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NSF Hispanic Serving Institution STEM Resource Hub

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*Promoting Success in
student transitions
from lower to upper
division coursework*

**SomosSTEM
at New Mexico
Highlands
University**



**SOMOS
STEM**

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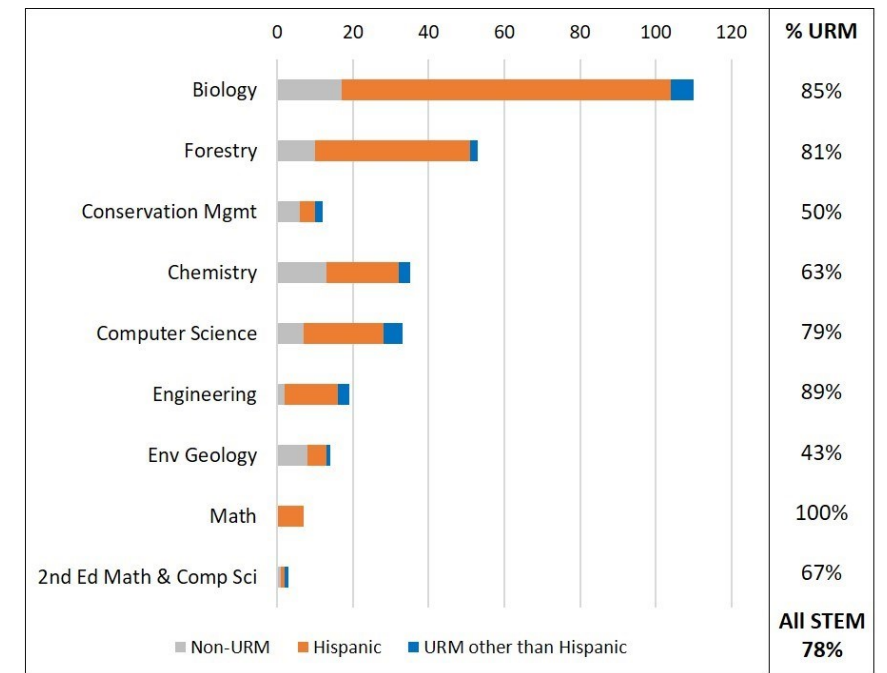
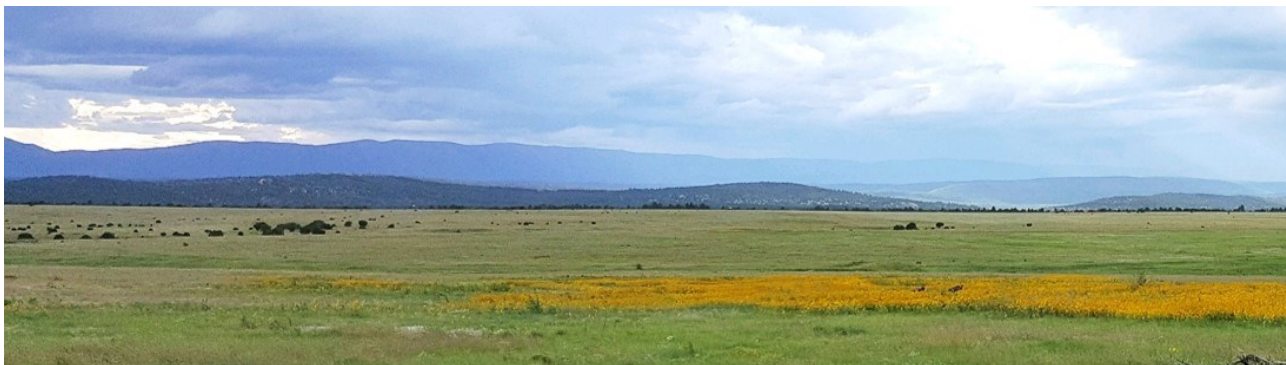
H NEW MEXICO
HIGHLANDS
UNIVERSITY

