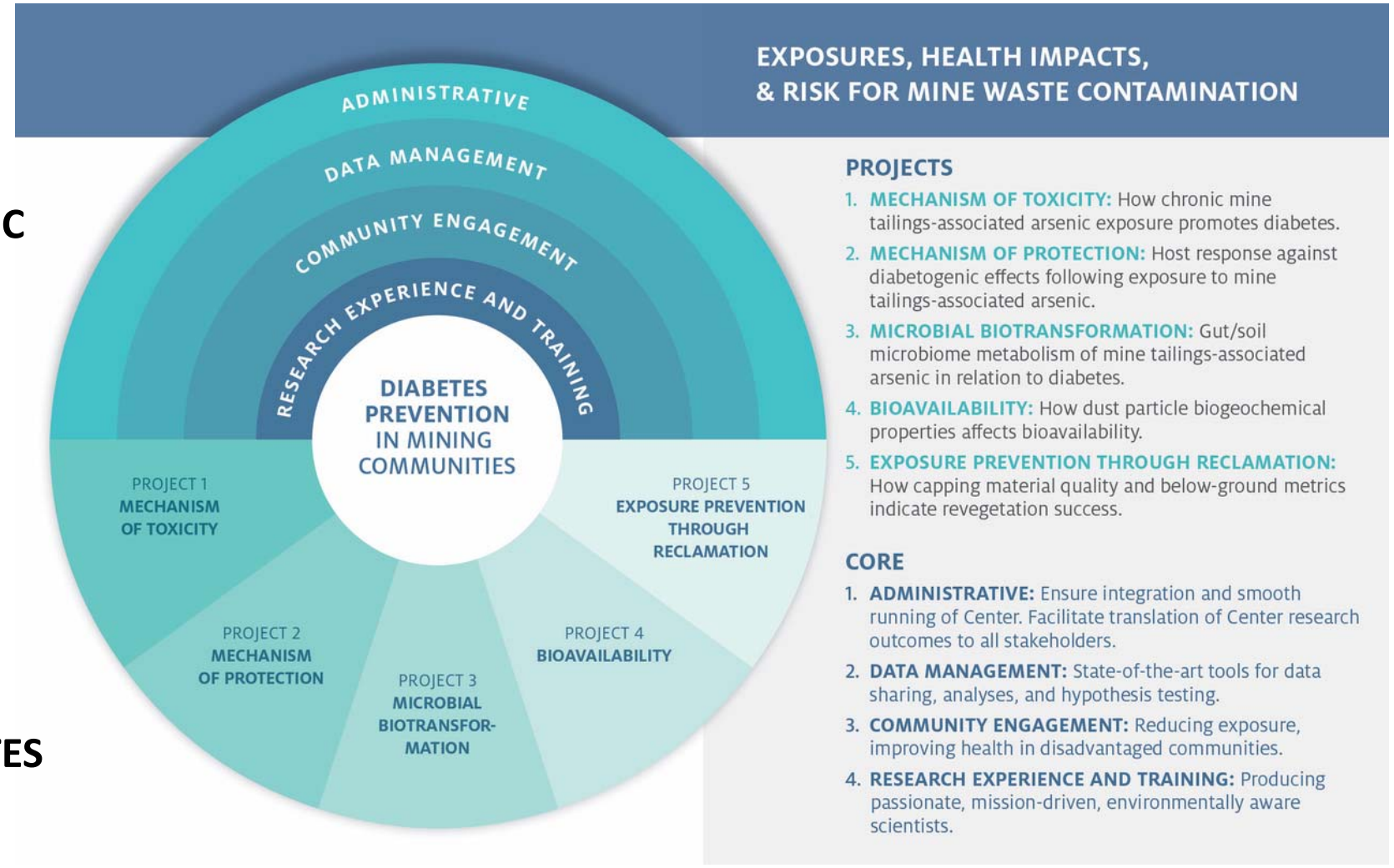
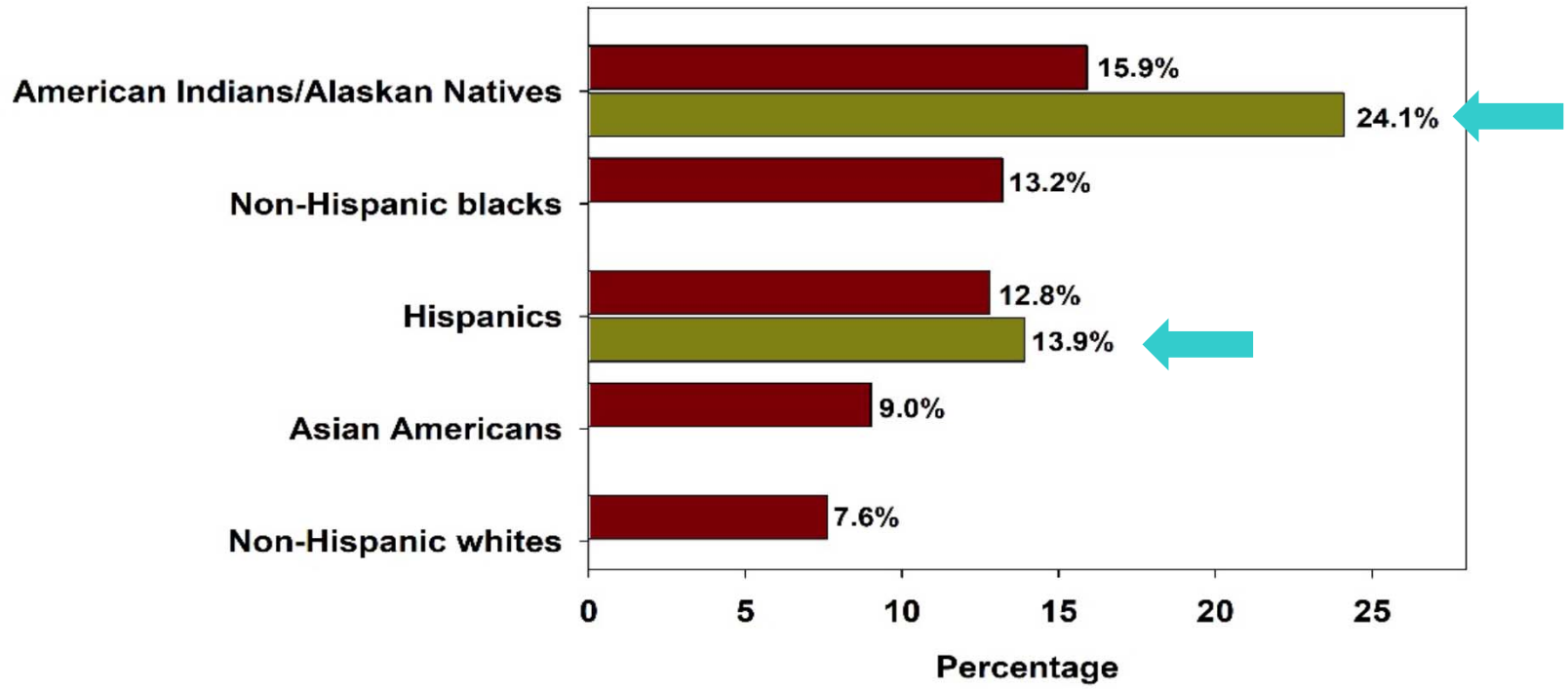
The University of Arizona Superfund Research Center

