RESEARCH WITH UNDERGRADUATES

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(based on previous sessions led by Cynthia Hall, Laura Rademacher, Josh Galster, Chris Kim, Rachel Beane, Elizabeth Catlos, Kathy Surpless, and many others)

Overview

- Your motivation
- Goals for undergraduate research
- Types of undergraduate research
- Who are undergraduates?
- Approaches to project design
- Outcomes & preserving knowledge
- Your plan for success

Your Motivation

- What are the benefits of undergraduate research? In other words, why involve undergraduates in your research?
- What are the challenges and pitfalls of working with undergraduates in research?

Goals for Undergraduate Research

- What do you want students to gain from the research experience?

Goals for Undergraduate Research

- Students learn techniques and tools of the discipline
  - process is as important as outcome
  - challenge to pose and answer meaningful questions
  - develop quantitative, problem-solving, and presentation skills
- Enliven intellectual climate on campus
  - stimulate discussion & collaboration within/across disciplines
  - increase # of high quality interactions between students & faculty outside of classroom
  - Provide a student-centered space to brainstorm ideas and discuss research
- Advance knowledge of discipline and/or result in new scholarly and creative works

Types of Undergraduate Research

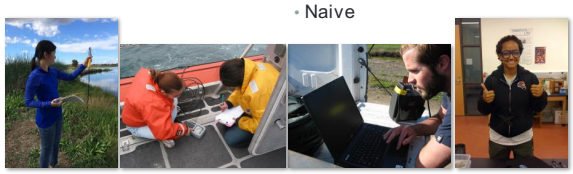
- Research as part of an undergraduate class
  - (Another session here on this!)
- Summer research / paid assistantship
- Independent study / honors thesis research

Successful Undergraduate Research: *Process vs Outcome*

- Learning experience for student
- Provide student guidance to understand significance of problem/question, practice methods, and execute project
- Facilitate communication between student & professor
- Investigate significant rather than trivial problems
- May lead to class presentations, senior theses, conference presentations, contributions to papers…

Undergraduate Students Are:

- Eager
- Fast learners
- Better connected
- Affordable
- Curious
- Rewarding
- Less experienced
- More time-intensive
- Overcommitted
- With you for shorter timeframes
- Distracted
- Naive



Recruiting, Selecting, and Guidelines

- Recruiting: You are the best advertisement!
  - Formal: ads, emails, events, & webpages
  - Informal: Word of mouth, class announcements, approaching good candidates directly

- Selection
  - Academic criteria: GPA, class and lab experience
  - Time available and compatible schedules
  - Compensation: salary, credit, volunteer
- Research Guidelines (or "Contracts")
  - Explicit expectations for both student & advisor

Designing "Doable" Projects

- Consider:
  - time allotted (as an estimate, multiply x3…or more!…the time it would take you to complete a step)
  - student's ability and motivation
  - student's & your other responsibilities

Undergraduate Research Approaches

- Part of mentor's larger research project(s)
- Projects of their own design
- Research peripheral to mentor's research
- Continuing previous student projects

- Students at different levels involved in research team
- Students complete research within class context
- Students complete research as part of structured Honors Program *(or similar)*

Multi-Student, Multi-Year Project

- Students work on different pieces of larger project

- Example: Scanning electron microscopy of ductile shear zones
  - Students not involved in sample collection
  - Scientific context needed
  - Sample prep and analysis
  - Students focus on different parts of shear zone each year
  - Pros: Easy project design, students must engage with prior student work and integrate
  - Cons: Students may not feel independence or ownership, may feel repetitive or duplicative for students students must engage in prior student work and integrate (!)

Form a Research Team

- Students work on different pieces of larger project(s)
- Example: Impact Research Group
  - 5 students, 3 faculty

PAID Research Assistants

- Students work on pieces of the mentor's funded research
- Example: Experimental Impact Cratering

Adapt Research to Local Field Areas

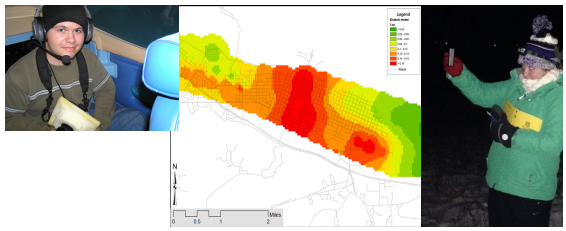
- Develop field-based program close to campus
- Logistically easier and less expensive
- May or may not be the research that you are most passionate about

Adapt Research to Include in Course

- Exposes many more students to research
- Feeling of independence and training to be scientists through coursework
- Data may be of limited/unregulated quality
- Can be a challenge to manage

Student Interest Determines Project

- Highly-motivated student. Other students can continue the study at higher resolution or different areas.
- Example: Light Pollution Survey of Winona, MN



Outcomes & Preserving Knowledge

- Presentations
  - Abstracts
  - Posters and/or Talks
- Symposia & Professional Technical meetings
  - Networking
- Theses

- Publications
  - Multiple student researchers may be needed
  - It might take multiple years
  - Have them write the straightforward parts: Methods, Results, Figures
- Knowledge Preservation
  - Lab books & wiki
  - ***File-sharing and backups***
  - ***Make your expectations known in advance!***

Your Suggestions & Questions?

- How have you designed projects for undergraduate researchers?
- What questions do you have about designing projects and working with undergraduates?

Design Your Project! Keep in mind:

- Topic
- Goal
- Number of students involved
- Recruitment method
- Scale
- Expected outcome

Planning Questions

1. Goal for incorporating ugrads into your research?
2. Important criteria to consider when selecting ugrads to conduct research with you? How will you recruit them?
3. Brief description of your scholarly research that will/does involve ugrads.
4. Strategy to conceptualize your research into undergrad-ready projects?
5. Outcomes you anticipate from research with ugrads?
6. Your main challenge to conducting research with undergraduate students?
7. One effective way to address this challenge based on what you've heard today?

Some Resources

- Undergraduate research: http://serc.carleton.edu/introgeo/studentresearch/index.html
- Collaborating with students: http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html#thoughts
- Guidelines for students: http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html#guidelines
- Advisor, Teacher, Role-Model, Friend: On being a mentor to students in science and engineering (full text online): http://www.nap.edu/openbook.php?record_id=5789