UNIVERSITY OF
Nebraska
Lincoln



State rural HSI and emerging NASNTI in Northern New Mexico

~1670 undergraduate students



Fall 2018 enrollment in STEM majors

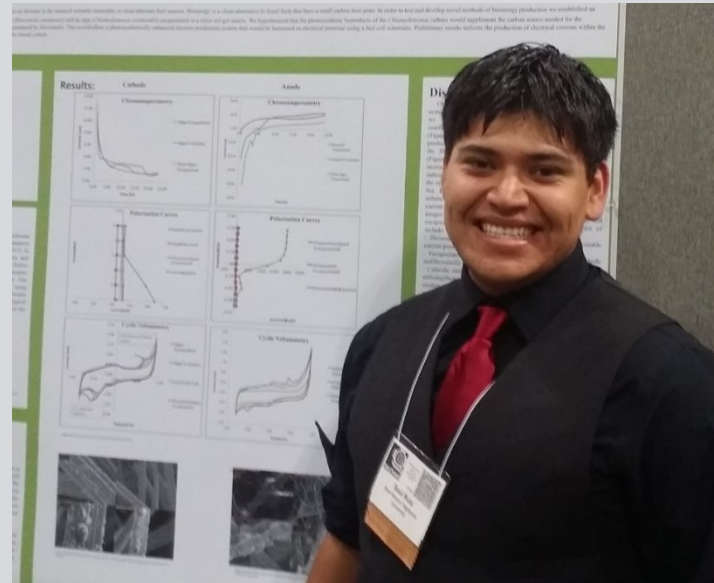


SOMOS STEM



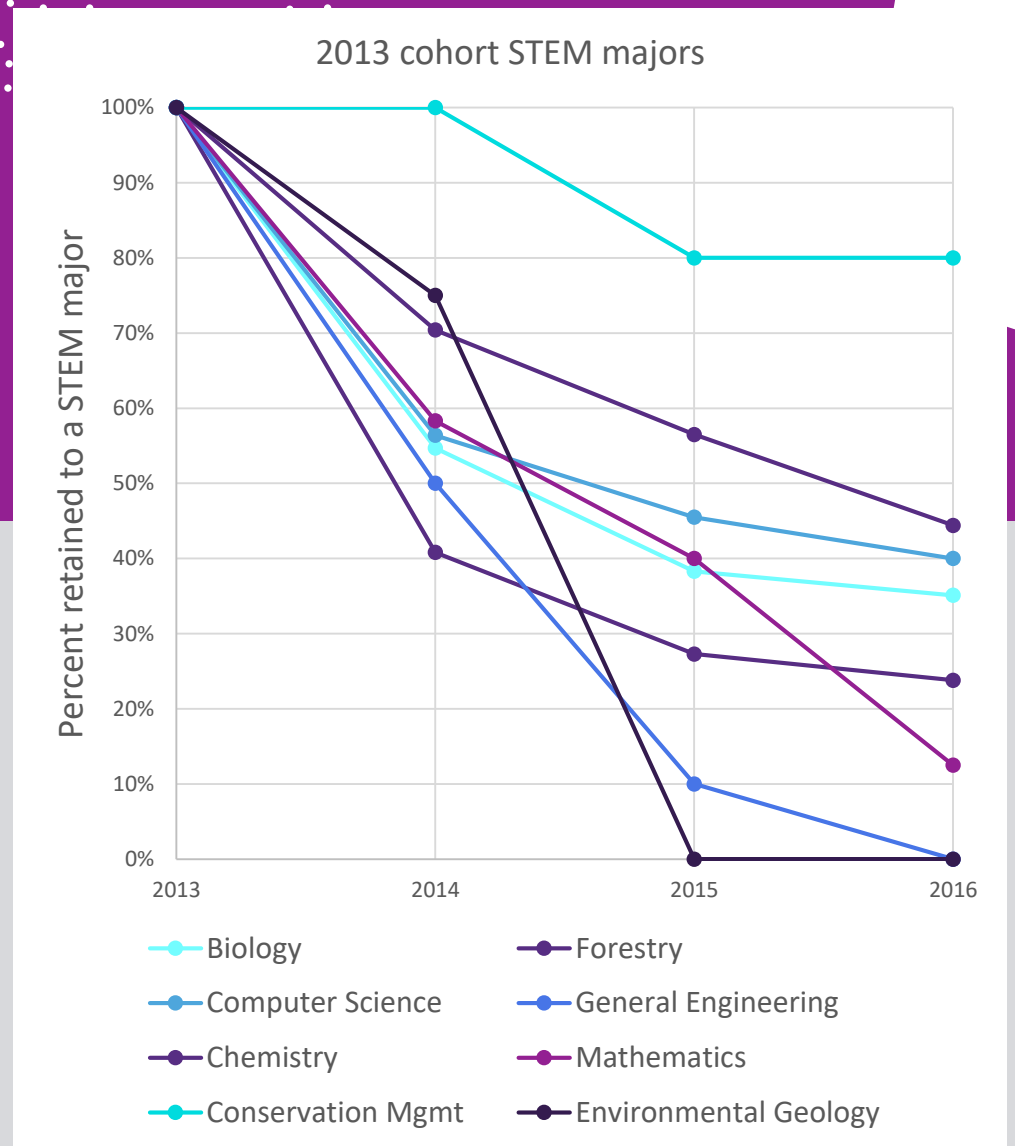
Goal NSF SomosSTEM Program (2020-2025)

