

Supplemental Material

*CBE—Life Sciences Education*

Buchanan *et al.*

Appendix A: Summary of CUREs and CURE-like activities published between 2000-2020 and assessed for this review. All CUREs are listed by author(s) and include year of publication, subdiscipline, course level, and the CURE components included in the curriculum.

| Authors                     | Year | Discipline   | Subdiscipline     | Level (Intro or Advanced) | Academic Year      | Length     | Explicitly Described as CURE | Use of Science Practices | Discovery | Relevance | Collaboration | Iteration | Students Develop the Research Question | Students Design the Methodology | Students Review Primary Literature | Students Disseminate the Results |
|-----------------------------|------|--------------|-------------------|---------------------------|--------------------|------------|------------------------------|--------------------------|-----------|-----------|---------------|-----------|--|---------------------------------|------------------------------------|----------------------------------|
| Odom & Grosse               | 2002 | Biology      | Molecular         | Advanced                  | Sophomore & Higher | 8 weeks    | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | Yes                                | No                               |
| Caspers & Roberts-Kirchhoff | 2003 | Biochemistry | Biochemistry      | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Griffin et al.              | 2003 | Biology      | Genetics          | Advanced                  | Sophomore & Higher | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | Yes                                | No                               |
| Gammie & Erdeniz            | 2004 | Biology      | Molecular         | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | Yes                             | Yes                                | No                               |
| Rasche                      | 2004 | Biology      | Microbiology      | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | Yes                             | Yes                                | Yes                              |
| Chen et al.                 | 2005 | Biology      | Genetics          | Introductory              | Freshman/Sophomore | 1 semester | No                           | Yes                      | Yes       | Yes       | No            | Yes       | No                                     | No                              | Yes                                | Yes                              |
| Gonzales & Semken           | 2006 | Geosciences  | Geosciences       | Advanced                  | All                | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Newton et al.               | 2006 | Chemistry    | Organic           | Advanced                  | Sophomore & Higher | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | Yes                             | Yes                                | No                               |
| Snellman et al.             | 2006 | Biology      | Ecology           | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Snellman et al.             | 2006 | Biology      | Molecular         | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Goyette & DeLuca            | 2007 | Biology      | Immunology        | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | No                               |
| Kerfeld & Simons            | 2007 | Biology      | Genetics          | Advanced                  | All                | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | No                                 | Yes                              |
| Kushner                     | 2007 | Biology      | Microbiology      | Advanced                  | Sophomore & Higher | 6 weeks    | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | No                                 | No                               |
| Van Engelen et al.          | 2007 | Chemistry    | Chemistry         | Advanced                  | All                | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | No                               |
| Brame et al.                | 2008 | Biology      | Genetics          | Advanced                  | Sophomore & Higher | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | No                               |
| Drew & Triplett             | 2008 | Biology      | Genetics          | Advanced                  | Sophomore & Higher | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | Yes                                | Yes                              |
| Ford et al.                 | 2008 | Chemistry    | Introductory      | Introductory              | Freshman           | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | No                              | No                                 | Yes                              |
| Hingamp et al.              | 2008 | Biology      | Genetics          | Advanced                  | Junior             | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | No                                 | No                               |
| Lopatto et al.              | 2008 | Biology      | Genetics          | Advanced                  | Sophomore & Higher | varies     | Yes                          | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | No                              | Yes                                | Yes                              |
| Marcus et al.               | 2010 | Biology      | Genetics          | Introductory              | Freshman           | 1 semester | No                           | Yes                      | Yes       | Yes       | No            | Yes       | Yes                                    | No                              | Yes                                | Yes                              |
| Parra et al.                | 2010 | Interdisc.   | Interdisciplinary | Advanced                  | Junior/Senior      | 10 weeks   | No                           | Yes                      | Yes       | Yes       | No            | Yes       | No                                     | Yes                             | Yes                                | Yes                              |
| Ault et al.                 | 2011 | Biology      | Genetics          | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | No                                     | Yes                             | Yes                                | No                               |
| Caccavo                     | 2011 | Biology      | Microbiology      | Advanced                  | Sophomore & Higher | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | No                               |
| Gardner et al.              | 2011 | Biology      | Introductory      | Introductory              | Freshman           | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Iimoto & Frederick          | 2011 | Chemistry    | Chemistry         | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Sargent Jones et al.        | 2011 | Biology      | Neurobiology      | Advanced                  | Junior/Senior      | 1 semester | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | Yes                             | Yes                                | Yes                              |
| Kloser et al.               | 2011 | Biology      | Ecology           | Introductory              | Freshman           | 10 weeks   | No                           | Yes                      | Yes       | Yes       | Yes           | Yes       | Yes                                    | No                              | No                                 | Yes                              |





|                       |      |               |              |              |                        |            |     |     |     |     |     |     |     |     |     |     |
|-----------------------|------|---------------|--------------|--------------|------------------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Witherow              | 2016 | Biochemistry  | Biochemistry | Advanced     | Junior/<br>Senior      | 10 weeks   | No  | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | No  |
| Chase et al.          | 2017 | Chemistry     | Introductory | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes | Yes | Yes |
| Cookmeyer et al.      | 2017 | Biochemistry  | Biochemistry | Advanced     | Sophomore &<br>Higher  | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Elgin et al.          | 2017 | Biology       | Genetics     | Advanced     | Sophomore &<br>Higher  | varies     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes |
| Flaherty et al.       | 2017 | Biology       | Ecology      | Advanced     | Junior/<br>Senior      | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Galush et al.         | 2017 | Biology       | Marine       | Advanced     | Sophomore &<br>Higher  | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Goudsouzian et al.    | 2017 | Biology       | Molecular    | Advanced     | Sophomore &<br>Higher  | 6 weeks    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Hekmat-Scafe et al.   | 2017 | Biology       | Molecular    | Introductory | Freshman               | 10 weeks   | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes |
| Kappler et al.        | 2017 | Biology       | Genetics     | Advanced     | Junior/<br>Senior      | 9 weeks    | No  | Yes | Yes | Yes | Yes | Yes | No  | No  | No  | Yes |
| Lefurgy & Mundorff    | 2017 | Biochemistry  | Biochemistry | Advanced     | Junior/<br>Senior      | 1 semester | No  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Lipchock et al.       | 2017 | Biochemistry  | Biochemistry | Advanced     | Junior/<br>Senior      | 10 weeks   | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | No  | No  |
| McDonough et al.      | 2017 | Biology       | Genetics     | Advanced     | Sophomore &<br>Higher  | varies     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes |
| McLaughlin & Patel    | 2017 | Biology       | Molecular    | Introductory | Freshman/<br>Sophomore | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mordacq et al.        | 2017 | Biology       | Introductory | Introductory | Freshman               | 9 weeks    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Mordacq et al.        | 2017 | Biology       | Introductory | Introductory | Freshman               | 9 weeks    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Peteroy-Kelley et al. | 2017 | Biology       | Molecular    | Advanced     | Sophomore &<br>Higher  | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Peteroy-Kelley et al. | 2017 | Biology       | Genetics     | Advanced     | Sophomore &<br>Higher  | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Walsh et al.          | 2017 | Biology       | Molecular    | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes | No  |
| Adkins et al.         | 2018 | Biology       | Microbiology | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | No  |
| Al-Ghadhban et al.    | 2018 | Engineering   | Engineering  | Advanced     | Junior/<br>Senior      | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Ayella & Beck         | 2018 | Biochemistry  | Biochemistry | Advanced     | Junior/<br>Senior      | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bhatt & Challa        | 2018 | Biology       | Genetics     | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bergstrom et al.      | 2018 | Biology       | Neurobiology | Advanced     | Junior/<br>Senior      | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Chand et al.          | 2018 | Biology       | Ecology      | Advanced     | Junior/<br>Senior      | 1 semester | No  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Chen                  | 2018 | Chemistry     | Introductory | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Eslinger et al.       | 2018 | Biology       | Microbiology | Introductory | All                    | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | No  |
| Fisher et al.         | 2018 | Biology       | Introductory | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Fyock et al.          | 2018 | Engineering   | Engineering  | Advanced     | Sophomore &<br>Higher  | 1 semester | Yes | Yes | No  | Yes | Yes | Yes | No  | No  | No  | No  |
| Gin et al.            | 2018 | Biology       | Forensics    | Advanced     | All                    | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | Yes | No  |
| Hotaling et al.       | 2018 | Biology       | Genetics     | Introductory | Freshman               | 7 weeks    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  |
| Kinner & Lord         | 2018 | Geosciences   | Geosciences  | Advanced     | All                    | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Laungani et al.       | 2018 | Biology       | Ecology      | Introductory | Freshman               | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Lee & Burnett         | 2018 | Food Sciences | Sciences     | Advanced     | Junior/<br>Senior      | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes | No  |
| May et al.            | 2018 | Chemistry     | Chemistry    | Introductory | Freshman/<br>Sophomore | 1 semester | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes |





|                          |      |                  |                                     |              |                    |             |     |     |     |     |     |     |     |     |     |     |
|--------------------------|------|------------------|-------------------------------------|--------------|--------------------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Duggan et al.            | 2020 | Biology          | Ecology, Behavior                   | Advanced     | Junior/Senior      | varies      | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Elkins & Zeller          | 2020 | Biology          | Forensic                            | Advanced     | Junior/Senior      | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fey et al.               | 2020 | Biology          | Ecology                             | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fey et al.               | 2020 | Interdisc.       | Environmental Science               | Advanced     | Junior/Senior      | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fuentes & Entezari       | 2020 | Biology          | Introductory                        | Introductory | Freshman           | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Furrow et al.            | 2020 | Biology          | Microbiology                        | Introductory | Freshman           | 10 weeks    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Gastreich                | 2020 | Biology          | Conservation                        | Advanced     | Junior/Senior      | 8-10 weeks  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Goller & Ott             | 2020 | Biology          | Genetics                            | Advanced     | Junior/Senior      | 8 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Good                     | 2020 | Biology          | Genetics                            | Advanced     | Junior/Senior      | 1 semester  | Yes | Yes | Yes | Yes | No  | Yes | Yes | Yes | Yes | Yes |
| Hamid                    | 2020 | Computer Science | Computer Science                    | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Hariyono et al.          | 2020 | Interdisc.       | Physics, Geosciences                | Introductory | All                | 1 semester  | No  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Haskew-Layton & Minkler  | 2020 | Biology          | Cellular                            | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Heller et al.            | 2020 | Chemistry        | Organic                             | Advanced     | Sophomore & Higher | 7 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Hills et al.             | 2020 | Biology          | Molecular                           | Advanced     | Senior             | 12 weeks    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Himmel et al.            | 2020 | Biology          | Neuroscience                        | Introductory | Freshman/Sophomore | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Hurst-Kennedy et al.     | 2020 | Biology          | Cellular                            | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | No  |
| Kissel                   | 2020 | Chemistry        | General                             | Introductory | Freshman           | 6 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Kruchten                 | 2020 | Biology          | Microbiology                        | Advanced     | Sophomore & Higher | 8 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes |
| Lyles & Oli              | 2020 | Biology          | Microbiology                        | Advanced     | Sophomore & Higher | 6 weeks     | Yes | Yes | Yes | Yes | Yes | No  | No  | No  | Yes | No  |
| Malotky et al.           | 2020 | Interdisc.       | Biology, Social Work, Public Health | Introductory | All                | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | Yes | Yes |
| Marsiglia et al.         | 2020 | Biochemistry     | Biochemistry                        | Advanced     | Junior/Senior      | 2 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | Yes | No  |
| Martinez-Vaz & Mickelson | 2020 | Biology          | Genetics                            | Advanced     | Junior/Senior      | 6 weeks     | No  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Ortiz et al.             | 2020 | Biology          | Wildlife Management                 | Introductory | All                | 8 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  |
| Palmer et al.            | 2020 | Biology          | Introductory                        | Introductory | All                | 4-5 weeks   | No  | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | No  |
| Parks et al.             | 2020 | Biology          | Microbiology                        | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Parks et al.             | 2020 | Biology          | Microbiology                        | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Parks et al.             | 2020 | Biology          | Microbiology                        | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Parks et al.             | 2020 | Biology          | Microbiology                        | Advanced     | Sophomore & Higher | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Petrie                   | 2020 | Biology          | Microbiology                        | Advanced     | Junior/Senior      | 2-3 weeks   | Yes | Yes | Yes | Yes | Yes | Yes | No  | No  | Yes | No  |
| Price et al.             | 2020 | Biology          | Genomics                            | Introductory | Freshman/Sophomore | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pufall & Wilson          | 2020 | Chemistry        | Organic                             | Advanced     | Junior/Senior      | 1 semester  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Rennhack et al.          | 2020 | Biology          | Physiology                          | Advanced     | Senior             | 9 weeks     | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Rubush & Stone           | 2020 | Chemistry        | General, Organic                    | Introductory | All                | 2 semesters | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Rumfelt et al.           | 2020 | Biology          | introductory                        | Introductory | Freshman           | 1 semester  | No  | Yes | Yes | Yes | Yes | Yes | No  | Yes | Yes | Yes |





