CURE (Course-based Undergraduate Research Experience)

Courses that provide opportunities for students to practice science by doing what scientists do.

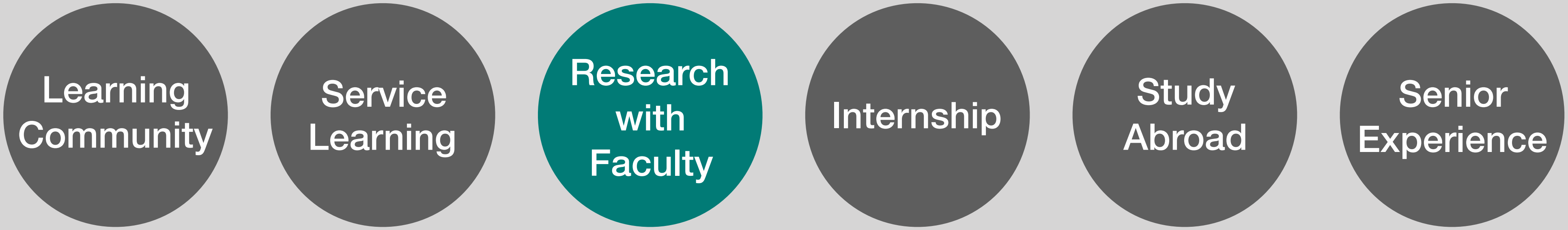
Entering university for STEM

