

# CBASE: Communities to Build Active STEM Engagement

A Unique Undergraduate Research Structure with Dramatic Effects on  
Persistence and Grad Rates

## Overview

- Background of our Institutional Gaps
- The CBASE structure
- Benefits of our structure in our context
- Activity #1 – Identification of your own gaps
- CBASE outcomes and core commitments
- Activity #2 - Can UGR programs in your context help to bridge your Gaps?

## Goals/Outcomes

- UGR structure
- Identification of Gaps on your campus
- Can UGR programs help to bridge those Gaps

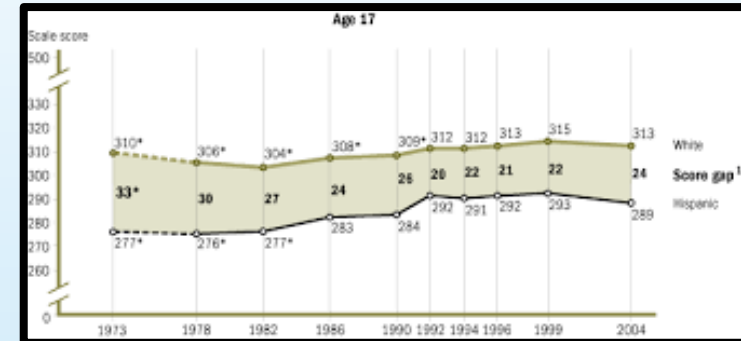
## What were our Institutional Gaps?