- Adame, V., Chapapas, H., Cisneros, M., Deaton, C., Deichmann, S., Gadek, C., Lovato, T. L., Chechenova, M. B., Guerin, P., & Cripps, R. M. (2016). An undergraduate laboratory class using CRISPR/Cas9 technology to mutate drosophila genes. *Biochem Mol Biol Educ*, 44(3), 263-275. doi:10.1002/bmb.20950.
- Adkins, S. J., Rock, R. K., & Morris, J. J. (2018). Interdisciplinary STEM education reform: dishing out art in a microbiology laboratory. *FEMS Microbiol Lett*, 365(1). doi:10.1093/femsle/fnx245.
- Adkins-Jablonsky, S. J., Akscyn, R., Bennett, B. C., Roberts, Q., & Morris, J. J. (2020). Is community relevance enough? Civic and science identity impact of microbiology CUREs focused on community environmental justice. *Front Microbiol*, 11, 578520. doi:10.3389/fmicb.2020.578520.
- Al-Ghadhban, S., Muqaibel, A., Alregib, G., & Al-Shaikhi, A. (2018). Seeding undergraduate research experience: From Georgia Tech to KFUPM case study. *International Journal of Electrical Engineering Education*, 55(4), 313-323.
- Allen, J. L., Kuehn, S. C., Creamer, E. C., & Austin, J. E. (2020a). A Multisemester, curriculum-embedded undergraduate research experience (MS-CURE) in the geosciences: Contextual factors influencing student motivation for pursuing research. *Scholarship and Practice of Undergraduate Research*, 4(2), 35-43. doi:10.18833/spur/4/2/8.
- Allen, P. E., Miller, C. W., & Dale, A. G. (2020b). Bringing the scientific process into the undergraduate classroom. *American Entomologist*, 66(4), 24-27. doi:10.1093/ae/tmaa063.
- Alkahrer, I., & Dolan, E. L. (2014). Integrating research into undergraduate courses: current practices and future directions. In S. C. Sunal D, Zollman D, Mason C, and Wright E (Ed.), *Research in Science Education: Research Based Undergraduate Science Teaching*. Charlotte, NC: Information Age.
- Alneyadi, A., Shah, I., & Ashraf, S. S. (2019). An innovative bioanalytical research project course to train undergraduate students on liquid chromatography-mass spectrometry. *Biochem Mol Biol Educ*, 47(3), 228-238. doi:10.1002/bmb.21225.
- Andrews, S. E., Runyon, C., & Aikens, M. L. (2017). The Math-Biology Values Instrument: Development of a tool to measure life science majors' task values of using math in the context of biology. *CBE Life Sci Educ*, 16(3). doi:10.1187/cbe.17-03-0043.
- Anunson, P. N., Winkler, G. R., Winkler, J. R., Parkinson, B. A., & Schuttlefield Christus, J. D. (2013). Involving students in a collaborative project to help discover inexpensive, stable materials for solar photoelectrolysis. *Journal of Chemical Education*, 90(10), 1333-1340. doi:10.1021/ed300574x.
- Aparna, Y., Anuradha, K., Jyothi, C., Sri Manjari, K., & Challa, A. K. (2020). Bringing real-world microbiology experiences to undergraduate students in resource-limited environments. *Front Microbiol*, 11, 589405. doi:10.3389/fmicb.2020.589405.
- Arnold, M. E., Broudeau, V. D., & Nott, B. D. (2013). Measuring science inquiry skills in youth development programs: The Science Process Skills Inventory. *Journal of Youth Development*, 8(1). doi:10.5195/jyd.2013.103.
- Arnold, D.M., Mortensen, C.J., Thoron, A.C. & Miller-Cushon, E.K. (2019). Contrasting science learning gains and attitudes of students in an early research-based experience. *NACTA* 63: 180-187.
- Ault, J. F., Renfro, B. M., & White, A. K. (2011). Using a molecular-genetic approach to investigate bacterial physiology in a continuous, research-based, semester-long laboratory for undergraduates. *J Microbiol Biol Educ*, 12(2), 185-193. doi:10.1128/jmbe.v12i2.326.
- Ayella, A., & Beck, M. R. (2018). A course-based undergraduate research experience investigating the consequences of nonconserved mutations in lactate dehydrogenase. *Biochem Mol Biol Educ*, 46(3), 285-296. doi:10.1002/bmb.21115.
- Bakshi, A., Patrick, L. E., & Wischusen, E. W. (2016). A framework for implementing course-based undergraduate research experiences (CUREs) in freshman biology labs. *The American Biology Teacher*, 78(6), 448-455. doi:10.1525/abt.2016.78.6.448.
- Barbera, J., Adams, W. K., Wieman, C. E., & Perkins, K. K. (2008). Modifying and validating the Colorado Learning Attitudes about Science Survey for use in chemistry. *Journal of Chemical Education*, 85(10), 1435-1439. doi:10.1021/ed085p1435.
- Barnett, K. L., Shea, K. M., McGeough, C., Trotta, K., Williams, S., Ly, M., & Aloisio, K. (2020). Semester-long course-based research project in second-semester organic chemistry: Synthesizing potential lead compounds for the

- treatment of a neglected tropical disease. *Journal of Chemical Education*, 97(4), 1008-1016. doi:10.1021/acs.jchemed.9b00685.
- Bascom-Slack, C. A., Arnold, A. E., & Strobel, S. A. (2012). Student-directed discovery of the plant microbiome and its products. *Science*, 338(6106), 485-486. doi:10.1126/science.1215227
- Baynham, P. J. (2016). Fostering students' identity as scientists as they search for new antimicrobial drugs. *Council on Undergraduate Research Quarterly*, 37, 19-23.
- Bell, A., Christian, L., Hecht, D., Huisinga, K., Rakus, J., & Bell, E. (2020). Teaching virtual protein-centric CUREs and UREs using computational tools. *Biochem Mol Biol Educ*, 48(6), 646-647. doi:10.1002/bmb.21454.
- Bell, J. H., Thrun, L., LeBeau, M., Makarevitch, I., Goldberg, J., & Martin, P. (2016). Antibiotic resistance genes detection in environmental samples. *CourseSource*, 3. doi:10.24918/cs.2016.3
- Bennett, J. A. (2020). The CURE for the typical bioinformatics classroom. *Front Microbiol*, 11, 1728. doi:10.3389/fmicb.2020.01728.
- Bergstrom, R. A. (2018). Building a new translational research Program with undergraduates: A student-driven research class. *Science Education and Civic Engagement*, 10(1), 15-21.
- Bhatt, J. M., & Challa, A. K. (2018). First year course-based undergraduate research experience (CURE) using the CRISPR/Cas9 genome engineering technology in zebrafish. *J Microbiol Biol Educ*, 19(1). doi:10.1128/jmbe.v19i1.1245.
- Blumer, L. S., & Beck, C. W. (2020). Introducing community ecology and data skills with the bean beetle microbiome project. *Advances in Biology Laboratory Education*, 41, 1045. doi:10.37590/able.v41.art24.
- Boltax, A. L., Armanious, S., Kosinski-Collins, M. S., & Pontrello, J. K. (2015). Connecting biology and organic chemistry introductory laboratory courses through a collaborative research project. *Biochem Mol Biol Educ*, 43(4), 233-244. doi:10.1002/bmb.20871.
- Bowlick, F. J., Bednarz, S. W., & Goldberg, D. W. (2016). Student learning in an introductory GIS Course: using a project-based approach. *Transactions in GIS*, 20(2), 182-202. doi:10.1111/tgis.12146.
- Bowling, B. V., Schultheis, P. J., & Strome, E. D. (2016). Implementation and assessment of a yeast orphan gene research project: Involving undergraduates in authentic research experiences and progressing our understanding of uncharacterized open reading frames. *Yeast*, 33(2), 43-53. doi:10.1002/yea.3139.
- Brame, C. J., Pruitt, W. M., & Robinson, L. C. (2008). A molecular genetics laboratory course applying bioinformatics and cell biology in the context of original research. *CBE Life Sci Educ*, 7(4), 410-421. doi:10.1187/cbe.08-07-0036.
- Brownell, S.E., Kloser, M.J., Fukami, T. & Shavelson, R.J. (2012). Undergraduate biology lab courses: Comparing the impact of traditionally based “cookbook” and authentic research-based courses on student lab experience. *J. Coll. Sci. Teach.* 41(4), 36-45.
- Brownell, S. E., Hekmat-Scafe, D. S., Singla, V., Chandler Seawell, P., Conklin Imam, J. F., Eddy, S. L., Stearns, T., & Cyert, M. S. (2015). A high-enrollment course-based undergraduate research experience improves student conceptions of scientific thinking and ability to interpret data. *CBE Life Sci Educ*, 14, 1-14.
- Burnette, J. M., 3rd, & Wessler, S. R. (2013). Transposing from the laboratory to the classroom to generate authentic research experiences for undergraduates. *Genetics*, 193(2), 367-375. doi:10.1534/genetics.112.147355
- Caccavo, F. (2011). An open-ended, inquiry-based approach to environmental microbiology. *The American Biology Teacher*, 73(9), 521-525. doi:10.1525/abt.2011.73.9.4.
- Campbell, A. M., Eckdahl, T., Cronk, B., Andresen, C., Frederick, P., Huckuntod, S., Shinneman, C., Wacker, A., & Yuan, J. (2014). pClone: synthetic biology tool makes promoter research accessible to beginning biology students. *CBE Life Sci Educ*, 13(2), 285-296. doi:10.1187/cbe.13-09-0189.
- Caspers, M. L., & Roberts-Kirchhoff, E. S. (2003). An undergraduate biochemistry laboratory course with an emphasis on a research experience. *Biochem Mol Biol Educ*, 31(5), 303-307. doi: <https://doi.org/10.1002/bmb.2003.494031050257>.
- Chaari, A., Al-Ali, D., & Roach, J. (2020). Biochemistry course-based undergraduate research experience: Purification, characterization, and identification of an unknown lactate dehydrogenase isoenzyme. *Biochem Mol Biol Educ*, 48(4), 369-380. doi:10.1002/bmb.21363.