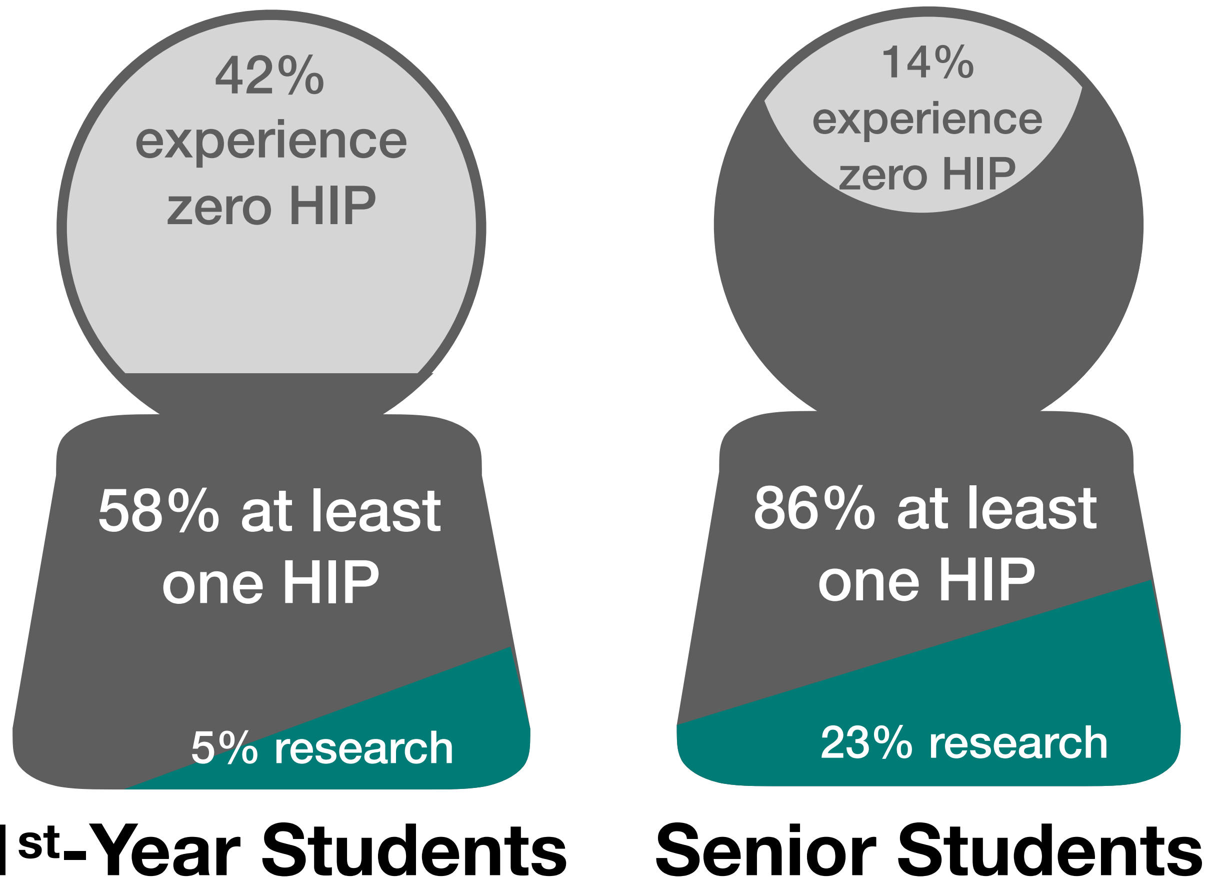
< 50% graduate in STEM

“In many cases, these …are capable students who **could have made valuable additions to the STEM workforce.**”

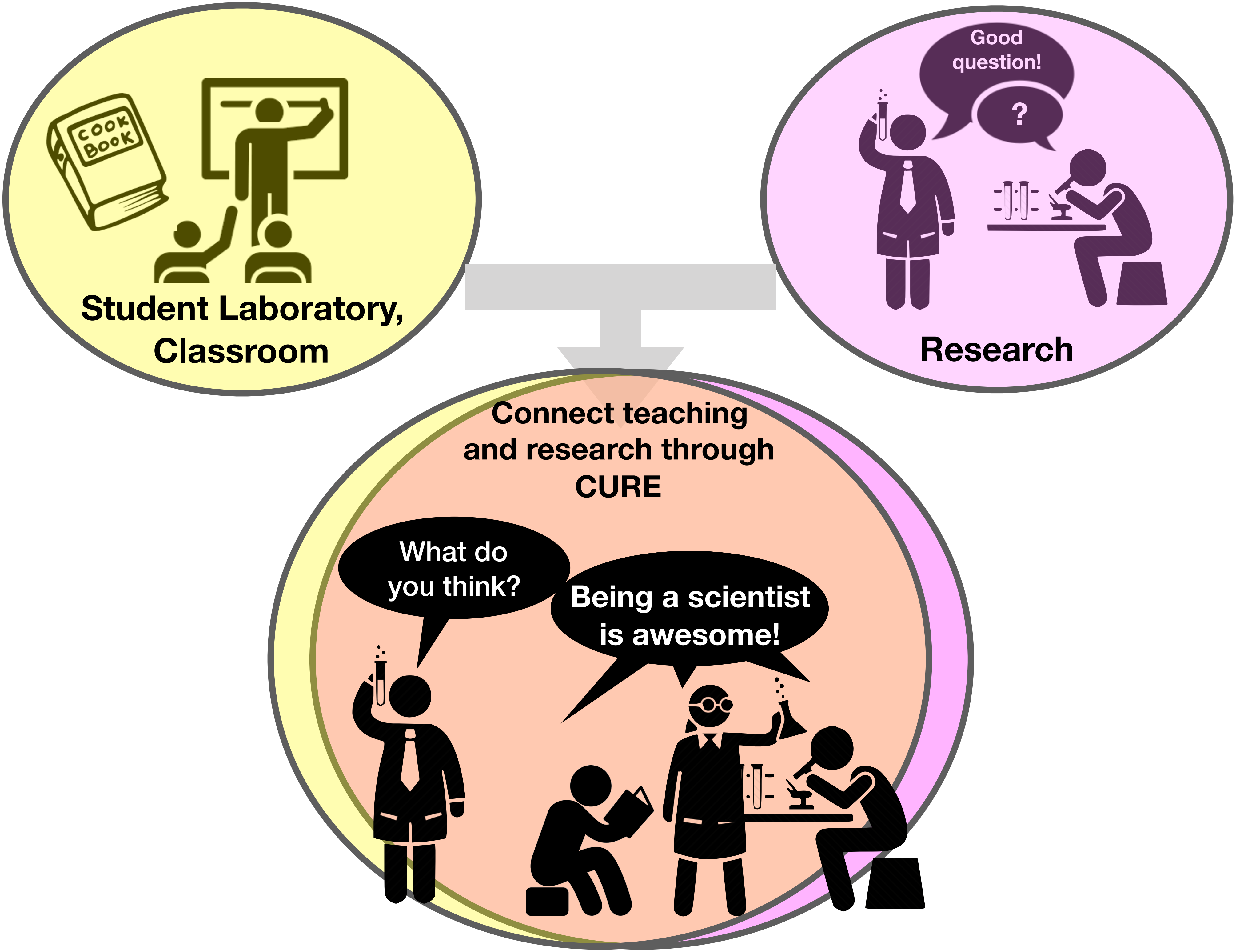
(Aulck et. al 2017)

