



**Training STEM graduate students to work
in Indigenous Communities to co-solve
FEWS challenges**

**Earth Educators Rendezvous
July 14, 2020**

Karletta Chief, PI, Associate Professor & Extension
Specialist



Agnese Nelms Haury
Program in Environment and Social Justice



I am Bitterwater.



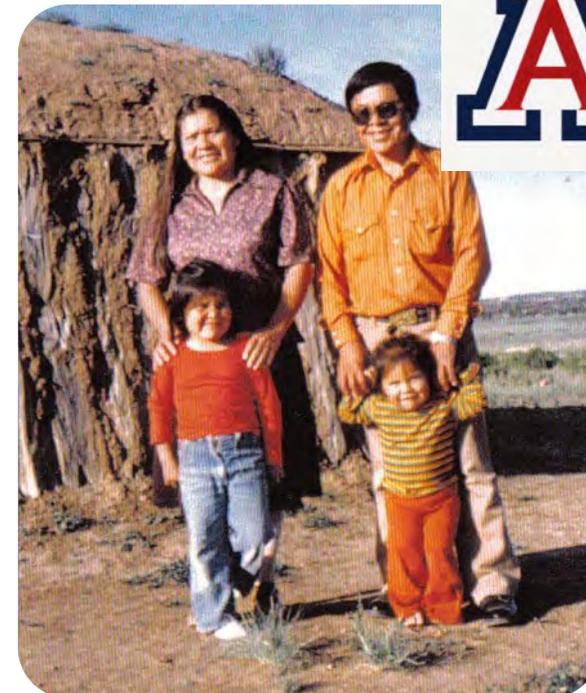
Red-house



Bitterwater

Near-the-Water

Red-Running-Into-The-Water



