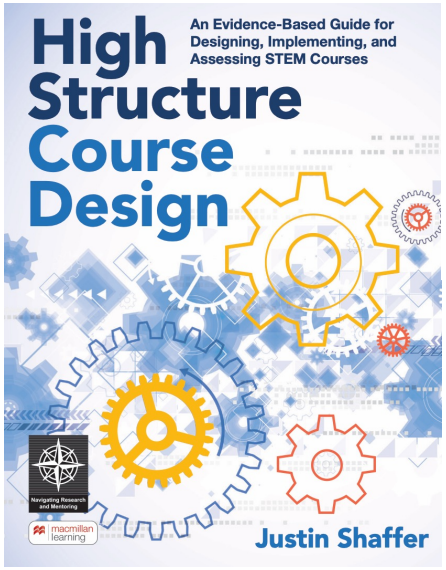
The Importance of Structure and Scaffolding in Course Design



MEAUXMENTUM 4
LOUISIANA HIGHER EDUCATION SUMMIT

Recombinant EDUCATION®

COLORADO SCHOOL OF MINES

Justin Shaffer

Feb 4, 2026

Improving STEM Education Together

Let's think about impact…

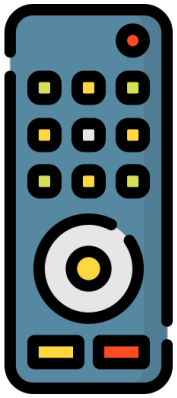
How many students have you taught in your career?

Why are you an educator?
Why do you do what you do?

What kinds of impacts are you having on your students and their futures?

By the end of this workshop, you will be able to…

- Explain what high structure course design is
- Describe how high structure course design is beneficial to student learning and other outcomes
- Develop ideas for implementing principles of high structure course design into your own courses



join.iclicker.com/EUYI

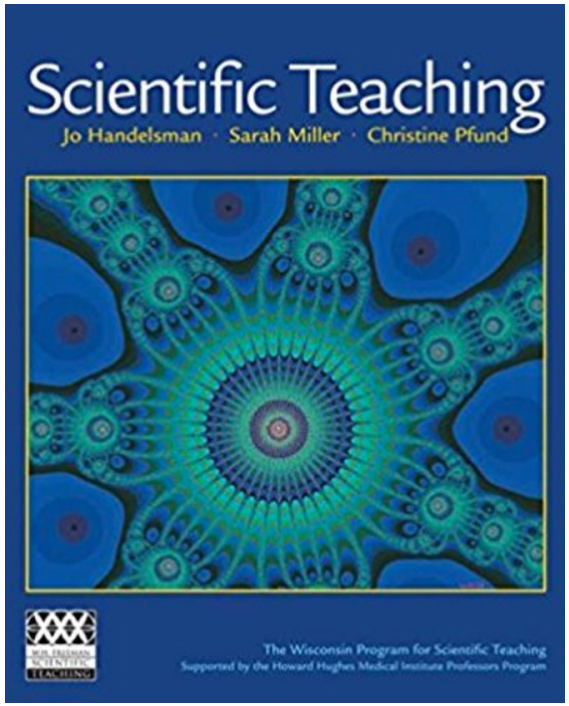
iClicker Events

All of a sudden, your chair informs you that you are going to be teaching a new course for the first time next week (what the…!?). What is the first thing you would do with regards to course design?

Type your answer into iClicker!
(140 character limit)

Where to begin with course design?

When I first started teaching I asked myself this question:
What is the most effective way to teach?