ARSENIC

DIABETES



Diabetes in the U.S. Southwest



Age-adjusted percentage of people aged 20 years or older with diagnosed diabetes by race/ethnicity, U.S. (2010-2012). Red bars = diabetes by race/ethnicity across the U.S. Green bars = regional percentages for American Indians in southern Arizona and for Mexican Americans showing increased diabetes in the U.S. Southwest.

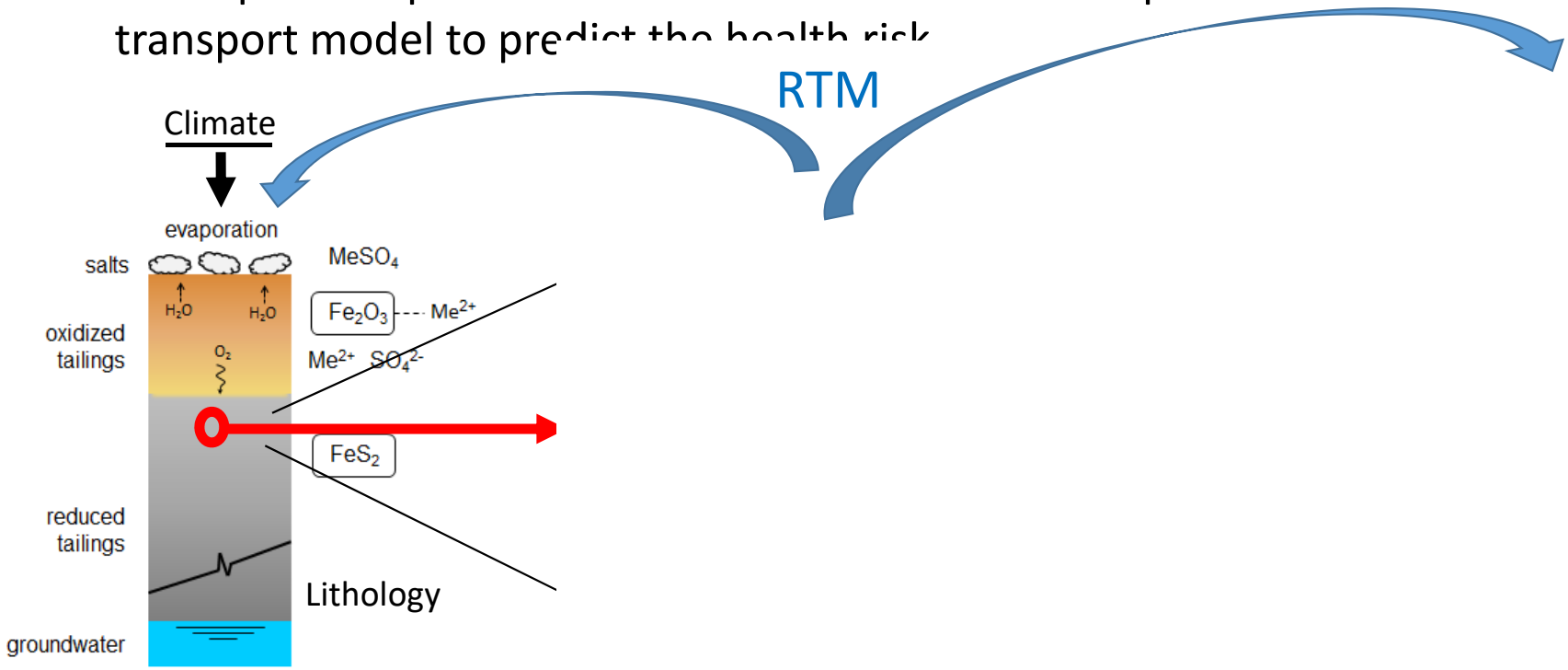
U.S. Southwest: Dust is an important and little considered exposure route

Project 4 (Jon Chorover/Mark Brusseau)
Environmental Controls on Bioavailability of Arsenic and Toxic Metals

Aim 1: Climate weathers tailings to change arsenic speciation with critical implications for human health risk (Projects 1-3, 5)

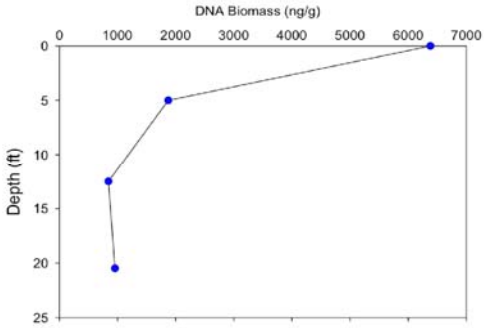
Aim 2: The mechanisms driving these changes occur at the pore scale

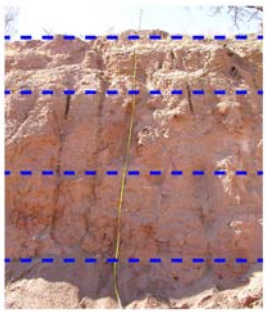
Aim 3: These pore- to profile-scale interactions can be incorporated into a reactive transport model to predict the health risk



Project 5 (Raina Maier/Julia Neilson/Craig Rasmussen/Alicja Babst-Kostecka) Importance of Capping Material Properties in Remediation of Mine Tailings