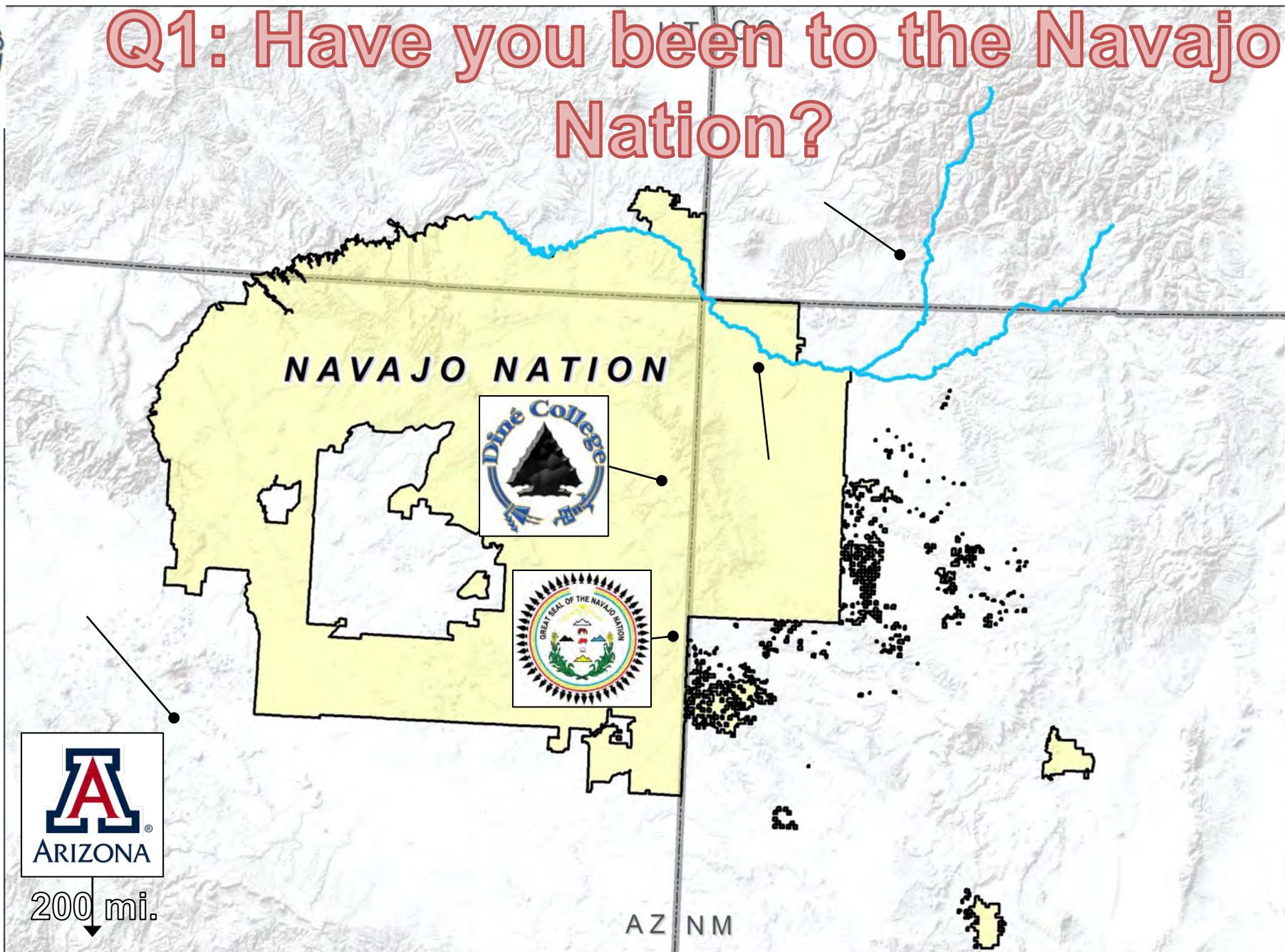


I am from the Navajo Nation





Q1: Have you been to the Navajo Nation?



Climb the Ladder of Education

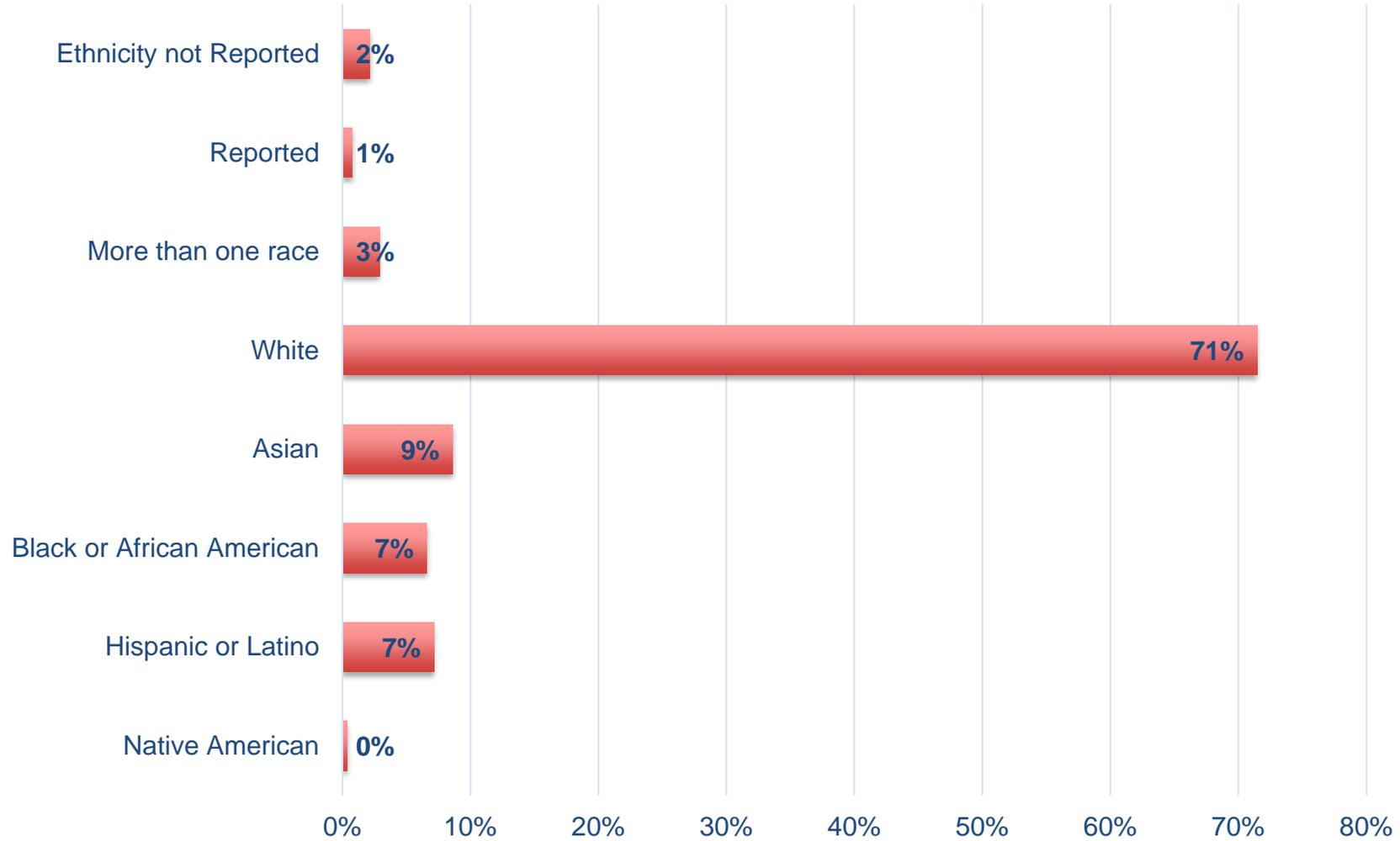


My grandchild, the whites have many things we Navajos need but cannot get. It is as though the whites were in a grassy valley, with wagons, plows, and plenty of food, we Navajos up on a dry mesa. We can hear them talking, but we cannot get to them.