- Chand, R.R., Kaur, M. & Singh, P. (2018). Reforms and promoting active learning via course-based research [CBR] at the University of Fiji. *Asian J of Dist. Educ.* 13(2), 20-31.
- Chase, A. M., Clancy, H. A., Lachance, R. P., Mathison, B. M., Chiu, M. M., & Weaver, G. C. (2017). Improving critical thinking via authenticity: the CASPiE research experience in a military academy chemistry course. *Chemistry Education Research and Practice*, 18, 55-63.
- Chatfield, C. (2014). A multi-unit project for building scientific confidence via authentic research in identification of environmental bacterial isolates. *Journal of Microbiology and Biology Education*, 15(2), 325-327. doi:10.1128/jmbe.v15i2.789.
- Chemers, M. M., Zurbruggen, E. L., Syed, M., Goza, B. K., & Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *Journal of Social Issues*, 67(3), 469-491.
- Chen, J., Call, G. B., Beyer, E., Bui, C., Cespedes, A., Chan, A., Chan, J., Chan, S., Chhabra, A., Dang, P., Deravanesian, A., Hermogeno, B., Jen, J., Kim, E., Lee, E., Lewis, G., Marshall, J., Regalia, K., Shadpour, F., Shemmassian, A., Spivey, K., Wells, M., Wu, J., Yamauchi, Y., Yavari, A., Abrams, A., Abramson, A., Amado, L., Anderson, J., Bashour, K., Bibikova, E., Bookatz, A., Brewer, S., Buu, N., Calvillo, S., Cao, J., Chang, A., Chang, D., Chang, Y., Chen, Y., Choi, J., Chou, J., Datta, S., Davarifar, A., Desai, P., Fabrikant, J., Farnad, S., Fu, K., Garcia, E., Garrone, N., Gasparyan, S., Gayda, P., Goffstein, C., Gonzalez, C., Guirguis, M., Hassid, R., Hong, A., Hong, J., Hovestreydt, L., Hu, C., Jamshidian, F., Kahen, K., Kao, L., Kelley, M., Kho, T., Kim, S., Kim, Y., Kirkpatrick, B., Kohan, E., Kwak, R., Langenbacher, A., Laxamana, S., Lee, C., Lee, J., Lee, S. Y., Lee, T. H., Lee, T., Lezcano, S., Lin, H., Lin, P., Luu, J., Luu, T., Marrs, W., Marsh, E., Min, S., Minasian, T., Misra, A., Morimoto, M., Moshfegh, Y., Murray, J., Nguyen, C., Nguyen, K., Nodado, E., 2nd, O'Donahue, A., Onugha, N., Orjiakor, N., Padhiar, B., Pavel-Dinu, M., Pavlenko, A., Paz, E., Phaklides, S., Pham, L., Poulouse, P., Powell, R., Pusic, A., Ramola, D., Ribbens, M., Rifai, B., Rosselli, D., Saakyan, M., Saarikoski, P., Segura, M., Singh, R., Singh, V., Skinner, E., Solomin, D., Soneji, K., Stageberg, E., Stavchanskiy, M., Tekchandani, L., Thai, L., Thiyaratnam, J., Tong, M., Toor, A., Tovar, S., Trangsrud, K., Tsang, W. Y., Uemura, M., Unkovic, M., Vollmer, E., Weiss, E., Wood, D., Wu, S., Wu, W., Xu, Q., Yackle, K., Yarosh, W., Yee, L., Yen, G., Alkin, G., Go, S., Huff, D. M., Minye, H., Paul, E., Villarasa, N., Milchanowski, A., & Banerjee, U. (2005). Discovery-based science education: functional genomic dissection in *Drosophila* by undergraduate researchers. *PLoS Biol*, 3(2), e59. doi:10.1371/journal.pbio.0030059.
- Chen, W. (2018). Introduction to research: A new course for first-year undergraduate students. *Journal of Chemical Education*, 95(9), 1526-1532. doi:10.1021/acs.jchemed.8b00102.
- Cianfrani, C., & Hews, S. (2020). Course-based research in the first semester of college: Teaching inquiry and building community using constructed wetlands for greywater treatment. *Journal of College Science Teaching*, 49(4), 66-74.
- Clark, T. M., Ricciardo, R., & Weaver, T. (2015). Transitioning from expository laboratory experiments to course-based undergraduate research in general chemistry. *Journal of Chemical Education*, 93(1), 56-63. doi:10.1021/acs.jchemed.5b00371.
- Clyne, A. M., Shieh, A., & Stanford, J. S. (2019). A course-based undergraduate research experience CURE in biofluid mechanics. *J Biomech Eng.* doi:10.1115/1.4044951.
- Cookmeyer, D. L., Winesett, E. S., Kokona, B., Huff, A. R., Aliev, S., Bloch, N. B., Bulos, J. A., Evans, I. L., Fagre, C. R., Godbe, K. N., Khromava, M., Konstantinovskiy, D. M., Lafrance, A. E., Lamacki, A. J., Parry, R. C., Quinn, J. M., Thurston, A. M., Tsai, K. J. S., Mollo, A., Cryle, M. J., Fairman, R., & Charkoudian, L. K. (2017). Uncovering protein-protein interactions through a team-based undergraduate biochemistry course. *PLoS Biol*, 15(11), e2003145. doi:10.1371/journal.pbio.2003145.
- Cooper, K. M., Blattman, J. N., Hendrix, T., Brownell, S. E., & Hewlett, J. (2019). The impact of broadly relevant novel discoveries on student project ownership in a traditional lab course turned CURE. *CBE—Life Sciences Education*, 18(4). doi:10.1187/cbe.19-06-0113.
- Cooper, K. M., Knope, M. L., Munstermann, M. J., & Brownell, S. E. (2020). Students who analyze their own data in a course-based undergraduate research experience (CURE) show gains in scientific identity and emotional ownership of research. *J Microbiol Biol Educ*, 21(3). doi:10.1128/jmbe.v21i3.2157.

- Corwin, L. A., Runyon, C., Robinson, A., & Dolan, E. L. (2015). The Laboratory Course Assessment Survey: A tool to measure three dimensions of research-course design. *CBE Life Sci Educ*, 14(4), ar37. doi:10.1187/cbe.15-03-0073.
- Coticone, S.R. & Van Houten, L.B. (2020). Integrating course-based undergraduate research experience (CUREs) in advanced forensic science curriculum as an active learning strategy. *J. Forensic Sci. Educ.* 2(2), 1-5.
- Cotner, S., & Hebert, S. (2016). Bean beetles make biology research sexy. *The American Biology Teacher*, 78(3), 233-240. doi:10.1525/abt.2016.78.3.233.
- Cresiski, R. H., & Lenkowski, J. R. (2020). Using zebrafish in a developmental biology lab course to explore interactions between development and the environment. *CourseSource*, 7. doi:10.24918/cs.2020.20.
- Cruz, C. L., Holmberg-Douglas, N., Onuska, N. P. R., McManus, J. B., MacKenzie, I. A., Hutson, B. L., Eskew, N. A., & Nicewicz, D. A. (2020). Development of a large-enrollment course-based research experience in an undergraduate organic chemistry laboratory: Structure–function relationships in pyrylium photoredox catalysts. *Journal of Chemical Education*, 97(6), 1572-1578. doi:10.1021/acs.jchemed.9b00786.
- Dahlberg, C. L., Wiggins, B. L., Lee, S. R., Leaf, D. S., Lily, L. S., Jordt, H., & Johnson, T. J. (2019). A short, course-based research module provides metacognitive benefits in the form of more sophisticated problem solving. *Journal of College Science Teaching*, 48(4), 22-30.
- Danowitz, A. M., Brown, R. C., Jones, C. D., Diegelman-Parente, A., & Taylor, C. E. (2015). A combination course and lab-based approach to teaching research skills to undergraduates. *Journal of Chemical Education*, 93(3), 434-438. doi:10.1021/acs.jchemed.5b00390.
- Delventhal, R., & Steinhauer, J. (2020). A course-based undergraduate research experience examining neurodegeneration in *Drosophila melanogaster* teaches students to think, communicate, and perform like scientists. *PLoS One*, 15(4), e0230912. doi:10.1371/journal.pone.0230912.
- Deveau, A. M., Wang, Y., & Small, D. J. (2020). Reflections on course-based undergraduate research in organic and biochemistry during COVID-19. *Journal of Chemical Education*, 97(9), 3463-3469. doi:10.1021/acs.jchemed.0c00787.
- Ditty, J. L., Williams, K. M., Keller, M. M., Chen, G. Y., Liu, X., & Parales, R. E. (2013). Integrating grant-funded research into the undergraduate biology curriculum using IMG-ACT. *Biochem Mol Biol Educ*, 41(1), 16-23. doi:10.1002/bmb.20662.
- Doolittle, A., & Faul, A. C. (2013). Civic Engagement Scale. *SAGE Open*, 3(3). doi:10.1177/2158244013495542.
- Duggan, J. M., Varner, J., Lanier, H. C., Flaherty, E. A., Dizney, L., Yahnke, C. J., Connors, P. K., Erb, L. P., & Hanson, J. D. (2020). Squirrels in space: Using radio telemetry to explore the space use and movement of sciurid rodents. *CourseSource*, 7. doi:10.24918/cs.2020.25.
- Dunbar, D., Terlecki, M., Watterson, N. & Ratmansky, L. (2013). An honors interdisciplinary community-based research course. *Honors in interdisciplinary community-based research*. 9, 129-140.
- Drew, J. C., & Triplett, E. W. (2008). Whole genome sequencing in the undergraduate classroom: Outcomes and lessons from a pilot course. *J Microbiol Biol Educ*, 9(1), 3-11.
- Elder, L., & Paul, R. (2007). Consequential validity: Using assessment to drive instruction. In *Foundation for Critical Thinking*. Tomales, CA.
- Elgin, S. C. R., Hauser, C., Holzen, T. M., Jones, C., Kleinschmit, A., Leatherman, J., & Genomics Education, P. (2017). The GEP: Crowd-sourcing big data analysis with undergraduates. *Trends Genet*, 33(2), 81-85. doi:10.1016/j.tig.2016.11.004.
- Elkins, K. M., & Zeller, C. (2020). What is the CURE for limited DNA? A forensic science course focused on NGS. *Journal of Forensic Science Education*, 2(2).
- Eslinger, M. (2018, June 6-8). CURE Biology: Analyzing microbes using a collaborative STEM approach. Paper presented at the Hawaii University International Conferences STEAM, Honolulu, HI.
- Estrada, M., Woodcock, A., Hernandez, P. R., & Schultz, P. W. (2011). Toward a model of social influence that explains minority student integration into the scientific community. *J Educ Psychol*, 103(1), 206-222. doi:10.1037/a0020743.