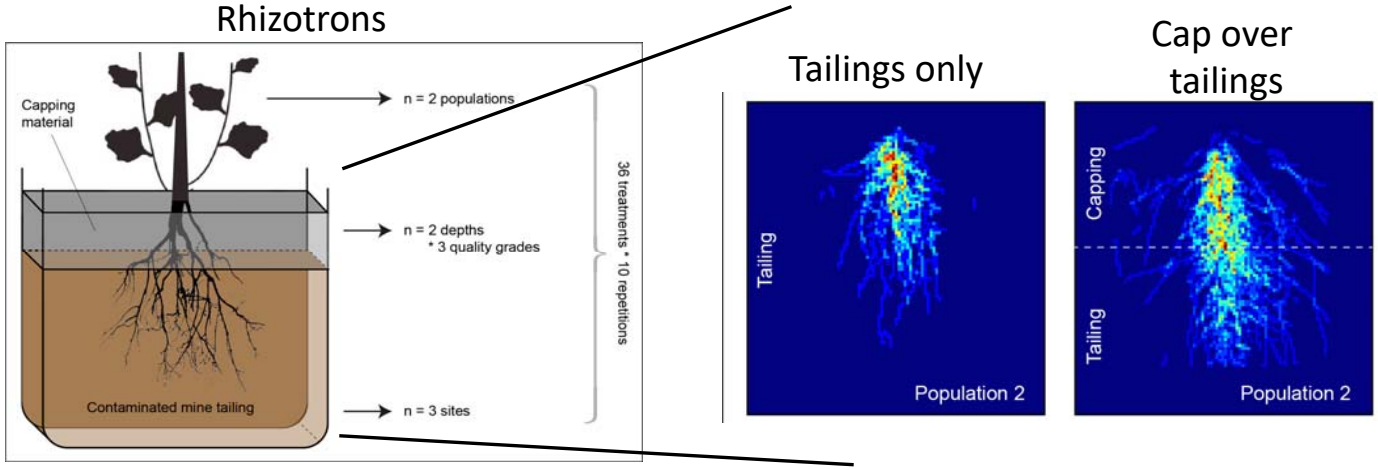
Aim 1: Examine microbiome and geochemical properties of capping material as a function of source, age, and depth (Project 4)



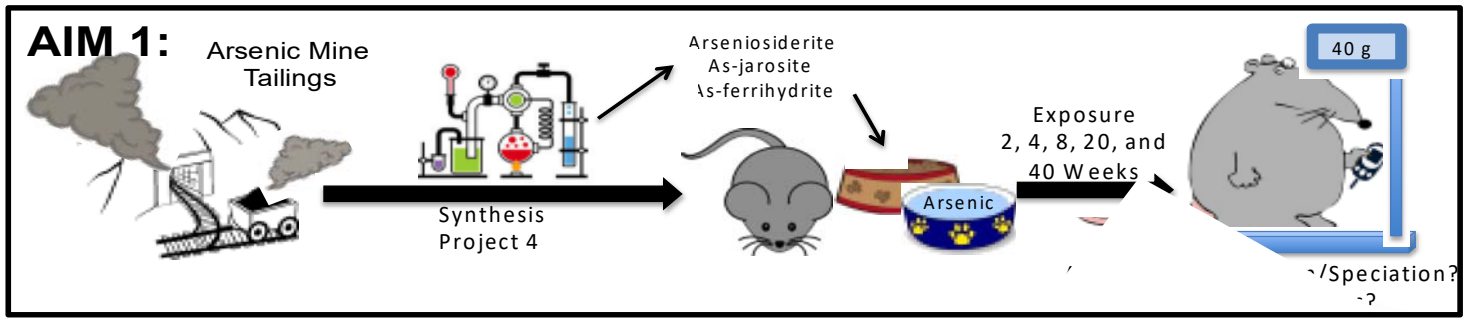


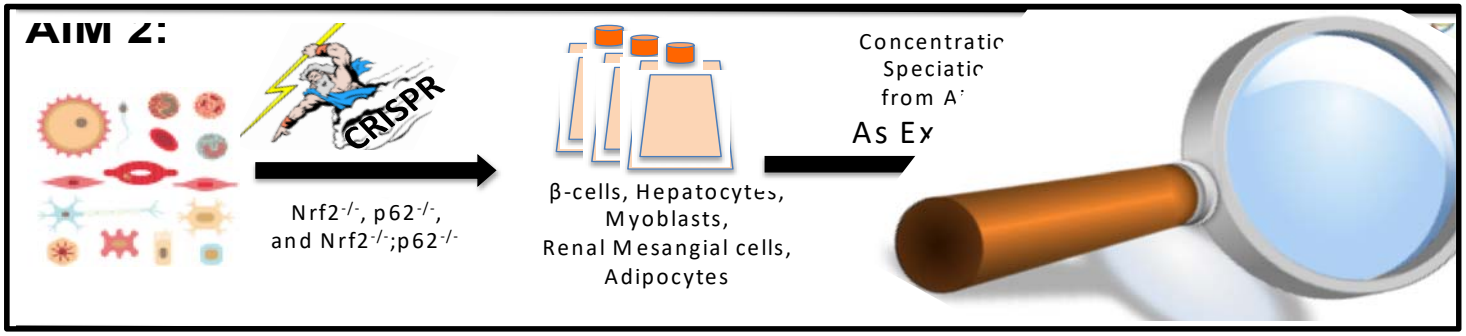
Aim 2: Correlate capping material microbiome and geochemical properties as well as locally adapted plant species to plant germination and growth success

