Student perspectives on "Successful Science" in a physics CURE and traditional lab course

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Course-based Undergraduate Research Experiences (CUREs)

CUREs provide[1-6]:

+ Research opportunities for entire classes of students
+ Reduction of participation barriers faced in traditional research experiences
+ Similar benefits as participation in traditional undergraduate research opportunities

Five CURE pillars:

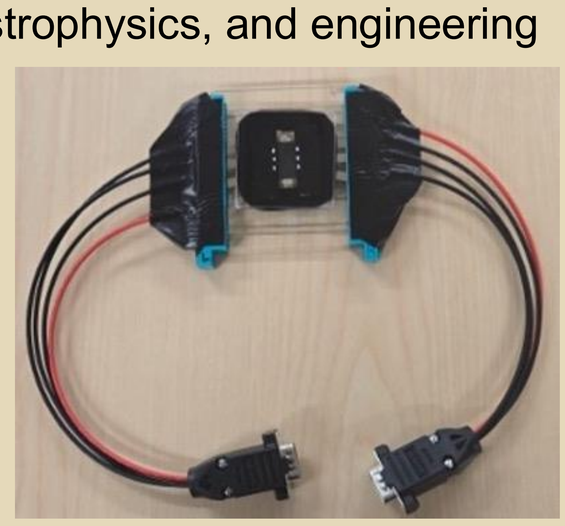
- **Scientific Practices**
- **Discovery**
- **Collaboration**
- **Relevance**
- **Iteration**

Solar Cell CURE

PHYS 2150: Experimental Physics 2

+ One-credit, sophomore-level laboratory course (~200 students/academic year)
+ Required for physics, astrophysics, and engineering physics majors

In collaboration with NREL, U.S. Department of Energy's primary national laboratory for energy systems, students investigate how illumination and temperature affect the performance of perovskite photovoltaics.

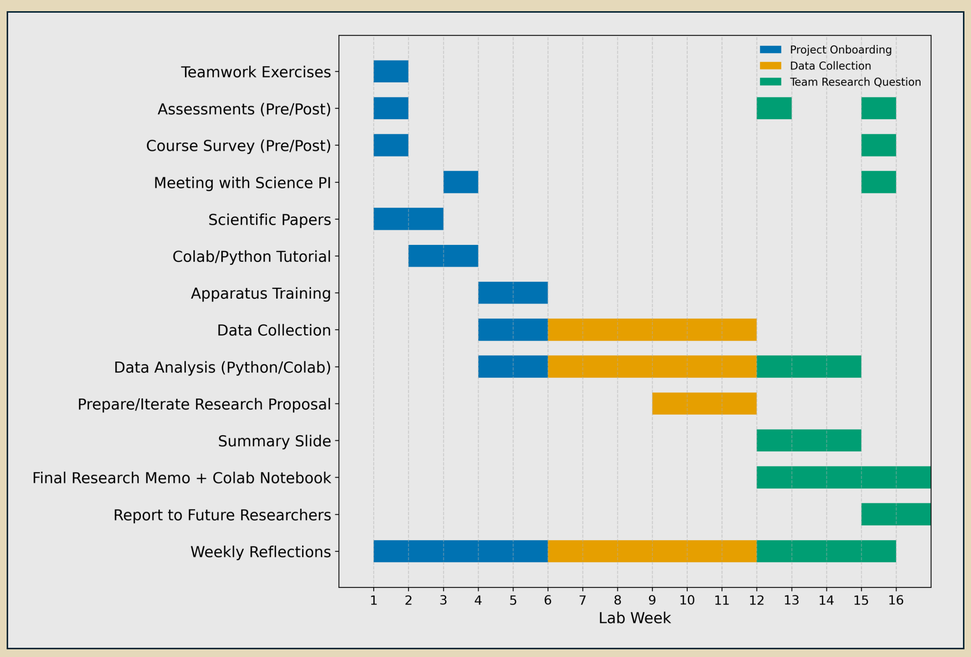


Example of solar cell. Six white dots in the center of the cell packaging are guides to indicate location of pixels.