- Farnham, K. R., & Dube, D. H. (2015). A semester-long project-oriented biochemistry laboratory based on *Helicobacter pylori* urease. *Biochem Mol Biol Educ*, 43(5), 333-340. doi:10.1002/bmb.20884
- Felzien, L. K. (2016). Integration of a zebrafish research project into a molecular biology course to support critical thinking and course content goals. *Biochem Mol Biol Educ*, 44(6), 565-573. doi:10.1002/bmb.20983.
- Fey, S. B., Theus, M. E., & Ramirez, A. R. (2020). Course-based undergraduate research experiences in a remote setting: Two case studies documenting implementation and student perceptions. *Ecol Evol*, 10(22), 12528-12541. doi:10.1002/ece3.6916.
- Fields, L., R. Craig, W., A. Wasileski, S., & L. Wolfe, A. (2019). Effects of shade on antibacterial production in aloe vera plants: A model course based undergraduate research experience for first- and second-year chemistry and biochemistry students. *World Journal of Chemical Education*, 7(4), 248-253. doi:10.12691/wjce-7-4-3.
- Fisher, G. R., Olimpo, J. T., McCabe, T. M., & Pevey, R. S. (2018). The Tigriopus CURE—A Course-Based Undergraduate Research Experience with Concomitant Supplemental Instruction. *Journal of microbiology & biology education*, 19(1), 19-1. Fisher, G.R. Authors (2018). *J Microbiol Biol Educ*.
- Flaherty, E. A., Walker, S. M., Forrester, J. H., & Ben-David, M. (2017). Effects of course-based undergraduate research experiences (CURE) on wildlife students. *Wildlife Society Bulletin*, 41(4), 701-711. doi:10.1002/wsb.810.
- Fleming, M. P. (2015). Out of your seat and on your feet! An adaptable course-based research project in plant ecology for advanced students. *CourseSource*, 2. doi:10.24918/cs.2015.6
- Ford, J. R., Prudente, C., & Newton, T. A. (2008). A model for incorporating research into the first-year chemistry curriculum. *Journal of Chemical Education*, 85(7), 929-933.
- Fuentes, A.-L., & Entezari, M. (2020). Water in your neighbourhood: a model for implementing a semester-long course-based undergraduate research project in introductory biology. *Education Inquiry*, 11(3), 211-275. doi:10.1080/20004508.2020.1716542.
- Full, R. J., Dudley, R., Koehl, M. A., Libby, T., & Schwab, C. (2015). Interdisciplinary laboratory course facilitating knowledge integration, mutualistic teaming, and original discovery. *Integr Comp Biol*, 55(5), 912-925. doi:10.1093/icb/icv095.
- Furrow, R. E., Kim, H. G., Abdelrazek, S. M. R., Dahlhausen, K., Yao, A. I., Eisen, J. A., Goldman, M. S., Albeck, J. G., & Facciotti, M. T. (2020). Combining microbial culturing with mathematical modeling in an introductory course-based undergraduate research experience. *Front Microbiol*, 11, 581903. doi:10.3389/fmicb.2020.581903.
- Fyock, A., Potter, L., Stone, R., & Popejoy-Sheriff, D. F. (2018). Filling the graduate pipeline via course-based undergraduate research experiences (CUREs). Paper presented at the Proceedings of the 2018 IISE Annual Conference. , Orlando, Florida.
- Galush, T., Mazur, C., & Cotner, S. (2017). A new approach to course-based research using a hermit crab-hydrozoan symbiosis. *CourseSource*, 4. doi:10.24918/cs.2017.2
- Gammie, A. E., & Erdeniz, N. (2004). Characterization of pathogenic human MSH2 missense mutations using yeast as a model system: a laboratory course in molecular biology. *Cell Biol Educ*, 3(1), 31-48. doi:10.1187/cbe.03-08-0006.
- Gardner, S. M., Adedokun, O. A., Weaver, G. C., & Bartlett, E. L. (2011). Human brains engaged in rat brains: Student-driven neuroanatomy research in an introductory biology lab course. *Journal of Undergraduate Neuroscience Education*, 10(1), A24-A36.
- Gaspar, B. J., & Gardner, S. M. (2013). Engaging students in authentic microbiology research in an introductory biology laboratory course is correlated with gains in student understanding of the nature of authentic research and critical thinking. *J Microbiol Biol Educ*, 14(1), 25-34. doi:10.1128/jmbe.v14i1.460.
- Gastreich, K. R. (2020). Assessing urban biodiversity with the eBird Citizen Science Project: A course-based undergraduate research experience (CURE) module. *CourseSource*, 7. doi:10.24918/cs.2020.18.
- Gin, L. E., Rowland, A. A., Steinwand, B., Bruno, J., & Corwin, L. A. (2018). Students who fail to achieve predefined research goals may still experience many positive outcomes as a result of CURE participation. *CBE Life Sci Educ*, 17(4), ar57. doi:10.1187/cbe.18-03-0036.
- Goedhart, C. M., & McLaughlin, J. S. (2016). Student scientists: Transforming the undergraduate biology lab into a research experience. *The American Biology Teacher*, 78(6), 502-508. doi:10.1525/abt.2016.78.6.502.

- Goller, C. C., & Ott, L. E. (2020). Evolution of an 8-week upper-division metagenomics course: Diagramming a learning path from observational to quantitative microbiome analysis. *Biochem Mol Biol Educ*, 48(4), 391-403. doi:10.1002/bmb.21349.
- Gonzales, D., & Semken, S. (2006). Integrating undergraduate education and scientific discovery through field research in igneous petrology. *Journal of Geoscience Education*, 54(2), 133-142. doi:10.5408/1089-9995-54.2.133.
- Good, D. J. (2020). A low-cost, in silico nutritional genomics course-based undergraduate research experience applicable to multiple disciplines. *Biochem Mol Biol Educ*, 48(4), 320-328. doi:10.1002/bmb.21352.
- Goudsouzian, L. K., McLaughlin, J. S., & Slee, J. B. (2017). Using yeast to make scientists: A six-week student-driven research project for the cell biology laboratory. *CourseSource*, 4. doi:10.24918/cs.2017.4.
- Goyette, S. R., & DeLuca, J. (2007). A semester-long student-directed research project involving enzyme immunoassay: appropriate for immunology, endocrinology, or neuroscience courses. *CBE Life Sci Educ*, 6(4), 332-342. doi:10.1187/cbe.07-01-0001.
- Gray, C., Price, C. W., Lee, C. T., Dewald, A. H., Cline, M. A., McAnany, C. E., Columbus, L., & Mura, C. (2015). Known structure, unknown function: An inquiry-based undergraduate biochemistry laboratory course. *Biochem Mol Biol Educ*, 43(4), 245-262. doi:10.1002/bmb.20873.
- Griffin, V., McMiller, T., Jones, E., & Johnson, C. M. (2003). Identifying novel helix-loop-helix genes in *Caenorhabditis elegans* through a classroom demonstration of functional genomics. *Cell Biol Educ*, 2(1), 51-62. doi:10.1187/cbe.02-09-0040.
- Grinnell College. RISC Survey. Retrieved from <https://www.grinnell.edu/academics/centers-programs/ctla/assessment/risc>.
- Hamid, F. (2020). A course-based undergraduate research experience (CURE) in computer science: an experience report. *Journal of Computing Sciences in Colleges*, 35(6), 56-65.
- Hanauer, D. I., & Dolan, E. L. (2014). The project ownership survey: measuring differences in scientific inquiry experiences. *CBE Life Sci Educ*, 13(1), 149-158. doi:10.1187/cbe.13-06-0123.
- Hanauer, D. I., Graham, M. J., & Hatfull, G. F. (2016). A measure of college student persistence in the sciences (PITS). *CBE Life Sci Educ*, 15(4). doi:10.1187/cbe.15-09-0185.
- Hanauer, D. I., & Hatfull, G. (2015). Measuring networking as an outcome variable in undergraduate research experiences. *CBE Life Sci Educ*, 14(4), ar38. doi:10.1187/cbe.15-03-0061.
- Hariyono, E., Prahani, B. K., & Mardiyanti, M. (2020). Volcano project design: Innovation in geoscience learning. *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, 8(2). doi:10.33394/j-ps.v8i2.3267.
- Hartings, M. R., Fox, D. M., Miller, A. E., & Muratore, K. E. (2015). A Hybrid integrated laboratory and inquiry-based research experience: Replacing traditional laboratory instruction with a sustainable student-led research project. *Journal of Chemical Education*, 92(6), 1016-1023. doi:10.1021/ed500793q.
- Harvey, P. A., Wall, C., Luckey, S. W., Langer, S., & Leinwand, L. A. (2014). The python project: a unique model for extending research opportunities to undergraduate students. *CBE Life Sci Educ*, 13(4), 698-710. doi:10.1187/cbe.14-05-0089.
- Hastie, E., Sellers, R., Valan, B., & Sherwood, D. R. (2019). A scalable CURE using a CRISPR/Cas9 fluorescent protein knock-in strategy in *Caenorhabditis elegans*. *J Microbiol Biol Educ*, 20(3). doi:10.1128/jmbe.v20i3.1847.
- Haskew-Layton, R. E., & Minkler, J. R. (2020). Chick embryonic primary astrocyte cultures provide an effective and scalable model for authentic research in a laboratory class. *Journal of Undergraduate Neuroscience Education*, 18(2), A86-A92.
- Hekmat-Safe, D. S., Brownell, S. E., Seawell, P. C., Malladi, S., Imam, J. F., Singla, V., Bradon, N., Cyert, M. S., & Stearns, T. (2017). Using yeast to determine the functional consequences of mutations in the human p53 tumor suppressor gene: An introductory course-based undergraduate research experience in molecular and cell biology. *Biochem Mol Biol Educ*, 45(2), 161-178. doi:10.1002/bmb.21024.
- Heller, S. T., Duncan, A. P., Moy, C. L., & Kirk, S. R. (2020). The value of failure: A student-driven course-based research experience in an undergraduate organic chemistry lab inspired by an unexpected result. *Journal of Chemical Education*, 97(10), 3609-3616. doi:10.1021/acs.jchemed.0c00829.

