Engaging Students in Course-Based Undergraduate Research Experiences

Allan Feldman, Ph.D.
Lina Dahlberg, Ph.D.

This material is based upon work supported by the National Science Foundation (NSF) under Grant No. DUE-1937267. Any opinions, findings, interpretations, conclusions or recommendations expressed in this material are those of its authors and do not represent the views of the AAAS Board of Directors, the Council of AAAS, AAAS’ membership or the National Science Foundation.
This presentation is being recorded. The recording and slides will be available in the coming week at

https://aaas-iuse.org

Please note: The discussion break-out groups following the presentations will NOT be recorded.
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https://aaas.org
The AAAS-IUSE initiative supports faculty, students, and the greater undergraduate STEM education community by disseminating research and knowledge about STEM teaching, learning, equity and institutional transformation.

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- Workshops
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- Resources
- Lessons Learned During COVID
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Engaging Students in Course-Based Undergraduate Research Experiences

Online workshop, AAAS/IUSE
May 10, 2022

Allan Feldman and Rita Ortiz
Overview of workshop

• How do people learn to do research?
• A course-based model to scaffold learning to do research
• Examples of course-based authentic research activities
• Questions and discussion
Model for learning how to do science in research groups

The research education of science and engineering students occurs as part of an apprenticeship. The apprenticeship takes place in research groups. Students have different roles in the research groups. They can be in the role of novice researcher, proficient technician, or knowledge producer. The members of the research group including the professor and other students facilitate the development of the students along the continuum of roles.

(Feldman et al., 2009; 2013)
Apprenticeships

To be an apprentice is to engage in legitimate peripheral participation in a community of practice, which results in the situated learning of skills and knowledge needed to become an expert in the field.

(Lave & Wenger, 1991)
Characteristics of apprenticeships

- The nature of learning and the practice of work are indistinguishable.
- The “master” partitions tasks into chunks that are doable by the apprentices to help them to develop new skills.
- The apprentices demonstrate their learning by accomplishing tasks in ways that are analogous to that of the expert.
Research groups

- A research group consists of a lead researcher, a group of students, and possibly post-doctoral fellows and technical staff.

- The group is defined by the area of study, and most importantly, the lead researcher, who is often a professor at a research university.

- Research groups generally have one of two configurations:
  - Tightly structured.
  - Loosely structured.
Web of relationships in research groups

Tightly structured

Loosely structured
Web of relationships in research groups

Example of an NSF Partnerships for International Research and Education (PIRE) project
Research groups as communities

- Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. (Wenger, 1998)
- Epistemic communities are one in which its members – scientists, students, and others – have recognized expertise and competence in a domain of science and have an authoritative claim to knowledge within that domain. (Haas, 1992)
Roles in research groups

- Novice researcher
- Proficient technician
- Knowledge producer
Novice researchers

• Short-term members of the group;
• Lack research skills (*methodological proficiency*);
• Lack the ability to formulate research questions, have difficulty drawing defensible conclusions from data, and are not expected to contribute much if anything to the analysis of data or the creation of new knowledge (*intellectual proficiency*).
Proficient technicians

• Longer-term members of the group,
• Have skills needed to collect and analyze data, to report results to other researchers, and can apply the methods that they have learned to new situations (*methodological proficiency*),
• Are not expected to be adept at developing research questions (*intellectual proficiency*), and
• Have the knowledge and skills necessary to become skilled practitioners in their field.
Knowledge producers

• Long term members of the research group;
• Can search out existing research methods and develop new methods (*methodological proficiency*).
• Can integrate information from their field and other domains, formulate research questions, draw defensible conclusions from data, and create, disseminate, and defend new knowledge that is a contribution to the field (*intellectual proficiency*).
Growth of expertise

Novice researcher to proficient technician:
Signaled by a growth in confidence and the ability to do more independent thinking including the design of experiments.

Proficient technician to knowledge producer:
Signaled by being able to analyze data to make defensible claims; an ability to add to the literature; the possession of knowledge that is equivalent or surpasses that of their advisor; and are critical of the work of other knowledge producers, including their advisors.
Model for learning to do research in research groups

(Feldman, A., Divoll, K., & Rogan-Klyve, A. , 2013)
Implications for CUREs

• Need realistic goals re methodological and intellectual proficiency, and the knowledge and skills needed to participate in an epistemic community.