SPIRE
POSTDOCTORAL FELLOWSHIP PROGRAM

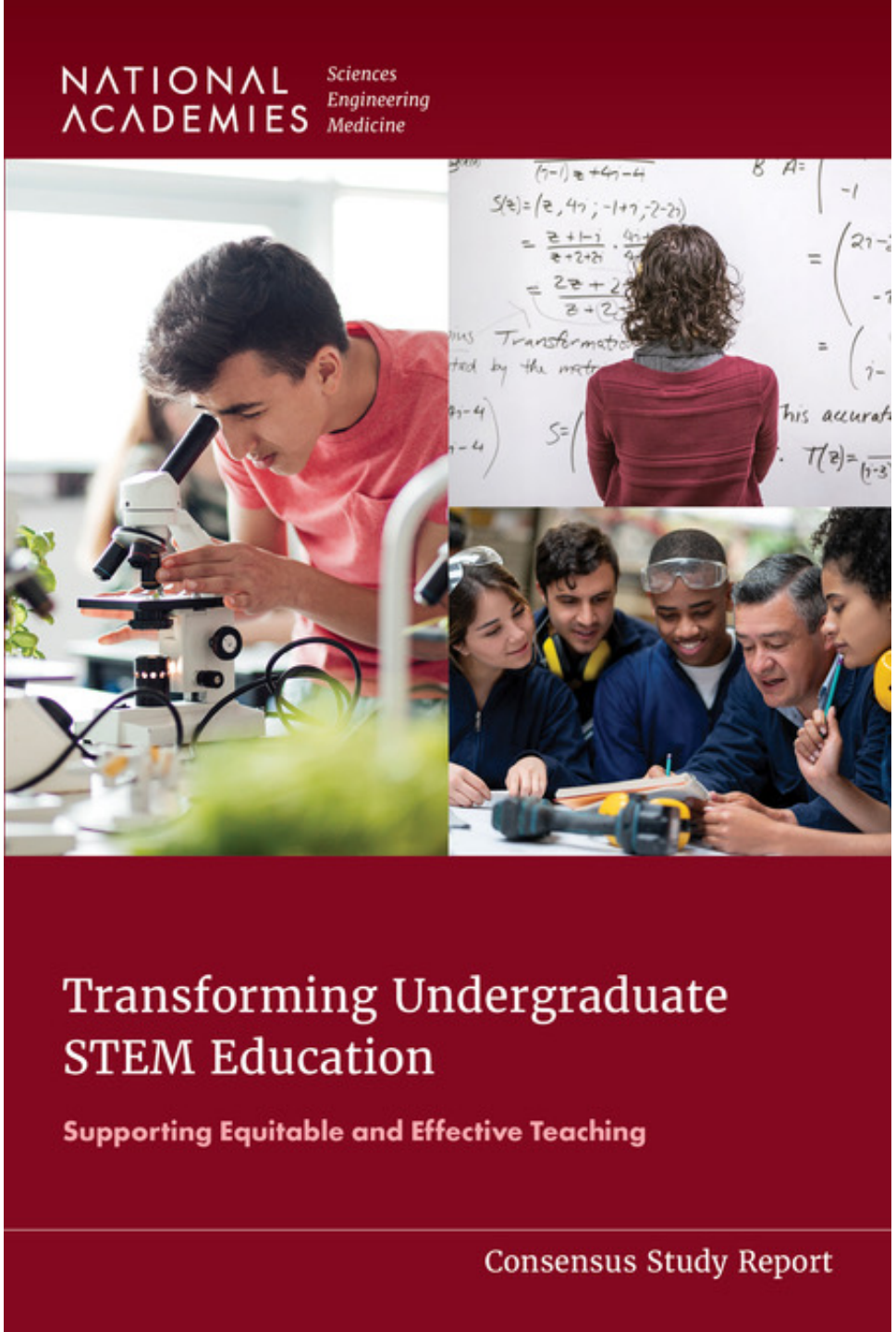
CBE Life Sciences Education

Evidence from research and training

Active learning and high structure course design

"Commonly used methods of teaching undergraduate STEM education benefit only a relatively small percentage of learners, leading many to choose not to enroll in STEM courses or pursue STEM careers. This trend severely limits participation in the STEM careers that play a critical role in our nation's prosperity. High quality instruction, learning, and engagement in STEM should be a key priority for colleges and universities across the United States."

https://nap.nationalacademies.org/catalog/28268/transforming-undergraduate-stem-education-supporting-equitable-and-effective-teaching



What are high structure courses?

Mary Pat Wenderoth
and Scott Freeman

Backward design

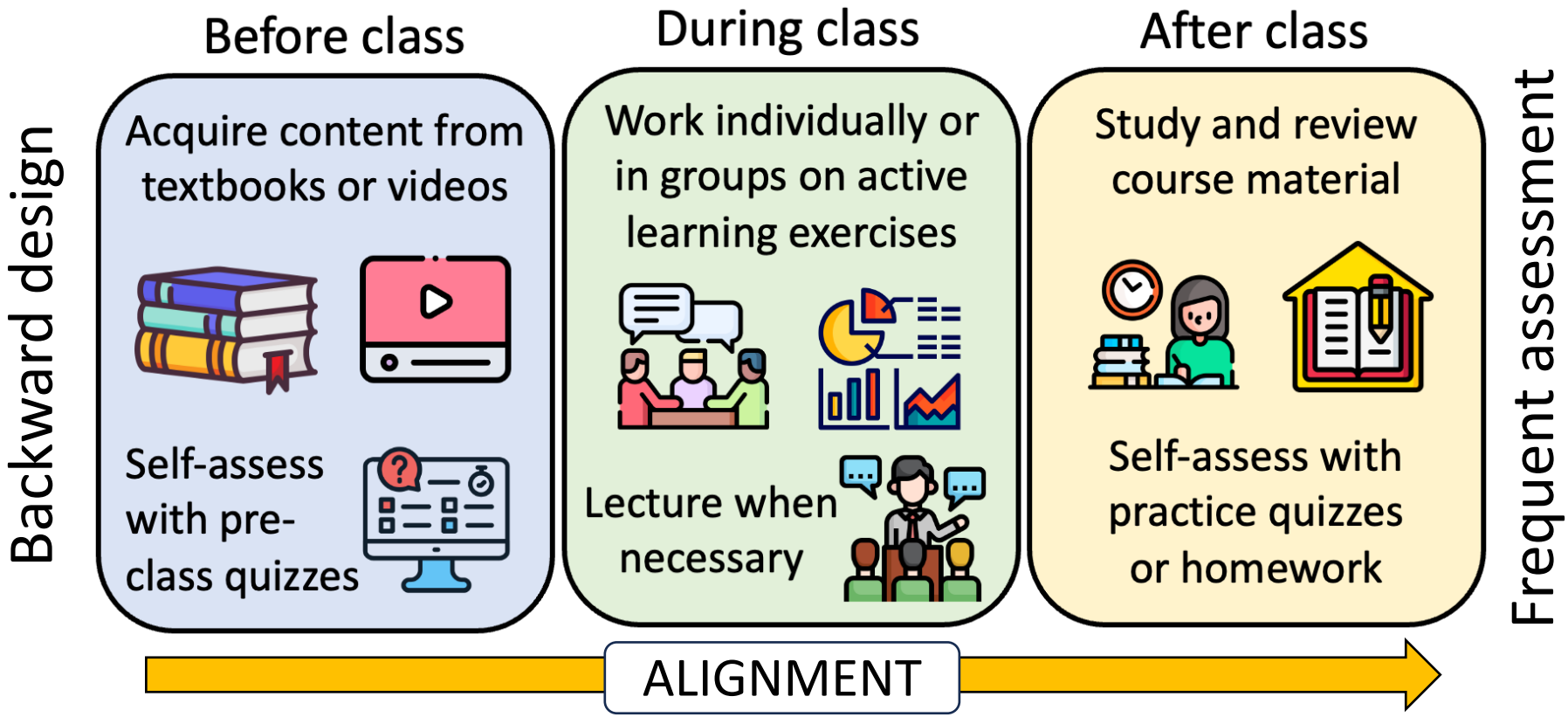
Before class	During class	After class
Acquire content from textbooks or videos	Work individually or in groups on active learning exercises	Study and review course material
Self-assess with pre-class quizzes	Lecture when necessary	Self-assess with practice quizzes or homework

Frequent assessment

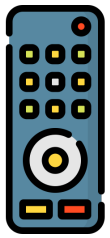
ALIGNMENT

Which part of high structure do you think would have the most positive impact on your students? Click/tap your screen!

Which part of high structure do you think would be the most challenging to develop/implement? Click/tap your screen!



Which part(s) of this model are you already doing?
Select all that apply.