The goal of the SomosSTEM Program is to increase persistence of minoritized or under-represented students in Life Sciences majors at NMHU through early, integrated, place-based and culturally informed experiences with the STEM research community shaped by near-peer and partnership expertise.



Challenge

- Early student retention in STEM majors is an ongoing challenge... everywhere
- The transition from lower to upper division coursework is a critical point for STEM persistence



High impact practices – *how to contextualize with HSI servingness?*

- Persistence framework for improving STEM success: build identity, motivation, confidence via learning communities, active learning, research (e.g. Graham et al., 2013)
- Early Course-based undergraduate research experiences (CUREs) promote inclusion, identity, motivation (e.g. Rodenbusch et al., 2016 CBE – Life Sci Ed; Bangera & Brownell 2014)
- Early bridge programs and internships can promote peer learning, mentorship, community, belonging, creativity & cultural connections (e.g. Estrada *et al.* 2016; Ashley *et al.* 2017; Yosso 2005)



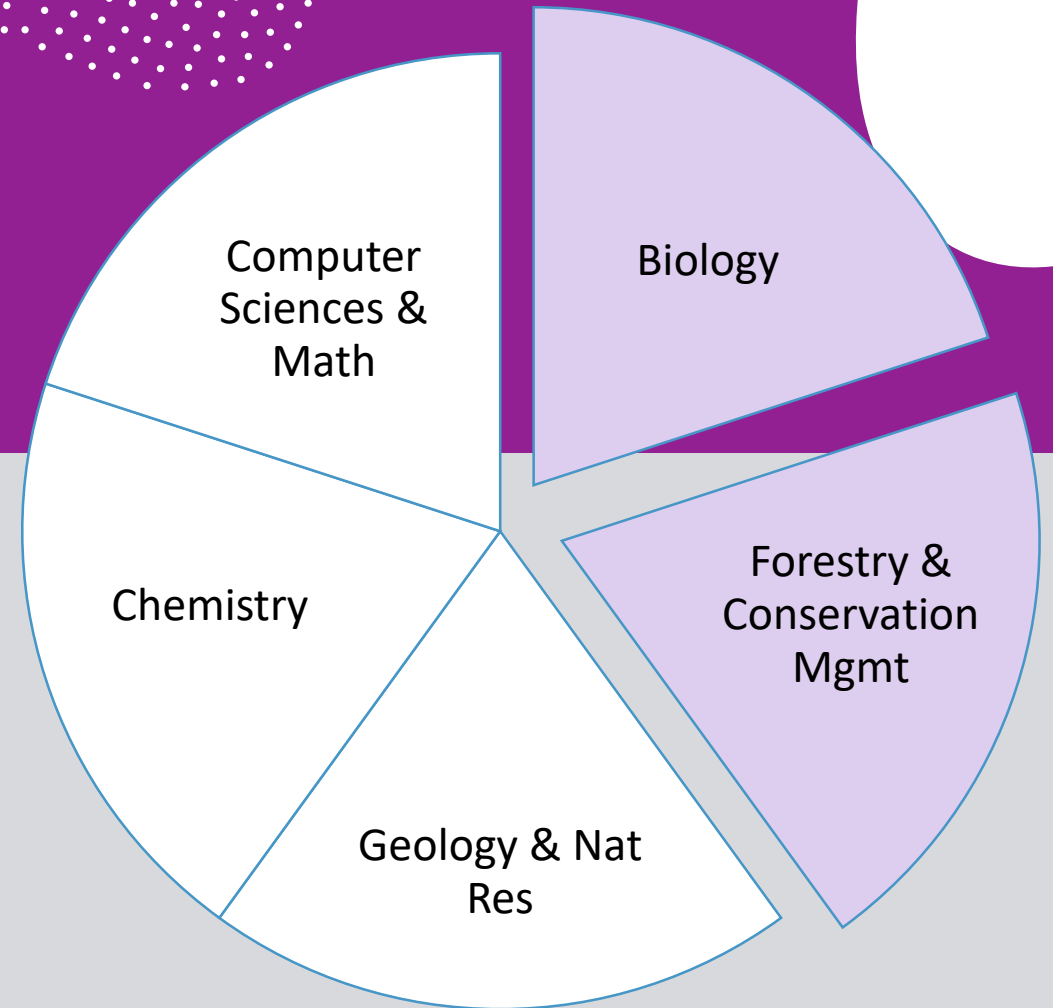
A focus on identity, belonging, self-efficacy, community