Course Overview

The course consists of three components:

(1) Project onboarding, **(2)** data collection and analysis, **(3)** investigating team-formulated research question



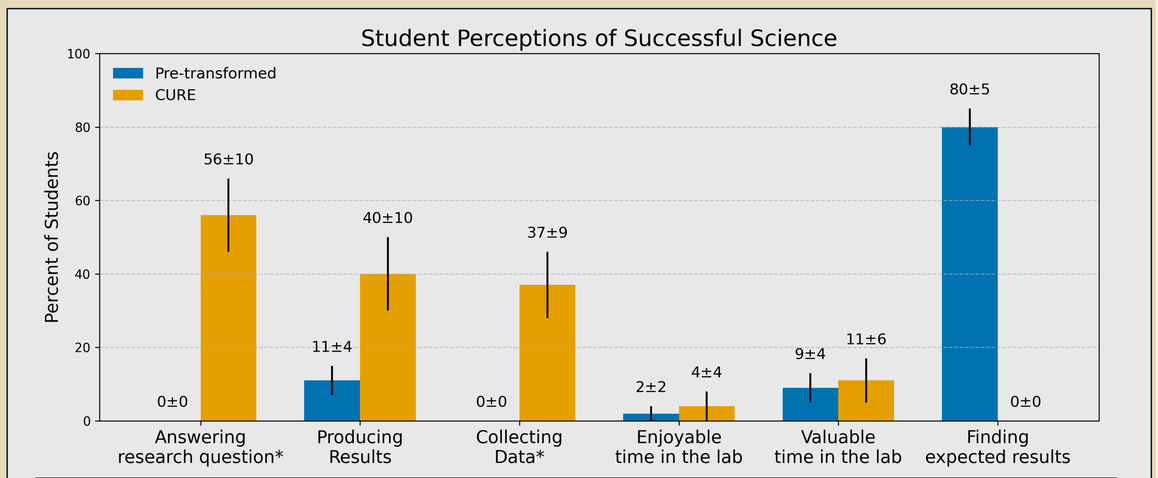
Student views of "Successful Science"

Data Source

End of Semester Reflection Assignment

+ Given to students in pre-transformed course (Sp23, F23, Sp24; N=253) and CURE (F24; N=103)
  + Students responded to nine prompts about their course experiences.
+ Here, we focus on student views of successful science, defined as:
  + ***Successful Science*** *- Producing data or results, experiencing success in experiments, or answering research questions that achieve scientific goals or objectives set by you or your research team*.

Results



The total percentage, with 95% confidence intervals, of student responses coded with each subcode. Codes that were added to the codebook after analyzing CURE data are indicated with an asterisk (*).

CURE

*"**Successful science is any science**. This course is taking measurements and making thorough conclusions based on evidence. That alone is science. Science should not be concerned with categories of successes and failures, but **pathways that all lead forward**. If you come across a dead end, **you still learn something to pass onto others**."*

*"I was a **little disappointed** when the answer to our research question was that the independent variable **had no effect** on the dependent. However, **I learned that a lot of times this is a valid and still important result**. Just because something is constant doesn't mean it isn't helpful...I thought that was a **very true to life** finding."*

Pre-transformed Course

*"I had experiences of successful science in this course. I felt very proud of my work **when we achieved the expected result experimentally** with a good error range."*

*"Seeing our data come together with graphs during data analysis was also a part of this as it helped us see that **we had successfully observed a scientific relationship**."*

Summary

+ Students in the pre-transformed course equated scientific success with **obtaining an expected or "correct" result**, while students in the CURE viewed success more broadly as the process of **collecting data**, **generating results**, and **addressing their team-formulated research question**.

Future Work

+ We will continue to iterate on the solar cell CURE.
+ Future results will contribute to a set of effective practices for instructors to design and implement physics CUREs.

Link to PERC paper, poster, and additional information

Acknowledgements

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References

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