A – Backward design (learning objectives)
B – Pre-class content acquisition and assessment
C – In-class active learning
D – After-class review and practice (e.g. homework)
E – Frequent summative assessment

Backward design

Frequent assessment

Before class

Acquire content from textbooks or videos

Self-assess with pre-class quizzes

During class

Work individually or in groups on active learning exercises

Lecture when necessary

After class

Study and review course material

Self-assess with practice quizzes or homework

ALIGNMENT

Why teach with high structure?

1. Students perform better[1,2]

2. Performance gaps reduce[3,4,5,6]

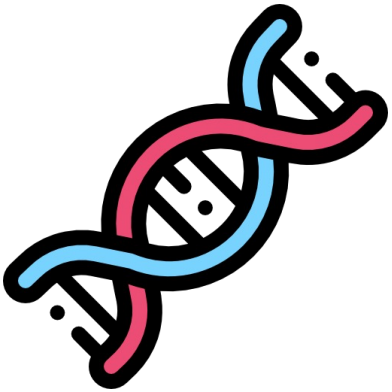
3. Students feel more belonging[7]

4. You can do more active learning and higher Bloom's activities in class

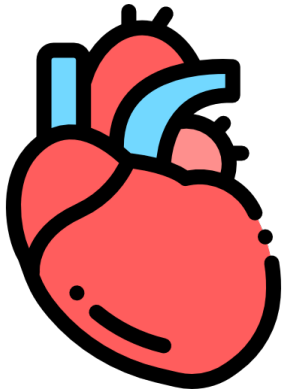
5. You can help students develop self-regulated learning skills

My high structure courses

Biological Sciences

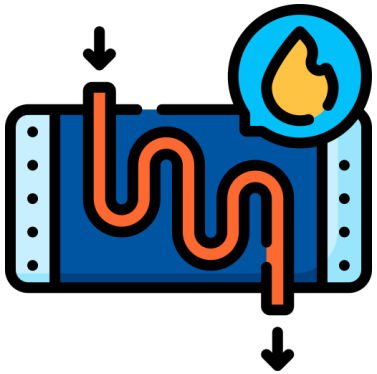


Introductory biology



Anatomy and physiology

Chemical Engineering



Introductory thermo-dynamics

Material and energy balances

Biomedical Engineering

Intro to biomedical engineering

My research program: developing, implementing, and assessing components of high structure courses

