

Supplemental Material

CBE—Life Sciences Education

Spell *et al.*

Authentic Research Experiences in Introductory Biology Laboratory Courses



As a part of REIL Biology -- a Research Coordination Network in Undergraduate Biology Education on Research Experiences in Introductory Laboratories (REIL), we are conducting a national survey to assess the current state of authentic research experiences in introductory biology laboratory courses.

The survey is anonymous and should take approximately 15 minutes to complete.

For information about REIL Biology, please visit rcn.ableweb.org.

If you have questions about this survey, please contact us.

Thank you for participating in the survey.

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There are 89 questions in this survey.

A note on privacy

This survey is anonymous.

The record kept of your survey responses does not contain any identifying information about you unless a specific question in the survey has asked for this. If you have responded to a survey that used an identifying token to allow you to access the survey, you can rest assured that the identifying token is not kept with your responses. It is managed in a separate database, and will only be updated to indicate that you have (or haven't) completed this survey. There is no way of matching identification tokens with survey responses in this survey.

In our discussions, we have found that faculty have divergent views on the essential components of an authentic research experience. We are interested in your perspective on authentic research experiences.

*In your opinion, what are the essential components of an authentic research experience in a laboratory class?

Introductory Biology Laboratory Courses at Your Institution

We are interested in the types of Introductory Biology laboratory courses taught at your institution and the degree to which those courses incorporate authentic research experiences as you have defined them.

*Please select the number of distinct introductory biology laboratory courses of each type that are taught at your institution.

For a 2 semester introductory sequence, select "2". Introductory courses that change topic based on instructor, but that have the same course number, should be considered only 1 course.

If you do not teach a particular type of course at your institution, select "0".

By "Science majors introductory biology," we mean a course that is taught to pre-dominantly science majors, although might be taken by students in other majors if those students are planning on attending graduate or professional school in the sciences. By "Mixed majors and non-majors introductory biology," we mean that all students taking introductory biology at your institution take the same course.

	Number of distinct courses
Non-majors introductory biology	___
Science Majors introductory biology	___
Mixed majors and non-majors introductory biology	___
Pre-health introductory biology	___
Other introductory biology	___

Please describe the other introductory biology laboratory course(s) taught at your institution.

Introductory Biology Laboratory Courses at Your Institution (repeated for each course listed)

We are interested in the degree to which the non-majors introductory biology laboratory courses incorporate authentic research experiences as you have defined them. For each course separately, we ask about your role in the course and basic demographic information about the course.

What is your role in the _____ introductory biology laboratory course (course #1) at your institution?

Check any that apply

Teach in the laboratory

Direct the laboratory

Prep for the laboratory

Train the instructors for the laboratory

I am not involved in the laboratory portion of this course

Other

Introductory Biology Laboratory Courses at Your Institution

We are interested in the degree to which the non-majors introductory biology laboratory courses incorporate authentic research experiences as you have defined them. For each course separately, we ask about your role in the course and basic demographic information about the course.

What is your role in the _____ introductory biology laboratory course (course #1) at your institution?

Check any that apply

Teach in the laboratory

Direct the laboratory

Prep for the laboratory

Train the instructors for the laboratory

I am not involved in the laboratory portion of this course

Other

Please describe your role in the _____ introductory biology laboratory course (course #1)?

What percentage of your non-majors introductory biology laboratory course (course #1) involves authentic research experiences (as you have defined them)?

___ % (Only numbers may be entered in this field)

Please provide the following demographic information for your non-majors introductory biology laboratory course (course #1). If the course is not taught every semester, provide information for a typical semester in which it is taught.

Only numbers may be entered in these fields

Approximately how many students enroll in course in a typical semester?

Approximately how many sections of the laboratory are taught in a typical semester?

How many hours per week does the laboratory itself (not lecture) meet?

How many class meetings are there for the laboratory itself (not lecture) during a typical semester?

Barriers to Implementing Authentic Research Experiences

We are interested in real and perceived barriers to the implementation of authentic research experiences in introductory biology laboratory courses.

*Based on your experiences, rate the degree to which each of the following factors is a real or perceived barrier to the implementation of authentic research experiences in introductory biology laboratory courses relative to a traditional laboratory course.

