CASFER

Center for Advancing Sustainable and Distributed Fertilizer Production

From Laboratory Foundation to Classroom Innovation

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CASE WESTERN RESERVE UNIVERSITY

MIT School of Engineering

NSF

Agenda

- Schedule Update
- Lesson Plan
- 5E Framework

Schedule - Update

- **June 12 - How to Apply to Graduate School by Dr. Ariel Furst (MIT)**
  - Optional
- **June 15 - Lunch with Dr. Botte**
  - TTU Participants
  - 50-minute Weekly Check-in
- **June 17 – 18 – Decision-making, team building, and stress management**
  - RAWLS College of Business

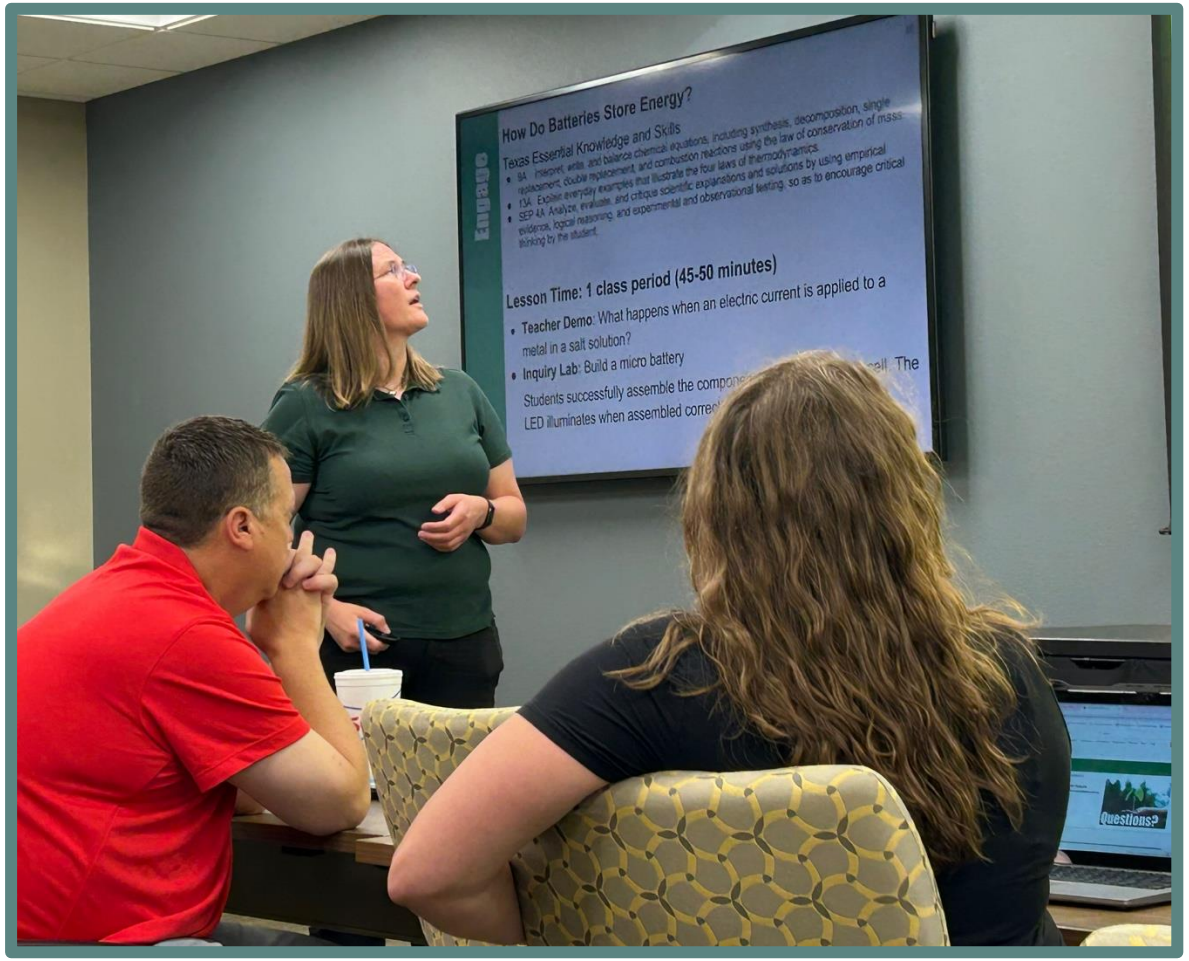
What was the first thing that came into your mind when you heard about CASFER's Research Experience for Teachers?

