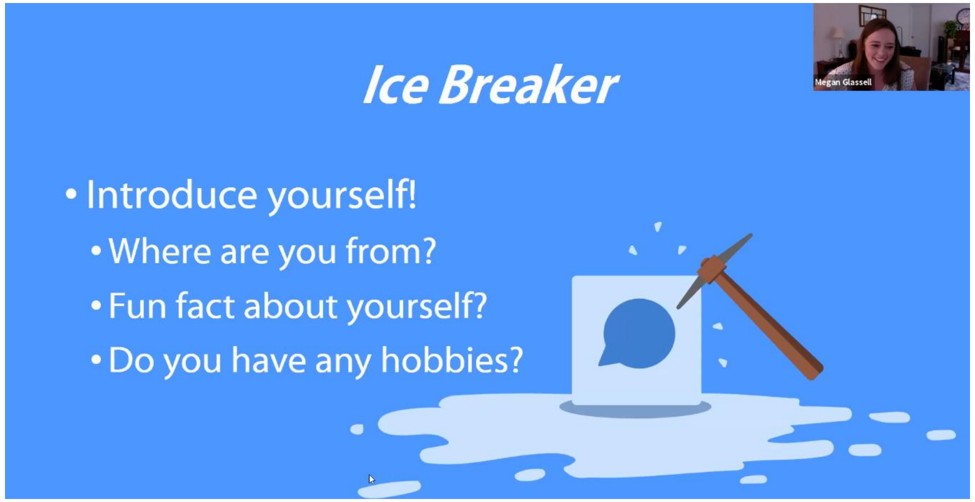

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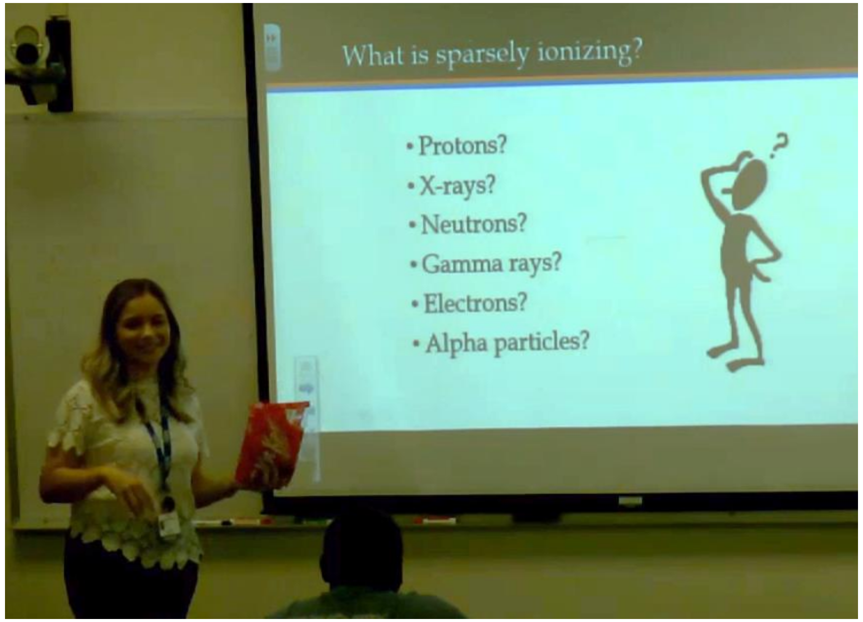
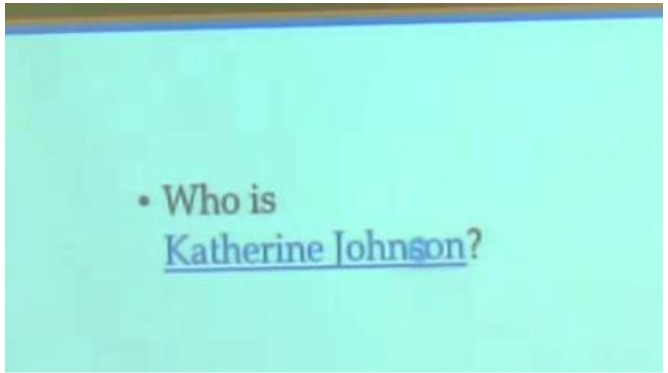
Create Engaging Lectures & Interactive Activities