	NA/Don't know	Not a barrier	A minor barrier	Somewhat of a barrier	A major barrier
Cost					
Lack of instructor preparation					
Instructor resistance					
Lack of lab prep support					
Lack of administrator support					
Lack of facilities					
Lack of equipment					
Effects on student evaluation of instructors					
Loss of content coverage and breadth					
Additional workload					
Lack of time for faculty to develop new research experiences					
Lack of ways to effectively assess students					
Class size					
Number of sections					
Lack of student preparation					

List any additional barriers to the implementation of authentic research experiences in introductory biology laboratory courses that are not listed above.

Demographic Information

The final part of the survey will ask you some basic questions about your institution.

*At which type of institution do you teach?

Choose one of the following answers

- Private
- Public
- For Profit

*What category best describes your institution?

Choose one of the following answers

- 2-year college
- Liberal Arts College
- Comprehensive or Masters Degree Granting University
- Research University

*Is your institution considered any of the following?

Choose one of the following answers

- Historically Black College or University (HBCU)
- Hispanic-serving Institution
- Native American or Tribal College or University
- Other minority-serving institution
- None of the above

Which of the following organizations are you a member of?

Check any that apply

- ABLE (Association for Biology Laboratory Education)
- CUR (Council on Undergraduate Research)
- NABT (National Association of Biology Teachers)
- NSTA (National Science Teachers Association)
- Other:

Table S1. Summary statistics by barrier type

Barrier	Mode	Median	Mean	Standard Deviation
Cost	3	2	2.37	1.14
Lack of instructor preparation	3	2	2.32	1.07
Instructor resistance	1	2	2.21	1.17
Lack of lab prep support	3	3	2.49	1.10
Lack of administrator support	1	1	1.92	1.18
Lack of facilities	1	2	2.36	1.13
Lack of equipment	3	3	2.49	1.10
Effects on student evaluation of instructors	1	1	1.39	0.91
Loss of content coverage and breadth	1	2	2.24	1.06
Additional workload	3	3	2.87	1.02
Lack of time for faculty to develop new research experiences	4	3	3.08	1.06
Lack of ways to effectively assess students	1	2	1.86	0.92
Class size	2	3	2.54	1.11
Number of sections	3	3	2.56	1.13
Lack of student preparation	3	3	2.63	1.10

Based on Likert scale of 1= “not a barrier”, 2 = “minor barrier”, 3 = “somewhat of a barrier”, 4 = “major barrier”.

Table S2. a) Mode response for each barrier by institution type. b) Median response for each barrier by institution type and Kruskal-Wallis test result. Bolded values were significantly different ($p < 0.05$).

a)				
Barrier	2-year college	Liberal Arts College	Comprehensive University	Research University
	Cost	4	3	3
Lack of instructor preparation	3	1	2	1
Instructor resistance	3	1	3	1
Lack of lab prep support	3	3	3	3
Lack of administrator support	1	1	1	1
Lack of facilities	3	1	3	3
Lack of equipment	3	1	3	3
Effects on student evaluation of instructors	1	1	1	1
Loss of content coverage and breadth	3	3	1	1

Additional workload	2	3	3	3
Lack of time for faculty to develop new research experiences	4	4	4	3
Lack of ways to effectively assess students	2	1	1	1,2
Class size	3,4	2	3	4
Number of sections	3	2	2,3	4
Lack of student preparation	4	2	3	3

b) Barrier	Median				Chi-square	P-value
	2-year college	Liberal Arts College	Comprehensive University	Research University		
Cost	3	2	3	3	5.04	0.17
Lack of instructor preparation	3	2	2	2	4.14	0.25
Instructor resistance	3	2	2.5	2	5.15	0.16
Lack of lab prep support	3	3	3	2	2.85	0.42
Lack of administrator support	2	1	2	1	3.99	0.26
Lack of facilities	3	2	2	3	4.25	0.24
Lack of equipment	3	2	3	3	14.43	0.00
Effects on student evaluation of instructors	1	1	1	1	2.17	0.54
Loss of content coverage and breadth	3	2	2	2	6.60	0.09
Additional workload	3	3	3	3	4.61	0.20
Lack of time for faculty to develop new research	4	4	3	3	9.20	0.03

experiences

Lack of ways to effectively assess students	2	2	2	2	1.68	0.64
Class size	3	2	2.5	3	8.22	0.04
Number of sections	3	2	2	3	10.33	0.02
Lack of student preparation	3	2	3	3	9.61	0.02

Based on Likert scale of 1= “not a barrier”, 2 = “minor barrier”, 3 = “somewhat of a barrier”, 4 = “major barrier”.