- Hills, M., Harcombe, K., & Bernstein, N. (2020). Using anticipated learning outcomes for backward design of a molecular cell biology course-based undergraduate research experience. *Biochem Mol Biol Educ*, 48(4), 311-319. doi:10.1002/bmb.21350.
- Himmel, N. J., Letcher, J. M., & Cox, D. N. (2020). Dissecting the molecular and neural circuit bases of behavior as an introduction to discovery-driven research; A report on a course-based undergraduate research experience. *Journal of Undergraduate Neuroscience Education*, 19(1), A21-A29.
- Hingamp, P., Brochier, C., Tealla, E., Gautheret, D., Thieffry, D., & Herrmann, C. (2008). Metagenome annotation using a distributed grid of undergraduate students. *PLoS Biol*, 6(11), 2362-2367.
- Hotaling, S., Slabach, B. L., & Weisrock, D. W. (2018). Next-generation teaching: a template for bringing genomic and bioinformatic tools into the classroom. *Journal of Biological Education*, 52(3), 301-313. doi:10.1080/00219266.2017.1357650.
- Hummel, E. D., & E. Stieber, S. C. (2019). Student-led computational inorganic chemistry research in a classroom Setting. *The Journal of Computational Science Education*, 10(1), 12-15. doi:10.22369/issn.2153-4136/10/1/2.
- Hunter, A. B., Weston, T. J., Laursen, S. L., & Thiry, H. (2009). URSSA: Evaluating student gains from undergraduate research in the sciences. *Council on Undergraduate Research*, 29, 15-19.
- Hurst-Kennedy, J., Saum, M., Achat-Mendes, C., D'Costa, A., Javazon, E., Katzman, S., Ricks, E., & Barrera, A. (2020). The impact of a semester-long, cell culture and fluorescence microscopy CURE on learning and attitudes in an underrepresented STEM student population. *J Microbiol Biol Educ*, 21(1). doi:10.1128/jmbe.v21i1.2001.
- Idica, A., Thompson, J., Munk Pedersen, I., & Kadandale, P. (2015). Using undergraduate molecular biology labs to discover targets of miRNAs in humans. *CourseSource*, 2. doi:10.24918/cs.2015.10.
- Iimoto, D. S., & Frederick, K. A. (2011). Incorporating student-designed research projects in the chemistry curriculum. *Journal of Chemical Education*, 88(8), 1069-1073. doi:10.1021/ed1011103
- Indorf, J. L., Weremijewicz, J., Janos, D. P., & Gaines, M. S. (2019). Adding authenticity to inquiry in a first-year, research-based, biology laboratory course. *CBE Life Sci Educ*, 18, 1-16. doi:10.1187/cbe.18-07-0126.
- Jones, C. K., & Lerner, A. B. (2019). Implementing a course-based undergraduate research experience to grow the quantity and quality of undergraduate research in an animal science curriculum1. *J Anim Sci*, 97(11), 4691-4697. doi:10.1093/jas/skz319.
- Jordan, T. C., Burnett, S. H., Carson, S., Caruso, S. M., Clase, K., DeJong, R. J., Dennehy, J. J., Denver, D. R., Dunbar, D., Elgin, S. C., Findley, A. M., Gissendanner, C. R., Golebiewska, U. P., Guild, N., Hartzog, G. A., Grillo, W. H., Hollowell, G. P., Hughes, L. E., Johnson, A., King, R. A., Lewis, L. O., Li, W., Rosenzweig, F., Rubin, M. R., Saha, M. S., Sandoz, J., Shaffer, C. D., Taylor, B., Temple, L., Vazquez, E., Ware, V. C., Barker, L. P., Bradley, K. W., Jacobs-Sera, D., Pope, W. H., Russell, D. A., Cresawn, S. G., Lopatto, D., Bailey, C. P., & Hatfull, G. F. (2014). A broadly implementable research course in phage discovery and genomics for first-year undergraduate students. *MBio*, 5(1), e01051-01013. doi:10.1128/mBio.01051-13.
- Kappler, U., Rowland, S. L., & Pedwell, R. K. (2017). A unique large-scale undergraduate research experience in molecular systems biology for non-mathematics majors. *Biochem Mol Biol Educ*, 45(3), 235-248. doi:10.1002/bmb.21033.
- Kean, K.M., Van Zee, K., & Mehl, R.A. (2018). Unnatural chemical biology: Research-based laboratory course utilizing genetic code expansion. *J. Chem. Educ.* 96(1), 66-74.
- Kerfeld, C. A., & Simons, R. W. (2007). The undergraduate genomics research initiative. *PLoS Biol*, 5(5), e141. doi:10.1371/journal.pbio.0050141.
- Kerr, M. A., & Yan, F. (2016). Incorporating course-based undergraduate research experiences into analytical chemistry laboratory curricula. *Journal of Chemical Education*, 93(4), 658-662. doi:10.1021/acs.jchemed.5b00547.
- Kinner, D., & Lord, M. (2018). Student-perceived gains in collaborative, course-based undergraduate research experiences in the geosciences. *Journal of College Science Teaching*, 48(2), 48-58.
- Kirkpatrick, C., Schuchardt, A., Baltz, D., & Cotner, S. (2019). Computer-based and bench-based undergraduate research experiences produce similar attitudinal outcomes. *CBE Life Sci Educ*, 18(1), ar10. doi:10.1187/cbe.18-07-0112.



- Kissel, D. S. (2020). Integrating faculty research into the undergraduate chemistry curriculum: A CURE using porous composite materials for water remediation. In L. A. Welch, M. Berger, S. Roberts-Kirchhoff, & M. A. Benvenuto (Eds.), *Environmental Research Literacy* (Vol. 1351): American Chemical Society.
- Kloser, M. J., Brownell, S. E., Chiariello, N. R., & Fukami, T. (2011). Integrating teaching and research in undergraduate biology laboratory education. *PLoS Biol*, 9(11), e1001174. doi:10.1371/journal.pbio.1001174.
- Kortz, K. M., & van der Hoeven Kraft, K. J. (2016). Geoscience education research project: Student benefits and effective design of a course-based undergraduate research experience. *Journal of Geoscience Education*, 64(1), 24-36. doi:10.5408/15-11.1.
- Kowalski, J. R., Hoops, G. C., & Johnson, R. J. (2016). Implementation of a collaborative series of classroom-based undergraduate research experiences spanning chemical biology, biochemistry, and neurobiology. *CBE Life Sci Educ*, 15(4). doi:10.1187/cbe.16-02-0089.
- Kruchten, A. E. (2020). A curricular bioinformatics approach to teaching undergraduates to analyze metagenomic datasets using R. *Front Microbiol*, 11, 578600. doi:10.3389/fmicb.2020.578600.
- Kushner, D. B. (2007). DNA Microarrays in the undergraduate microbiology lab: experimentation and handling large datasets in as few as six weeks. *Journal of Microbiology and Biology Education*, 8, 3-12.
- Lau, J. K., Paterniti, M., & Stefaniak, K. R. (2019). Crossing floors: Developing an interdisciplinary CURE between an environmental toxicology course and an analytical chemistry course. *Journal of Chemical Education*, 96(11), 2432-2440. doi:10.1021/acs.jchemed.9b00289.
- Lee, T. W., Carpenter, B. S., Birol, O., Katz, D. J., & Schmeichel, K. L. (2019). The Pipeline CURE: An iterative approach to introduce all students to research throughout a biology curriculum. *CourseSource* 6, 1-6.
- Lefurgy, S. T., & Mundorff, E. C. (2017). A 13-week research-based biochemistry laboratory curriculum. *Biochem Mol Biol Educ*, 45(5), 437-448. doi:10.1002/bmb.21054.
- Laungani, R., Tanner, C., Brooks, T. D., Clement, B., Clouse, M., Doyle, E., Dworak, S., Elder, B., Marley, K., & Schofield, B. (2018). Finding some good in an invasive species: Introduction and assessment of a novel CURE to improve experimental design in undergraduate biology classrooms. *J Microbiol Biol Educ*, 19(2). doi:10.1128/jmbe.v19i2.1517.
- Lee, Y. M., & Burnett, D. (2018). Enhancing undergraduate research experience through a food science research project. *Journal of Food Science Education*, 18(1), 11-20. doi:10.1111/1541-4329.12152.
- Li, B., Jia, X., Chi, Y., Liu, X., & Jia, B. (2019). Project-based learning in a collaborative group can enhance student skill and ability in the biochemical laboratory: a case study. *Journal of Biological Education*, 54(4), 404-418. doi:10.1080/00219266.2019.1600570.
- Light, C. J., Fegley, M., & Stamp, N. (2019). Emphasizing iterative practices for a sequential course-based undergraduate research experience in microbial biofilms. *FEMS Microbiol Lett*, 366(23). doi:10.1093/femsle/fnaa001.
- Lipchock, J. M., Ginther, P. S., Douglas, B. B., Bird, K. E., & Patrick Loria, J. (2017). Exploring protein structure and dynamics through a project-oriented biochemistry laboratory module. *Biochem Mol Biol Educ*, 45(5), 403-410. doi:10.1002/bmb.21056.
- Lopatto, D. (2004). Survey of Undergraduate Research Experiences (SURE): first findings. *Cell Biol Educ*, 3(4), 270-277. doi:10.1187/cbe.04-07-0045.
- Lopatto, D. (2007). Undergraduate research experiences support science career decisions and active learning. *CBE Life Sci Educ*, 6(4), 297-306. doi:10.1187/cbe.07-06-0039.
- Lopatto, D., C. A., D. Barnard, C. Chandrasekaran, H.-M. Chung, C. Du, T. Eckdahl, A. L. Goodman, C. Hauser, C. J. Jones, O. R. Kopp, G. A. Kuleck, G. McNeil, R. Morris, J. L. Myka, A. Nagengast, P. J. Overvoorde, J. L. Poet, K. Reed, G. Regisford, D. Revie, A. Rosenwald, K. Saville, M. Shaw, G. R. Skuse, C. Smith, M. Smith, M. Spratt, J. Stamm, J. S. Thompson, B. A. Wilson, C. Witkowski, J. Youngblom, W. Leung, C. D. Shaffer, J. Buhler, E. Mardis, S. C. R. Elgin. (2008). Genomics Education Partnership. *Science*, 322(5902), 684-685. doi:10.1126/science.1165351.
- Lyles, J. K., & Oli, M. (2020). Fermentation revival in the classroom: investigating ancient human practices as CUREs for modern diseases. *FEMS Microbiol Lett*, 367(21). doi:10.1093/femsle/fnaa183.

