Creating Interdisciplinary Research Pathways for Early STEM Students

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INTRODUCTION

Undergraduate research experiences engage students in a unique combination of activities to achieve diverse cognitive and behavioral outcomes [1,2,3]. Participation:

- advances student learning [4,5]
- increases the likelihood of earning a degree [6]
- retains diverse students in fields in which they are traditionally underrepresented [6].

Course-based undergraduate research experiences (CUREs) are high-impact strategies that expose more students to the benefits of participating in authentic scientific practice [7, 8, 9] and accelerates this early in the postsecondary curriculum [10].

Additionally, research shows that microcommunities of peer-to-peer relationships and faculty mentors, common in undergraduate research programs, support underrepresented student's long-term success in STEM [11, 12]. These relationships foster the development of a STEM identity, ultimately allowing students to see themselves as able to make meaningful contributions to their disciplines.

The undergraduate research program at North Seattle College (NSC) has evolved from a grassroots effort with a few students to a two-phase multi-year program that engages hundreds of students at various levels of research activities [13]. UREs at NSC are currently offered in a variety of formats all of which are linked together to create structured research pathways (Figure 1).

CUREs in Gateway Chemistry and Biology Courses

The path to engaging and retaining a diverse array of STEM students at NSC begins with embedded CUREs in gateway STEM courses including general chemistry and biology:

**First Year Course-Based Research Experiences**

**INTERDISCIPLINARY INVESTIGATIONS: IDI-CLASSROOM**

IDI-Labs highlight a single, core research-grade instrument (Figure 6). Students build skills across the three-quarter experience (Figure 7). In general chemistry, for example, students replace two labs with an exploration of fluoride in water where they learn how to access primary literature and ion chromatography (IC). In the second quarter, students revisit a question about solubility, design their protocol, and analyze samples. The third quarter culminates with a 5-6 week project where students iteratively collect and analyze samples and present at a college-wide symposium.

In general biology, students progress through a series of exercises culminating in a student-designed, multi-week investigation into solar respiration presented at the college symposium.

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**Second Year Research Experiences**

**STUDENT-DRIVEN UNDERGRADUATE RESEARCH: YEAR-LONG URE**

Second year students can choose to take a 3-quarter undergraduate research experience by enrolling in a team-taught, skills-focused series of courses designed around core principles (Figure 8).

**Phase 1: The Foundation**

Students spend their first quarter conducting a small-scale, scaffolded project and building essential skills including:

- Finding and reading primary literature
- Developing a research question
- Immersion in STEM culture

**Phase 2: Create Space**

Students are led through 3 modules that develop skills in designing and effecting student based research

- Students are introduced to research methods and are led through a series of reflective exercises
- Students are introduced to theoretical and practical aspects of research and are led through a series of reflective exercises
- Students are introduced to ethical and professional aspects of research and are led through a series of reflective exercises

**Phase 3: The Immersion**

Students and mentors collaborate throughout the year-long research experience to improve their skills in scientific thinking, communication, and team dynamics.

**Final Thoughts**

- Interdisciplinary. Investigative. Exclusive. Innovative curriculums transforms STEM gateway courses to achieve more with our students, to drive a cultural shift, and to move towards an equitable experience for all students.
- Early research opportunities are evolving in community colleges—research is needed to determine best practices.

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**References:**

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