Designing Effective Undergraduate Research Projects

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Overview

- Different types of projects
- Questions to consider
- Tips from past workshop leaders and participants
- Research contracts, proposals, and deliverables
- Funding
- Other resources
## Some Different Types of Projects

<table>
<thead>
<tr>
<th>Individual project</th>
<th>Group project</th>
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</thead>
<tbody>
<tr>
<td>Taught within a regular course</td>
<td>Research or independent study credits</td>
</tr>
<tr>
<td>Question designed by professor</td>
<td>Question designed by student</td>
</tr>
<tr>
<td>Project relates to professor's research specialty</td>
<td>Project does not relate to professor's research specialty</td>
</tr>
<tr>
<td>Senior research</td>
<td>Honors thesis research</td>
</tr>
<tr>
<td>Fall/Winter/Spring</td>
<td>Summer</td>
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</tbody>
</table>
Questions to Consider

• Is there an institutional expectation that you advise a certain number of students on research projects?
  – What other time commitments do you have?

• Will the project complement your own research program?
  – Are you willing or expected to advise a student on a project outside your expertise?
Questions to Consider

• Are you willing or able to adapt your research to questions that can be addressed locally?
  – Local projects are often more suitable for undergraduate research.

• Is funding needed to support the project?
Questions to Consider

• Who are you in relation to this student or group of students?
  – Do you see yourself as a mentor, supervisor, or employer?

• Do you prefer to guide a team of students on one problem or to work with one or more students on separate problems?
Questions to Consider

- Who is the student?
  - What type of research questions interest her?
  - What courses has she taken?
  - What outside interests does she have?
  - Does she work better independently or in a small group?
  - Would she work better with more direction or more freedom?
  - Has she done a summer or class project previously?
  - What’s her motivation for doing a research project?
    - Prepare for graduate study? Experience research? Get credit/money for something she’s interested in? Fulfill a requirement?
- Do you know the student well enough to answer these questions?
Questions to Consider

• What do you want the student to gain from the research experience?
  – Problem solving
  – Time management
  – Increased confidence
  – Creativity
  – Skill with an analytical technique
  – Quantitative techniques
  – Presentation skills
  – Writing skills
  – Something else?

• Try ranking them in order of priority.
Questions to Consider

• Is the research project appropriate for an undergraduate? In other words, is it "do-able" in the allotted time given the student's ability and motivation level and his/her other responsibilities?
  – This can be tough to judge ahead of time, so adjustments may be needed along the way.
Tips

• When possible, combine student projects:
  – Team-based projects that build on the peer-learning potential and also support your research are an effective way to maximize your effort.
Tips

• One way to approach group or long-term projects is to have many students work on the same large project, each owning a small piece of it.

  – Example: Characterizing a particular formation
    » Measuring stratigraphic sections
    » Tracing marker horizons
    » Analyzing textures
    » Doing pebble counts
    » Identifying fossils
Tips

• Have mutually agreed upon written expectations, time tables, goals, and deliverables.

• Have weekly check-in sessions and set interim deadlines to discourage procrastination.

• Do quality control checks on students' work.
• Require students to read background primary literature early and often.
  – Have students discuss readings with each other and you during check-in sessions.

• Bring current and potential research students to professional meetings early on, even before they present their own research.
  – It will motivate them.
  – It will give them examples of good and bad presentations.
Tips

• Everything takes longer than you think when working with undergraduates.

• Mentoring and managing will not be the same for each student researcher.
  – Be flexible and responsive.
Research Contracts

• To smooth the research process, make expectations for both student and advisor clear and explicit.
• One way is to create a research contract that may include:
  – Project title and overall goal
  – Research and learning objectives
  – Start and end date of project
  – Dates to accomplish specific objectives
  – Dates for training, material acquisition, field work, instrument time
  – Safety considerations
  – Responsibilities of student and advisor
  – Deliverables
  – Evaluation plan
Research Proposals

• The student gains ownership in the research project when she is involved in developing a research proposal.
  – It also provides a chance for student and advisor to work together to focus a project.

• Within a department or college, the research proposal may be used to:
  – Determine if a student should be allowed to do/continue with a project that will be considered for honors, and/or
  – Secure internal funding.
Research Proposals

• A good research proposal should:
  – Clearly state the thesis of the project
  – Explain the broad significance of the project and put it in context by providing background information
  – Outline the methods, timetable, and expected results
  – Indicate materials and funds that will be needed
  – Cite and list relevant references
Deliverables

- Some possibilities include:
  - Data set
  - Map(s)
  - Web page
  - Research paper
  - Undergraduate thesis
  - Poster or oral presentation to department or at college-wide symposium
  - Abstract and presentation at regional or national meeting
  - Paper in peer-reviewed journal
Guidelines for Co-authorship

As a rule of thumb, to merit co-authorship on a peer-reviewed paper, participants (undergraduate or otherwise) should have contributed significantly to at least 2 of the following project components:

1. idea for and design of the project
2. data collection
3. data interpretation and writing
Funding

• There may be internal sources of funding that can be used for research expenses, summer student stipends, or travel to conferences. Check with your:
  – Department
  – College
  – College/university honors program
  – Development office - Alumni donor funds

• Potential external sources:
  – Some scientific associations (e.g., GSA, AGU) offer funds for students to attend conferences.
  – NSF-RUI and REU grants may support undergraduate research projects.
  – Geological surveys may have funds for regional projects (e.g., USGS-EDMAP).
Resources

- Council on Undergraduate Research (CUR) [http://www.cur.org](http://www.cur.org). Information and booklets on undergraduate research, including “Reinvigorating the Undergraduate Experience,” “How to Mentor Undergraduate Researchers,” and “Developing and Sustaining a Research-Supportive Curriculum: A Compendium of Successful Practices”


- Case studies for working with research students [http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html](http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html)
Resources

• *Research Learning Contracts:*
Resources

- **Research Proposals**
  - Research proposal guidelines and support materials, Department of Geological and Environmental Sciences, James Madison University, [http://csmres.jmu.edu/geollab/Fichter/studresrch/studresrch.html](http://csmres.jmu.edu/geollab/Fichter/studresrch/studresrch.html)
  - The Art of the Proposal, University of New Hampshire, Center for Undergraduate Research, includes example of a geology proposal. [http://www.unh.edu/undergrad-research/apply_proposal.html#resources](http://www.unh.edu/undergrad-research/apply_proposal.html#resources)
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