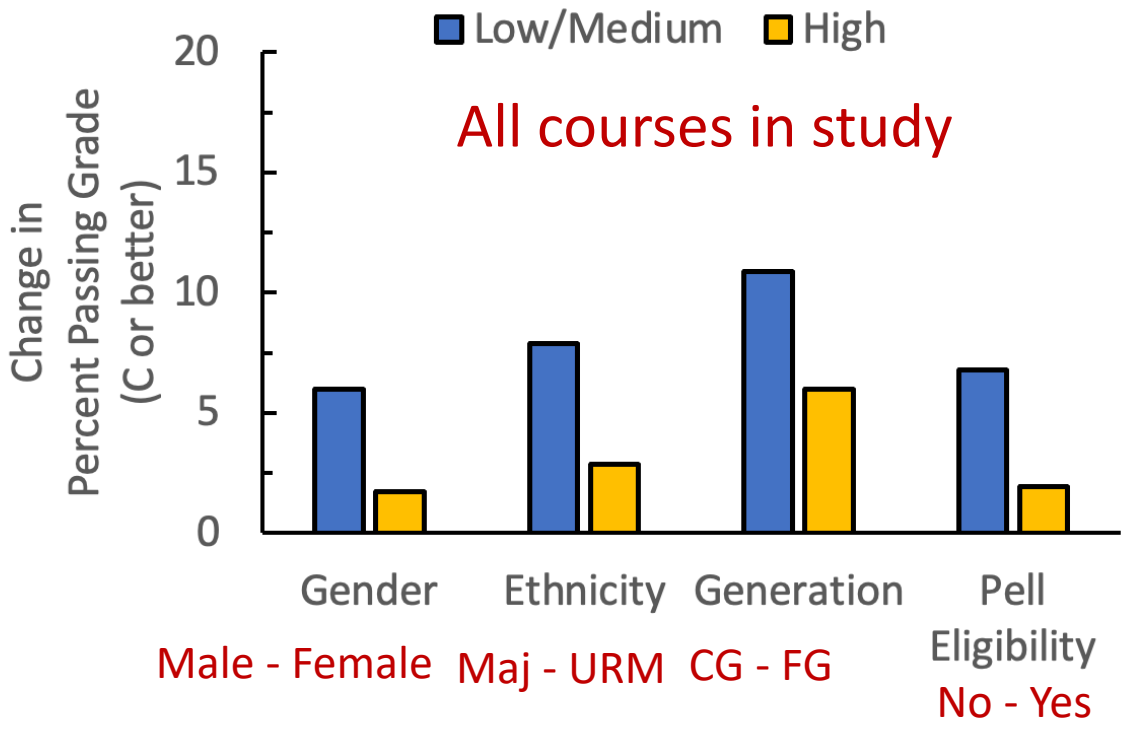
COLORADO SCHOOL OF MINES

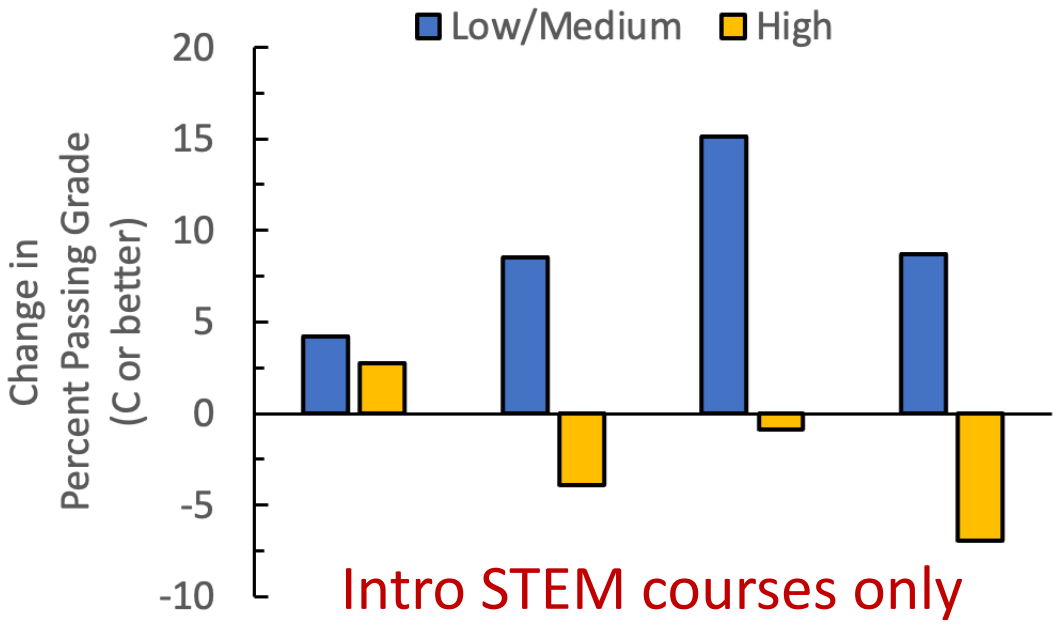
Coleman Dusavage

Sidney Wilson

Alex Montoya

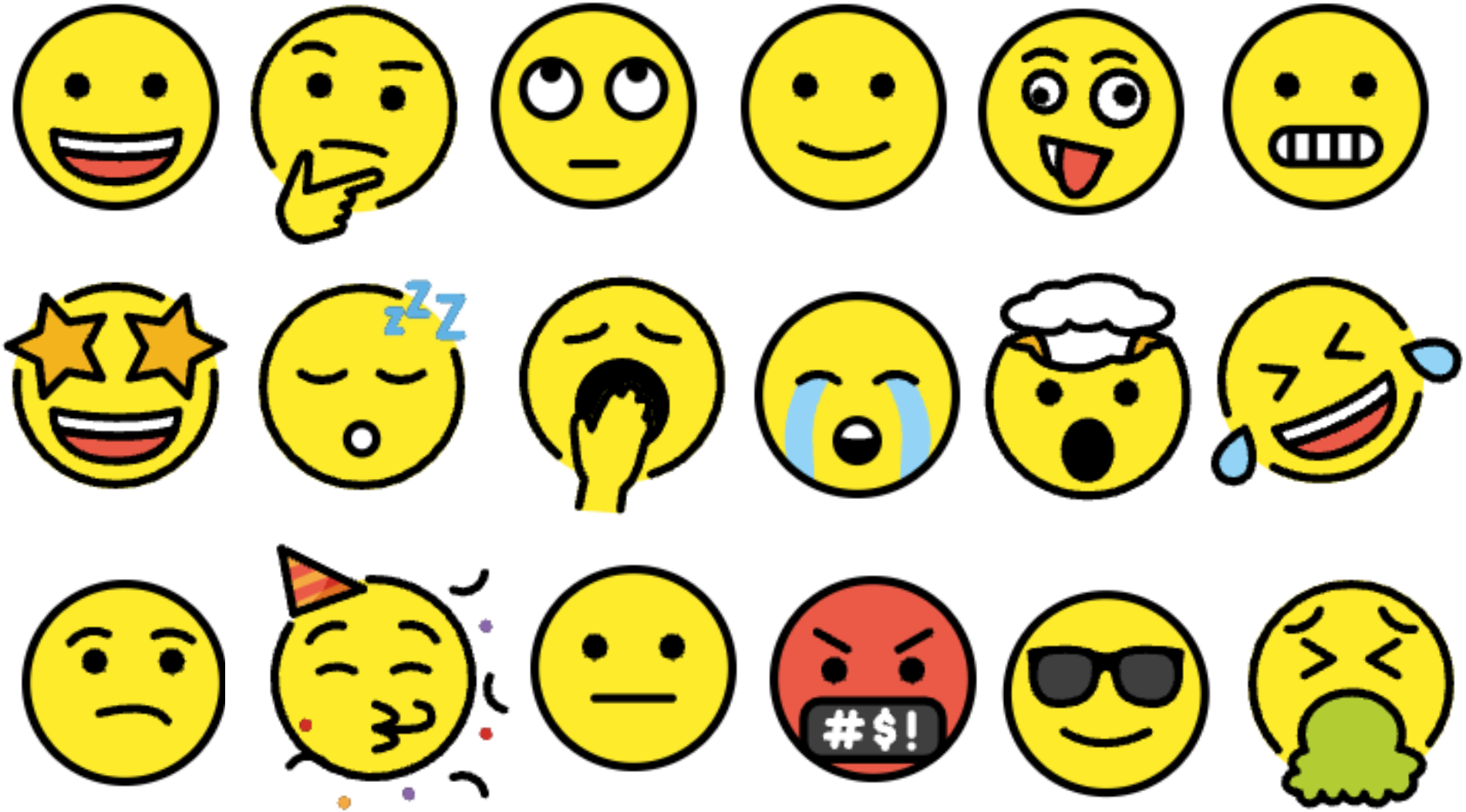
- Survey of 69 semesters of 39 unique courses at Mines from Spring 2021 to Spring 2023
    - Biology, chemistry, chemical engineering, civil engineering, computer science, economics, engineering design, electrical engineering, geology, HASS, math, mechanical engineering, physics
- Survey data included usage of pre-class or after-class assignments and estimates of time spent on active learning in class
- Calculated passing rates (C or better) and Z scores to compare between classes





Questions, comments, or concerns?