To perform well in college, it is important that individuals perceive college as an extension of **who they are**, **where they come from**, and the degree to which they can **see themselves enacting successful college-going behavior** without sacrificing the culture and values of their community.



SomosSTEM Capacity building objectives

1. Increase the first fall to second fall retention rate of Life Sciences (Biology, Conservation Management, and Forestry) majors to 70%,
2. Increase the retention rate to junior year for first-time, full-time Life Sciences majors to 60%,
3. Have 90% of STEM Community Partner mentors complete Equity & Inclusion Training, and
4. Have 90% of life Sciences faculty complete professional development activities associated with the SomosSTEM! Program.



**Curriculum
& Student
Experiences
Focus**

CUREs

Near-peer & culturally informed

Freshmen and sophomores

Life science courses

Fellowship

Academic year place-based science experiences with agency/community partners

Freshman and sophomore year

Internships

9-week summer internship

With 1 week cohort orientation, final week CURE development

Community voices lecture series: local leaders doing science

**Faculty &
Agency
Partners
Culturally
Responsive
Approaches**

Culturally responsive teaching

Culturally responsive mentorship

CURE pedagogy

**Research
Focus**

Psychosocial skill development

Science Identity

Sense of belonging

Self efficacy

*Persistence
Success
In Science*

Intern-built CUREs

- Course-based undergraduate research experiences (CUREs) are multi-week or whole semester projects doing real research that connects with real scientists outside of the university/college and engages faculty in research interests
- SomosSTEM ibCUREs add to the CURE model:
 - Freshman/sophomore introductory level courses
 - Projects are local, involve agency or community partners
 - Beginning [SomosSTEM CURE template](#) includes reflection relating work to culture, family, place
 - Intern authors provide multiple lenses and culturally informed experiences
- All instructors complete culturally responsive teaching 6 session workshop

Intern-built CUREs

- ✓ 1 full ibCURE in use
- ✓ 5 ibCURE prototypes
- ✓ 14 faculty-built CUREs with revisions from SomosSTEM student leaders
- ✓ 17/21 Life sciences full time instructors have completed CRT training
- ✓ **Year 3 CUREs in seven courses with nine faculty, 167 freshmen/sophomores**

SomosSTEM CURE Library

Post-fire ecological restoration with one rock dams

Impacts of microplastics exposure on human immune health

Novel Dictyostelids in Soil

Pinon Juniper Encroachment Research

River restoration ecology & biodiversity

Grassland Fire Ecology and Climate Change

Genetics of Immune Response in Boreal Toads

COVID-19 Pandemic: Community Responses

Bison conservation genetics & cattle hybridization

Fire Ecology Education for K-12

Rapid Assessment (RAM) of post-fire rangeland



Watershed Restoration in Hermit's Peak/Calf Canyon Burn Scar

Ocean Henry¹ and Josh Morales¹



SomosSTEM Internship Program 2023, New Mexico Highlands University¹, Hermit's Peak Watershed Alliance

Big science challenge/question

Do dams improve plant diversity and density?