Gap1 - Workload



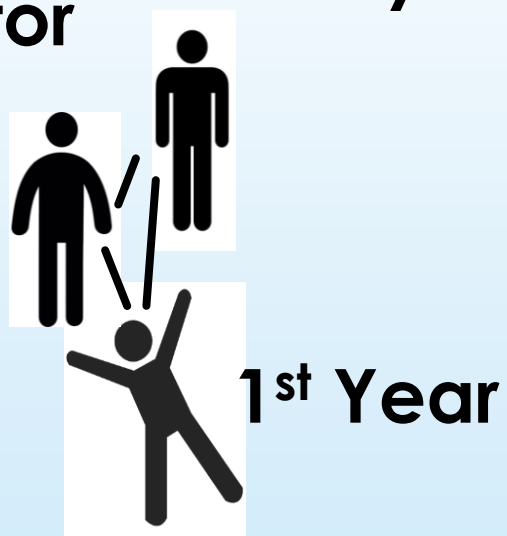
Gap2 - Achievement



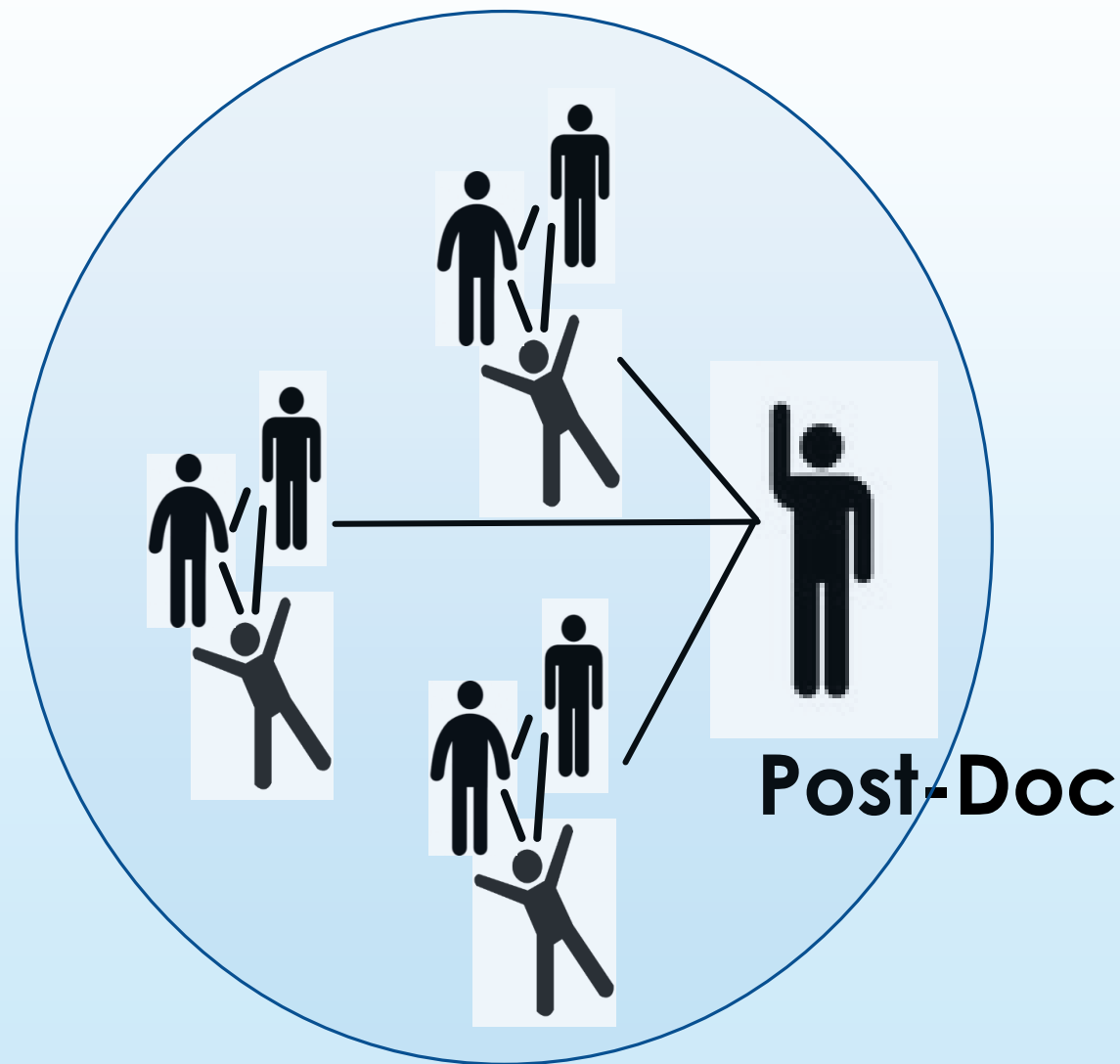
Gap3 - Recruitment



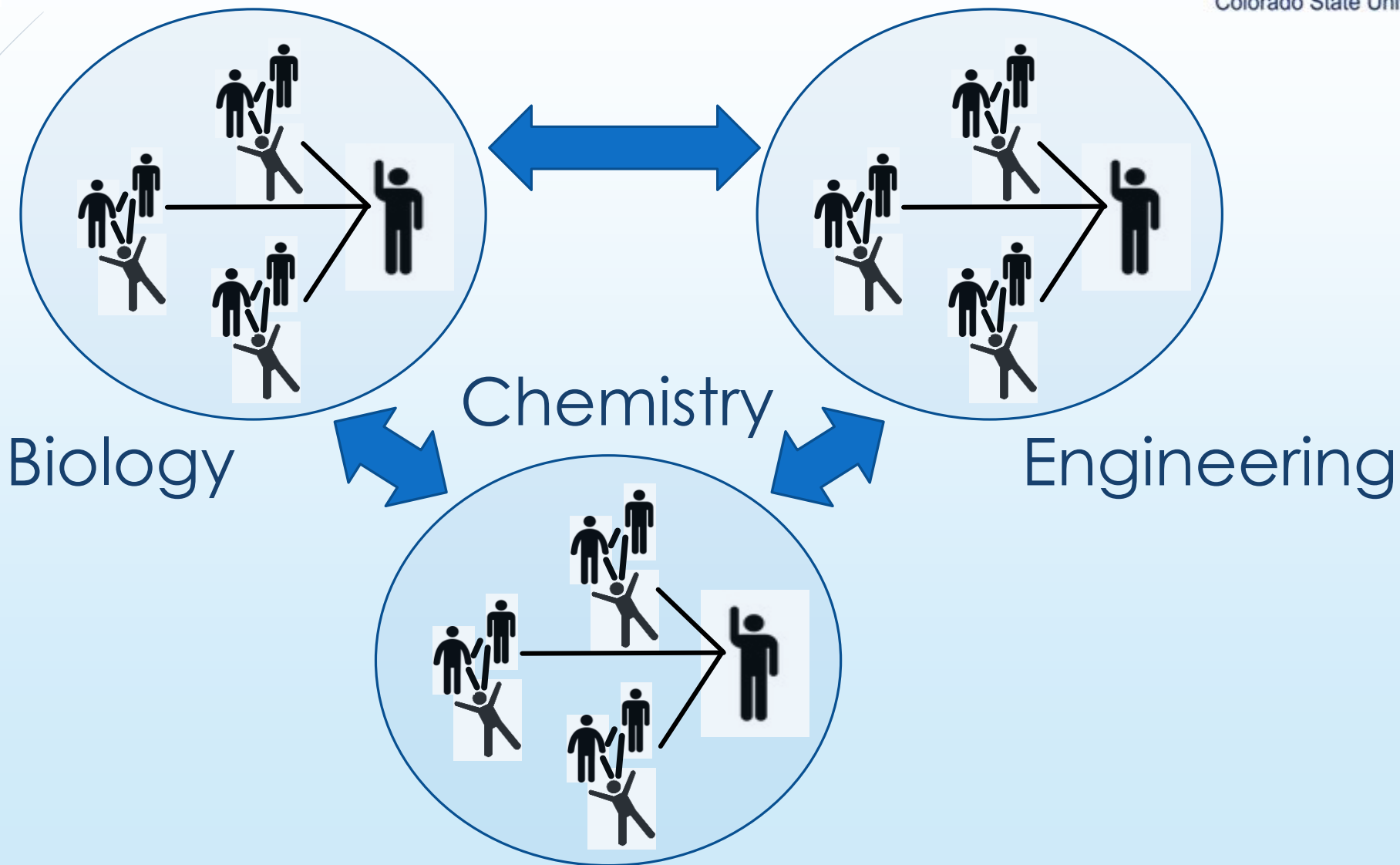