How are you feeling about implementing high structure design into your courses at this point?



www.openmoji.org

High structure can be used for *any* course, discipline, level, class size, and format…

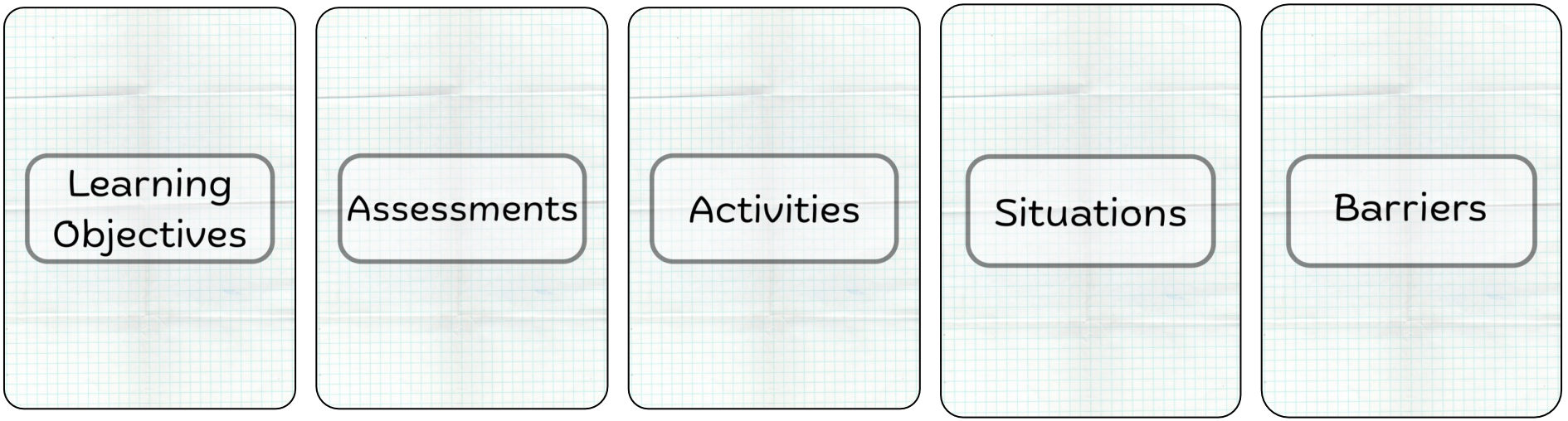
But you need to *tailor* the approach to match the needs of your students, instructors, and institution

Let’s practice with Alignment!

www.recombinanteducation.com/cards

How to play Alignment

1. Separate and shuffle the five types of cards and place them face down in the order below
2. Choose a topic from a class that you teach



What you want your students to be able to do

Larger, higher stakes summative assessments

Pre-class, in-class, or after-class activities

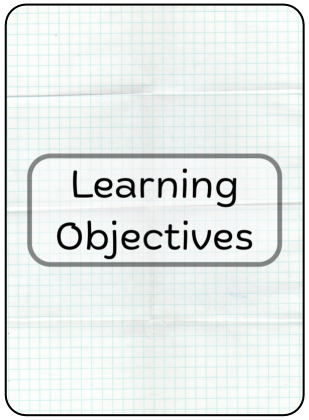
Different course design situations

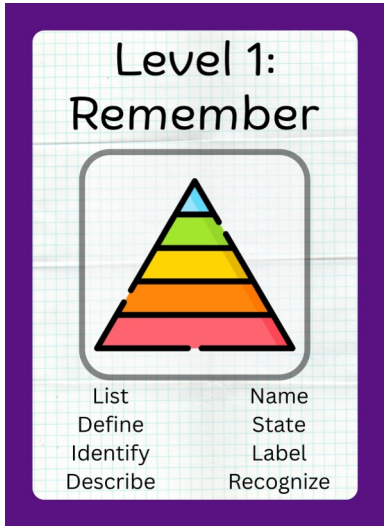
Barriers to using evidence-based practices

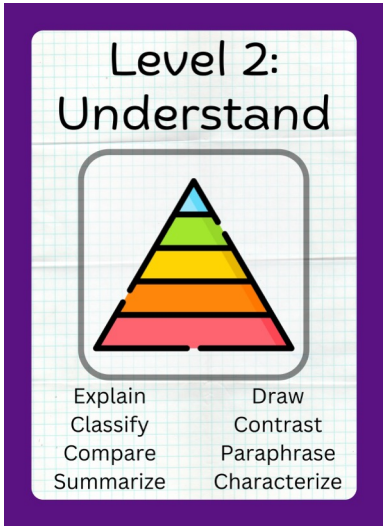
3. Flip over the top Learning Objectives card and write a learning objective for your topic

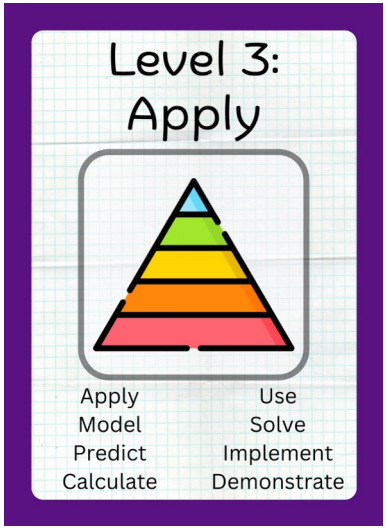
Learning objectives should be SMART

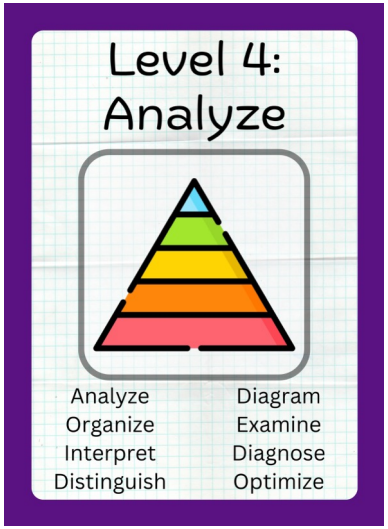
- Specific
- Measurable
- Attainable
- Relevant
- Timely