- Spark *intrinsic motivation* to drive learning
  - Real-word problems & clinical scenarios

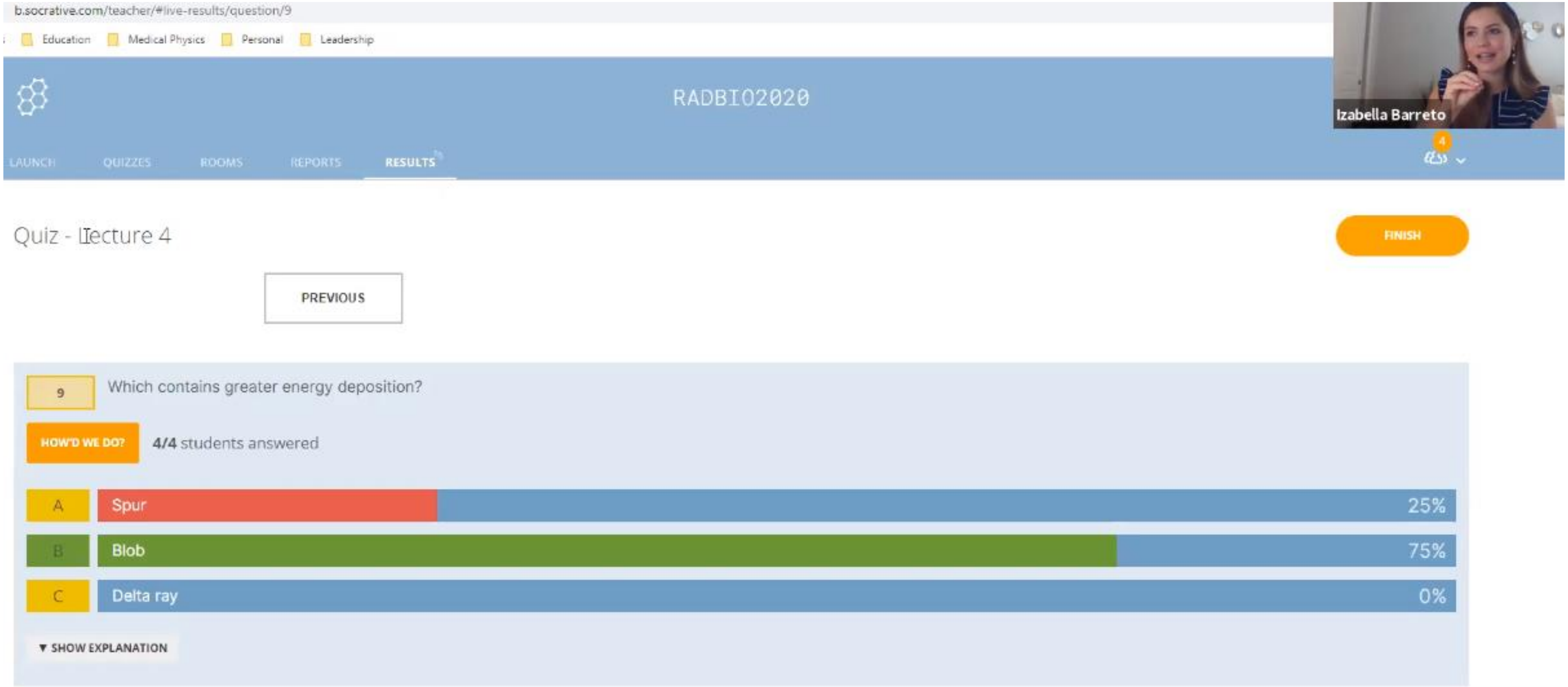
- Formative feedback
  - Low-stakes quizzes, games, extra credit

Answer questions for candy





Socrative Quizzes



Jeopardy for extra credit before an exam

General	Radiation Interactions	DNA Damage & Repair	Chromosome Damage	Measurement methods
1 point	1 point	1 point	1 point	1 point
2 points	2 points	2 points	2 points	2 points
3 points	3 points	3 points	3 points	3 points