Peer Mentor  
(J/S) Faculty Mentor

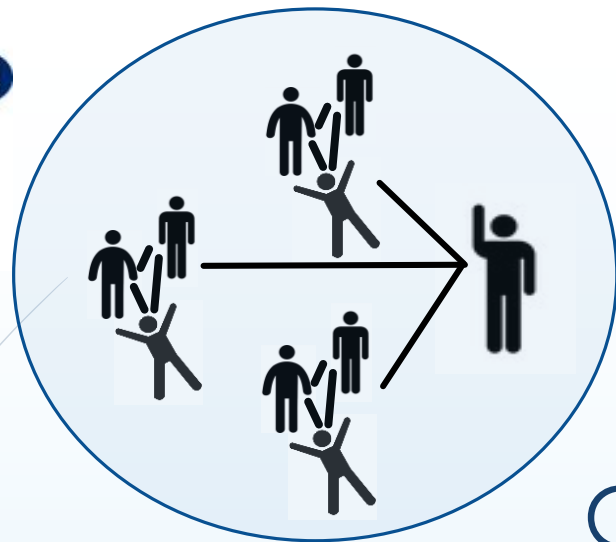


Research Teams



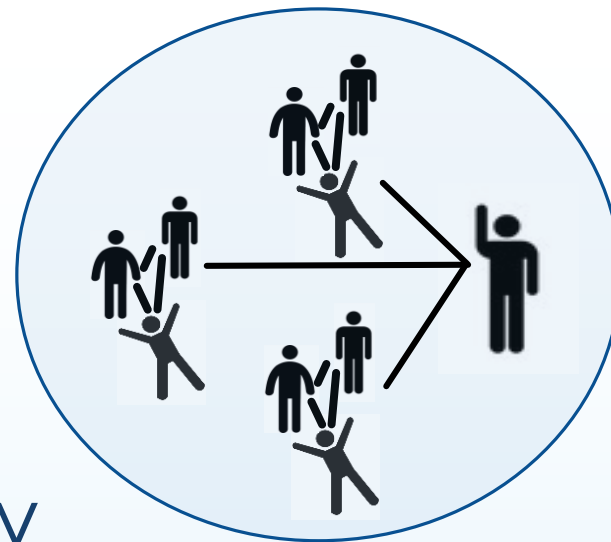
# Research Communities