• Type of research group matters (tightly loosely structured are more efficient than loosely structured).

• Should be highly structured with well-defined research projects and scaffolding activities (e.g., journal clubs and regular research group meetings).
CURE design based on Feldman et al.

• 3-credit course on how to do research (provides scaffolding)
• Research experiences in STEM faculty research groups
• Mentoring by graduate students
## Course components

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>SEPs</th>
<th>Student product</th>
<th>Lab activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to the practices of science</td>
<td>8</td>
<td>Research application</td>
<td>Lab tours, Laboratory safety training</td>
</tr>
<tr>
<td></td>
<td>Introduction to the practices of science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Searching &amp; reviewing the literature</td>
<td>3, 8</td>
<td>Review of article provided by GSM</td>
<td>Introduction to research methods</td>
</tr>
<tr>
<td></td>
<td>Discussion of articles in URGs with GSM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Developing a researchable question</td>
<td>1, 3, 8</td>
<td>Description of the scientist’s research group including the members &amp; their roles</td>
<td>Help GSM collect data</td>
</tr>
<tr>
<td>4</td>
<td>Developing a researchable question – peer review of elevator pitches</td>
<td>1, 3, 8</td>
<td>Video elevator pitches</td>
<td>Set-up for URG’s research</td>
</tr>
<tr>
<td>5</td>
<td>Conceptualizing data</td>
<td>1, 3</td>
<td>Mini research proposal</td>
<td>Begin data collection</td>
</tr>
<tr>
<td>6</td>
<td>Using mathematical representations to analyze data</td>
<td>3, 5 8</td>
<td>Description of data collection methods &amp; how data are related to the research questions</td>
<td>Continue collecting data</td>
</tr>
<tr>
<td>7</td>
<td>Students present ways mathematics is used by their GSMS &amp; how that is relevant to their research</td>
<td>3, 4, 5</td>
<td>Example(s) of how the URGs’ GSMS use mathematics in their research</td>
<td>Continue collecting data &amp; begin data analysis</td>
</tr>
</tbody>
</table>

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<th>SEPs</th>
<th>Student product</th>
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</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Use of models in science</td>
<td>2, 3, 4, 5</td>
<td>Update of data collection &amp; analysis</td>
<td>Continue collecting data &amp; data analysis</td>
</tr>
<tr>
<td>9</td>
<td>Students present ways models are used in their research</td>
<td>2, 3, 4, 5</td>
<td>Example(s) of models used in URG research</td>
<td>Continue collecting data &amp; data analysis</td>
</tr>
<tr>
<td>10</td>
<td>Identifying results</td>
<td>3, 4, 5, 6</td>
<td></td>
<td>Continue collecting data &amp; data analysis</td>
</tr>
<tr>
<td>11</td>
<td>Warranting scientific research, constructing explanations, &amp; argumentation</td>
<td>3, 4, 5, 6, 7</td>
<td>Initial findings</td>
<td>Continue collecting data &amp; data analysis</td>
</tr>
<tr>
<td>12</td>
<td>Reporting research</td>
<td>3, 4, 5, 6, 7</td>
<td>Explanations for findings</td>
<td>Continue collecting data &amp; data analysis</td>
</tr>
<tr>
<td>13</td>
<td>Group work &amp; consulting with instructor</td>
<td>4, 5, 6, 7, 8</td>
<td></td>
<td>Developing report &amp; poster</td>
</tr>
<tr>
<td>14</td>
<td>Poster presentations</td>
<td>8</td>
<td>Report &amp; Poster</td>
<td></td>
</tr>
</tbody>
</table>
Research experiences in STEM faculty research groups

- **Geosciences** – focus on the nexus of hydrological connectivity, geological controls on physical and chemical hydrology, hydrological controls on ecosystem structure and function. Research sites include depressional wetlands, headwater streams and mainstem rivers, and mangroves and lagoons.

- **Environmental Engineering** - focus on developing sustainable treatment processes for drinking water and wastewater, biological waste-to-energy technologies, and water and sanitation systems for developing countries.