High-Impact Practices (HIP) are “*enriching educational experiences that can be* ***life-changing***.”





(National Survey of Student Engagement, 2018 High-Impact Practices, U.S. Summary)


COOK BOOK
Student Laboratory, Classroom
Good question!
?
Research
Connect teaching and research through CURE
What do you think?
Being a scientist is awesome!

CUREs compared to traditional research internship

	CURE	Tradition Research
Scale	Many	Few
Mentorship Structure	One to Many	One to one
Enrollment	Open to all students in a course	Open to a select few students (often self-
Setting	Teaching lab	Research Lab
Mentoring	Consistent / Structured	Varied

(Auchincloss et al., 2014)

Think & work like a scientist	**+**	+
Identify as a scientist	+	**+**
Confidence	+	+
Interest in STEM	+	+
Career/Grad preparation	+	**+**
Skills	**+**	+

(Olivares-Donoso et al., 2019)

The CURE (Course-based Undergraduate Research Experience)

SCIENTIFIC PRACTICES

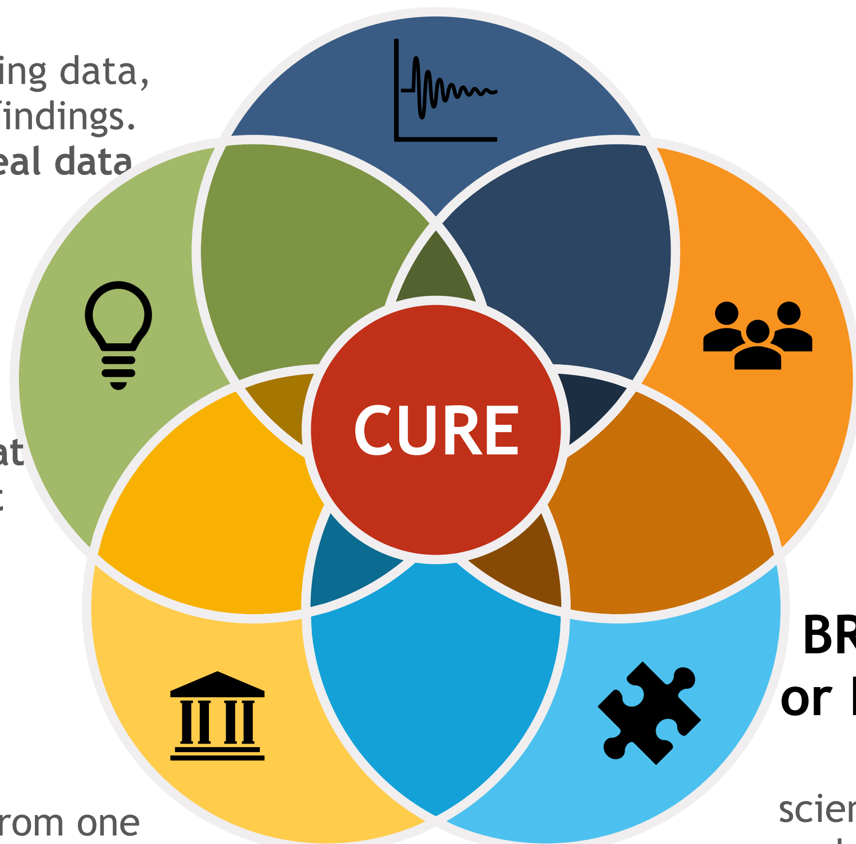
Formulating hypotheses, Collecting data, analyzing data, communicating findings. **Coping with the messiness of real data**

DISCOVERY

Discovery of **new knowledge that is unknown to both the student and instructor.**

ITERATION

Iterative process in which data from one experiment is used to design or guide a subsequent one.