Photo credit: Ocean Henry

Learning Objectives

1. Water retention
2. Erosion control
3. Post-fire mitigation
4. Drought mitigation
5. Importance of species diversity
6. Community collaboration

Science skills objectives:

1. Ability to count diversity + density (plants +insects)
2. GIS tools
3. Shannon Diversity Index
4. Transects Quadrats
5. Robel pole

Utility Value for Students

The framework of using One Rock Dams for ecological restoration in terms of erosion control and water retention can be applied to any community or watershed.

Agency or Community Partners

- Hermit's Peak Watershed Alliance
 - NMHU Conservation Science Center
 - Albuquerque Wildlife Federation
- Assist local community members unable to receive federal post-fire restoration assistance.

CURE Activities

Session 1: Intro to Erosion Control

e.g. Provide a background for freshmen on the history of Erosion control, discuss different types of dams, and build a mini dam.

Steps:

1. Erosion control structure history
2. Intro to ORD Restoration lecture
3. Before + After Pictures
4. Different types of dams
5. Activity: Build a mini dam
6. Experimental Design: Create a hypothesis and think of materials needed for session two
7. Homework: Think of a place important to you where a potential dam can be built.



Photo credit: Ocean Henry

Session 2: Visit the Site

e.g. Develop a hypothesis to address the impacts of disturbance on diversity and community.

Steps:

1. Visit site
2. Talk to one landowner, minimum
3. Find location to build a structure
4. Gather materials, stage a ORD
5. Collect data on diversity within the eroded channels
 - Assess diversity of where ORD is going to be built and area where ORD will not be built in channel.

CURE Activities

Session 3: Build a Dam

e.g. Visit site x split into two groups, and build a one rock dam in the chosen locations within the property.

Steps:

1. Finish gathering materials
- One group learns gathering materials
- One group learns building



Top left: Apache Plume, Top right: Coyote Willow, Bottom Left: Buffalo Grass, Bottom right: Blue Grama

Session 4: Collect Data On Built Structures

e.g. data collection & analyzing solutions to the challenge

Steps:

1. Visit site with previously built dams
2. Collect data and use similar experimental design as used for session two.

Session 5: Data Analysis

Left up to the instructors choice of teaching and guiding through methods of data analysis

Community Connections

Perception of land by land owner has changed/ been affected following post-fire erosion. Community and watershed health is affected by retention of water and channel runoff into major water source.

Sociocultural Connections

Not all land owners can afford large-scale repair and/or restoration of their property. Generational ties to place and land are abundant in the burn scar.



Reflection Questions

1. Do you feel you've made a stronger connection with the local community?
2. Do you feel the studies you've done will make an impact on the future diversity and ecology?

Checking for Understanding Questions

1. Was there any significant difference in the eroded area vs. the already worked area?
2. Can this be applied to your community?
3. Create a case study (of your choice) focusing on the direct benefits of the structures in the ephemeral areas. (Species specific, water retention, etc.)

References

https://www.lincolnwildflowers.info/grasses/photos/1_grama1.jpg
https://mhc.mo.gov/files/default/files/ivies/gallery_main_image/public/2021-09/duffalo_Grass_2-20-14.jpg?0x5F5442F_8
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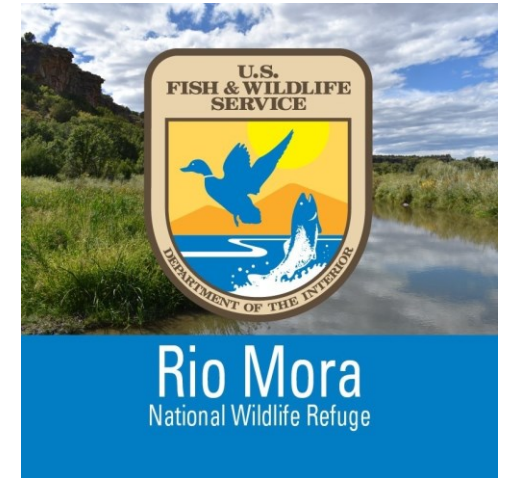
Acknowledgements & Contact Info