Promote Collaborative Learning

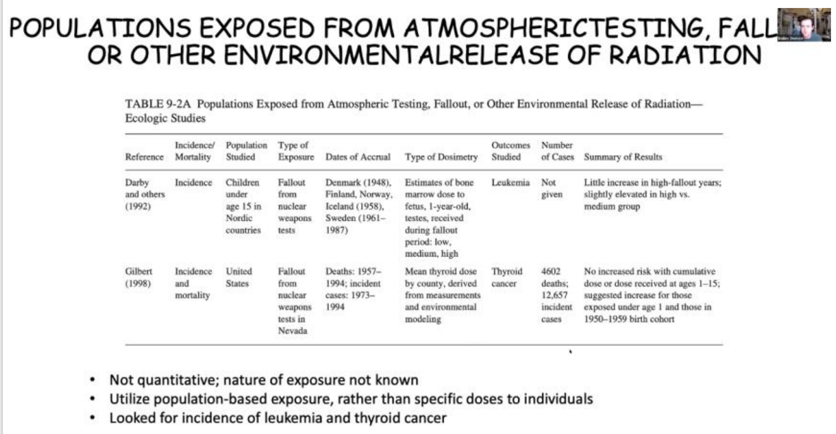
- Collaboration maximizes student learning
- Significant class time devoted to small group activities
  - Think-Pair-Share, “Jigsaw” Peer Teaching, Problem solving
- Exploit collaborative virtual tools
  - Chat and Discussion boards, Breakout rooms
  - Online apps like Google Doc, Padlet, Jamboard, etc

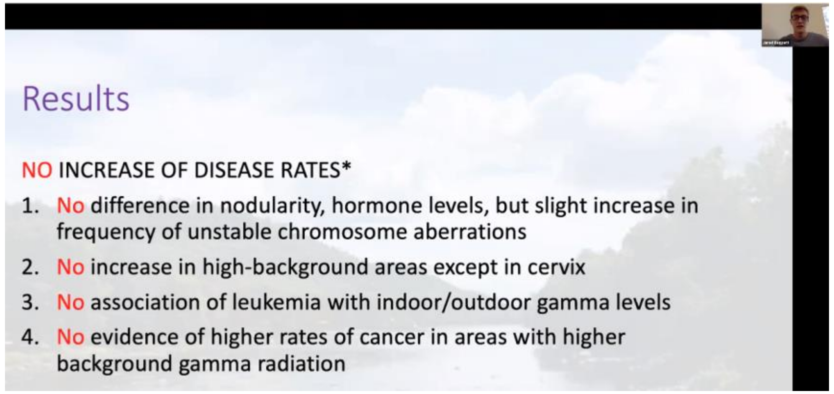
Without speaking, walk around the room and find the person holding the card that pairs with the cell on your card

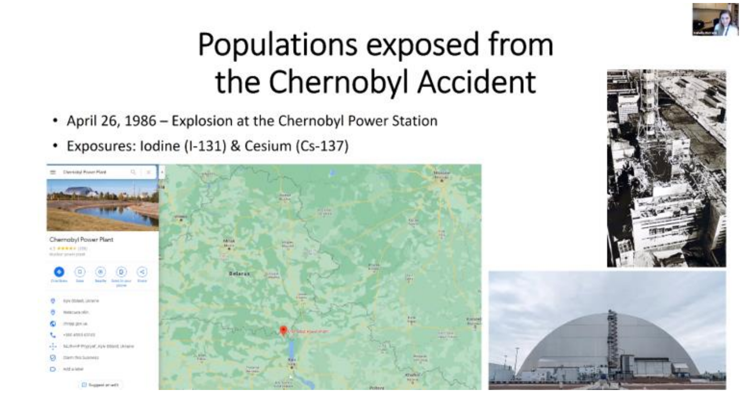
Read, discuss in groups, teach the class