- **Integrative Biology** – focus on the intersection of microbial ecology and public health microbiology, with a focus on the pollution of water with fecal indicator bacteria (FIB) and associated pathogens.

- **Physics** – focus on the capabilities, characteristics, and limitations of the instruments in the facilities while investigating the effect on results from standards, and samples that are directly applicable the research conducted by physicists.

- 11 Scientists/Engineers agreed to open their labs to the students.
Role of graduate student mentors (GSMs)
Example of course-based authentic research activities
Pilot study

An existing required undergraduate science education course titled “Science, Technology, and Society” was modified

• to focus on the Food-Energy-Water (FEW) nexus and

• to provide students with the opportunity to engage in research activities related to the nexus.
Why Does It Matter?

- Next Generation Science Standards
- Science and Engineering Practices
- Less than 20% of STEM and Science Education majors graduate with research experiences (Egan et. al. 2013)
Educational Research Questions

1. In what ways does this course-based undergraduate research experience help students learn the practices of science and engineering?

2. Does the focus on the FEW nexus have positive effects on students’ motivation to engage in authentic research activities? If so, in what ways and why?

3. How did the experience affect their future teaching?
Participants

• 10 Biology Education majors, 1 Biomedical major. All juniors or seniors.
• 8 women, 3 men
• Two graduate student mentors
• Diverse student group
Data Collection

- Surveys
- Observations of the course
- Sample Assignments and activities
  - SEPs presentations
  - Science mysteries
  - Interim and final research reports
- Final Semester interviews
  - Audio-recording only
The Research Experiences

Factors that affect the growth of algae – red tide

Use of biosand filters to produce potable water

Biodigester to produce compost and biogas from food waste
Biodigester project
Based on the data provided, what is the best type of waste?

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Methane Yield (L/kg VS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm oil mill waste</td>
<td>610</td>
</tr>
<tr>
<td>Municipal solid waste</td>
<td>360 – 530</td>
</tr>
<tr>
<td>Fruit and vegetable wastes</td>
<td>420</td>
</tr>
<tr>
<td>Food waste</td>
<td>396</td>
</tr>
<tr>
<td>Rice straw</td>
<td>350</td>
</tr>
<tr>
<td>Household waste</td>
<td>350</td>
</tr>
<tr>
<td>Swine manure</td>
<td>337</td>
</tr>
<tr>
<td>Maize silage and straw</td>
<td>312</td>
</tr>
<tr>
<td>Food waste leachate</td>
<td>294</td>
</tr>
<tr>
<td>Lignin-rich organic waste</td>
<td>200</td>
</tr>
</tbody>
</table>
Based on the data provided, what is the best Retention time?
Based on the data provided, what is the best temperature?
Preliminary findings: Learning SEPs

• Students gained methodological intellectual proficiency: developing research questions, use of models, data gathering and analysis, and reporting results.

• Students did not progress beyond the role of novice researcher.

• Felt that they were acting like scientists.

• Students had not experienced authentic research activities in science courses previously.

• Students would have liked more emphasis on literature review.

• May have been better to have only one or two project choices rather than three.

• They reported that the lab tours helped them to see the SEPs in action.

• Graduate student mentors were helpful to the students, but the GSMs had very different levels of research expertise.
Preliminary findings: Effect of focus on FEW nexus

• Level of motivation for the students was different for the three projects.
• They gained new perspective on FEW issues and environmental awareness.
• They saw ways in which they could use the FEW nexus to motivate their students to learn science concepts.
Preliminary findings: Students’ intentions to incorporate research experiences into their teaching

- Most of the students said they would incorporate authentic research experiences into their own teaching.
- In their final paper they described how they would do it with their students.
- Noted barriers that they would need to face (e.g., coverage for high stakes exams).


Thank You

Questions?