Table S3. Responses for each barrier by minority or not and Wilcoxon Rank Sum test result. Bolded values were significantly different ($p < 0.05$).

Barrier	Mode		Median		Chi-square	P-value
	Non-minority	Minority	Non-minority	Minority		
Cost	3	4	2	3	3.75	0.05
Lack of instructor preparation	3	3	2	2.5	0.36	0.55
Instructor resistance	1	4	2	2.5	1.49	0.22
Lack of lab prep support*	3	3	3	3	4.15	0.04
Lack of administrator support	1	4	1	2	8.17	0.00
Lack of facilities	1	3	2	3	6.81	0.01
Lack of equipment	3	3	2	3	3.86	0.05
Effects on student evaluation of instructors*	1	1	1	1	4.61	0.03
Loss of content coverage and breadth	1	3	2	2	0.11	0.74
Additional workload	3	3	3	3	0.18	0.68
Lack of time for faculty to develop new research	4	4	3	4	8.25	0.00

experiences

Lack of ways to effectively assess students	1	2	2	2	1.86	0.17
Class size	2	2	3	2.5	0.04	0.83
Number of sections	3	3	3	3	0.19	0.67
Lack of student preparation	3	4	3	3	1.68	0.19

Based on Likert scale of 1= “not a barrier”, 2 = “minor barrier”, 3 = “somewhat of a barrier”, 4 = “major barrier”.

* Based on the sum of the ranks, the barrier was greater for faculty of minority institutions.

Table S4. Responses for each barrier for public and private institutions and Wilcoxon Rank Sum test result. Bolded values were significantly different ($p < 0.05$).

Barrier	Mode		Median		Chi-square	P-value
	Public	Private	Public	Private		
Cost	3	3	3	2	4.98	0.03
Lack of instructor preparation	3	3	2	2	0.42	0.52
Instructor resistance	1	1	2	2	1.67	0.20
Lack of lab prep support	3	3	2.5	3	2.52	0.11
Lack of administrator support	1	1	1.5	1	0.41	0.52
Lack of facilities	3	1	3	2	2.96	0.09
Lack of equipment	3	1,2	3	2	17.8	0.00
Effects on student evaluation of instructors	1	1	1	1	0.58	0.45
Loss of content coverage and breadth	1	3	2	2	0.39	0.53
Additional workload	3	3	3	3	1.57	0.21
Lack of time for faculty to develop new research	4	4	3	3	0.00	0.99

experiences

Lack of ways to effectively assess students	2	1	2	2	1.08	0.30
Class size	4	3	3	2.5	0.65	0.42
Number of sections	4	2	3	2	4.64	0.03
Lack of student preparation	4	2	3	2	12.21	0.00

Based on Likert scale of 1= “not a barrier”, 2 = “minor barrier”, 3 = “somewhat of a barrier”, 4 = “major barrier”.

Table S5. Barriers entered by respondents that did not clearly fit within the barrier choices within the survey and the frequency with which they were mentioned.

Barrier	Frequency
time for implementation	12
student attitude, resistance, motivation	6
lab-lecture connection - for example, authentic research labs do not align with lecture material	5
logistics	5
creativity (lack of)	5
faculty development needed/access to others' labs or curricular materials	4
effects of class size	2
effects on faculty evaluation	2
content mismatch with authentic research - content does not lend itself to authentic research	
experiences	2
faculty already have too much work	2
language barriers	1

changing student culture of learning - "just give me the answer" mentality	1
lack of good journals that will accept results of research performed with classes	1
course goal expectation cannot include all aspects of authentic research -- it's too much	1
lack of leadership	1
students not prepared from high school	1
lack of awareness of content by outside faculty	1
staff are not well prepared	1
difficulty in transferability of course material between in-state institutions	1
group dynamics difficulties in non-majors	1
type of instructor facilitates cookbook labs	1
curricular flaw leads to cookbook lab experiences	1