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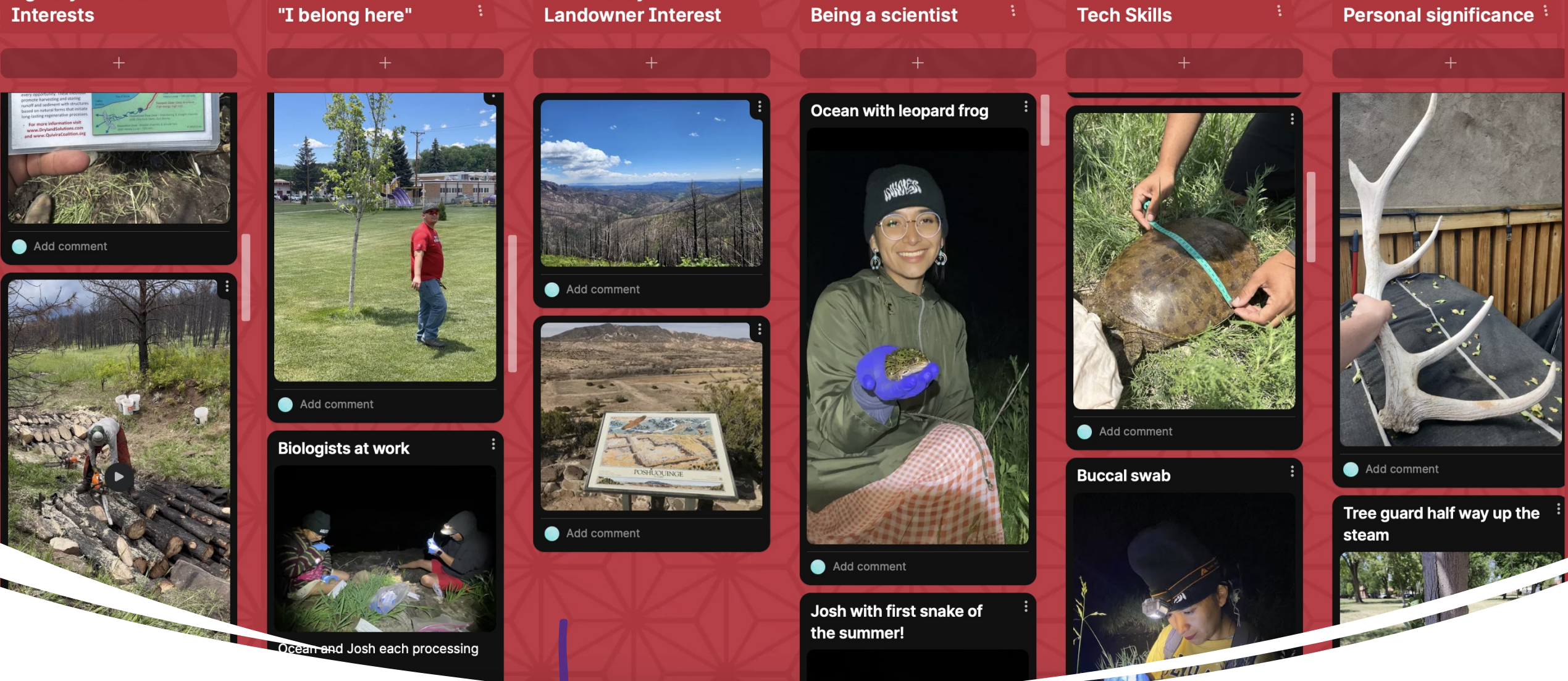


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Fall 2023 example:
Two instructors, 50 students



HERMIT'S PEAK
WATERSHED ALLIANCE



Summer Internships with local agencies

- Student cohorts from CUREs
- 1 week professional development
- 7 week internship in groups 2-4 students
- 1 week ibCURE development
- Agency culturally responsive mentorship training
- Faculty mentor weekly tracking

Fellowship (Summer Bridge Redesign)

- Bridging in-class CUREs to full summer internship
- Academic year span with cocurricular & extracurricular activities with near-peer leaders, faculty, community/agency partners
- Building community and cultural context for STEM learning

Why don't students
sign up for 2-week
summer bridge?