- Makarevitch, I., Frechette, C., & Wiatros, N. (2015). Authentic research experience and "Big Data" analysis in the classroom: Maize response to abiotic stress. *CBE Life Sci Educ*, 14(3). doi:10.1187/cbe.15-04-0081.
- Malotky, M. K. H., Mayes, K. M., Price, K. M., Smith, G., Mann, S. N., Guinyard, M. W., Veale, S., Ksor, V., Siu, L., Mlo, H., Young, A. J., Nsonwu, M. B., Morrison, S. D., Sudha, S., & Bernot, K. M. (2020). Fostering inclusion through an interinstitutional, community-engaged, course-based undergraduate research experience. *J Microbiol Biol Educ*, 21(1). doi:10.1128/jmbe.v21i1.1939.
- Marcus, J. M., & Huges, T. M. (2010). Engaging first-year undergraduates in hands-on research experiences: The Upper Green River barcode of life project. *Journal of College Science Teaching*, 39(3), 39-45.
- Marra, M. H., Tobias, Z. J. C., Cohen, H. R., Glover, G., & Weissman, T. A. (2015). In vivo time-lapse imaging in the zebrafish lateral line: A flexible, open-ended research project for an undergraduate neurobiology laboratory course. *Journal of Undergraduate Neuroscience Education*, 13(3), A215-A224.
- Marsiglia, W. M., Qamra, R., Jackson, K. M., & Traaseth, N. J. (2020). A CURE biochemistry laboratory module to study protein-protein interactions by NMR spectroscopy. *Journal of Chemical Education*, 97(2), 437-442. doi:10.1021/acs.jchemed.9b00364.
- Martinez-Vaz, B. M., & Mickelson, M. M. (2020). In silico phage hunting: Bioinformatics exercises to identify and explore bacteriophage genomes. *Front Microbiol*, 11, 577634. doi:10.3389/fmicb.2020.577634.
- Matzner, S. L., Carney, C. L., Hagemeyer, D. A., & Miles, C. (2019). Fatal attraction: Visual cues in attracting prey to carnivorous plants. *The American Biology Teacher*, 81(4), 269-277. doi:10.1525/abt.2019.81.4.269.
- May, N. W., McNamara, S. M., Wang, S., Kolesar, K. R., Vernon, J., Wolfe, J. P., Goldberg, D., & Pratt, K. A. (2018). Polar plunge: Semester-long snow chemistry research in the general chemistry laboratory. *Journal of Chemical Education*, 95(4), 543-552. doi:10.1021/acs.jchemed.7b00823.
- McDermott, M. L. (2016). Lowering barriers to undergraduate research through collaboration with local craft breweries. *Journal of Chemical Education*, 93(9), 1543-1548. doi:10.1021/acs.jchemed.5b00875.
- McDonough, J., Goudsouzian, L. K., Papaj, A., Maceli, A. R., Klepac-Ceraj, V., & Peterson, C. N. (2017). Stressing *Escherichia coli* to educate students about research: A CURE to investigate multiple levels of gene regulation. *Biochem Mol Biol Educ*, 45(5), 449-458. doi:10.1002/bmb.21055.
- McLaughlin, J. S., & Johnson, D. K. (2006). Assessing the field course experiential learning model: Transforming collegiate short-term study abroad experiences into rich learning environments. *Frontiers: The Interdisciplinary Journal of Study Abroad*, 13, 65-85.
- McLaughlin, J. S., & Patel, M. A. (2017). An authentic research experience for undergraduates in the developmental biology and physiology laboratory using the chick embryonic heart. *The American Biology Teacher*, 79(8), 645-653. doi:10.1525/abt.2017.79.8.645.
- McLaughlin, J., Patel, M., Johnson, D. K., & de la Rosa, C. L. (2018). The impact of a short-term study abroad program that offers a course-based undergraduate research experience and conservation activities. *Frontiers: The Interdisciplinary Journal of Study Abroad*, 30(3), 100-118.
- Mena, I. B., Schmitz, S., & McLaughlin, D. (2015). An evaluation of a course that introduces undergraduate students to authentic aerospace engineering research. *Advances in Engineering Education*, 4, 1-27.
- Miller, C. W., Hamel, J., Holmes, K. D., Helmey-Hartman, W. L., & Lopatto, D. (2013). Extending your research team: Learning benefits when a laboratory partners with a classroom. *BioScience*, 63(9), 754-762. doi:10.1525/bio.2013.63.9.11.
- Miller, J. A., Witherow, D. S., & Carson, S. (2009). A laboratory-intensive course on RNA interference and model organisms. *CBE Life Sci Educ*, 8(4), 316-325. doi:10.1187/cbe.09-02-0012.
- Moore, S. D., & Teter, K. (2014). Group-effort applied research: expanding opportunities for undergraduate research through original, class-based research projects. *Biochem Mol Biol Educ*, 42(4), 331-338. doi:10.1002/bmb.20802.
- Mordacq, J. C., Drane, D. L., Swarat, S. L., & Lo, S. M. (2017). Development of course-based undergraduate research experiences using a design-based approach. *Journal of College Science Teaching*, 46(4), 64-75.
- Murren, C. J., Wolyniak, M. J., Rutter, M. T., Bisner, A. M., Callahan, H. S., Strand, A. E., & Corwin, L. A. (2019). Undergraduates phenotyping *Arabidopsis* knockouts in a course-based undergraduate research experience:

Exploring plant fitness and vigor using quantitative phenotyping methods. *J Microbiol Biol Educ*, 20(2). doi:10.1128/jmbe.v20i2.1650.

- Nahmani, M. (2019). Versatile undergraduate neurobiology course-based research experiences using open access 3D electron microscopy image volumes. *Journal of Undergraduate Neuroscience Education*, 18(1), A66-A75.
- Newton, T. A., Tracy, H. J., & Prudente, C. (2006). A research-based laboratory course in organic chemistry. *Journal of Chemical Education*, 83(2), 1844-1849.
- Ochoa, S. D., Dores, M. R., Allen, J. M., Tran, T., Osman, M., Vazquez Castellanos, N. P., Trejo, J., & Zayas, R. M. (2019). A modular laboratory course using planarians to study genes involved in tissue regeneration. *Biochem Mol Biol Educ*, 47(5), 547-559. doi:10.1002/bmb.21259.
- Odom, D. P., & Grossel, M. J. (2002). Using the two-hybrid screen in the classroom laboratory. *Cell Biol Educ*, 1(1), 43-62. doi:10.1187/cbe.02-02-0002.
- Olson, J. M., Evans, C. J., Ngo, K. T., Kim, H. J., Nguyen, J. D., Gurley, K. G. H., Ta, T., Patel, V., Han, L., Truong, N. K., Liang, L., Chu, M. K., Lam, H., Ahn, H. G., Banerjee, A. K., Choi, I. Y., Kelley, R. G., Moridzadeh, N., Khan, A. M., Khan, O., Lee, S., Johnson, E. B., Tigranyan, A., Wang, J., Gandhi, A. D., Padhiar, M. M., Calvopina, J. H., Sumra, K., Ou, K., Wu, J. C., Dickan, J. N., Ahmadi, S. M., Allen, D. N., Mai, V. T., Ansari, S., Yeh, G., Yoon, E., Gon, K., Yu, J. Y., He, J., Zaretsky, J. M., Lee, N. E., Kuoy, E., Patananan, A. N., Sitz, D., Tran, P., Do, M. T., Akhave, S. J., Alvarez, S. D., Asem, B., Asem, N., Azarian, N. A., Babaesfahani, A., Bahrami, A., Bhamra, M., Bhargava, R., Bhatia, R., Bhatia, S., Bumacod, N., Caine, J. J., Caldwell, T. A., Calica, N. A., Calonico, E. M., Chan, C., Chan, H. H., Chang, A., Chang, C., Chang, D., Chang, J. S., Charania, N., Chen, J. Y., Chen, K., Chen, L., Chen, Y., Cheung, D. J., Cheung, J. J., Chew, J. J., Chew, N. B., Chien, C. T., Chin, A. M., Chin, C. J., Cho, Y., Chou, M. T., Chow, K. K., Chu, C., Chu, D. M., Chu, V., Chuang, K., Chugh, A. S., Cubberly, M. R., Daniel, M. G., Datta, S., Dhaliwal, R., Dinh, J., Dixit, D., Dowling, E., Feng, M., From, C. M., Furukawa, D., Gaddipati, H., Gevorgyan, L., Ghaznavi, Z., Ghosh, T., Gill, J., Groves, D. J., Gurara, K. K., Haghighi, A. R., Havard, A. L., Heyrani, N., Hioe, T., Hong, K., Houman, J. J., Howland, M., Hsia, E. L., Hsueh, J., Hu, S., Huang, A. J., Huynh, J. C., Huynh, J., Iwuchukwu, C., Jang, M. J., Jiang, A. A., Kahlon, S., Kao, P. Y., Kaur, M., Keehn, M. G., Kim, E. J., Kim, H., Kim, M. J., Kim, S. J., Kitich, A., Kornberg, R. A., Kouzelos, N. G., Kuon, J., Lau, B., Lau, R. K., Law, R., Le, H. D., Le, R., Lee, C., Lee, C., Lee, G. E., Lee, K., Lee, M. J., Lee, R. V., Lee, S. H. K., Lee, S. K., Lee, S. D., Lee, Y. J., Leong, M. J., Li, D. M., Li, H., Liang, X., Lin, E., Lin, M. M., Lin, P., Lin, T., Lu, S., Luong, S. S., Ma, J. S., Ma, L., Maghen, J. N., Mallam, S., Mann, S., Melehani, J. H., Miller, R. C., Mittal, N., Moazez, C. M., Moon, S., Moridzadeh, R., Ngo, K., Nguyen, H. H., Nguyen, K., Nguyen, T. H., Nieh, A. W., Niu, I., Oh, S. K., Ong, J. R., Oyama, R. K., Park, J., Park, Y. A., Passmore, K. A., Patel, A., Patel, A. A., Patel, D., Patel, T., Peterson, K. E., Pham, A. H., Pham, S. V., Phuphanich, M. E., Poria, N. D., Pourzia, A., Ragland, V., Ranat, R. D., Rice, C. M., Roh, D., Rojhani, S., Sadri, L., Saguros, A., Saifee, Z., Sandhu, M., Scruggs, B., Scully, L. M., Shih, V., Shin, B. A., Sholklapper, T., Singh, H., Singh, S., Snyder, S. L., Sobotka, K. F., Song, S. H., Sukumar, S., Sullivan, H. C., Sy, M., Tan, H., Taylor, S. K., Thaker, S. K., Thakore, T., Tong, G. E., Tran, J. N., Tran, J., Tran, T. D., Tran, V., Trang, C. L., Trinh, H. G., Trinh, P., Tseng, H. H., Uotani, T. T., Uraizee, A. V., Vu, K. K. T., Vu, K. K. T., Wadhwani, K., Walia, P. K., Wang, R. S., Wang, S., Wang, S. J., Wiredja, D. D., Wong, A. L., Wu, D., Xue, X., Yanez, G., Yang, Y. H., Ye, Z., Yee, V. W., Yeh, C., Zhao, Y., Zheng, X., Ziegenbalg, A., Alkali, J., Azizkhanian, I., Bhakta, A., Berry, L., Castillo, R., Darwish, S., Dickinson, H., Dutta, R., Ghosh, R. K., Guerin, R., Hofman, J., Iwamoto, G., Kang, S., Kim, A., Kim, B., Kim, H., Kim, K., Kim, S., Ko, J., Koenig, M., LaRiviere, A., Lee, C., Lee, J., Lung, B., Mittelman, M., Murata, M., Park, Y., Rothberg, D., Sprung-Keyser, B., Thaker, K., Yip, V., Picard, P., Diep, F., Villarasa, N., Hartenstein, V., Shapiro, C., Levis-Fitzgerald, M., Jaworski, L., Loppato, D., Clark, I. E., & Banerjee, U. (2019). Expression-based cell lineage analysis in *Drosophila* through a course-based research experience for early undergraduates. *G3 (Bethesda)*, 9(11), 3791-3800. doi:10.1534/g3.119.400541.
- Ortiz, J. L., Conkey, A. A. T., Brennan, L. A., Fedynich, L., & Green, M. (2020). Incorporating research into the undergraduate wildlife management curriculum. *Natural Sciences Education*, 49(1). doi:10.1002/nse.20028.
- Oufiero, C. E. (2018). The organismal form and function lab-course: A new CURE for a lack of authentic research experiences in organismal biology. *Integrative Organismal Biology*, 1(1). doi:10.1093/iob/obz021.