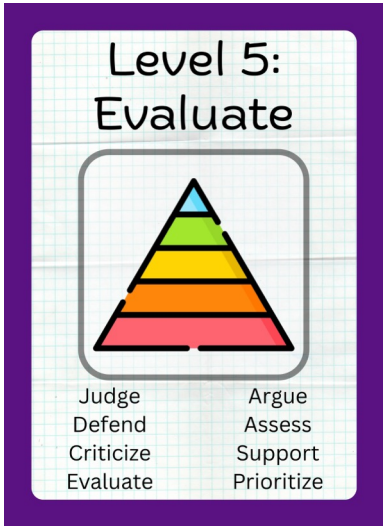


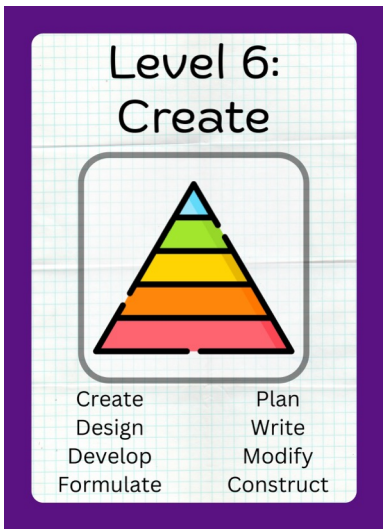




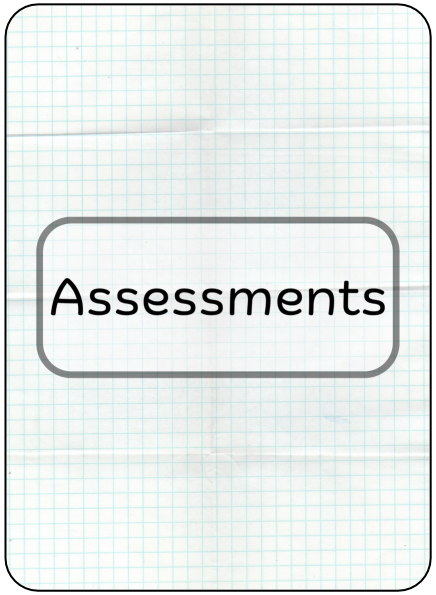






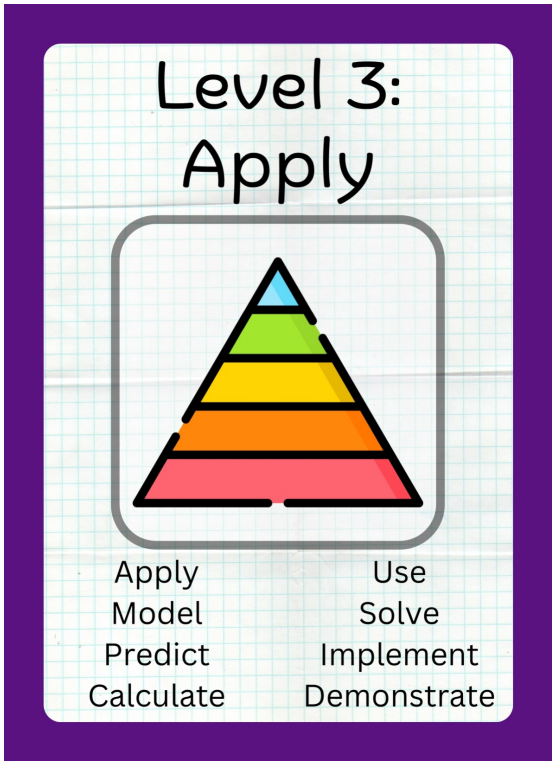


4. Flip over the top Assessments card and determine a way to use that Assessment to measure whether your students can achieve the Learning Objective

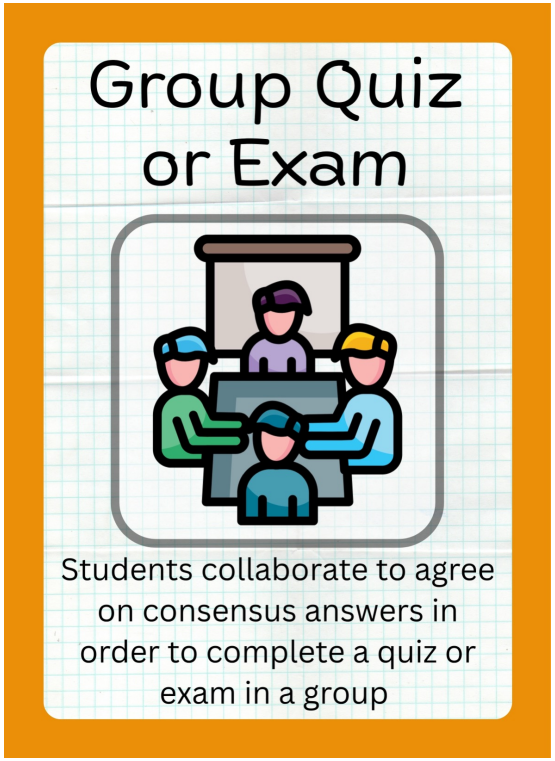


5. Flip over the top Activities card and determine a way to use that Activity to give students practice so that they will do well on the Assessment which measures whether your students can achieve the Learning Objective

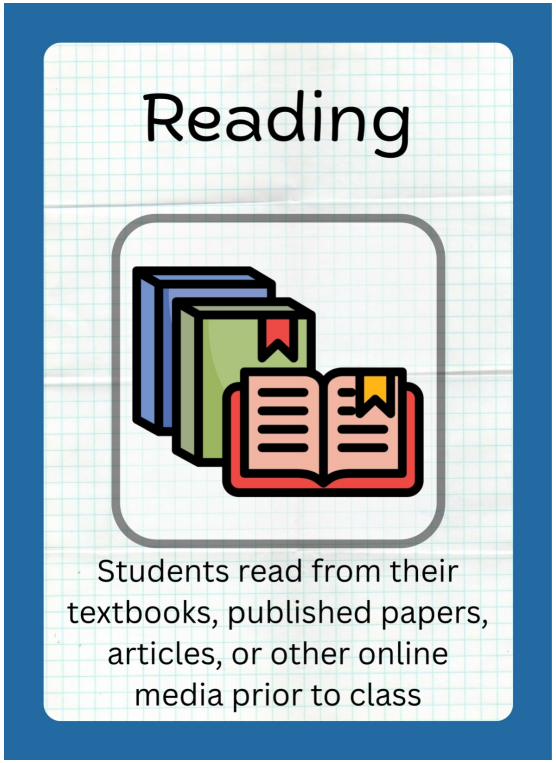
Example for introductory biology
Topic: cell structure and function