2020-2023
Pandemic constraints,
financial, family
commitments

2022
Hermit's Peak
megafire
family commitments,
financial impacts

Research Problem



Co-PIs Drs. Elvira Abrica,
Deryl Hatch-Tocaimaza



Research evidence is clear about *what* **factors matter** most in shaping students' individual interests, commitment, and ability to persist in STEM fields.

What is less clear and urgently needed is an understanding of *whether and how* a **web of integrated interventions** make a difference in the ways intended.

Ultimately: a question of *environments* rather than *interventions*

Education Research Objectives

How do SomosSTEM program activities contribute to life sciences majors persistence through the further development of URM student psychosocial attributes (science identity, sense of belonging, and science self-efficacy) on two fronts:

1. Quantitatively measure the influences of the program's community-based STEM learning experiences on the development of science identity, sense of belonging, and science self-efficacy and subsequent persistence in life science majors, for URM students who have participated in SomosSTEM activities.
2. **Qualitatively identify mechanisms of the program's community research and culturally informed place-based research activities that students believe contribute most to developing science identity, sense of belonging, and science self-efficacy.**

Research Methods

Abrica, E., Hatch-Tocaimaza, D. K., Corey-Rivas, S., Garcia, J., Dixit, A. A. Community-Based, Culturally Engaging STEM Learning Environment and Its Impact on Students' Psychosocial Attributes at a Rural Hispanic Serving Institution (HSI). Under review: *CBE-Life Sciences Education*

5-Year cross-sectional, longitudinal and mixed methods study design

- 196 participants enrolled in the full mixed-methods study, involving both quantitative and qualitative data collection.

Qualitative Research

- Data from observation, interviews, or verbal interactions and focuses on the meanings and interpretations of the participants.

3-Years of Focus Groups

- 9 focus groups
- 36 participants during a three-year period (fall 2020–spring 2023).
- 36 participants will be asked to participate in 1-1 follow-up interviews to assess the longitudinal effects of SomosSTEM activities and persistence outcomes.

Conceptual Framework to Guide Inquiry

The Culturally Engaging Campus Environments (CECE) Model: A New Theory of Success Among Racially Diverse College Student Populations

Samuel D. Museus

Almost half of all college students who enter a four-year postsecondary institution will fail to complete a bachelor's degree within 6 years of entering higher education (National Center for Education Statistics [NCES] 2012). In addition, students of color face substantial racial and ethnic disparities in college persistence and degree attainment. Indeed, while 62 % of White students who begin college at a four-year institution complete a bachelor's degree within 6 years of matriculation, that figure is only 39, 40, and 50 % for American Indian and Alaskan Native, Black, and Latino students, respectively (NCES 2012). Although Asian Americans and Pacific Islanders (AAPIs) exhibit high levels of educational attainment in the aggregate.

Responds to critiques of prevalent theories of student success:
involvement, integration, and engagement

SomosSTEM as a Culturally Engaging Learning Environment

	CURE	Internship	Community Voices Lecture Series	Faculty Engagement
CECE Indicator #1: Cultural Familiarity	x	x	x	x
CECE Indicator #2: Culturally Relevant Knowledge	x	x	x	x
CECE Indicator #3: Cultural Community Service		x		
CECE Indicator #4: Opportunities for Meaningful Cross-Cultural Engagement				
CECE Indicator #5: Collectivist Cultural Orientations	x	x	x	

SomosSTEM as a Culturally Engaging Learning Environment

	CURE	Internship	Community Voices Lecture Series	Faculty Engagement
CECE Indicator #6: Culturally Validating Environments	x	x	x	x
CECE Indicator #7: Humanized Educational Environments	x	x	x	x
CECE Indicator #8: Proactive Philosophies	x	x	x	x
CECE Indicator #9: Availability of Holistic Support	x	x	x	

CUREs Supporting students transitioning from lower to upper-level coursework

Dr. Abrica summarizing a student in a CURE class: “said that he felt like, within the CURE experience, a leader who was called upon to answer questions using technology. He described a CURE in which he used technology to look at DNA of local animals and determine whether they were farm-raised cattle or wild bison...He repeatedly described that by being entrusted to use technology to make decisions about real-world problems, he felt that he was a scientist and leader.”