COLLABORATION

Collaboration between students within and between teams.

BROADLY RELEVANT or IMPORTANT WORK

Student work fits into a broader scientific endeavor that has meaning beyond the particular coursework context.

(Auchincloss et al., 2014)

Think, pair, share

AND…What other reasons are there to teach a CURE?

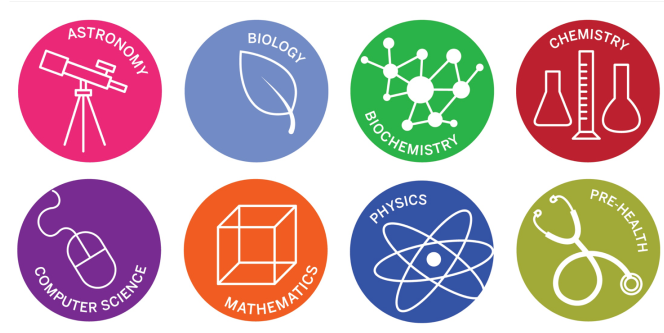
(other than increased access to research)

CURE = Whole classes of students address a research question that has relevance to a community beyond the classroom (most often a specific academic community).

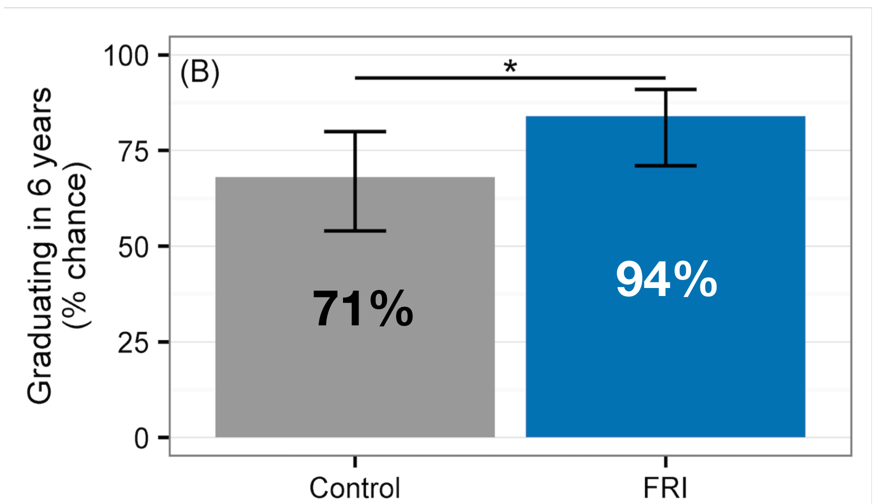
1. CUREs increase retention in STEM

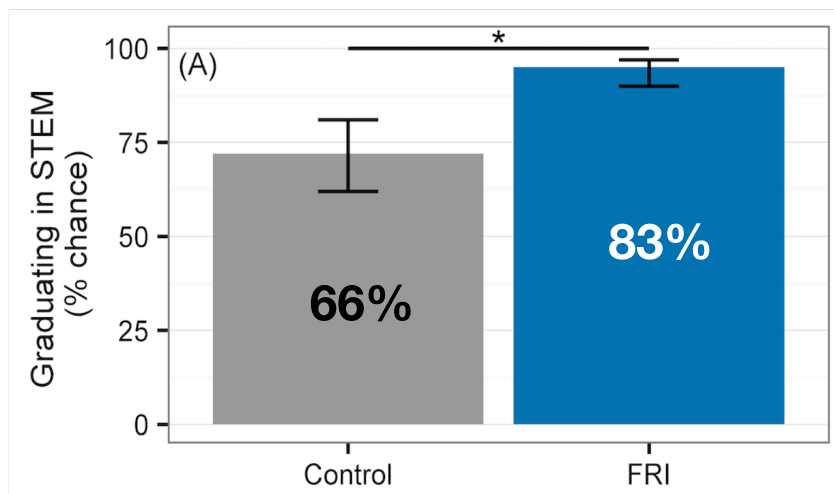
The University of Texas at Austin
Freshman Research Initiative
College of Natural Sciences