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afeldman@usf.edu
Including collaboration as a design element in Course-based Undergraduate Research Experiences

Dr. Lina Dahlberg
Department of Biology
Western Washington University
Bellingham, Washington USA

- Primarily undergraduate institution (PUI)
- 15,000 students
- 85% of students are from Washington State
Cellular level

ERAD = ER-associated degradation

ERAD

- XBP1s
- BiP
- ER chaperones
- ERAD
- Lipid synthesis

Fold and refold proteins
Remove terminally misfolded proteins
Increase capacity (reduce crowding)

Organismal (student) level

CUREs = Course-based Undergraduate Research Experiences

- Educate student researchers in laboratory classrooms
- Introduce faculty-driven research into laboratory classrooms
- Understand how students approach problem solving
By focusing on elements that students value as part of their learning, we can strengthen laboratory courses even if they do not become full CUREs.

As science educators, we can help build communities of people who help each other search for answers to real questions.
Outline

• Important elements of CUREs
• Ways to include meaningful collaboration in laboratory courses and CUREs or CURE modules
• Models for introducing collaboration
  • Temporal
  • Intramural
  • Extramural
• Discussion/breakout groups to follow:
  • How can I use the ideas for introducing collaboration in my classroom, and how will I know if what I am doing is helping/working?
  • Are there other cheap and easy things can I do to address elements that students value in CUREs?
  • What kinds of planning goes into setting up an intramural or extramural collaboration through CUREs?
Outline

• Important elements of CUREs

Single course, faculty-research driven

The Impact of Broadly Relevant Novel Discoveries on Student Project Ownership in a Traditional Lab Course Turned CURE

Katelyn M. Cooper, Joseph N. Blattman, Taija Hendrix, and Sara E. Brownell

Linked courses, faculty-research driven

Implementation of a Collaborative Series of Classroom-Based Undergraduate Research Experiences Spanning Chemical Biology, Biochemistry, and Neurobiology

Jennifer R. Kowalski, Geoffrey C. Hoops, and R. Jeremy Johnson

There are many ways to run a CURE

Dispersed programs, big-questions

Tiny Earth: A Big Idea for STEM Education and Antibiotic Discovery


The Genomics Education Partnership: Successful Integration of Research into Laboratory Classes at a Diverse Group of Undergraduate Institutions

Course-based Undergraduate Research Experiences (CUREs) provide students with laboratory research opportunities.

CUREs can...

• give students hands-on time with real research
• require students to assess, plan, evaluate, monitor, and reflect
• promote science-identities and scientific confidence
• reach larger, more diverse groups of students than independent research opportunities.
Course-based Undergraduate Research Experiences (CUREs) provide students with an authentic laboratory setting.

Course-based research includes:

- Using scientific practices
- Discovery
- Broadly relevant or important work
- Collaboration
- Iteration

... but full CUREs can be time-consuming and expensive

Auchincloss, et al., 2014.
Course-based Undergraduate Research Experiences (CUREs) provide students with an authentic laboratory setting.

Course-based research includes:

• Using scientific practices
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• Iteration

What elements of course-based research are most important for students, and why?

• Introduce course-based research across levels of a biology curriculum
• Identify elements that students report as important
• Interview students to discover how those elements impact learning
• Revise courses to include and improve elements that are important to students’ learning

Dahlberg, et al., 2018
Wiggins, et al., 2021
Grove, et al., 2021

Auchincloss, et al., 2014.
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Auchincloss, et al., 2014.

Dahlberg, et al., 2018
Wiggins, et al., 2021
Grove, et al., 2021
Introduction to Cell and Molecular Biology
96 students/course, up to 3 courses per quarter

Methods in Molecular Biology
48 students/course, 1 course per quarter

Advanced Cell and Molecular Biology Laboratories
16 students/course, 1 course per quarter
Existing laboratory curriculum
Research module or research-based curriculum
Existing laboratory curriculum
Research module or research-based curriculum
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Research module or research-based curriculum

Existing laboratory curriculum

Research module or research-based curriculum

Existing laboratory curriculum

Research module or research-based curriculum

Dahlberg, et al., 2018

Wiggins, et al., 2021
Elements that students reported as highly valued:

Collaboration  Iteration

Dahlberg, et al., 2018
Wiggins, et al., 2021
Elements that students reported as highly valued:

Collaboration  Iteration

Dahlberg, et al., 2018
Wiggins, et al., 2021
Outline

• Important elements of CUREs
• Ways to include meaningful collaboration in laboratory courses and CUREs or CURE modules

How can we design useful elements of laboratory coursework in cheap and easy ways?