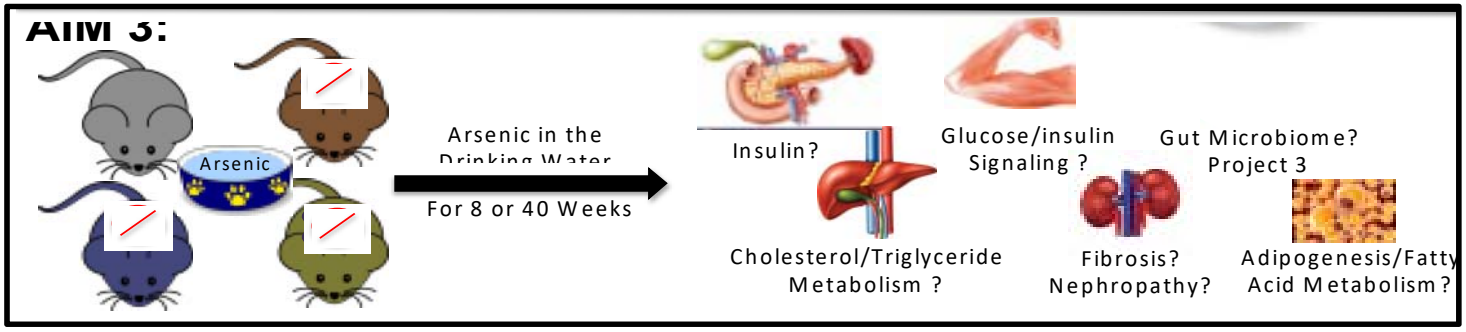
Aim 3: Develop remediation guidance for industry and regulatory agencies by applying optimized conditions for a range of mine tailings



Project 1 (Donna Zhang), Diabetogenic Mine Tailings: Mechanistic Link Between Arsenic, NRF2, Autophagy, and Diabetes



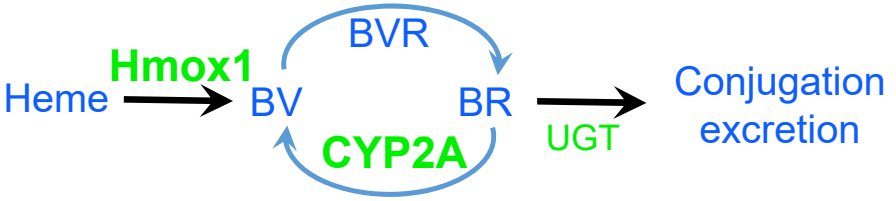




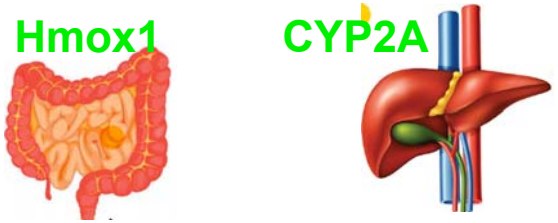
Project 2 (Xinxin Ding/Qing-Yu Zhang)
Role of CYP2A and Hmox1 in the Diabetogenic Effects of Arsenic in Mine Tailings

AIM 1:

WT **Cyp2A5** **Cyp2A5 CYP2A6**



Exposures (80 or 40 weeks)
Arsenic in water
Arseniosiderite
As-Jarosite
As-ferrihydrite



AIM 2:

WT **IE-Hmox1; villin-Cre**

Arsenic concentration/speciation
Diabetic outcome
PGF15, FGP21, BVR, BR, other metabolites

AIM 3: Bile acids

Arsenic concentration/speciation - **Project 4**

Metagenomic profile of gut microbiome - **Project 3**

Project 3 (Pawel Kiela/Paul Carini/Albert Barberan), Microbial Contributions to Arsenic Transformation in the Gut

AIM 1: Characterize gut microbiome taxonomic and metabolic potential

Mouse fecal samples from *Project 1*

Profile

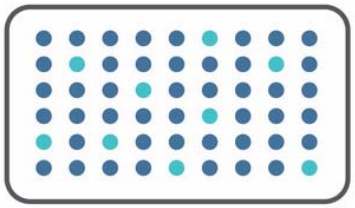
1) Microbial communities
2) Microbial functional gene profiles
3) As specifics profiles (with *Project 4*)

AIM 2: Quantify capacity of synthetic communities (SYNCOM) to sequester/metabolize As

High throughput microbial cultivation

1) Create 120 SYNCOMs
2) Test SYNCOMS for As speciation
3) Identify SYNCOMs that:

(i) sequester As, (ii) produce high toxicity As species, (iii) produce low toxicity As species