Case Study
- Multiple research “streams”
- Drew on faculty members’ work
- Ongoing research projects
- Managed by a “research educator” (postdoc)
- Two-semester-long CUREs



FRI students are more likely to graduate and more likely to graduate with a STEM degree

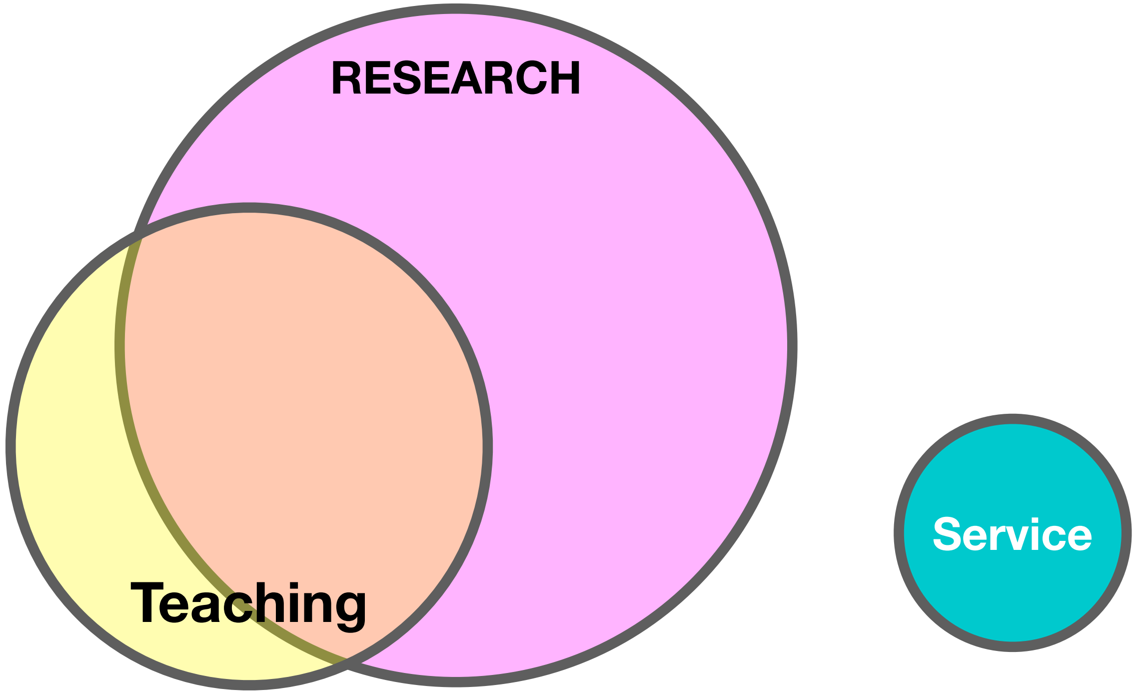




Effect is the same for students from ALL backgrounds

(Rodenbusch et al., 2016)

2. The instructor benefits



Faculty who teach CUREs do it because they

- Want to connect their teaching to research (76%)
- Enjoy it (74%)
- Do it for promotion and tenure (74%)
- Find it helps them to publish more (61%)
- Increases their research productivity (61%)
- Find it personally satisfying (47%)

Shortlidge et al., 2016 Interview study (N=38)

3. The scientific community benefits

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Fungal Genet Biol. Author manuscript; available in PMC 2017 April 01.

Published in final edited form as:
Fungal Genet Biol. 2016 April ; 89: 18–28. doi:10.1016/j.fgb.2016.01.012.

Highly Cited Paper

Comprehensive curation and analysis of fungal biosynthetic gene clusters of published natural products

Yong Fuga Li[1,6], Kathleen J. S. Tsai[2], Colin J. B. Harvey[1], James Jian Li[1], Beatrice E. Ary[2], Erin E. Berlew[2], Brenna L. Boehman[2], David M. Findley[2], Alexandra G. Friant[3], Christopher A. Gardner[4], Michael P. Gould[2], Jae H. Ha[3], Brenna K. Lilley[4], Emily L. McKinstry[2], Saadia Nawal[2], Robert C. Parry[2], Kristina W. Rothchild[2], Samantha D. Silbert[3], Michael D. Tentilucci[2], Alana M. Thurston[2], Rebecca B. Wai[2], Yongjin Yoon[2], Raeka S. Aiyar[1], Marnix H. Medema[5], Maureen E. Hillenmeyer[1], and Louise K. Charkoudian[2]