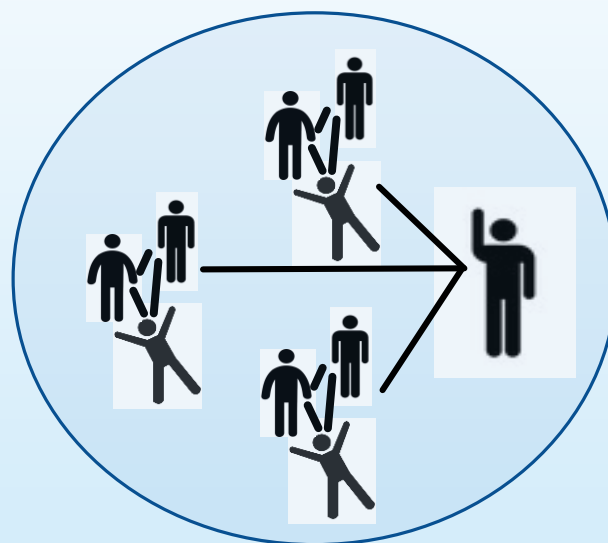


Biology

Chemistry



Engineering



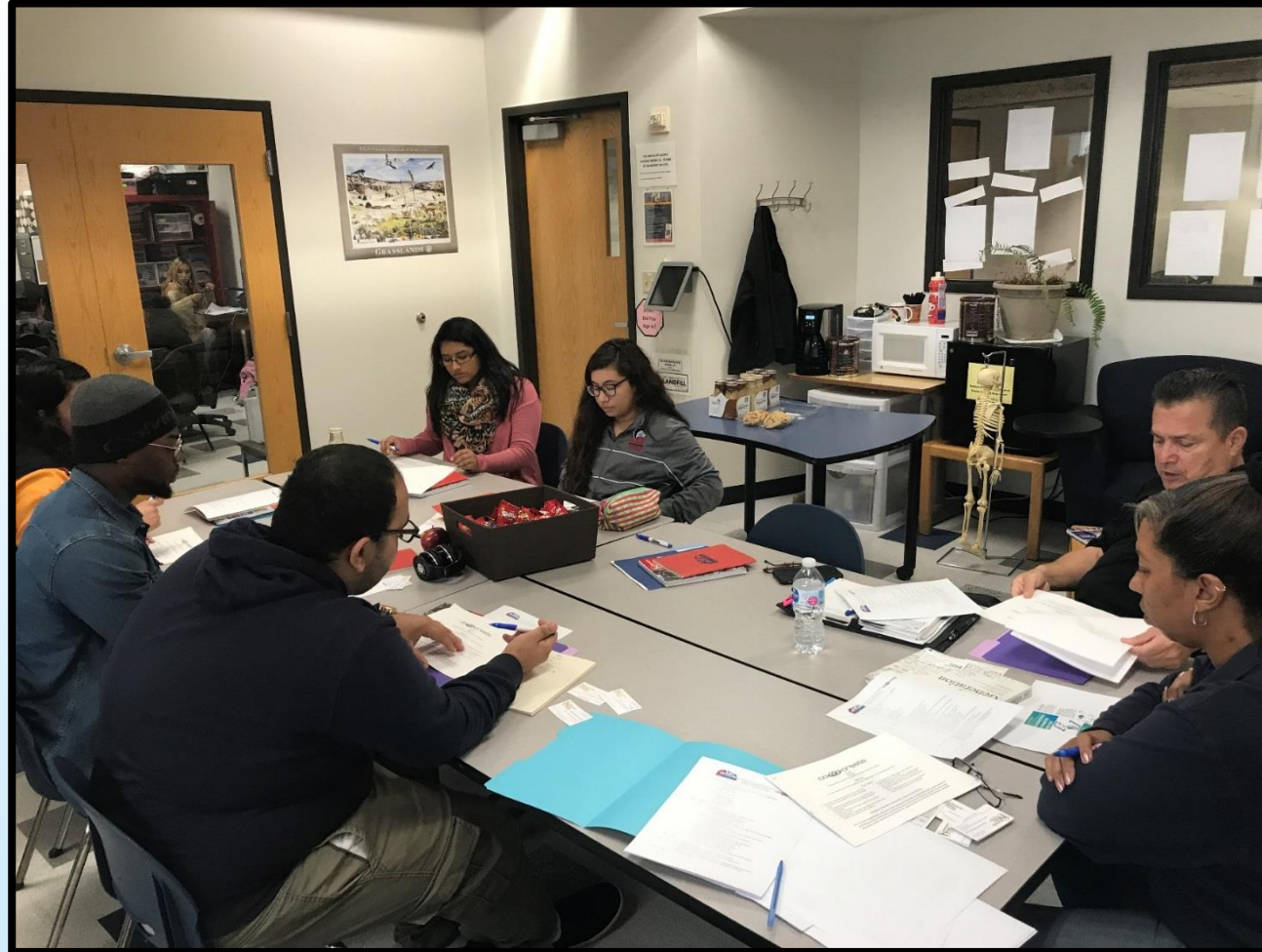
- Bridge Workload Gap
- Bridge Achievement Gap
- Bridge Recruitment Gap