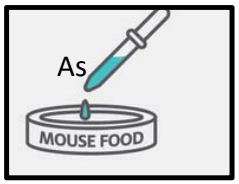


AIM 3: Test capacity of synthetic communities to modulate diabetic outcomes of As exposure

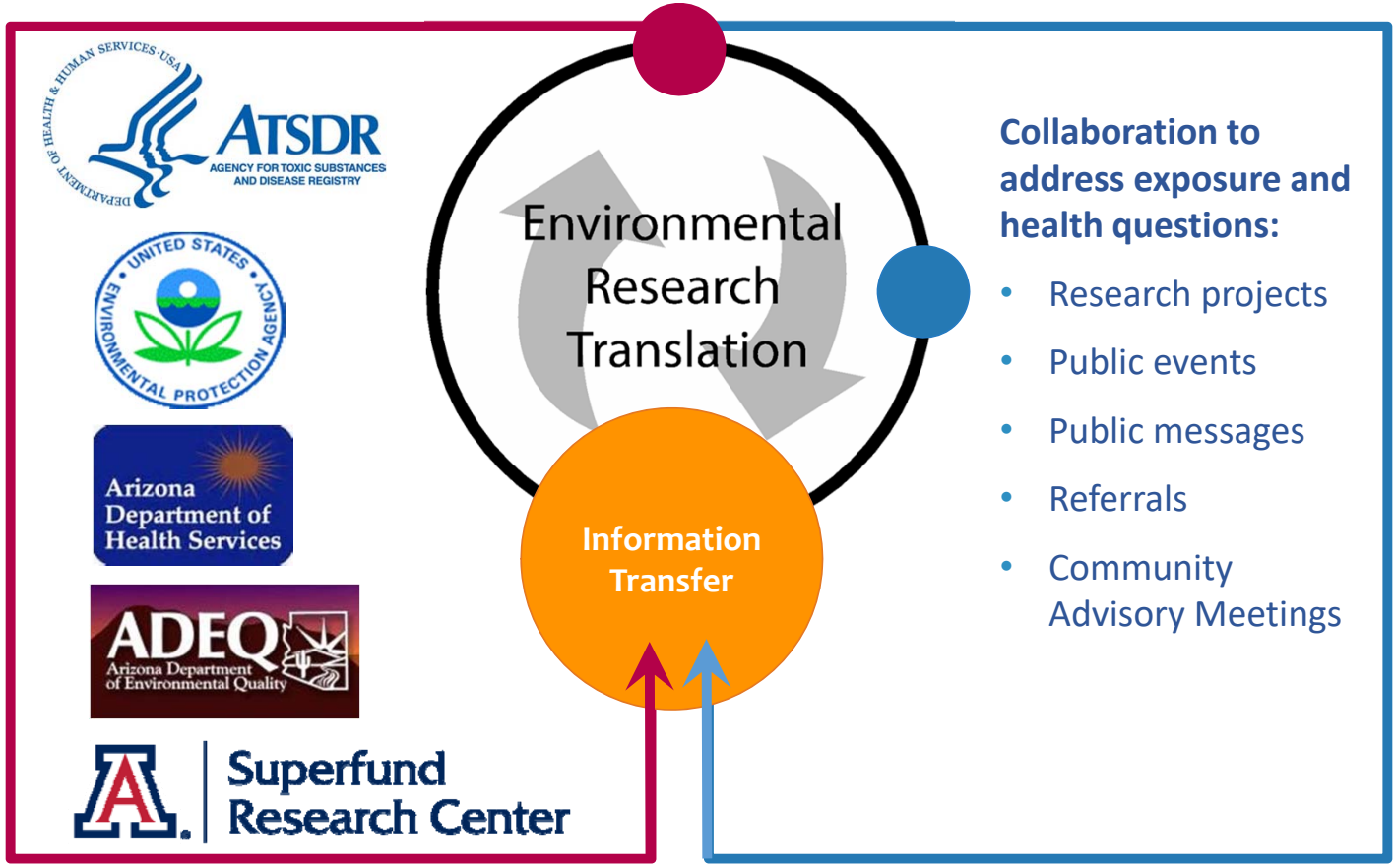
1) Test SYNCOMS – feed to germ-free mice
2) Expose mice to As and assess diabetes response
3) Further testing in SPF mice using promising SYNCOMS