Research Experience for Teachers (RET)

- Collaboration with faculty/graduate student mentors and fellow trainees
- Attend scheduled seminars (*i.e.*, research, CASFER technology, poster presentation)

Research Experience for Teachers (RET)

- Develop a lesson plan that **translates CASFER's research concepts into K-12 classroom activities**
- Offer **continued professional support** (e.g., coaching) after the RET program



Lesson Plan

- **Final Project** (Educational Component)
- Covers **the research activity or topic from your RET experience**
  - For example: Electrolysis, Forever Chemicals (PFOS and PFAS)
- Presentation day : July 23rd

Lesson Plan

- **Subject and Grade Level**
- **Topic**
- **Lesson Objective(s)**
- ***Curriculum/ Academic Standards** (e.g., TEKS)
- **Duration of the Lesson**
- **Instructional Procedures** based on **5E Framework**
  - Materials for the activity
- **CASFER Alignment:** Describe how this lesson connects to CASFER's research focus areas.

5E Framework

- Engage
- Explore
- Explain
- Elaborate
- Evaluate

Based upon **cognitive psychology, constructivist-learning theory**, and **best practices in science teaching**

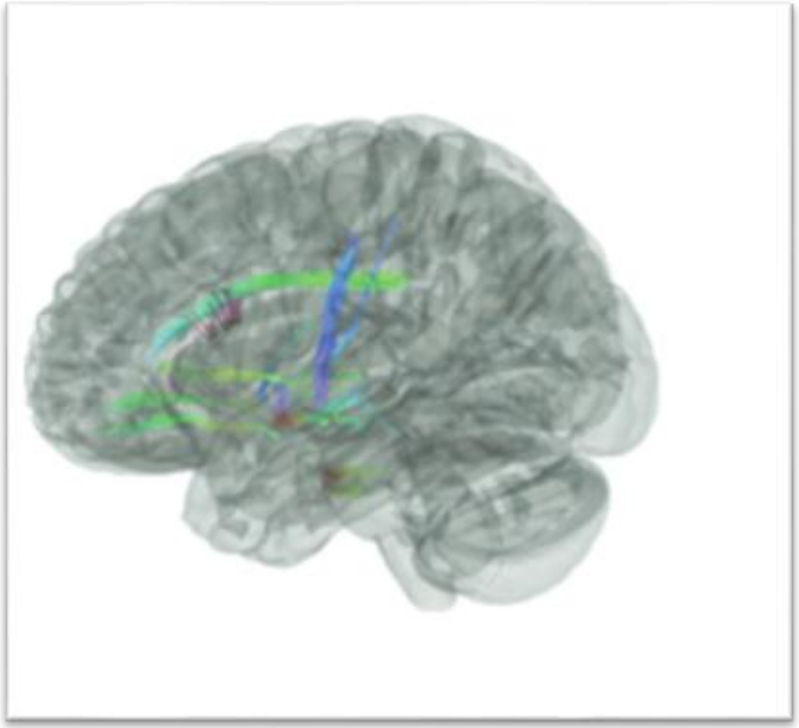
Dr. Rodger Bybee and his Biological Sciences Curriculum Study team (BSCS)

Engage

- Assess students' prior knowledge and/or identify possible misconceptions.
- Examples:
  - Ask questions
  - Homework / assignments
    - Read an article and reflect