(Afghani et al. 2013)

(Good, Halpin, and Halpin 2000)



# Community-Based Research

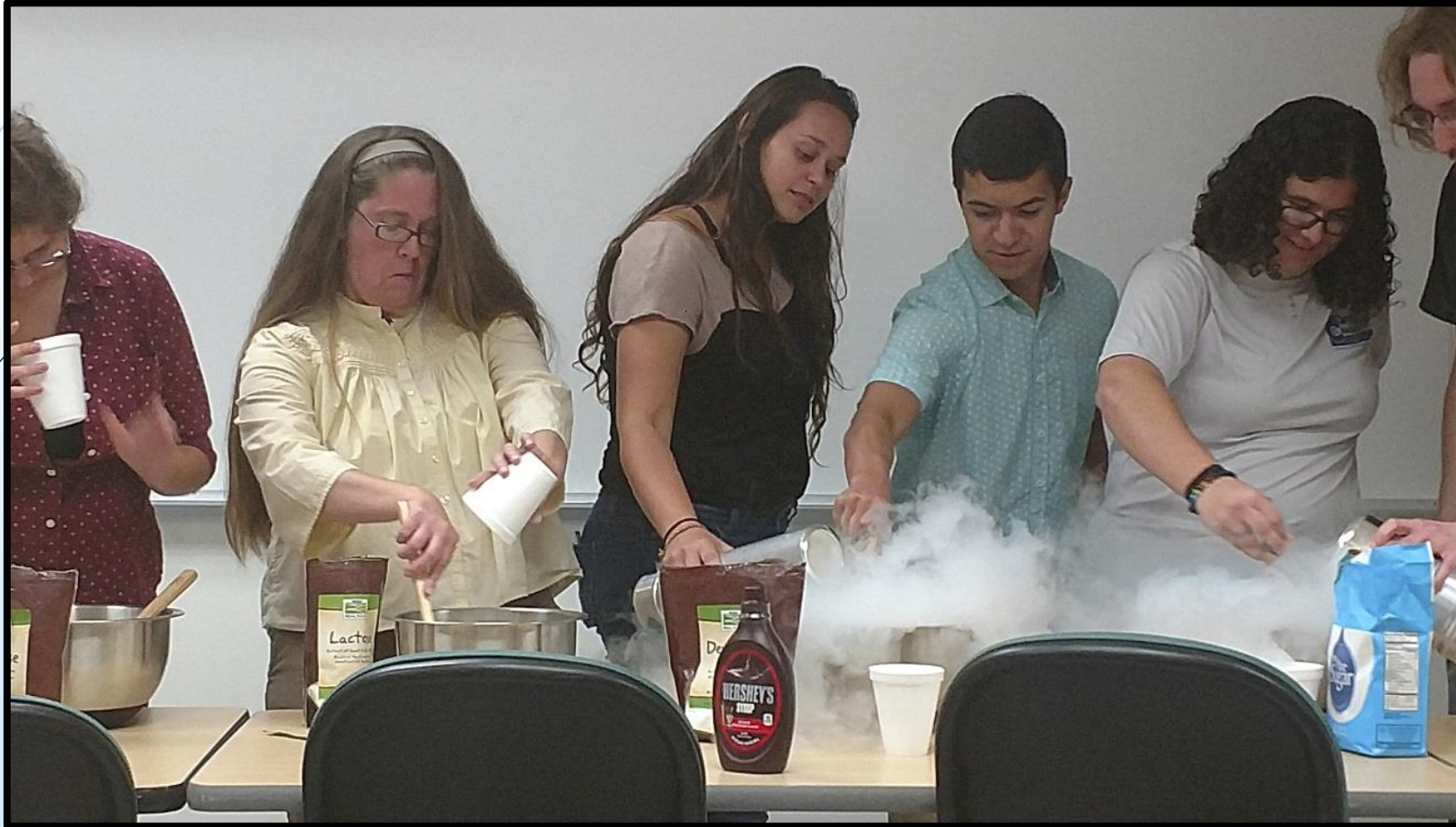


(White, Altschuld, and Lee 2006)  
(Atwater et al. 2013)