Predict the structural and functional effects of a drug on a cell



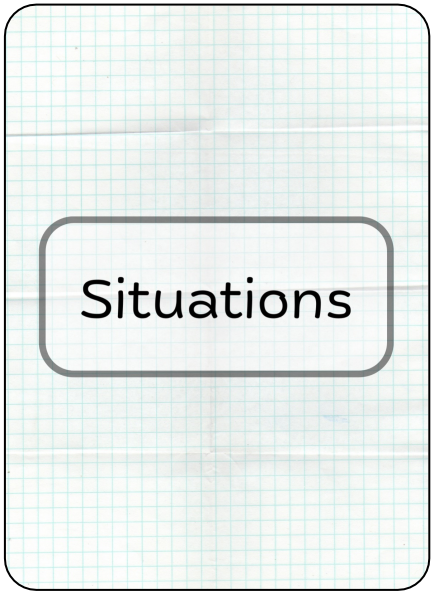
Students work together on a quiz to evaluate how a drug affects a cell



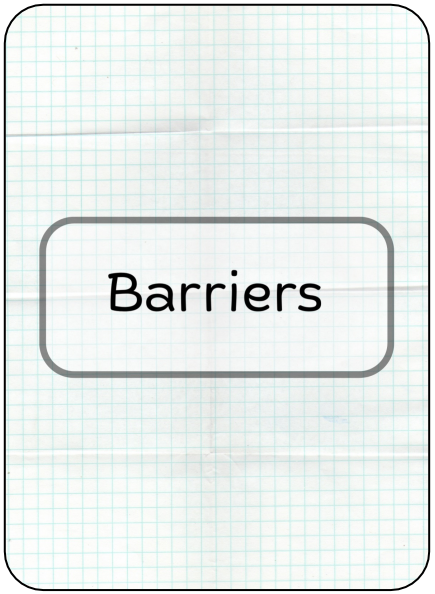
Students read about cell structure and function before class

Advanced play!

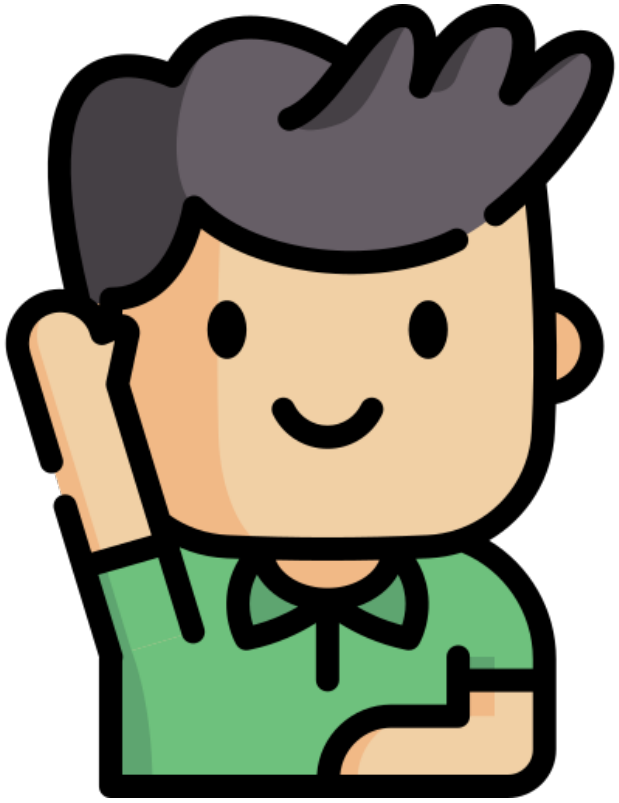
6. Flip over the top Situations card and determine how to adapt your course design to this new situation! Would your design work or does it need to be modified?



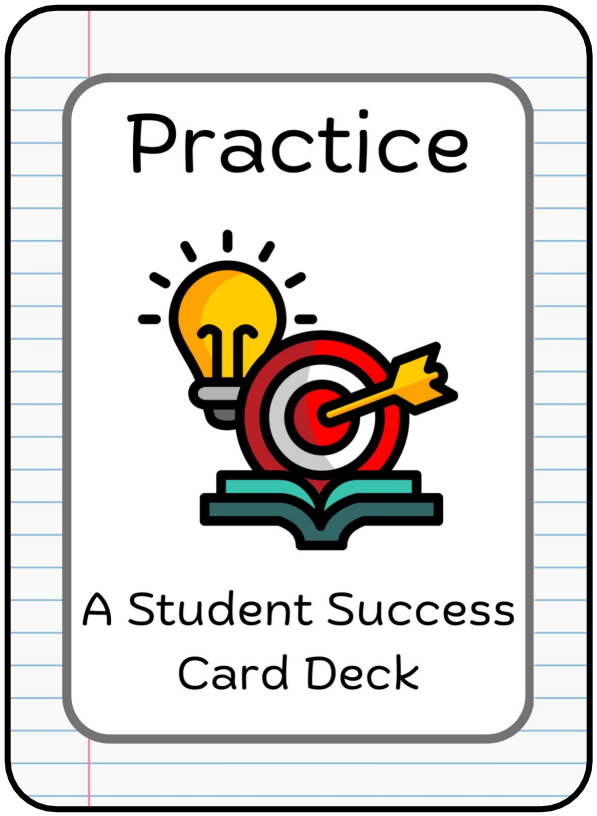
7. Flip over the top Barriers card and discuss – have you ever encountered this barrier? How did you or would you overcome it?



Questions, comments, or concerns?



What do you want to explore next?



Want more?