Collaboration
Laboratory course design: collaboration as part of research and for student learning

| Building collaboration into course design | Relationship to research | Relationship to the student experience |
How can we design useful elements of collaboration into laboratory coursework in **cheap** and **easy** ways?

<table>
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<tr>
<th>Building collaboration into course design</th>
<th>Relationship to research</th>
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<td>Allow for, and normalize, group struggle</td>
<td>Appreciation of space and time for errors, and confirmation from authority/trusted source</td>
<td>Efficiency is not a student goal at this level; students need to build practice before efficiency.</td>
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<td>Interaction with science communities off campus</td>
<td>Collaboration in and between &quot;real-world&quot; science labs is seen as an essential process and as a skill.</td>
<td>Framing the universality of troubleshooting in science with student technique struggles/troubleshooting</td>
</tr>
</tbody>
</table>
How can we design useful elements of collaboration into laboratory coursework in **cheap** and **easy** ways?

<table>
<thead>
<tr>
<th>Examples for how collaboration can be progressively redesigned into CURE courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introducing collaboration</strong></td>
</tr>
<tr>
<td><strong>Improved implementation</strong></td>
</tr>
<tr>
<td><strong>Even Better implementation</strong></td>
</tr>
</tbody>
</table>
Outline

• Important elements of CUREs
• Ways to include meaningful collaboration in laboratory courses and CUREs
  • Models for introducing collaboration
    • Temporal
    • Intramural
    • Extramural
Temporal: Working across academic sessions

MidLab

Wild-type  C25E10.12  ubc-6

Control  Upstream  Downstream  Entire ORF  Control  Upstream  Downstream  Entire ORF  Control  Upstream  Downstream  Entire ORF

AdvLab

Relative GFP Fluorescence (AFU)

C25E10.12 depletions result in an increase in HSP-4 during unfolded protein response in C. elegans

Lindsey Barnes, Lina Dahlberg, K. Brokoff, and J. Aguilera
1. Department of Biology, Western Washington University, Bellingham, WA USA

Mid
Adv

COVID-19
Collaboration between AdvLabs expands the range of research questions and available techniques.

Intramural: Working across the building, or across campus
Intramural: Working across the building, or across campus
Relative quantification of GLR-1 cDNA in wild type C. elegans

Behavioral analysis of trained and untrained C. elegans

Western Blot of GLR-1::GFP in trained and untrained C. elegans

DNA damage may induce greater nuclear localization of tagged-Twi8

Twi8 KO strains of Tetrahymena have elevated DNA damage

Localization of two RNAi pathway genes in Tetrahymena

Intramural: Working across the building, or across campus
Extramural: Engaging with the scientific community

Dahlberg and Groat Carmona, 2018

Results of genotyping experiments

<table>
<thead>
<tr>
<th>N2 (WT)</th>
<th>C25E30.12 (CRISPR and control)</th>
<th>Ub-4 (recessive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flanking ubc-4</td>
<td>2581 bp</td>
<td>7187 bp</td>
</tr>
<tr>
<td>Ubc-4: PHS::CBw6 R</td>
<td>Nothing</td>
<td>889 bp</td>
</tr>
<tr>
<td>Ubc-4::CBw6::CBw6 R</td>
<td>Nothing</td>
<td>2033 bp</td>
</tr>
<tr>
<td>Ubc-4::CBw6::CBw6 R</td>
<td>Nothing</td>
<td>1172 bp</td>
</tr>
<tr>
<td>Flanking C25E30.12</td>
<td>NA</td>
<td>7187 bp</td>
</tr>
<tr>
<td>C25E30.12::Ub-4 R</td>
<td>NA</td>
<td>899</td>
</tr>
</tbody>
</table>

Table 1

Activity

Here are our top 10 community curators for phenotype data in the last 3 months!