# Recruitment



Structures and Placement



Course and Curriculum Re-Design

# Activity #1

## What Gaps exist at your institution?

# Measures of Success

Faculty Participation	Before CBASE - 11	Year 1 - 11	Year 2 - 20
Student Participation	Before CBASE - 28	Year 1 - 44	Year 2 - 96
Student Retention Rate	CBASE - 100%	CSU-Pueblo - 63%	
Student Graduation Rate	CBASE - 100%	CSU-Pueblo - 37%	

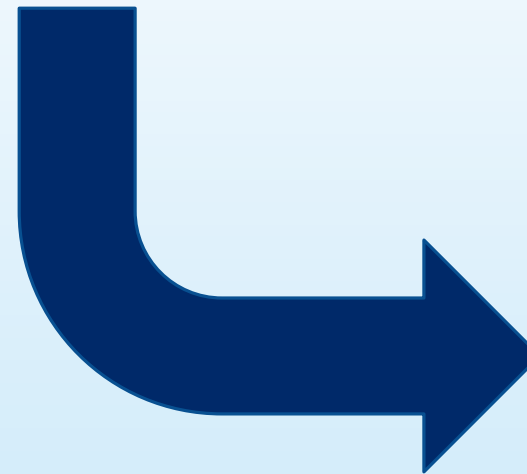
# Measures of Success

- Plans after graduation
- Mentoring
  - Beneficial
  - Role in Project
  - Understanding
- Learning – Research vs. coursework
- Benefits
  - Career path
  - Tolerance for Obstacles
  - Construction of knowledge
  - Independent work

# Core Commitments or Principles **STRUCTURE**



Strong Vision  
Dedicated Staff  
Clear Processes and Expectations



Consistency  
Visibility  
Transparency  
Equity

(Kinkead and Blockus 2012)

# Core Commitments or Principles

## ACCESS & SUCCESS



(Dee and Gershenson 2017)



# Core Commitments or Principles

## MENTORING



## Mentorship cascades

- ❖ Faculty-Student
- ❖ Student-Student
- ❖ Faculty-Faculty

# Core Commitments or Principles EXPECTATION OF PRODUCTIVITY

## Prevalence of West Nile Virus Antibodies and Blood Mercury Levels in Song Birds Collected from the Colorado Fountain Creek Region

Alyssa R. Torres, J. Jordan Steel, and Claire W.V. Ramos  
Biology Department, Colorado State University - Pueblo

### Abstract

West Nile Virus (WNV) is a positive strand RNA virus (Flaviviridae) that is transmitted by mosquitoes (Culex species). The virus is normally maintained and amplified in avian reservoir hosts, but infected mosquitoes will also bite humans, horses, and other vertebrates and can result in the transmission of the virus. WNV infections have been reported all over North America, including recent infections in Colorado. It is hypothesized that birds with higher mercury concentrations will have more WNV antibodies present. In a collaborative effort, birds have been trapped, banded, and blood samples were collected from birds in the Fountain Creek Region of Colorado in summers of 2014-17. Blood samples are now being screened for mercury levels using a DMA 9000 Mercury analyzer and for WNV antibodies using an indirect ELISA (enzyme-linked immunosorbent assay). Initial screening results show multiple birds being positive for WNV antibodies. Over 700 bird blood samples have been collected over the last 4 years and will be analyzed for WNV antibodies, geographic location, bird species, bird age, mercury levels, and WNV antibody titer data are being gathered and analyzed for any correlations between WNV exposure and mercury concentration.