- Pagano, J. K., Jaworski, L., Lopatto, D., & Waterman, R. (2018). An inorganic chemistry laboratory course as research. *Journal of Chemical Education*, 95(9), 1520-1525. doi:10.1021/acs.jchemed.7b00812.
- Palmer, M. S., Willis, C., Barry, K., Packer, C., Moe, A., & Wassenberg, D. (2020). Exploring species interactions with "Snapshot Serengeti". *CourseSource*, 7. doi:10.24918/cs.2020.49.
- Parks, S., Joyner, J. L., & Nusbaum, M. (2020). Reaching a large urban undergraduate population through microbial ecology course-based research experiences. *J Microbiol Biol Educ*, 21(1). doi:10.1128/jmbe.v21i1.2047.
- Parra, K. J., Osgood, M. P., & Pappas, D. L., Jr. (2010). A research-based laboratory course designed to strengthen the research-teaching nexus. *Biochem Mol Biol Educ*, 38(3), 172-179. doi:10.1002/bmb.20358.
- Pedwell, R. K., Fraser, J. A., Wang, J. T. H., Clegg, J. K., Chartres, J. D., & Rowland, S. L. (2018). The beer and biofuels laboratory: A report on implementing and supporting a large, interdisciplinary, yeast-focused course-based undergraduate research experience. *Biochem Mol Biol Educ*, 46(3), 213-222. doi:10.1002/bmb.21111.
- Periyannan, G. R. (2019). Bacterial cellobiose metabolism: An inquiry-driven, comprehensive undergraduate laboratory teaching approach to promote investigative learning. *Biochem Mol Biol Educ*, 47(4), 438-445. doi:10.1002/bmb.21237.
- Peteroy-Kelly, M. A., Marcello, M. R., Crispo, E., Buraei, Z., Strahs, D., Isaacson, M., Jaworski, L., Lopatto, D., & Zuzga, D. (2017). Participation in a year-long CURE embedded into major core genetics and cellular and molecular biology laboratory courses results in gains in foundational biological concepts and experimental design skills by novice undergraduate researchers. *J Microbiol Biol Educ*, 18(1). doi:10.1128/jmbe.v18i1.1226.
- Petrie, K. L. (2020). There're CRISPRs in my yogurt: A discovery-based CURE at the intersection of industrial food production and the human microbiome. *Front Microbiol*, 11, 578737. doi:10.3389/fmicb.2020.578737.
- Pieczynski, J. N., Deets, A., McDuffee, A., & Lynn Kee, H. (2019). An undergraduate laboratory experience using CRISPR-cas9 technology to deactivate green fluorescent protein expression in *Escherichia coli*. *Biochem Mol Biol Educ*, 47(2), 145-155. doi:10.1002/bmb.21206.
- Pogoda, C. S., Keepers, K. G., Stanley, J. T., & Kane, N. C. (2019). A CURE-based approach to teaching genomics using mitochondrial genomes. *CourseSource*, 6. doi:10.24918/cs.2019.33.
- Potter, L., Stone, R., Fyock, A., & Popejoy-Sheriff, D. F. (2018). Implementing a course-based undergraduate research experience (CURE) into an IE Curriculum. Paper presented at the 2018 ASEE Annual Conference and Exposition, Salt Lake City, UT.
- Pontrello, J. K. (2015). Bringing research into a first semester organic chemistry laboratory with the multistep synthesis of carbohydrate-based HIV inhibitor mimics. *Biochem Mol Biol Educ*, 43(6), 417-427. doi:10.1002/bmb.20915.
- Price, S. A., Larouche, O., Friedman, S. T., Corn, K. A., Wainwright, P. C., & Marinez, C. M. (2020). A CURE for a major challenge in phenomics: a practical guide to implementing a quantitative specimen-based undergraduate research experience. *Integrative Organismal Biology*, 2(1), 1-13. doi:10.1093/iob/obaa004/5741413.
- Procko, C., Morrison, S., Dunar, C., Mills, S., Maldonado, B., Cockrum, C., Peters, N. E., Huang, S. C., & Chory, J. (2019). Big data to the bench: Transcriptome analysis for undergraduates. *CBE Life Sci Educ*, 18(2), ar19. doi:10.1187/cbe.18-08-0161.
- Pufall, M. A., & Wilson, A. M. (2020). An idea to explore: A collaboration and cross training in an extended classroom-based undergraduate research experience between primarily undergraduate and research-intensive institutions. *Biochem Mol Biol Educ*, 48(3), 269-275. doi:10.1002/bmb.21340.
- Rasche, M. E. (2004). Outcomes of a research-driven laboratory and literature course designed to enhance undergraduate contributions to original research. *Biochem Mol Biol Educ*, 32(2), 101-107.
- Reed, K. E., & Richardson, J. M. (2013). Using microbial genome annotation as a foundation for collaborative student research. *Biochem Mol Biol Educ*, 41(1), 34-43. doi:10.1002/bmb.20663
- Reeves, T. D., Warner, D. M., Ludlow, L. H., & O'Connor, C. M. (2018). Pathways over time: functional genomics research in an introductory laboratory course. *CBE Life Sci Educ*, 17(1). doi:10.1187/cbe.17-01-0012.
- Rennhack, J. P., VanRyn, V. S., Poteracki, J. M., & Wehrwein, E. A. (2020). From proposal to poster: course-based undergraduate research experience in a physiology laboratory course. *Adv Physiol Educ*, 44(3), 459-463. doi:10.1152/advan.00011.2020.

- Rhodes, T. (2010). *Assessing Outcomes and Improvement: Tips and Tools for Using Rubrics*. Washington D.C.: Association of American Colleges and Universities.
- Rhode Ward, J., Clarke, H. D., & Horton, J. L. (2014). Effects of a research-infused botanical curriculum on undergraduates' content knowledge, STEM competencies, and attitudes toward plant sciences. *CBE Life Sci Educ*, 13(3), 387-396. doi:10.1187/cbe.13-12-0231.
- Roberts, R., Hall, B., Daubner, C., Goodman, A., Pikaart, M., Sikora, A., & Craig, P. (2019). Flexible implementation of the BASIL CURE. *Biochem Mol Biol Educ*, 47(5), 498-505. doi:10.1002/bmb.21287.
- Rowland, S. L., Lawrie, G. A., Behrendorff, J. B. Y. H., & Gillam, E. M. J. (2012). Is the undergraduate research experience (URE) always best?: The power of choice in a bifurcated practical stream for a large introductory biochemistry class. *Biochemistry and Molecular Biology Education*, 40(1), 46-62. doi:10.1002/bmb.20576.
- Rubush, D. M., & Stone, K. L. (2020). A learning community involving collaborative course-based research experiences for foundational chemistry laboratories. *Education Sciences*, 10(4). doi:10.3390/educsci10040117.
- Rumfelt, K. E., Wonderlin, N. E., Hulbert, D., & White, P. J. T. (2020). From DNA extraction to sequence analysis: A semester-long undergraduate research project on fish mislabeling. *The American Biology Teacher*, 82(3), 170-175. doi:10.1525/abt.2020.82.3.170.
- Russell, J. E., D'Costa, A. R., Runck, C., Barnes, D. W., Barrera, A. L., Hurst-Kennedy, J., Sudduth, E. B., Quinlan, E. L., Schlueter, M., Iskhakova, A., & Haining, R. (2015). Bridging the undergraduate curriculum using an integrated course-embedded undergraduate research experience (ICURE). *CBE Life Sci Educ*, 14(1), ar4. doi:10.1187/cbe.14-09-0151.
- Sanders, E.R. &Hirsch, A.M. (2014). Immersing undergraduate students into research on the metagenomics of the plant rhizosphere: A pedagogical strategy to engage civic-mindedness and retain undergraduates in STEM. *Front. Plant. Sci.* 5, 1-4.
- Sargent Jones, L., Allen, L., Cronise, K., Juneja, N., Kohn, R., McClellan, K., Miller, A., Nazir, A., Patel, A., Sweitzer, S.M., Vickery, E., Walton, A., & Young, R. (2011). Incorporating scientific publishing into an undergraduate neuroscience course: A case study using IMPULSE. *Journal of Undergraduate Neuroscience Education*, 92(2), A84-A91.
- Sarmah, S., Chism, G. W., 3rd, Vaughan, M. A., Muralidharan, P., Marrs, J. A., & Marrs, K. A. (2016). Using zebrafish to implement a course-based undergraduate research experience to study teratogenesis in two biology laboratory courses. *Zebrafish*, 13(4), 293-304. doi:10.1089/zeb.2015.1107.
- Semsar, K., Knight, J. K., Birol, G., & Smith, M. K. (2011). The Colorado Learning Attitudes about Science Survey (CLASS) for use in biology. *CBE Life Sci Educ*, 10(3), 268-278. doi:10.1187/cbe.10-10-0133.
- Sewall, J. M., Oliver, A., Denaro, K., Chase, A. B., Weihe, C., Lay, M., Martiny, J. B. H., & Whiteson, K. (2020). Fiber Force: A fiber diet intervention in an advanced course-based undergraduate research experience (CURE) course. *J Microbiol Biol Educ*, 21(1). doi:10.1128/jmbe.v21i1.1991.
- Seymour, E., Hunter, A.-B., Laursen, S. L., & DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, 88(4), 493-534. doi:10.1002/sce.10131.
- Shanle, E. K., Tsun, I. K., & Strahl, B. D. (2016). A course-based undergraduate research experience investigating p300 bromodomain mutations. *Biochem Mol Biol Educ*, 44(1), 68-74. doi:10.1002/bmb.20927.
- Sharma, A., Tale, E., Hernandez, M., & Phuong, V. (2020). Engaging students with computing and climate change through A course in scientific computing. *Journal of STEM Education: Innovations and Research*, 20(21).
- Shelby, S. J. (2019). A course-based undergraduate research experience in biochemistry that is suitable for students with various levels of preparedness. *Biochem Mol Biol Educ*, 47(3), 220-227. doi:10.1002/bmb.21227.
- Shi, J., Wood, W. B., Martin, J. M., Guild, N. A., Vicens, Q., & Knight, J. K. (2010). A diagnostic assessment for introductory molecular and cell biology. *CBE Life Sci Educ*, 9(4), 453-461. doi:10.1187/cbe.10-04-0055.
- Shuster, M. I., Curtiss, J., Wright, T. F., Champion, C., Sharifi, M., & Bosland, J. (2019). Implementing and evaluating a course-based undergraduate research experience (CURE) at a Hispanic-Serving Institution. *Interdisciplinary Journal of Problem-Based Learning*, 13(2). doi:10.7771/1541-5015.1806.

