RESEARCH WITH UNDERGRADUATES

Laura Rademacher & Cynthia Hall
(based on previous sessions led by 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

• Advance knowledge of discipline and/or result in new scholarly and creative works

• Students learn ways 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
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 with 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
• Searching
• Rewarding

• Less experienced
• More time-intensive
• Overcommitted
• With you for shorter timeframes
• Distracted
• Naive
Recruiting, Selecting, and Contracts

• 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 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 Approach

- Work on piece of mentor’s larger research project(s)
- Work on projects of their own design
- Work on research topics of peripheral interest to mentor’s research
- Work on continuing previous 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)
Project Design Approach

• Multi-student, multi-year project
  • Students work on different pieces of larger project

• Example: Wildfire impacts on watershed processes
  • Field water chem
  • Lab water analysis
  • Field sediment analysis
  • Sediment lab analysis
  • Field biology analysis
  • Lab biology analysis
  • Multiple watersheds
  • Discharge analysis
  • Historic records
Project Design Approach

- Adapting research to local field areas
  - Develop field-based program close to campus for class & summer
  - Foster balance between family, research, teaching

- Example: Investigating urban water pollution
  - Field water chem
  - Lab water analysis
  - Sediment collection & observations
  - Sediment chem analysis
  - Field biology analysis
  - Lab biology analysis
Project Design Approach

- Adapting research for inclusion in a course
  - Exposes many more students to research practices

- Example: place sensors at beginning of semester
  - Collect data throughout
  - Analyze data as part of syllabus
  - Have a final product

![Image of a group of students measuring a stream with a long tape measure and a large rock with a keychain on it.](image-url)
Outcomes & Preserving Knowledge

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

- Publications
  - Multiple student researchers may be needed
  - Have them write the straightforward parts: Methods, Results, Figures
- Knowledge Preservation
  - Lab books & wiki
  - *File-sharing and backups*
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
Some Resources

• Undergraduate research:
  [http://serc.carleton.edu/introgeo/studentresearch/index.html](http://serc.carleton.edu/introgeo/studentresearch/index.html)

• Collaborating with students:
  [http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html#thoughts](http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html#thoughts)

• Guidelines for students:
  [http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html#guidelines](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):