Bridging the Gap: from Classroom to Bench

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Overview

• Undergraduate Program in Neuroscience
• Theory of change
• Research Questions & Findings
• Next steps
Undergraduate Program in Neuroscience Enrollment
Undergraduate Program in Neuroscience

Pre-HHMI

Core Courses

Basic Science Courses

Electives/ Specialization

Faculty-Mentored Research
Undergraduate Program in Neuroscience Enrollment

![Bar chart showing enrollment and graduates from Fall 2008 to Spring 2013.](image)
Undergraduate Program in Neuroscience

Pre-HHMI

1. Should research be a/the goal?
2. Lab course =?= Research
3. ...the Gap

Post-HHMI
Undergraduate Program in Neuroscience

**Pre-HHMI**
- Core Courses
- Basic Science Courses
- Electives/Specialization
- Faculty-Mentored Research

**Post-HHMI**
- Core Courses
- Basic Science Courses
  - Lab
  - Science Courses
- Electives
- Research
- Specialization
- Science Literacy/Informed/Skilled

[NE 102 – Cell/Mol]
[NE 203 – Principles]
Early research-based coursework and research experiences will improve:

1. Students’ understanding of research/science/career paths
2. Students’ satisfaction with major/college
3. Bridge the gap between lab course/research

RQ1: Effect of lab classes on research experience

RQ2: Effect of research on academic experience
Data Collection

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<td>Senior survey (N=31)</td>
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<td>NE 102 pre survey (N=101)</td>
<td>NE 102 post &amp; focus groups (N=101)</td>
<td>Summer survey &amp; focus groups (N=10)</td>
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<td>NE 203 post survey (N=56)</td>
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<td>UROP survey (N=70)</td>
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**RQ1: Effect of lab classes on research experience**

1. Pre/ post assessment – NE 102
2. Focus groups – summer research students
3. Post assessment – NE 203
4. Mentor feedback survey

**RQ2: Effect of research on academic experience**

5. Focus groups – summer research students
6. Post assessment – NE 203
7. Survey of all summer research students
8. Neuroscience senior surveys
NE 102: Students gain knowledge of lab skills (n=101; pre/post)

![Bar chart showing percentage correct pre and post for various lab skills.

- Reincarnation DNA:
  - Pre: 60%
  - Post: 90%

- Separate proteins:
  - Pre: 65%
  - Post: 85%

- Identify proteins:
  - Pre: 70%
  - Post: 90%

- Tag GFP to protein:
  - Pre: 50%
  - Post: 70%

- Immunoblot:
  - Pre: 60%
  - Post: 80%]
NE 102: Students report readiness for research

Learning lab techniques: 80%
Applying techniques to mol bio: 80%
Ready for research: 70%

% goal on pretest (N=101)
% goal met on post (N=101)
Focus groups after summer research: Smooth the transition to research (NE 102 & 203)

“I learned how to use a pipette. I learned really simple things that they kind of took for granted in the lab.”
(NE 102 student, sophomore)

“NE 203 was a big help in terms of learning actual lab etiquette and practices and stuff like that.”
(NE 203 student, junior)
Mentor survey: Greater gains during summer (NE 102)

- Understand journal articles**
- Set up experiments
- Collect data
- Apply results

- took new courses (N=7)
- took old courses (N=13)
- everyone (N=20)
Post survey: Preparation for subsequent courses

Did any prior courses prepare you for NE 203/BI 325? (n=97)

- New mol bio course (NE 102): 61% (33/56)
- Standard mol bio course (BI 108): 15% (6/41)
RQ1 Summary: The new lab courses

Students gain
1. knowledge of lab skills
2. smoother transition to research
3. better link with course sequence
RQ2: Effect of research on academic experience

Senior survey (N=62) 2011, 2012
93% respondents did research (58/62)

“Research component gives real life experience.”

“The focus on research provided me with valuable guidance and skills for the future.”

“The research was a very important part of my undergrad experience.”
RQ2: Most effective aspect of undergraduate exp.

Q: What aspect of the neuroscience program did you find most effective?