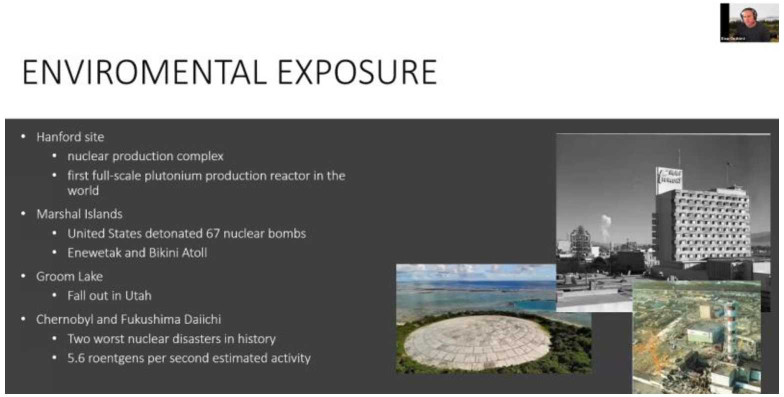
Padlet

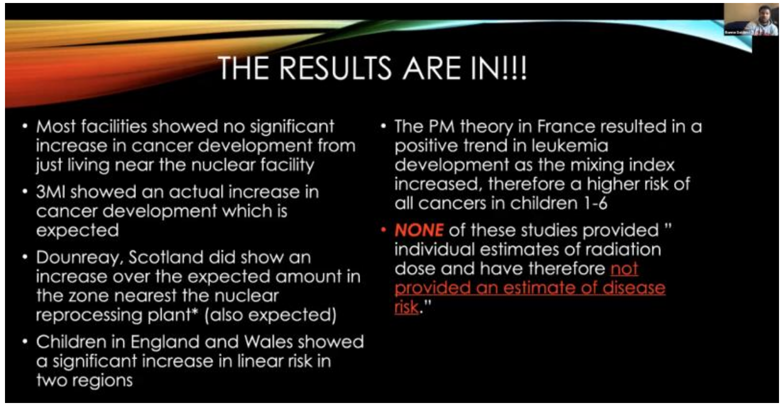
Students read assigned sections from BEIR-VII, created summary slides, and taught the class











Brainstorm what you think may be a possible radiation-induced health effect

Google JamBoard

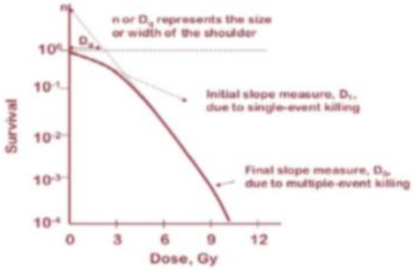
Meet your partner in a breakout room and create 4 Q&A's related to today's lecture

Doug and Jared Questions

1. LET is considered,
   a. An absolute quantity
   b. An average quantity
   c. A minimum quantity
   d. A maximum quantity

2. The units of the alpha/beta ratio are
   a. 1/Gy
   b. Gy
   c. Gy/cm
   d. cm/Gy

3. Draw a survival curve labeling the axis D_1, D_0, and D_q and describe what they represent.



4. In your own words, describe radiation damage resulting in DNA single strand breaks and double strand breaks.

Ex: Single strand breaks are a common result of low doses of radiation. A single strand break occurs when one strand of a DNA is broken or when both strands have breaks but are separated by several base pairs. However, when both strands are broken nearly adjacent to one another, directly across or separated by only a few base pairs, it is considered a double strand break. Single strand breaks are considered inconsequential since they are easily and quickly repaired. While double strand breaks frequently can cause death to cells.

Q: Given the relation

$$LET \sim \frac{Q^2}{E_K} \sim \frac{Q^2}{v^2}$$

how can it be possible for an uncharged heavy particle (e.g. a neutron) to have a higher LET than a charged particle (e.g. an electron)?
A: This relation applies only to charged particles. A neutron can have a higher LET than an electron despite being electrically neutral since it does not rely on coulombic field interactions to transfer energy to the target medium, but rather direct interactions with other nuclei. Neutrons have a relatively high LET since they are slow-moving and can produce secondary recoil particles such as protons.

Q: Given a photon beam of intensity I_0 incident on a lead slab ($\rho = 11.4\ g/cm^3$), at what depth in the slab would the measured beam intensity $I = 0$? Assume the photons have an average range of 2 cm.
A: The process is stochastic, and any single photon has some probability of never interacting with the target medium. Thus the measured beam intensity can never actually be zero (or equivalently, zero beam intensity can be achieved only at infinite slab depth).