GF mouse

\+ SYNCOM +



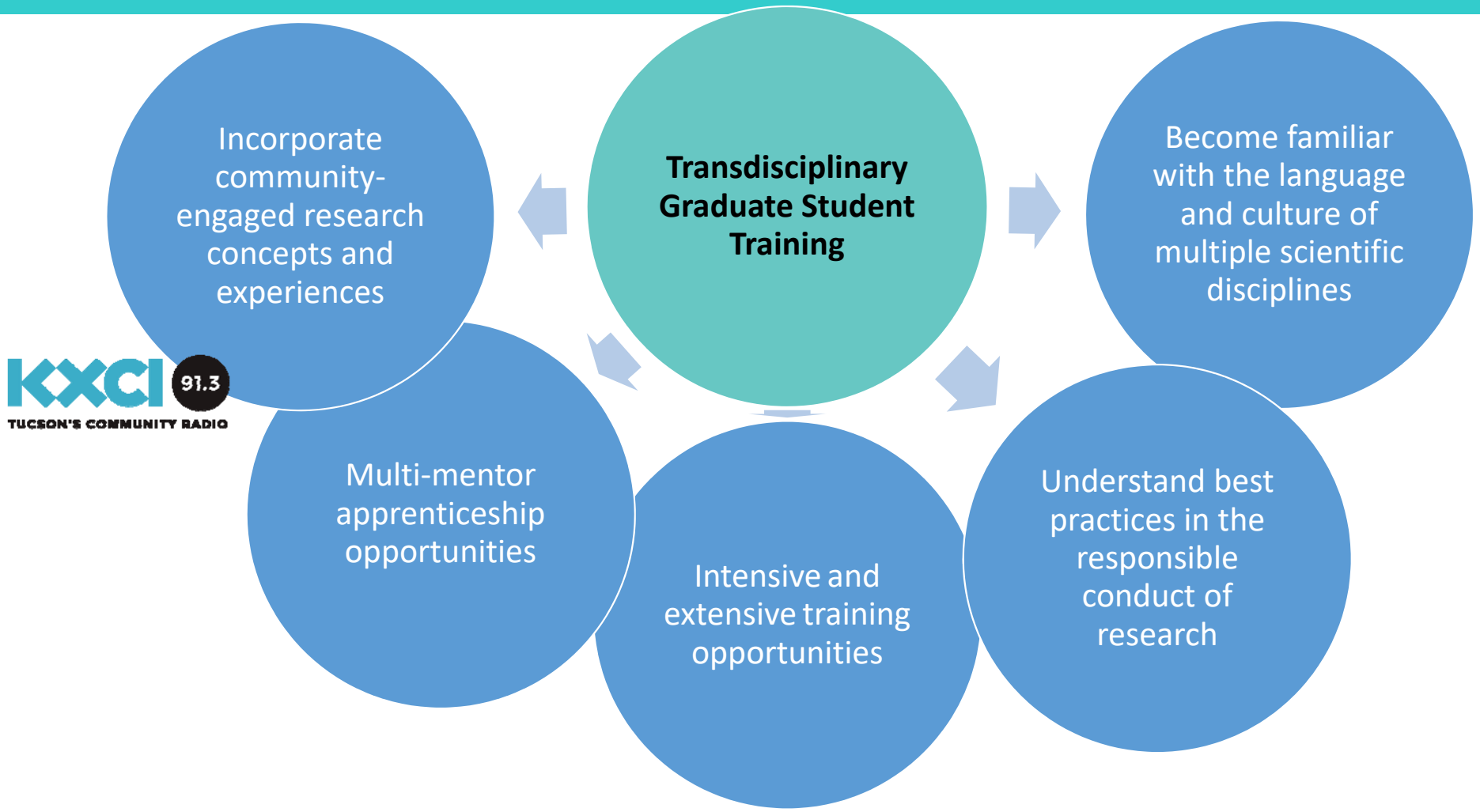
Research Translation (Monica Ramirez-Andreotta)
Long-term multi-stakeholder interactions, 2015 - present



Our Principles:

- **Transdisciplinary Team Approach**
- **Effective Collaboration**
- **Cultural Model of Risk Communication**
- **Public Participation in Research**
- **Technology Transfer**
- **Information Dissemination to Stakeholders**

Training Core (Raina Maier/Monica Ramirez-Andreotta/Donna Zhang)



Community Engagement Core (Karletta Chief/Stephanie Carroll/Raina Maier)

AIM 1: Community-engaged participatory research focused on Native American communities

AIM 2: Training, education and capacity building focused on community health representatives focused on food sovereignty

