



Inspiring undergraduate learning through research: building young scientists' skills through provision of mentorship and real-world research

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Abstract

“The needs of the patient come first” is the primary value of Mayo Clinic.

To meet these clinical needs, basic and translational research endeavors enhance knowledge to provide more effective patient care.

Inclusion of undergraduates in authentic research is an effective tool to increase interest and competency in a biomedical research career.

Mayo Clinic supports undergraduate research experiences through a variety of programs:

- Mayo Clinic Summer Undergraduate Research Fellowship (SURF)
- Undergraduate Research Employment Program (UREP)
- Special Research Student (SRS) off-campus credit experiences.

Yet, not all undergraduate students are able to participate in these formal research opportunities.

To expand the connection of undergraduate students with researchers and educators, a Course-based Undergraduate Research Experience (CURE) was developed to engage students through their undergraduate institution

This CURE provided undergraduate students at the University of Minnesota Rochester, an opportunity to participate in ongoing biomedical research and increase their interest, familiarity and confidence in research.

Of interest, **four of the twenty students** (two iterations of the CURE) continued to work within research at Mayo Clinic in a variety of roles including admittance into the graduate school.

Here we will share the course objectives, design elements, student outcomes, required support and our overall experience with the program.

Objectives: Course-Based Research Experience

Scientific Thinking

- Identify, locate and critically evaluate primary literature
- Explain cellular processes including DNA replication, transcription, translation, and regulation
- Identify and formulate valid scientific arguments and hypotheses
- Critically evaluate data and design experiments to address a novel question
- Integrate skills and knowledge from across disciplines and perspectives

Molecular Biology Laboratory Techniques

- Perform basic molecular techniques in a laboratory setting
- Implement the scientific method through proposal of hypotheses which explain biological phenomena
- Conduct experiments aimed to test the proposed biological hypotheses

Oral and Written Communication

- Effectively communicate results both orally and in writing
- Using results obtained, develop a specific aims and figure legend page as a component of a grant application
- Create and present scientific findings in the form of an oral presentation and research poster

Methods

Research Question Development

We explored of binding kinetics of transcription factors in pancreatic cancer as an ideal model

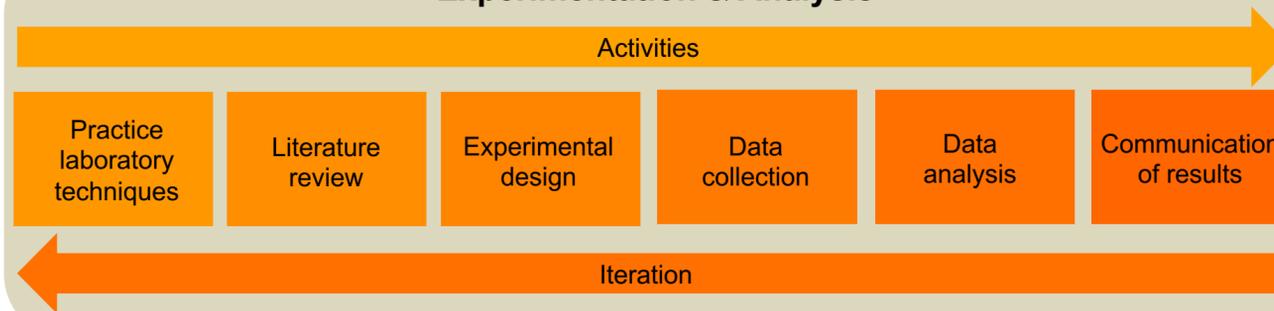
- This model allowed for student familiarity with common laboratory techniques exploring:
 - DNA (primer design, polymerase chain reaction, gel electrophoresis)
 - mRNA expression (primer design, qPCR technologies)
 - Protein (western blot analysis)
 - Transcription factor binding kinetics (chromatin immunoprecipitation assays)

Scholarly Conversation & Learning Artifacts

This course consisted of 5 hours of lecture and lab per week. Lecture components included:

- Primary literature discussion
- Specific aims page & figure legends pertinent to the chosen research question
- Exams: take-home, open book & problem-based

Experimentation & Analysis



Communication of Results

Dissemination of results allows students to robustly synthesize and summarize their experience

- Poster & oral presentations

Outcomes



Figure 1. The outcomes of this experience are numerous. Listed above is a summary of pivotal course outcomes and goals.

Conclusions

- **The students involved in this CURE were provided an immersive scientific experience analogous to Mayo Clinic SURF students** (*author's experience & observations)
- Using an anonymous course evaluation all students articulated that they have:
 - A deeper understanding of the subject matter
 - Their interest in the subject was stimulated
 - They would recommend this course to other students
- The implementation of this course required approval and support of Mayo Clinic & UMR administration, financial consideration, & substantial time input from course faculty.
- The rewards of students designing, implementing and concluding their own research study is great. These experiences bolster their future statements of purpose and contributed to scientific identification.