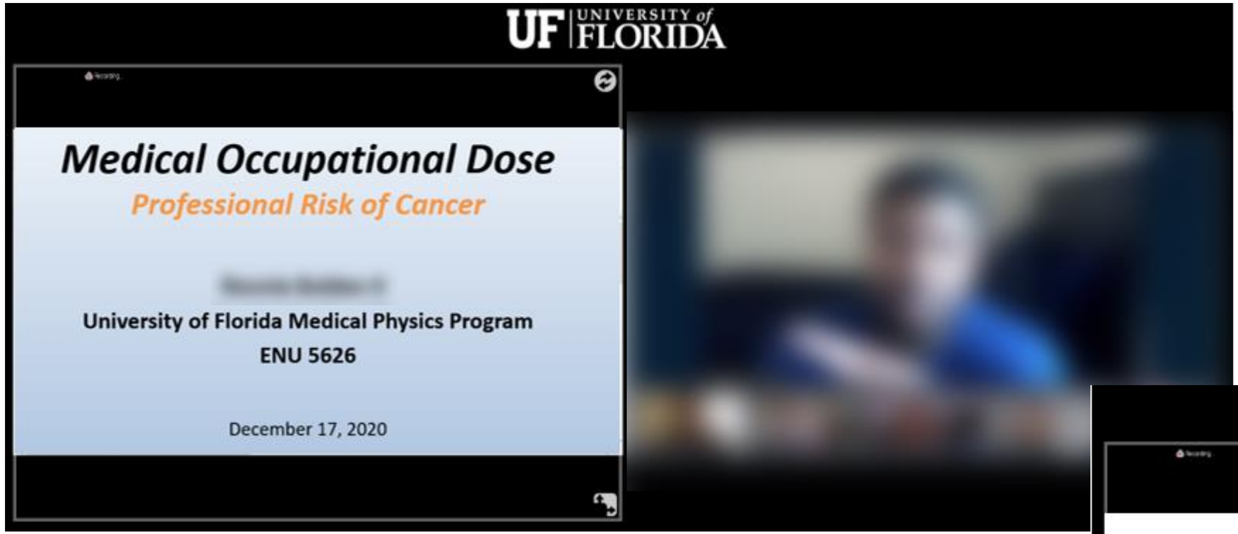
Q: Why is it so much more lethal for a cell to experience two DSBs on homologous chromosomes near the same locus (single-hit) as compared to two DSBs, also on homologous chromosomes, but at different loci (double-hit)?
A: In the former case, homologous recombination cannot be used to repair damage and the cell must resort to NEHJ, which has lower repair fidelity.

Q: Why is it especially dangerous to expose germ line cells to radiation, as compared to somatic cells?
A: Many germ line cells are undergoing or are the product of meiosis, which ultimately produces haploid daughter cells lacking chromosomes with sister chromatids. As a result, homologous recombination is not possible to repair DNA damage due to irradiation.

Q: In a group of asynchronous cells, how can we determine the relative amount of time each cell spends in each phase of the cell cycle?
A: Assuming the cells are asynchronous, the relative proportion of cells in each phase of the cell cycle should correspond to the relative amount of time spent in each phase (e.g. half of a population of cells being in G_1 implies that approximately half of a given cell's life is spent in the G_1 phase).

Q: Why is the hydroxyl radical the dominant species in terms of cell killing, despite hydrogen peroxide being both more damaging and longer-lived *in vivo*?
A: Even though hydrogen peroxide is more damaging to DNA and can exist for longer in solution, the hydroxyl radical is responsible for a majority (65%) of cell killing for two main reasons: it is simply produced in larger quantities (which makes sense, given that it is the chemical precursor to H_2O_2), and it also is not subject to being picked up by cellular radical scavengers as is hydrogen peroxide. (The cell naturally produces a lot of H_2O_2 and therefore has mechanisms in place to decrease levels of this molecule in the cytoplasm.)

