

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

Individual project	Group project
Taught within a regular course	Research or independent study credits
Question designed by professor	Question designed by student
Project relates to professor's research specialty	Project does not relate to professor's research specialty
Senior research	Honors thesis research
Fall/Winter/Spring	Summer

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

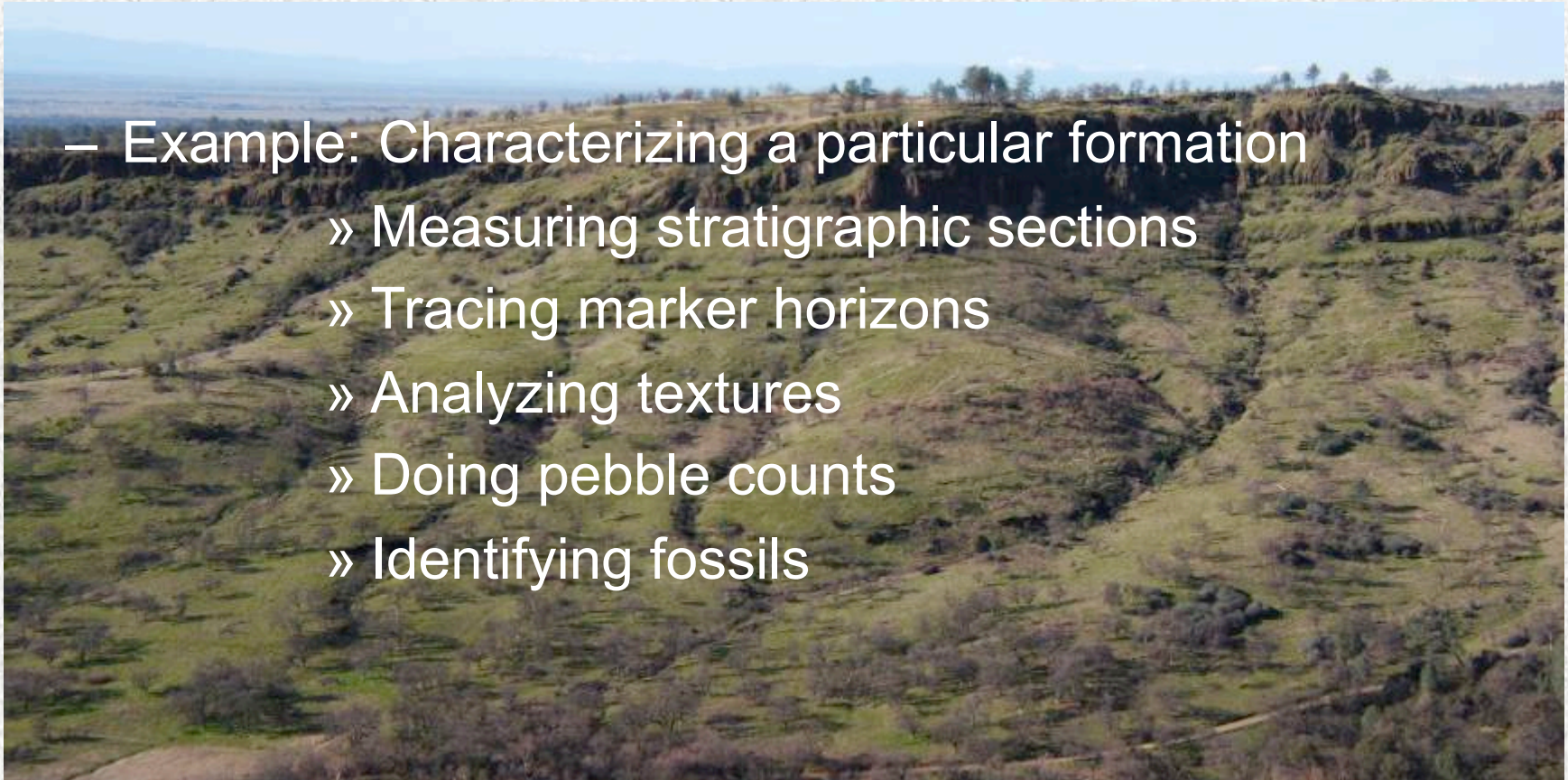
- When possible, combine student projects:
 - Team-based projects that build on the peer-learning potential and also support your research are an effective way to maximize your effort.