### Introduction

- Mercury is a neurotoxin that has shown to have negative effects on wild birds. High mercury levels have shown changes in migration patterns and changes in bird song. High mercury levels have also shown a slow down in the immune response of song birds.
- West Nile Virus (WNV) is a positive strand RNA virus (Flaviviridae) that is transmitted by mosquitoes (Culex species).
- An indirect ELISA (enzyme-linked immunosorbent assay) is originally used to detect seroreactivity against St. Louis encephalitis virus (SLEV) and Borna disease virus (BDV), but has now been modified for detecting anti-WNV antibodies in wild avian species.
- Two-step ELISA that involves two different binding processes of primary antibody and labeled secondary antibody.
- Secondary antibody is conjugated with a reporter that can easily be detected in a high throughput assay.
- Advantages for using an indirect ELISA are high sensitivity, flexibility, and cost saving.

Summer 2014-2016 birds were trapped with mist nets, banded, and blood were collected from the Fountain Creek Region of Colorado.

### Results

#### Mercury vs WNV Antibody Titers All Birds

Figure 1: The normalized PN values compared to the mercury concentration in all birds captured from the summers of 2014 and 2015.

#### Prevalence of WNV antibodies in all birds sampled

Figure 2: Percentage of birds highly positive, moderately positive, and negative for WNV antibodies as determined by PN values.

#### Mercury vs WNV Antibody Titers House Wrens

Figure 3: The normalized PN values compared to the mercury concentration in all house wrens caught in the summers of 2014 and 2015.

#### Prevalence of WNV antibodies in House Wrens

Figure 4: Percentage of wild house wrens highly positive, moderately positive, and negative for WNV antibodies as determined by PN values.

#### Mercury vs WNV Antibody Titers Red-Shafted Flickers

Figure 5: The normalized PN values compared to the mercury concentration in red-shafted flickers caught in the summers of 2014 and 2015.

#### Prevalence of WNV antibodies in Red-Shafted Flickers

Figure 6: Percentage of red-shafted flickers highly positive, moderately positive, and negative for WNV antibodies as determined by PN values.

### Methods

Birds were captured using mist nets and tagged with aluminum bands. The second right tail feather, small branch of breast feathers, and blood samples were taken from each bird. Multiple measurements were recorded from each bird (sexes, wing length, age, etc.). Bird blood is currently being screened for mercury using a DMA 9000 mercury analyzer. This entails placing the blood sample into a metal boat and then getting the concentration of mercury in the sample.

The same blood is also currently being screened for WNV antibodies using an indirect ELISA. Briefly, wells are coated with WNV antigen (Pro-M and E antigen) and then field caught bird serum is loaded into the wells. After a 1 hour incubation, the serum is removed and the wells are washed. A goat anti-wild bird immunoglobulin Y conjugated with Horseradish peroxidase was used as the secondary antibody. After incubation and washing, the HRP was detected by adding the TMB substrate and watching for color changes. 2M Hydrochloric acid was used to quench the reaction and the plates were analyzed at a 450nm absorbance using a Bio-Rad plate reader. A positive sample (WNV positive sera from a crow) and a negative well (no sera) was used on each plate. Positive over negative values were calculated for each sample and used to determine the WNV titer in the blood samples.

### Conclusion

The results show that there is no apparent correlation between the mercury concentrations and WNV antibody presence when looking at all the bird samples together. These results are preliminary and hundreds of samples remained to be screened. When looking at the mercury concentrations and WNV antibody presence in individual bird species, there may be some trends that need to be further investigated.

### Future Directions

In the future, more complete analysis will be performed using bird samples collected from summers 2016-2017. There are over 300 samples that are still currently being analyzed for these correlations.

We are also seeking to find bird samples collected from areas with lower concentrations of high mercury. All current samples are showing low mercury concentration levels and higher mercury levels may be needed in order to see a correlation between Hg and WNV.

### Acknowledgements

This work was partially funded by a SEED grant from Colorado State University-Pueblo awarded to Claire Ramos and CSU-Pueblo's C-BASE (Communities to Build Active STEM Engagement) grant from the US Department of Education (PR Award # P011C160025). We would also like to thank Dr. Greg Ebel and Claudia Ruckert for helping with the protocol development and providing the WNV positive serum for this work. The field lab members also provided helpful discussion and input on experimental design and data analysis.

# Context Matters



## Activity #2

Can UGR programs in your context help to bridge your Gaps?

# Questions?