- Si, J. (2020). Course-based research experience of undergraduate medical students through project-based learning. *Korean J Med Educ*, 32(1), 47-57. doi:10.3946/kjme.2020.152.
- Siegel, M. A., & Ranney, M. A. (2003). Developing the changes in attitude about the relevance of science (CARS) questionnaire and assessing two high school science classes. *Journal of Research in Science Teaching*, 40(8), 757-775. doi:10.1002/tea.10110.
- Siritunga, D., Montero-Rojas, M., Carrero, K., Toro, G., Velez, A., & Carrero-Martinez, F. A. (2011). Culturally relevant inquiry-based laboratory module implementations in upper-division genetics and cell biology teaching laboratories. *CBE Life Sci Educ*, 10(3), 287-297. doi:10.1187/cbe.11-04-0035.
- Sirum, K., & Humburg, J. (2011). The Experimental Design Ability Test (EDAT). *Bioscene: Journal of College Biology Teaching*, 37(1), 8-16.
- Slee, J. B., & McLaughlin, J. S. (2019). Making it stick: A CURE designed to introduce students to the scientific process and the host response to foreign materials. *Biochem Mol Biol Educ*, 47(4), 417-425. doi:10.1002/bmb.21248.
- Smith, J.T., Harris, J.C., Lopez, O.J., Valverde, L., & Borchert, G.M. (2015). "On the job" learning: A bioinformatics course incorporating undergraduates in actual research projects and manuscript submissions. *Biochem Mol Biol Educ*, 43(3), 154-161.
- Smith, M. K., Wood, W. B., & Knight, J. K. (2008). The Genetics Concept Assessment: a new concept inventory for gauging student understanding of genetics. *CBE Life Sci Educ*, 7(4), 422-430. doi:10.1187/cbe.08-08-0045.
- Snellman, E., Krueger, J. A., & Unangst, E. T. (2006). Moving research into the classroom: Successful adaptations at a service academy. *Journal of College Science Teaching*, 35(5), 32-26.
- Sommers, A. S., Miller, A. W., Gift, A. D., Richter-Egger, D. L., Darr, J. P., & Cutucache, C. E. (2020). CURE disrupted! Takeaways from a CURE without a wet-lab experience. *Journal of Chemical Education*, 98(2), 357-367. doi:10.1021/acs.jchemed.0c01214.
- Sorensen, A. E., Corral, L., Dauer, J. M., & Fontaine, J. J. (2018). Integrating authentic scientific research in a conservation course-based undergraduate research experience. *Natural Sciences Education*, 47(1). doi:10.4195/nse2018.02.0004.
- Staub, N. L., Poxleitner, M., Braley, A., Smith-Flores, H., Pribbenow, C. M., Jaworski, L., Lopatto, D., & Anders, K. R. (2016). Scaling up: Adapting a phage-hunting course to increase participation of first-year students in research. *CBE Life Sci Educ*, 15(2). doi:10.1187/cbe.15-10-0211.
- Stein, B., Haynes, A., Michael, R., Ennis, T., & Cecil, M. (2007). Assessing critical thinking in STEM and beyond. Paper presented at the Innovations in E-learning, Instruction Technology, Assessment and Engineering Education, New York, NY.
- Stiemsma, L. T., Davis, S. D., & Brewster, J. L. (2020). Analysis of microbial water contamination, soil microbial community structure, and soil respiration in a collaborative first-year students as scholars program (SAS). *Front Microbiol*, 11, 590035. doi:10.3389/fmicb.2020.590035.
- Stoeckman, A. K., Cai, Y., & Chapman, K. D. (2019). iCURE (iterative course-based undergraduate research experience): A case-study. *Biochem Mol Biol Educ*, 47(5), 565-572. doi:10.1002/bmb.21279.
- Stovall, G. M., Huynh, V., Engelman, S., & Ellington, A. D. (2019). Aptamers in education: Undergraduates make aptamers and acquire 21st century skills along the way. *Sensors (Basel)*, 19(15). doi:10.3390/s19153270.
- Sun, E., Graves, M. L., & Oliver, D. C. (2020). Propelling a course-based undergraduate research experience using an open-access online undergraduate research journal. *Front Microbiol*, 11, 589025. doi:10.3389/fmicb.2020.589025.
- Swanson, H. I., Sarge, O. P., Rodrigo-Peiris, T., Xiang, L., & Cassone, V. M. (2016). Development of a course-based undergraduate research experience to introduce drug-receptor concepts. *J Med Educ Curric Dev*, 3. doi:10.4137/JMECD.S31233.
- Sweat, K. G., Marshall, P. A., Foltz-Sweat, J. L., & Broatch, J. E. (2018). Developing a course-based research experience for undergraduates. *J. of the Arizona-Nevada Academy of Science*, 47(2), 36-43.
- Talley, C. H., & Williams, K. P. (2018). Preparing future healthcare professionals for community engagement: A course-based research experience. *The ABNF Journal*, 29(2), 33-41.
- Tawde, M., & Williams, M. (2020). Antibiotic resistance in environmental microbes: Implementing authentic research in the microbiology classroom. *Front Microbiol*, 11, 578810. doi:10.3389/fmicb.2020.578810.

- Thompson, S. K., Neill, C. J., Wiederhoeft, E., & Cotner, S. (2016). A model for a course-based undergraduate research experience (CURE) in a field setting. *J Microbiol Biol Educ*, 17(3), 469-471. doi:10.1128/jmbe.v17i3.1142.
- Tomasik, J. H., Cottone, K. E., Heethuis, M. T., & Mueller, A. (2013). Development and preliminary impacts of the implementation of an authentic research-based experiment in general chemistry. *Journal of Chemical Education*, 90(9), 1155-1161. doi:10.1021/ed300328p.
- Tootle, T. L., Hoffman, D. S., Allen, A. K., Spracklen, A. J., & Grown, C. M. (2019). Mini-course-based undergraduate research experience: Impact on student understanding of STEM research and interest in STEM programs. *Journal of College Science Teaching*, 48(6), 44-54.
- Treacy, D. J., Sankaran, S. M., Gordon-Messer, S., Saly, D., Miller, R., Isaac, S. R., & Kosinski-Collins, M. S. (2011). Implementation of a project-based molecular biology laboratory emphasizing protein structure-function relationships in a large introductory biology laboratory course. *CBE Life Sci Educ*, 10(1), 18-24. doi:10.1187/cbe.10-07-0085.
- Van Engelen, D. L., Suljak, S. W., Hall, J. P., & Holmes, B. F. (2007). Undergraduate introductory quantitative chemistry laboratory course: Interdisciplinary group projects in phytoremediation. *Journal of Chemical Education*, 84(1), 128-131.
- Vargas, M., Nunez, T., Alfaro, M., Fuertes, G., Gutierrez, S., Ternero, R., Sabattin, J., Banguera, L., Duran, C., & Peralta, M. A. (2020). A project based learning approach for teaching artificial intelligence to undergraduate students. *International Journal of Engineering Education*, 36(6), 1773-1782.
- Vater, A., Mayoral, J., Nunez-Castilla, J., Labonte, J. W., Briggs, L. A., Gray, J. J., Makarevitch, I., Rumjahn, S. M., & Siegel, J. B. (2020). Development of a broadly accessible, computationally guided biochemistry course-based undergraduate research experience. *Journal of Chemical Education*, 98(2), 400-409. doi:10.1021/acs.jchemed.0c01073.
- Villa-Cuesta, E., & Hobbie, L. (2016). Genetics research project laboratory: A discovery-based undergraduate research course. doi:10.1534/gsaprep.2016.003.
- Walsh, S., Becker, A., Sickler, P. S., Clarke, D. G., & Jiminez, E. (2017). An undergraduate laboratory manual for analyzing a CRISPR mutant with a predicted role in regeneration. *J Hum Bio & Health Edu*, 1(2).
- Wang, J. T., Daly, J. N., Willner, D. L., Patil, J., Hall, R. A., Schembri, M. A., Tyson, G. W., & Hugenholtz, P. (2015). Do you kiss your mother with that mouth? An authentic large-scale undergraduate research experience in mapping the human oral microbiome. *J Microbiol Biol Educ*, 16(1), 50-60. doi:10.1128/jmbe.v16i1.816.
- Werby, S. H., & Cegelski, L. (2019). Design and implementation of a six-session CURE module using biofilms to explore the chemistry–biology interface. *Journal of Chemical Education*, 96(9), 2050-2054. doi:10.1021/acs.jchemed.8b00957.
- Wiley, E. A., & Stover, N. A. (2014). Immediate dissemination of student discoveries to a model organism database enhances classroom-based research experiences. *CBE Life Sci Educ*, 13(1), 131-138. doi:10.1187/cbe.13-07-0140
- Williams, L. C., & Reddish, M. J. (2018). Integrating primary research into the teaching lab: Benefits and impacts of a one-semester CURE for physical chemistry. *Journal of Chemical Education*, 95(6), 928-938. doi:10.1021/acs.jchemed.7b00855.
- Witherow, D. S. (2016). A ten-week biochemistry lab project studying wild-type and mutant bacterial alkaline phosphatase. *Biochem Mol Biol Educ*, 44(6), 555-564. doi:10.1002/bmb.20982
- Wolkow, T. D., Durrenberger, L. T., Maynard, M. A., Harrall, K. K., & Hines, L. M. (2014). A comprehensive faculty, staff, and student training program enhances student perceptions of a course-based research experience at a two-year institution. *CBE Life Sci Educ*, 13(4), 724-737. doi:10.1187/cbe.14-03-0056.
- Wooten, M. M., Coble, K., Puckett, A. W., & Rector, T. (2018). Investigating introductory astronomy students' perceived impacts from participation in course-based undergraduate research experiences. *Physical Review Physics Education Research*, 14(1). doi:10.1103/PhysRevPhysEducRes.14.010151.
- Yan, J., Hu, S., Xu, X., Zhao, D., Wu, M., Luo, S., & Xia, Y. (2018). Identification of an unknown glycoprotein from whole cell lysate using conA and mass spectrometry. *Biochem Mol Biol Educ*, 46(4), 373-381. doi:10.1002/bmb.21134.

Zelaya, A. J., Gerardo, N. M., Blumer, L. S., & Beck, C. W. (2020). The bean beetle microbiome project: A course-based undergraduate research experience in microbiology. *Front Microbiol*, 11, 577621.  
doi:10.3389/fmicb.2020.577621.