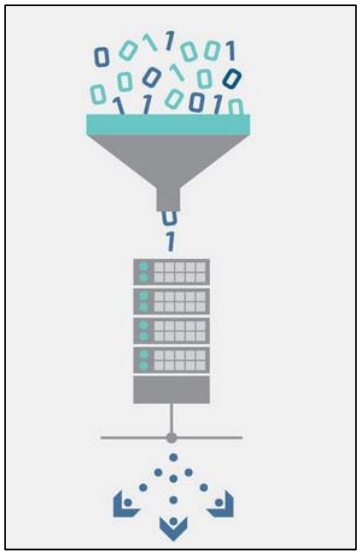
AIM 3: Community engagement tools – sharing information and supporting implementation

COVID-19 on the Navajo Nation

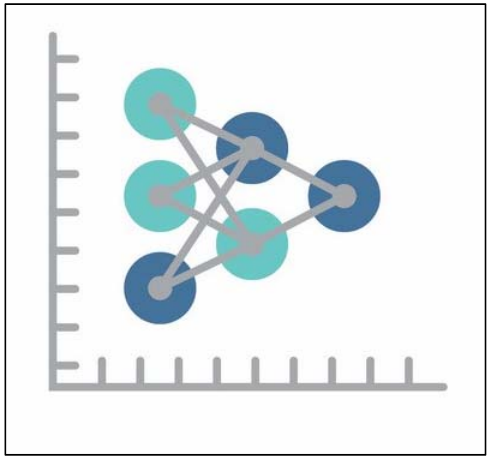
- One of the highest COVID-19 infection rate per capita
- Anticipating 2nd wave of COVID-19 cases in Fall 2020
- Identifying direct linkages to environmental and individual risk factors associated with COVID-19 infection rates and deaths on the Navajo Nation is critical and urgent to inform new mitigation strategies and policies and to prevent future large scale outbreaks

Data Management and Analysis Core (Aikseng Ooi/Nirav Merchant)

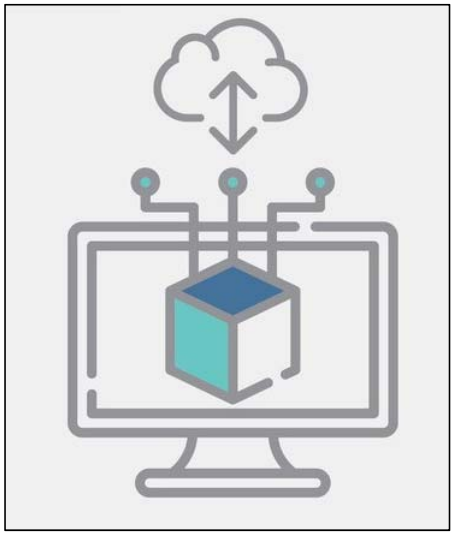
Aim 1: Enable data storage, processing, analysis and sharing



Aim 2: Develop predictive algorithms for all projects



Aim 3: Establish and maintain a web application to allow researchers and community members to compare data



We assist our researchers in management and analysis of their data using researcher-friendly and extensible infrastructure as well as providing predictive algorithm development

We enable our researchers and leaders to analyze shared datasets and potentially identify new research questions

CYVERSE

LEVERAGING CYVERSE INFRASTRUCTURE THROUGHOUT ALL AIMS

Combining Research Translation and Data Science – an example

Using Community Participation in the Scientific Research Process = Citizen Science

Steps in Research	Community Role and Activity
Choose or define question(s) for study	• Questions are derived from: community needs assessment, community advisory boards, non-governmental organizations in the area, and/or ongoing interactions with local community members

gardenroots
A Citizen Science Garden Project

- *Are my soils safe?*
- *Is it safe for me to consume the vegetables from my garden?*
- *If so, how much?*

gardenroots
The Superior, AZ Garden Project

- *Is my air safe to breathe?*
- *Are their uncontrolled sources of dust in my community?*

gardenroots
The Nevada County, CA Garden Project

- *Is ingestion of soil and plants grown locally contributing to arsenic and cadmium exposures?*
- *If so, is this associated with the local breast cancer incidence rates?*
- *Are children being exposed through gardening?*

Research to Data Science Action for Systematic Change

How can we make citizen science collected data interoperable with existing government datasets?

What ontologies need to be made for this to occur?
Do they exist for all the vulnerabilities exist in rural, medically-underserved mining communities?
What about the resiliencies?

In mining communities, are there existing formal and informal forms of capital and structures that can positively respond and combat environmental health insults leading to diabetes and obesity? How do we mobilize?

How should environmental health vulnerability and resiliency data be organized, accessed, and visualized to maximize translational science efforts?

Also supported by SRP supplement – Internal Use Case Study led by Ramirez-Andreotta and Ramona Walls, Dec 2019


Thanks!
Questions?
Superfund
Research Center