Literature review, risk calculations, presentations, discussion



Number of Assessments Increased

		Fall 2019	Fall 2020
During class	Extra Credit	2	2
	Exams	3	3
	Graded Quizzes	1	**2**
	Ungraded Socrative Quizzes	0	**5**
	Team work	0	**5**
	Peer instruction	0	**2**
Outside of Class	Projects	2	2
	Homework Assignments	8	**10**
	Reading Assignments	2	**5**
	Team work	0	**1**

Results

- All students demonstrated:
  - ✓ **Strong participation and enthusiasm**
  - ✓ **Great team work and support**
  - ✓ **High grades (above B+)**
  - ✓ **Positive instructor feedback**

Questions	Response Rate	Instructor Mean	College Mean
The instructor was enthusiastic about the course.	100%	5.00	4.51
The instructor explained material clearly and in a way that enhanced my understanding.	100%	5.00	4.38
The instructor maintained clear standards for response and availability	100%	5.00	4.41
The instructor fostered a positive learning environment that engaged students.	100%	5.00	4.44
The instructor provided prompt and meaningful feedback on my performance in the course.	100%	5.00	4.28
The instructor was instrumental to my learning in the course.	100%	5.00	4.36
Course content was relevant & useful.	100%	5.00	4.32
The course fostered regular interaction between student and instructor.	100%	5.00	4.01
Course activities improved my ability to analyze, solve problems, and think critically.	100%	5.00	4.22
Overall, this course was a valuable educational experience.	100%	5.00	4.37

- Dr. Barreto did a great job keeping the class involved in the lecture. It's easy to space off during zoom sessions and I feel she did a great job interacting with students.
- The class breaks were a welcome relief and made the information intensive lectures easier to pay attention to.
- Dr. Barreto provided good PowerPoints and created many interactive activities for us to do with our classmates.
- I felt like I had an instructor who didn't expect perfection but expected 100% effort. I respect that - It makes you want to give it your all.

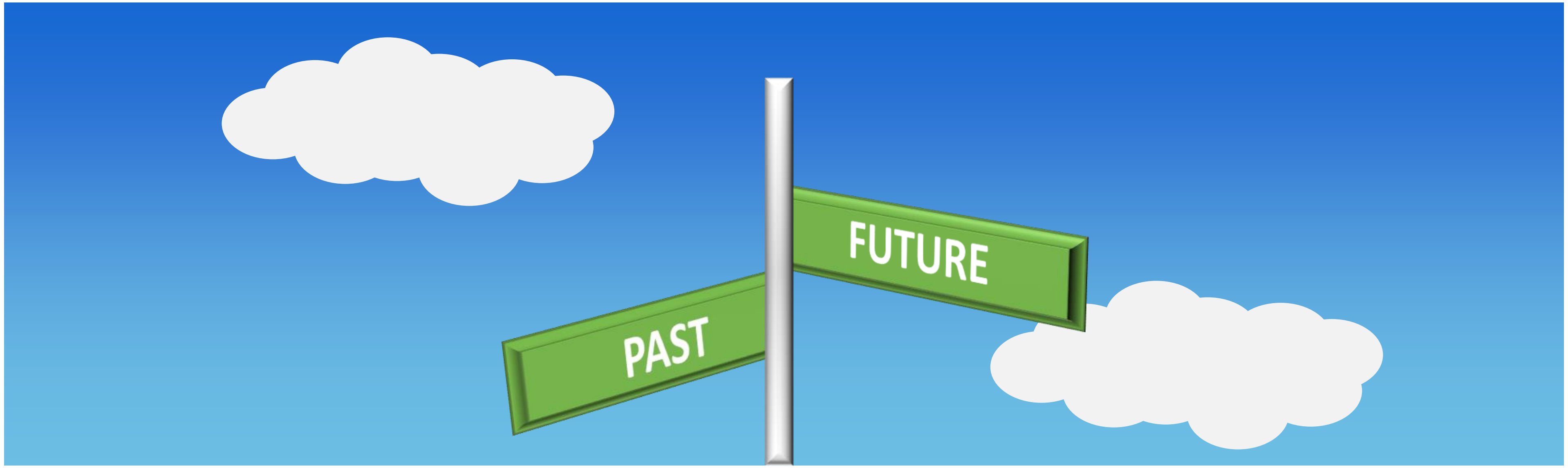
Challenges of Active Learning

- It takes more class time
- Planning takes more prep work

- Instructors lack institutional support
- Large class sizes complicate implementation

- Instructors may believe students are engaged
- Students may resist new approaches

Final Thoughts



- The pandemic has opened the door to new teaching opportunities
  - Give students a role in actively participating
  - Emphasize community and collaboration
  - Use technology to enhance the learning experience

Thank you!

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