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Chemistry, Haverford Coll…

High Energy Density Physics 9 (2013) 82–90

Contents lists available at SciVerse ScienceDirect

High Energy Density Physics

journal homepage: www.elsevier.com/locate/hedp

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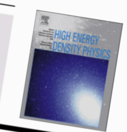

An experimental platform for creating white dwarf photospheres in the laboratory

Ross E. Falcon [a,b,*], G.A. Rochau [b], J.E. Bailey [b], J.L. Ellis [a], A.L. Carlson [b], T.A. Gomez [a], M.H. Montgomery [a], D.E. Winget [a], E.Y. Chen [a], M.R. Gomez [b], T.J. Nash [b]

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ARTICLE INFO

Article history:
Received 2 June 2012
Received in revised form
18 October 2012
Accepted 24 October 2012
Available online 1 November 2012

Keywords:
Laboratory experiments
Astrophysics
Hydrogen line profiles
Stellar atmospheres
White dwarf stars

ABSTRACT

We present an experimental platform for measuring hydrogen Balmer emission and absorption line profiles for plasmas with white dwarf (WD) photospheric conditions ($T_e \sim 1$ eV, $n_e \sim 10^{17}$ cm^{-3}). These profiles will be used to benchmark WD atmosphere models, which, used with the spectroscopic method, are responsible for determining fundamental parameters (e.g., effective temperature, mass) for tens of thousands of WDs. Our experiment, performed at the Z Pulsed Power Facility at Sandia National Laboratories, uses the large amount of X-rays generated from a z-pinch dynamic hohlraum to drive plasma formation in a gas cell. The platform is unique compared to past hydrogen line profile experiments in that the plasma is radiation-driven. This decouples the heating source from the plasma to be studied in the sense that the radiation temperature causing the photoionization is ind… conditions of the gas. For the first time we measure hydr… conditions in the laboratory for the purpose… can be used to study oth… atomic li…

Note

pubs.acs.org/joc

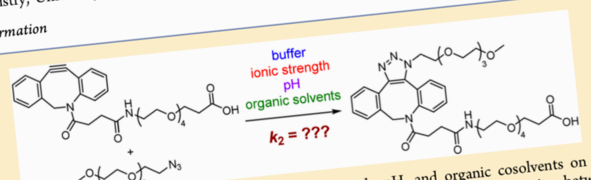
JOC The Journal of Organic Chemistry

Effect of Buffer Conditions and Organic Cosolvents on the Rate of Strain-Promoted Azide–Alkyne Cycloaddition

Derek L. Davis,‡ Erin K. Price,‡ Sabrina O. Aderibigbe, Maureen X.-H. Larkin, Emmett D. Barlow, Renjie Chen, Lincoln C. Ford, Zackery T. Gray, Stephen H. Green, Yuwei Jin, Keith S. Keddington, Alexandra D. Kent, Dasom Kim, Ashley Lewis, Rami S. Marrouche, Mark K. O'Dair, Daniel R. Powell, Mick'l H. C. Scadden, Curtis B. Session, Jifei Tao, Janelle Trieu, Kristen N. Whiteford, Zheng Yuan, Goyeun Yun, Judy Zhu, and Jennifer M. Heemstra*

Department of Chemistry, University of Utah, Salt Lake City, Utah 84112, United States

Supporting Information



ABSTRACT: We investigate the effect of buffer identity, ionic strength, pH, and organic cosolvents on the rate of strain-promoted azide–alkyne cycloaddition with the widely used DIBAC cyclooctyne. The rate of reaction between DIBAC and a hydrophilic azide is highly tolerant to changes in buffer conditions but is impacted by organic cosolvents. Thus, bioconjugation reactions using DIBAC can be carried out in the buffer that is most compatible with the biomolecules being labeled, but the use of organic cosolvents should be carefully considered.

…the kinetics of DIBAC reactions are highly tolerant to … impacted by organic

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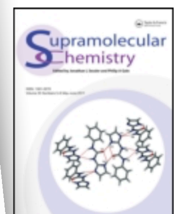
…doi/10.1021/acs.joc.6b01112.