- Teaching/outreach: Tally of mentions
- Interdisciplinary: Tally of mentions
- Advising: Tally of mentions
- Electives: Tally of mentions
- Core courses: Tally of mentions
- Research: Tally of mentions

The chart shows that research and core courses are the most effective aspects, while teaching/outreach is the least effective.
RQ2: Positive effect on coursework

“I'm actually far more excited to tackle my coursework in the fall ......I'm actually going to know significantly more than I would have if I hadn't done this summer research.” (focus groups, 2012)

“I think [reading journals] definitely would help in how I approach literature or textbooks for class because now I know how to pick things apart better that would otherwise be difficult to understand” (focus groups, 2012)
NE 203 Grades / Prior Summer Research

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<tr>
<th>Grade</th>
<th>Summer Research (n=23)</th>
<th>No Research (n=63)</th>
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<td>A</td>
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RQ2: Clarification of career plans

Senior survey

62% same before/after (n=32)
14% away from research (n=7)
24% towards research (n=12)

Q: Did this program help to clarify your academic/professional goals?
“I think research experience really helped my understand what my future plans may be.”

“Yes, although I have decided not to pursue neuroscience, my research experience has helped me to find a new path in special education.”
RQ2: Summary – Research experiences

Students gain:

1. Real world context for science content
2. Positive effect on course work
3. Clarification of career plans
Bridging the gap: Satisfied with research, not lab courses

Questions 4 and 5: Overall, how satisfied are you with your …… research experience? ….. laboratory courses?

Chart showing frequency distribution of satisfaction with research and lab courses.
Bridging the gap: How to improve lab courses

Question 2. What types of activities would you include in a laboratory course that would help introduce undergraduate to scientific research? (open ended Q, n=70)

- present results
- lab ethics
- lab etiquette
- scientific writing
- use primary literature
- analyze procedures
- data analysis
- design the procedure
- lab techniques

Gap
Bridging the gap: Focus on lab techniques

“I would design the course so that it is laboratory work only, without lectures or discussion sections, so that it is focused entirely on what goes on in a laboratory and how to conduct research.” (UROP survey - Biology major)

“Techniques. Every single lab that does research on campus only has a couple of things that they do. …it’s a very certain niche what you actually deal with. So if there was just a survey class that gives you all the things you can possibly use as tools……” (Neuro major – focus groups)
Bridging the gap: More student involvement

“I would try to set up the lab to encourage actually having to think about what you're doing instead of just following the procedure.” (BMB major)

“Having to plan in advance and figure out the logistics of your experiment is just as valuable of a skill as being able to run experiments and collect data. Traditional undergraduate labs (in my experience) do not force the students to think about the experimental design. Students do not normally have to consider questions such as, "Is this the most effective way of taking this measurement?" or, "Could I choose a simpler way of constructing this apparatus?" (physics major)
The Gap – Issues

- Focus on low level skills/techniques?
- “Scaling up” intensive research experiences to large courses
- Time required for research
- Number of faculty labs

- How do you “bridge the gap?”
Future plans

Integrated Science Experience (I.S.E.)

**Goals**
1. Improve retention
2. Establish community of undergraduate scientists
3. Prepare future STEM faculty in research-based teaching & learning
4. Increase participation of research-active faculty in intro science program & research based education

**Freshman Seminar (~800-1000 students)**
*Nature of Science*
Model development; Data management, interpretation, & analysis; Roots of scientific motivation
Social/moral authority of science/scientists; Relationship to law, government, ethics, religion
Funding; Dissemination & communication; Science careers

**Integrated Freshman Life Science Lab (~400 students)**
*Combined introductory chemistry/biology/neuroscience lab*
Biotechnology; Macromolecule/Alzheimer’s Disease; Nerve Cells; Kinetics & enzyme inhibitors

**Integrated Sophomore Life Science Lab (~500 students)**
*Combined organic chemistry/cell biology/neuroscience lab*
Natural Products Chemistry; Medicinal Chemistry; Biopolymers; Nanoparticles

Gap
Summary and Conclusion

Many benefits to early research and research-based coursework

Overemphasis on low level skills over high level thinking?
Measurement is a challenge
Gap still exists
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✓ Preparing and Supporting LAs
✓ LA Panel Discussion/Observing LAs
✓ Using LAs to Flip Your Classroom