<table>
<thead>
<tr>
<th>Community Contributors</th>
<th>Number of Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahna Skop</td>
<td>99</td>
</tr>
<tr>
<td>Caroline Dahlberg</td>
<td>87</td>
</tr>
<tr>
<td>Emily Ruth Troemel</td>
<td>42</td>
</tr>
<tr>
<td>Tyler Joseph Kennedy</td>
<td>42</td>
</tr>
<tr>
<td>Suzi Birnbaum</td>
<td>27</td>
</tr>
<tr>
<td>Francesca Jean</td>
<td>21</td>
</tr>
<tr>
<td>Matt W.G. Walker</td>
<td>17</td>
</tr>
<tr>
<td>Stephanie Nava</td>
<td>16</td>
</tr>
<tr>
<td>Simona D Frederiksen</td>
<td>16</td>
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<tr>
<td>Rex Terry</td>
<td>15</td>
</tr>
</tbody>
</table>

Want to be a community curator? Submit data

Grove, et al., 2021

MidLab

Dahlberg and Groat Carmona, 2018

AdvLab
Full CUREs can be time-consuming and expensive

By focusing on elements that students value as part of their learning, we can strengthen laboratory courses even if they do not become full CUREs.

- Collaboration is an important part of research that students value.
- Collaboration can be cheap and easy to include in course design.
- Collaborative research courses can lead to productive and relevant student research experiences
<table>
<thead>
<tr>
<th>Scientific Practices</th>
<th>Discovery</th>
<th>Relevant Research</th>
<th>Collaboration</th>
<th>Iteration</th>
</tr>
</thead>
</table>

By focusing on elements that students value as part of their learning, we can strengthen laboratory courses even if they do not become full CUREs.

As science educators, we can help build communities of people who help each other search for answers to real questions.
WWU Undergraduate Researchers
Intro students
MidLab students
AdvLab students

Heino Hulsey-Vincent
Brandon Henderson
Jade Stair
Tiara Johnson
Haley Sefi-Cyr
Kyle Neal
McKaila Leytze

Rikki Ulrich
Daniel Hassell
Mackenzi Chapman
Alissah Rupert
Neriah Alvinez
Samiya Ismail

WWU
Graduate teaching assistants
Suzanne Lee
Nick Galati
David Leaf
Kendra Bradford
Joe Somera
Jose Serrano-Moreno
Lynn Pillitteri
Anna Groat Carmona (UW-Tacoma)
Robin Kodner

UW-Seattle
Benjamin Wiggins
(Shoreline Community College)
Hannah Jordt
Leah Lily

University of British Columbia
Mark Edgely
Erica Li-Leger
Vinci Au
Don Moerman

Caltech
Chris Grove, WormBase
Outline

• Important elements of CUREs
• Ways to include meaningful collaboration in laboratory courses and CUREs
• Models for introducing collaboration
  • Temporal
  • Intramural
  • Extramural

How did this [IntroLab] module change your understanding of how research is done?

• Collaboration  • Iteration
How can we design useful elements of *repetition* into laboratory coursework in **cheap** and **easy** ways?

<table>
<thead>
<tr>
<th>Repetition to build into course design.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice/dry run before running lab experiment</td>
</tr>
<tr>
<td>Activities that span the gap between lecture and laboratory</td>
</tr>
<tr>
<td>Understanding laboratory space</td>
</tr>
<tr>
<td>‘Repeat-a-lab’ opportunities at the end of the term</td>
</tr>
</tbody>
</table>
AdvLab student experiences during collaborative annotation

“I felt like I already had a pretty solid understanding of the differences between genotype and phenotype, but I guess Wormbase really solidified that idea.”

I feel like Wormbase confused me more than it helped... it was difficult for me to realize that transgenic animals... could also be considered control conditions.

Grove, et al., 2021
AdvLab student experiences during collaborative annotation

Annotating helped me learn more about the scientific community and how things are actually annotated and that it's not just done by a computer system or by the researchers themselves.

It gives a deeper connection with the scientific community because you can be annotating a gene of interest from a paper, then when you see that author or gene of interest again you will be able to remember what the paper is talking about.

Grove, et al., 2021
Facilitated Breakout Rooms:

1. Navigate to the bottom of your screen and click “Breakout Rooms” button
2. Self-select into your breakout group based on topic interest

Note: If you do not see the Breakout Rooms button, please post in the chat to ask to be placed in a breakout room.
Discussion Breakout Room Recap
Thank you for attending!

Slides and recording will be available in the coming weeks.

We value your feedback, please take a few minutes to complete the survey.