Supramolecular Chemistry

Taylor & Francis

ISSN: 1061-0278 (Print) 1029-0478 (Online) Journal homepage: https://www.tandfonline.com/loi/gsch20

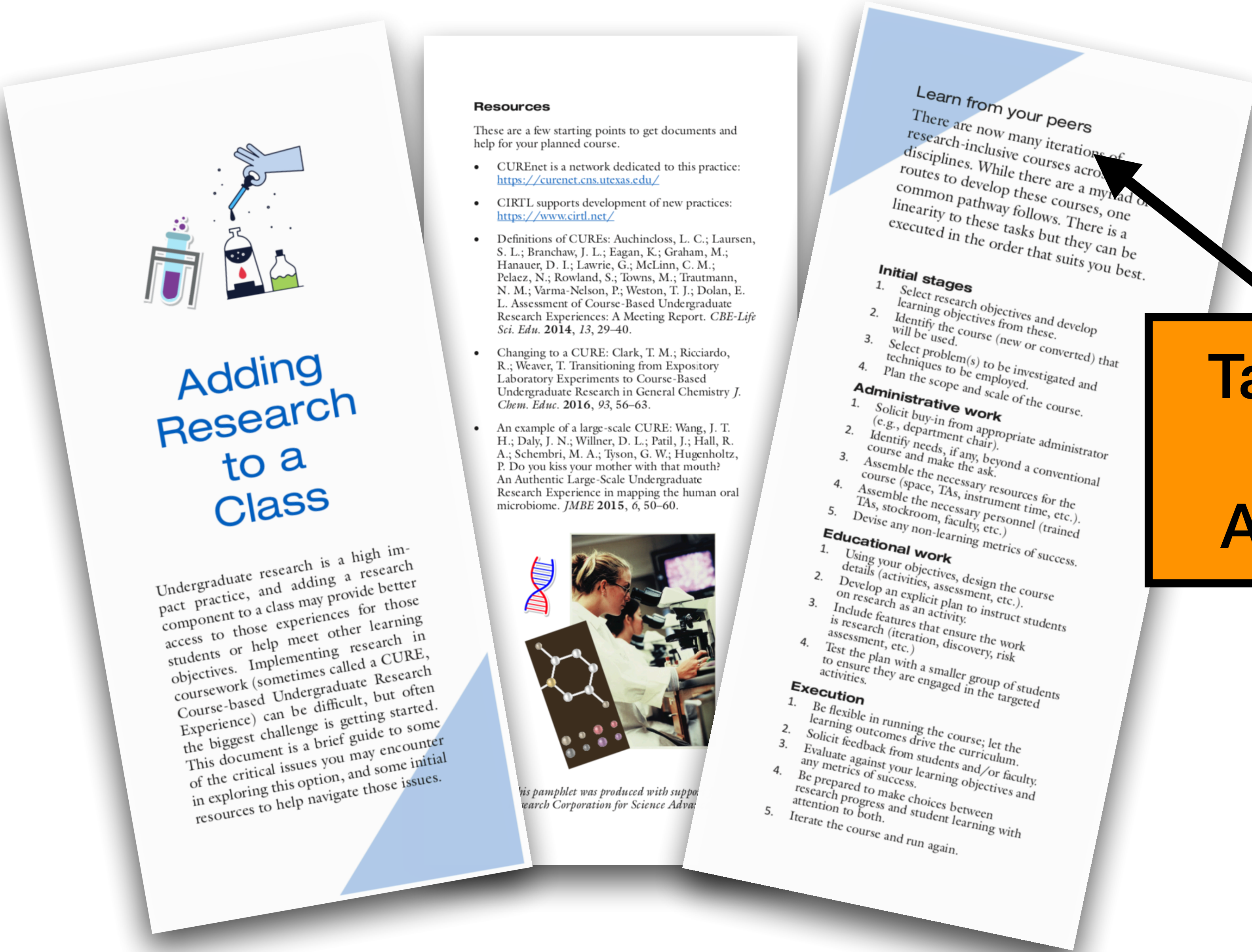
Pattern-based discrimination of organic acids and red wine varietals by arrays of synthetic receptors