Faculty as Validating Agents Supporting students transitioning from lower to upper-level coursework

- SomosSTEM trained STEM faculty and local community STEM mentors to build capacity for mentoring using a collectivist, holistic, and validating approach.
- Summer internships: Allowed students to build efficacy and science identity in designing CUREs for incoming students.
- Dr. Abrica: “This was exemplified in the experiences of Alexander, who as part of his summer internship, developed a CURE for incoming students. He explained how his CURE made him feel like a scientist, and not only does he feel like he is a scientist but that he could be in a position to teach others how to do science in the field as a future faculty member in biology. Creating curriculum for other students was promotive of Alexander’s academic disposition, particularly his self-efficacy and desire to pursue post-baccalaureate education.”



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Summary SomosSTEM Supporting Student Early Transitions

- Towards our goal of creating a learning environment with early, integrated, place-based and culturally informed experiences with the STEM research community, we have
 - Engaged community and agency partners in 1 day to summer-long projects
 - Challenged STEM faculty to develop high context and community-based curriculum reflecting culturally responsive practices
 - Integrated high impact practices - immediately - in freshman STEM core classes
 - Identified the importance of faculty, staff, and near peers as validating agents, directly contribute to students' perceptions of science identity, belonging, efficacy
 - Implementation team at a teaching university – importance of a full time activities director to create flexibility and adaptation in program

Freshman/sophomore
Curriculum change
Community, place,
integrated science
identities

Faculty, staff, community
revising “servingness”
Culturally responsive
pedagogy

Thank you

- Amazing students at NMHU
- Faculty and staff of the Biology and Forestry Departments
- NMHU ARMAS center
- ESCALA in Education
- Dr. Erin Dolan, CURE Institute, CUREnet
- On Course Dr. Jonathan Brenan, Carolina Martinez
- HSI STEM Hub Grant Writing Program!
- UNL & NMHU Grants Office Staff
- Dr. Andres Salazar
- META Associates



Community Voices Supporting students transitioning from lower to upper-level coursework

“The SomosSTEM Community Voices lecture series draws on local-area scientists and professionals who share students’ cultural, racial, and/or ethnic backgrounds to illustrate and personify what it looks to conduct place- and community-based science in real life.” – Dr. E. Abrica

It's not just, they're in the lab eight hours of the day, or they're outside just looking at birds eight hours of the day. There's a huge range of jobs in the STEM field. And I think that's maybe something that needs to be made more available I guess, you could say. Like, just provide the opportunity of seeing a wide range of jobs that can be done. It's not just, "You're a biologist. You just work in the lab all day long." Do you know what I mean?

Community Voices Supporting students transitioning from lower to upper-level coursework

“The SomosSTEM Community Voices lecture series draws on local-area scientists and professionals who share students’ cultural, racial, and/or ethnic backgrounds to illustrate and personify what it looks to conduct place- and community-based science in real life.” – Dr. E. Abrica

I think it makes them relatable. Because not only do they look like you, but they have a whole range of things that they've done. And from when their starts like, "Oh, I wasn't even doing this." Most of the time it's like the really successful people that you see, they'll tell you know like, "Oh, I started doing this and all of a sudden I'm doing something completely different." And I think that kind of tells the student, "You know, it's okay if you don't really know what you're doing right now, it's okay. Because if you find an interest you can just keep going and you'll eventually get there." Which I think is something that a lot of first and second year students might struggle with, is finding what they want to do.

SomosSTEM approach

Issue

- Racial and ethnic disparities in STEM fields persist

Knowns

- Psychosocial attributes are pivotal
 - Sense of belonging
 - Science identity
 - Self-efficacy
- Certain activities proven impactful
 - Mentoring, authentic research, peer learning, community of practice, culturally responsive environment