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



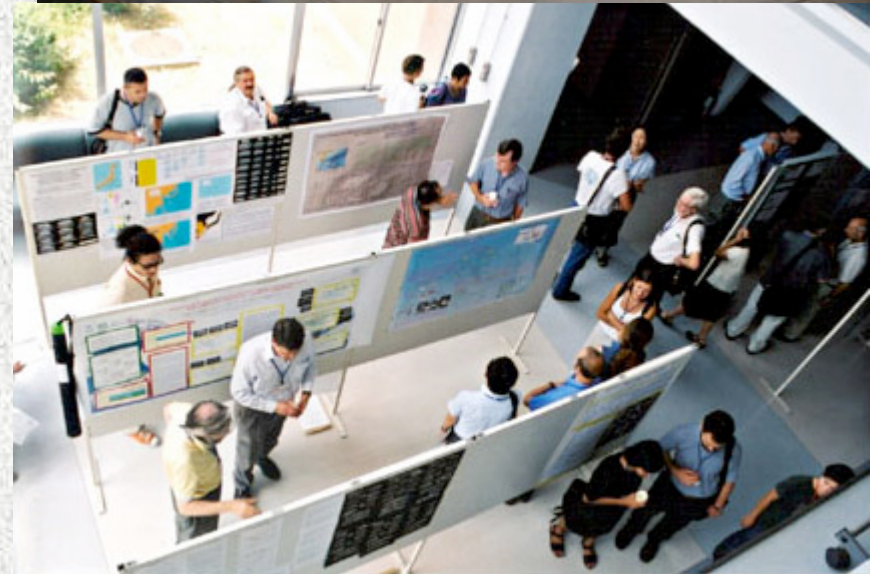
Tips

- 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.



Tips

- 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.

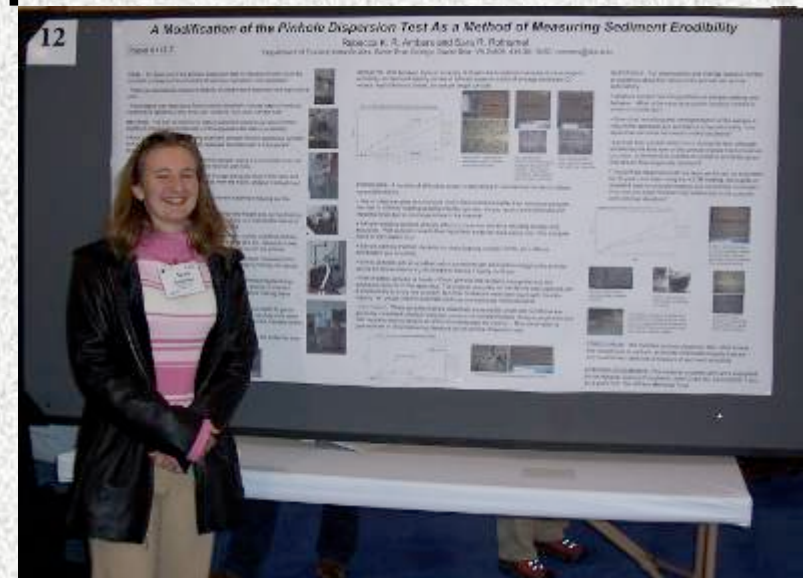


Research Proposals

- 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

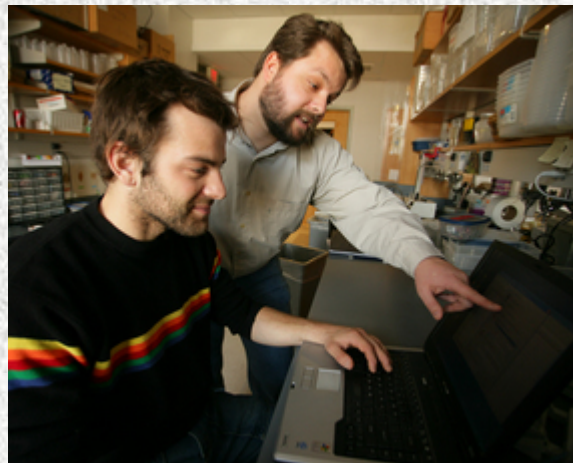
- Some possibilities include:
 - Data set
 - Map(s)
 - Web page
 - Research paper
 - Undergraduate thesis
 - Poster or oral presentation to department or at college-wide symposium
 - Abstract and presentation at regional or national meeting
 - Paper in peer-reviewed journal



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>. 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”
- National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (1997) *Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering*. Washington, DC: National Academy Press. <http://www.nap.edu/readingroom/books/mentor/>
- Mabrouk, P. Guide to research for undergraduates. Funded through NSF DUE-0341080, <http://www.webguru.neu.edu/>
- Kurdziel and Libarkin (2002) Research methodologies in science education: Undergraduate research mentoring, teacher workshops, and K-12 outreach activities. *Journal of Geoscience Education*, v. 50, p. 602-609. <http://serc.carleton.edu/files/nagt/jge/columns/ResMethv50n5p602.pdf>
- Case studies for working with research students <http://serc.carleton.edu/NAGTWorkshops/earlycareer/research/students.html>

Resources

- *Research Learning Contracts:*
 - Mabrouk, P. A. (2002) Research learning contracts - A formula for successful undergraduate research experiences. CUR 2002 Workshop Report. <http://www.cur.org/conferences/cur2002summaries/R22.html>
 - Mabrouk, P.A. (2003) Research learning contracts: A useful tool for facilitating successful undergraduate research experiences. CUR Quarterly XXIV(1), 26-30. (Summarized on-line at http://www.sc.edu/our/faculty_learning.shtml)
 - WebGuru-Guide to research for undergraduates: http://www.webguru.neu.edu/devices/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>
 - 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

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