Engage

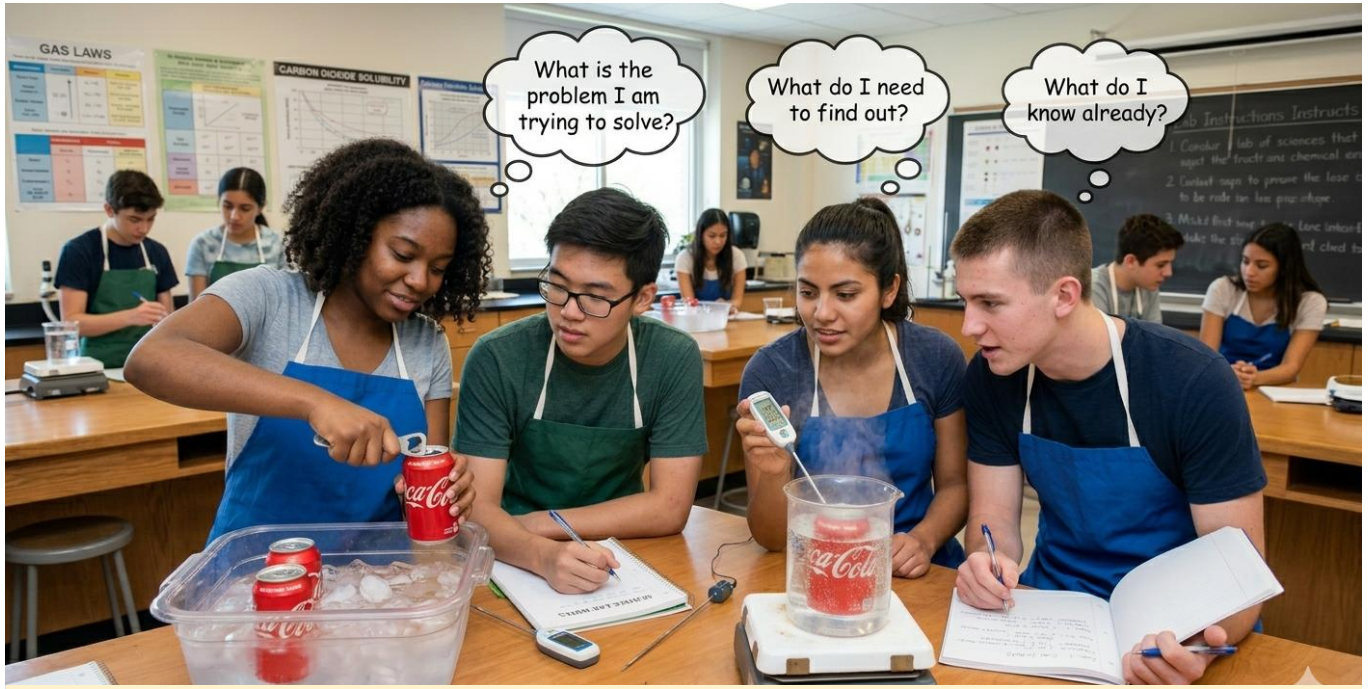
- USC CANDLE – Dr. Mary Helen Immordino-Yang
- **Teens' brain** - undergoing many changes
- **Transcendent thinking** - involves analyzing situations for their deeper meaning, historical context, or civic importance.
- Students **engage in transcendent thinking** and civic reasoning show patterns of **brain growth related to a stronger sense of self and satisfaction in life.**



Source: University of Southern California - Center for Affective Neuroscience, Development, Learning and Education (CANDLE)

Explore

- Teacher provides the students with a common, concrete learning experience
- A unique phase - Students are given a **“hands-on” experience before any formal explanation of concepts**
  - Lab investigation



Source: Google. (2025). Gemini 3.5 Flash [Large language model]. https://gemini.google.com

Which soda, the warm or the cold one, had more dissolved carbon dioxide? List all the ways that you know.

Explain

- Involves **active participation by both teacher and students**
- **Students** must *first have* the opportunity to **express their own explanations and ideas**
- **Teacher introduces scientific** and **technical information**
- Clarification of misconceptions

Source: Google. (2025). Gemini 3.5 Flash [Large language model]. https://gemini.google.com

Elaborate

- Goal: To help students develop **deeper and broader understanding** of the concepts
- Teacher: guide and give students opportunities to practice the application of their **new** knowledge.
  - Classroom activity
  - Homework / assignment (e.g., solve new problems)

Source: Google. (2025). Gemini 3.5 Flash [Large language model]. https://gemini.google.com

Evaluate

Students to reflect on and **demonstrate** their understanding or **mastery of the concepts and skills** that have been explored

- Quiz
- Performance-based assessments
- Portfolio

Source: Google. (2025). Gemini 3.5 Flash [Large language model]. https://gemini.google.com

References

- Duran, L. B., & Duran, E. (2004). The 5E instructional model: A learning cycle approach for inquiry-based science teaching. *Science Education Review*, *3*(2), 49-58.
- Tanner, K. D. (2010). Order matters: using the 5E model to align teaching with how people learn. *CBE—Life Sciences Education*, *9*(3), 159-164.
- How to Use the 5E Model in Your Science Classroom
- How can teachers integrate transcendent thinking and civic reasoning into the classroom?

Images

- pexels.com

Next week

- Weekly Check-in (Monday)
- 10:00 – 10:50 am Central Time
- Hybrid

Think about:

- Grade level you plan to teach (CASFER concept)
- Your first-week experience: What worked, what was challenging?
- Questions or ideas to share with the group
- Let’s support each other

Contact Information

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Connect with us on our socials!

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