Course-based Undergraduate Research Experiences

CUREs allow one to engage in the process of science through research embedded into the curriculum. This means that the outcome is not pre-determined, the focus is on the process such that students are able to fail “safely” prior to completion of the project. It also affords opportunities to be collaborative through team work and peer review processes. A key component is that it engages outside stakeholders (although who that might be can vary depending on the project, the key is that it’s not just an in-class project).

# Benefits to CUREs:

* Through a student lens - engaging in a project where there is not an already pre-determined outcome tends to motivate students, particularly when they can explore an area of interest or if it helps the larger community. By having this be non-optional (it’s a part of the class), students can safely “try on” the identity of being a scientist, and doing this early in the academic experience can be critical for that identity development. In addition, by shifting the dynamic from instructor and student to co-investigators, it creates an equity frame for the student experience.
* Through a faculty lens - by teaching something without a pre-determined outcome keeps things interesting and fresh, particularly in an introductory level course where it typically involves repetitive content.

# Potential Pitfalls to CUREs:

* From the student perspective - if teamwork dynamics and microaggressions are not addressed, it can lead to further marginalization of already marginalized students (e.g., students of color, neurodivergent students, non-binary students, etc…). When the outcome is not pre-determined, it can mean a null result, which while reflective of the process of science can lead to a decrease in motivation and interest in science for those students.
* From a faculty perspective - to run a CURE smoothly requires time in preparation and careful scaffolding. Faculty who are not fully supported by their institution may feel that the risk-taking of shifting the dynamic of instructor-student is not one that they can take.

# Key Resources:

An excellent guide to walk you through the process: Dolan & Weaver (2021). A guide to course-based undergraduate research: Developing and implementing CUREs in the natural sciences. New York, NY; Macmillan Learning.

Example curriculum, ways to share your own CURES: https://serc.carleton.edu/189618

A deep exploration of the range of CUREs at an introductory level at 2YCs: CURE webinar: <https://nagt.org/248291>

Strategies for addressing microaggressions prior to engaging in group work, the “RAVEN” method: https://www.diverseeducation.com/opinion/article/15106837/how-to-respond-to-racial-microaggressions-when-they-occur

Independent Research

Independent research involves individual students working with a faculty member on a research project. The project can be in the context of a capstone experience or an ongoing opportunity. The experience often follows an apprenticeship model with the faculty member initiating the research question and the student conducting the inquiry.

# Benefits:

* Students get experience working in a research laboratory environment.
* Students work with and develop mentoring relationships with advanced undergraduates, graduate students, post-doctoral scholars and other staff in addition to the faculty member.
* Students are sometimes paid a stipend to participate in research
* Researchers get “another pair of hands” to work on research projects.

# Potential Pitfalls

* Stipends are dependent on faculty or departmental funding.
* Only a small number of students can participate in research at one time under this format
* Unless there is an established program to facilitate connecting students and faculty, this is dependent on faculty or student initiative which can bias the population of students conducting research towards those

# Key Resources:

* Lopatto, (2009). [Science in Solution: The Impact of Undergraduate Research on Student Learning](http://web.grinnell.edu/sureiii/Science_in_Solution_Lopatto.pdf). Tucson, AZ: Research Corporation for Science Advancement.
* A helpful tool for engaging in conversations between peer and mentor: Evaluate-UR: <https://serc.carleton.edu/141500> (Modified version also exists for CUREs)
* Council for Undergraduate Research: Community Board that provides a place to exchange ideas and questions: CUR Community: https://community.cur.org/home

2YC-4YCU Collaborations

Two-year colleges (2YC) are more diverse than most 4-year institutions (4YCU) and as such, have the potential to support a more diverse array of students in participating in research early in their academic career. The transfer process for many students can be a challenge for any of a possible array of academic, social and cultural reasons resulting in a lack of persistence in a given major or even their college goals entirely. Collaborations where students who are still attending 2YC and are able to do undergraduate research at a 4YCU can help to address these issues. This research can be a summer program or integrated throughout the year.

# **Benefits to collaborations:**

* To the students: it is a chance to meet peers and faculty at the potential transfer institution. This can include fostered mentoring to support learning the science and navigating a new campus culture. Students will gain expertise with instrumentation and skills they wouldn’t have otherwise have access to at their 2YC. All of this can help with identity development in both a larger academic construct as well as a science identity which can ultimately help with more successful transfer and persistence. In addition, it can strengthen their academic connections between research and general course content.
* For the faculty: The collaborative potential can inform both the teaching practices and science for 2YC and 4YCU faculty. With better prepared transfer students, it increases the potential major pool (possibly more diverse), who are more ready to jump in from day one of transfer. There is potential for upper division majors to become peer mentors to 2YC students (and 2YC faculty also serving as mentors), thus building skills for all students while fostering a supportive and inclusive environment. There are grant programs that are specifically designated for 2YC-4YCU partnerships that are distinct from other pools of money, but for any grant proposal it can result in solid broader impacts.

# **Potential Pitfalls**

* Students who attend 2YC may not have the same skills that non-transfer students have from the same institution, including math and English. As such, students can be trained, but it may take longer to onboard. Students at 2YC are more likely to have home and work obligations that impede the ability to work traditional lab hours, in addition transportation may also be a challenge - all of these can lead to a perception of lowered motivation. Which is to say, that there are differences in institutional cultures that can lead to misinterpretations and can lead to misunderstandings of how to best support students. It may require more explicit conversations to assure everyone is on the same page - starting with faculty prior to engaging in collaborations.
* Mentoring can be a very powerful component of this type of program, but mentoring requires training and expertise - if not done well, it can cause harm.

# Key Resources:

Some NSF programs that are 2YC specific or require a 2YC as a lead institution include Advancing Technical Education (ATE) and something else?

An amazing array of resources in the appendices: Gamage et al. (2022) Supporting STEM transfer students through cross-institutional undergraduate research experiences, Journal of Geoscience Education, 70:3, 339-353, DOI: [10.1080/10899995.2021.2005510](https://doi.org/10.1080/10899995.2021.2005510)

Research Experiences for Undergraduates (REUs)

Summer research experiences at institutions around the country. Many are funded by the National Science Foundation and they generally last between 6 and 10 weeks. Students are paid to work with a faculty mentor on a research project. The programs are run independently and each have their own structure and requirements. Some are aimed specifically at students from two-year colleges or who are early in their undergraduate careers.

# Benefits of REUs:

* Formal structure of engagement between students and faculty mentors
* A cohort of students working with different mentors that can provide social support and expands the network of peers and mentors
* Students receive stipends and usually some allowance for room, board, and travel.

# Potential Pitfalls

* Extended time away from home is difficult or impossible for some students.
* Positions are limited in each REU program so students must apply to participate and meet eligibility requirements.

# Key Resources:

* [NSF REU Information for Students](https://www.nsf.gov/crssprgm/reu/) - NSF provides a searchable database of REU programs they fund to help students and faculty find appropriate programs.
* Great example of a “pre”-REU as a creative way of thinking about starting an REU earlier than many: Donna J. Charlevoix, Aisha R. Morris, Kelsey Russo-Nixon & Heather Thiry (2022) Engaging two-year college students in geoscience: Summer Pre-REU internships and professional development to prepare students for participation in research, Journal of Geoscience Education, 70:3, 323-338, DOI: [10.1080/10899995.2021.1977770](https://doi.org/10.1080/10899995.2021.1977770)