Lauren T. Gallagher , Jae Seok Heo , Matthew A. Lopez , Brenton M. Ray , Jennifer Xiao , Alona P. Umali , Anna Zhang , Sunanda Dharmarajan , Hildegarde Heymann & Eric V. Anslyn

To cite this article: Lauren T. Gallagher , Jae Seok Heo , Matthew A. Lopez , Brenton M. Ray , Jennifer Xiao , Alona P. Umali , Anna Zhang , Sunanda Dharmarajan , Hildegarde Heymann & Eric V. Anslyn (2012) Pattern-based discrimination of organic acids and red wine varietals by arrays of synthetic receptors, Supramolecular Chemistry, 24:2, 143-148, DOI: 10.1080/10610278.2011.638379

To link to this article: https://doi.org/10.1080/10610278.2011.638379

How to get started



Adding Research to a Class

Undergraduate research is a high impact practice, and adding a research component to a class may provide better access to those experiences for those students or help meet other learning objectives. Implementing research in coursework (sometimes called a CURE, Course-based Undergraduate Research Experience) can be difficult, but often the biggest challenge is getting started. This document is a brief guide to some of the critical issues you may encounter in exploring this option, and some initial resources to help navigate those issues.

Resources

These are a few starting points to get documents and help for your planned course.

- CUREnet is a network dedicated to this practice: https://curenet.cns.utexas.edu/
- CIRTL supports development of new practices: https://www.cirtl.net/
- Definitions of CUREs: Auchincloss, L. C.; Laursen, S. L.; Branchaw, J. L.; Eagan, K.; Graham, M.; Hanauer, D. I.; Lawrie, G.; McLinn, C. M.; Pelaez, N.; Rowland, S.; Towns, M.; Trautmann, N. M.; Varma-Nelson, P.; Weston, T. J.; Dolan, E. L. Assessment of Course-Based Undergraduate Research Experiences: A Meeting Report. *CBE-Life Sci. Edu.* **2014**, *13*, 29–40.
- Changing to a CURE: Clark, T. M.; Ricciardo, R.; Weaver, T. Transitioning from Expository Laboratory Experiments to Course-Based Undergraduate Research in General Chemistry *J. Chem. Educ.* **2016**, *93*, 56–63.
- An example of a large-scale CURE: Wang, J. T. H.; Daly, J. N.; Willner, D. L.; Patil, J.; Hall, R. A.; Schembri, M. A.; Tyson, G. W.; Hugenholtz, P. Do you kiss your mother with that mouth? An Authentic Large-Scale Undergraduate Research Experience in mapping the human oral microbiome. *JMBE* **2015**, *6*, 50–60.

...is pamphlet was produced with suppo... ...earch Corporation for Science Adva...

Learn from your peers

There are now many iterations of research-inclusive courses acro... disciplines. While there are a myriad o... routes to develop these courses, one common pathway follows. There is a linearity to these tasks but they can be executed in the order that suits you best.

Initial stages

1. Select research objectives and develop learning objectives from these.
2. Identify the course (new or converted) that will be used.
3. Select problem(s) to be investigated and techniques to be employed.
4. Plan the scope and scale of the course.

Administrative work

1. Solicit buy-in from appropriate administrator (e.g., department chair).
2. Identify needs, if any, beyond a conventional course and make the ask.
3. Assemble the necessary resources for the course (space, TAs, instrument time, etc.).
4. Assemble the necessary personnel (trained TAs, stockroom, faculty, etc.)
5. Devise any non-learning metrics of success.

Educational work

1. Using your objectives, design the course details (activities, assessment, etc.).
2. Develop an explicit plan to instruct students on research as an activity.
3. Include features that ensure the work is research (iteration, discovery, risk assessment, etc.)
4. Test the plan with a smaller group of students to ensure they are engaged in the targeted activities.

Execution

1. Be flexible in running the course; let the learning outcomes drive the curriculum.
2. Solicit feedback from students and/or faculty.
3. Evaluate against your learning objectives and any metrics of success.
4. Be prepared to make choices between research progress and student learning with attention to both.
5. Iterate the course and run again.

Talk about it!!

&

Ask for help.

Some peers who use CURE....