

# RESEARCH WITH UNDERGRADUATES

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*(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



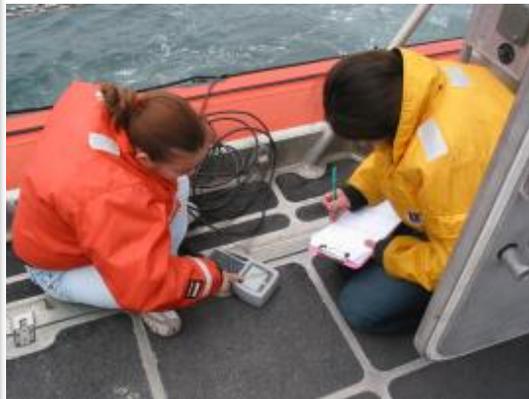
# Successful Undergraduate Research: *Process vs Outcome*

- 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
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- 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



# 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>
- 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](http://www.nap.edu/openbook.php?record_id=5789)