- Take some time to think about what you like about high structure course design and what you want to try to incorporate into your course
- Use this handout to help you design high structure lessons for your courses

Even more resources…

ChE special section

HIGH STRUCTURE COURSE DESIGN FOR CHEMICAL ENGINEERING

Justin F. Shaffer
Colorado School of Mines • Golden, CO 80401

Chemical Engineering Education
Vol. 58, No. 1, Winter 2024

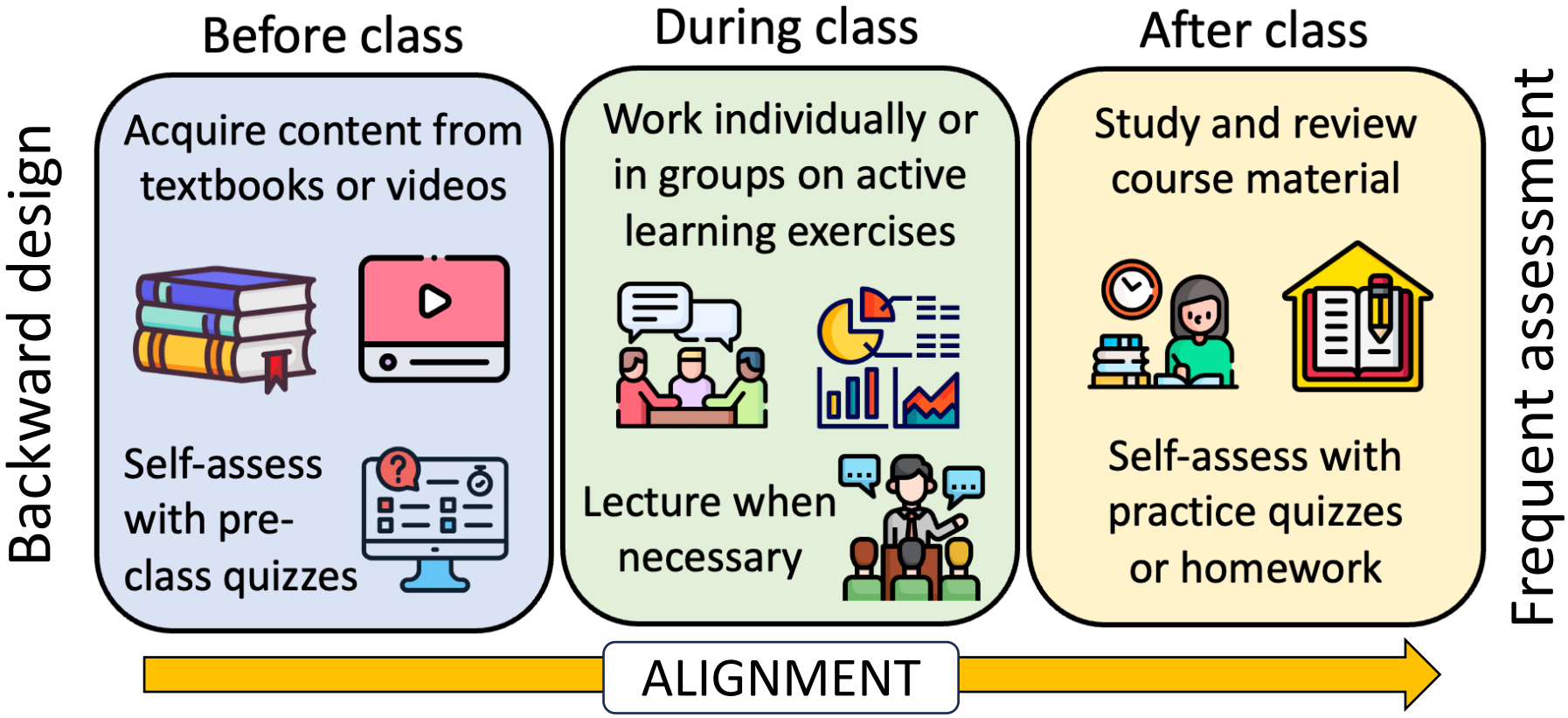
CEE

UNIVERSITY of VIRGINIA

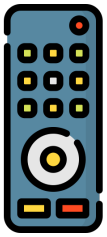
TEACHING HUB

Questions to consider…

- What do you like about high structure? What don't you like?
- How do you think this course design model would be received by your students? Colleagues? Administrators?
- Do you think high structure would work in your discipline? Do you think it would work better in some disciplines than others?
- What resources would you need to implement high structure in your own courses?



What is one word you would use to describe high structure course design?



Type it into iClicker!

Let's think about impact…

Former teaching philosophy

I know that I won't ever find a cure for cancer, but maybe I will inspire a student who will someday do just that

Updated teaching philosophy

I know that I won't ever find a cure for cancer, but maybe I will inspire an instructor who will inspire a student who will someday do just that

Working with passionate faculty like yourselves is key to spreading evidence-based practices and improving student outcomes

Thank you so much!
Happy course designing!

Learn more!

justin@recombinanteducation.com

www.recombinanteducation.com

justin-shaffer

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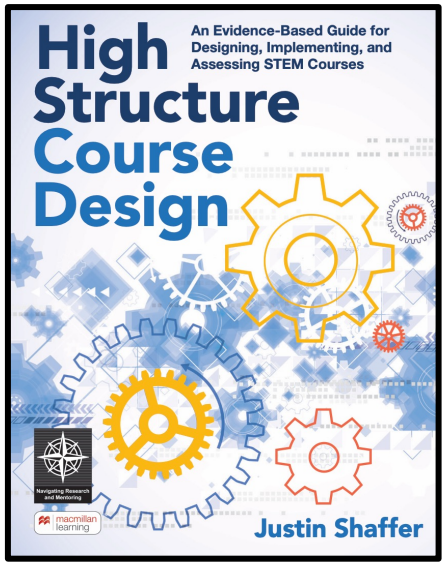

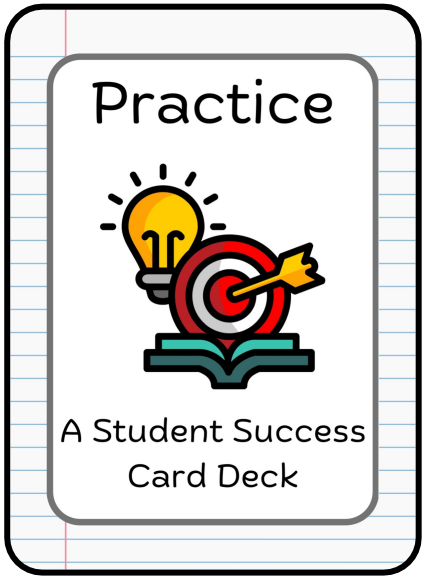

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