***My grandchild, school is the ladder.
Tell our people this. Climb the ladder
of education.***

Chief Manuelito, Navajo Head Chief

PhDs Earned in the U.S in 2016



FEWS challenges facing Indigenous People

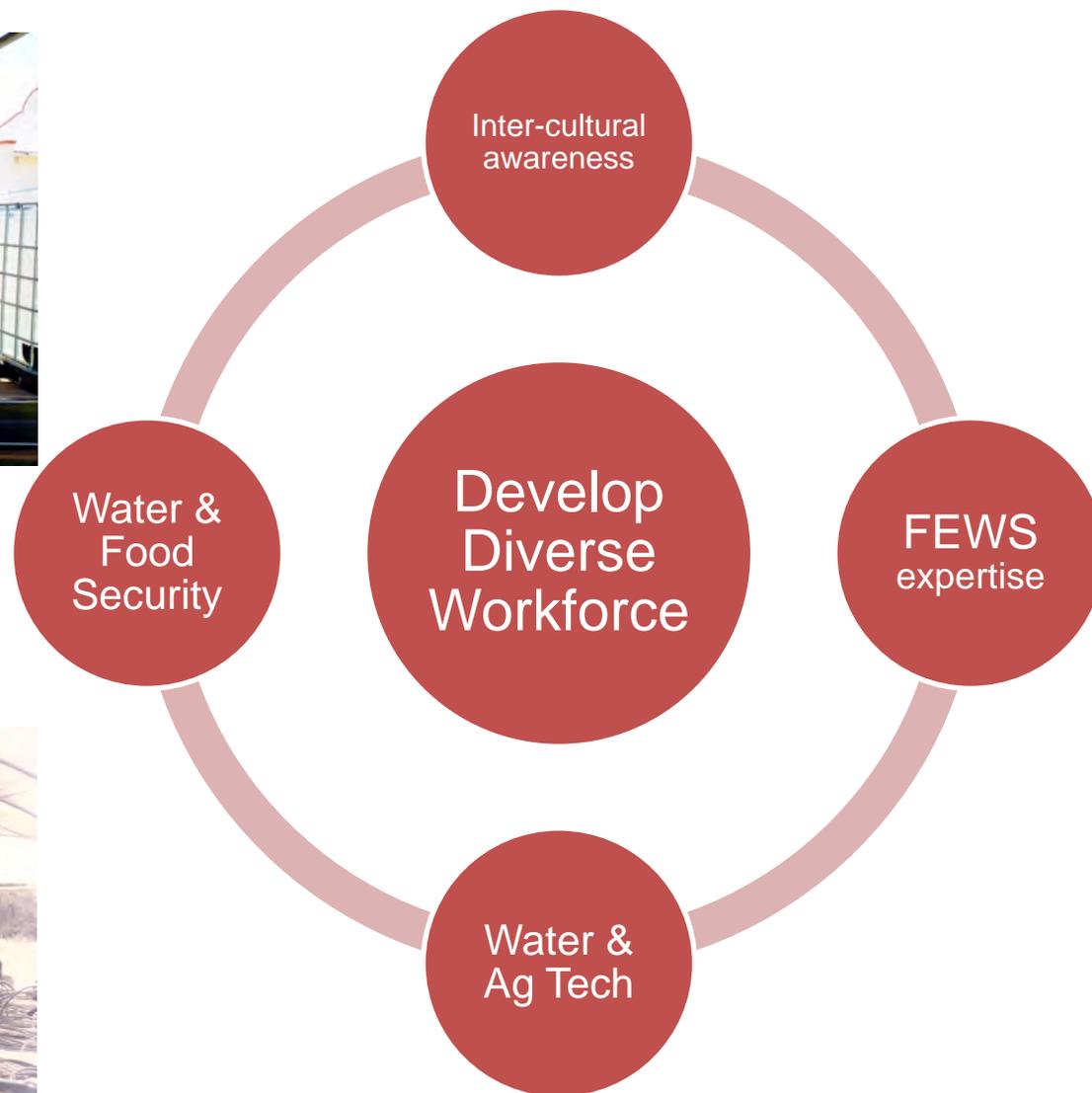




Vision



12 trainees (9 PhDs, 3 MS)
42% Native American
58% Minorities
50% Male & Female



<https://energy.arizona.edu/indigefewss>





Goal



To provide a unique, on-site research, and training opportunity for masters and PhD students that bridges engineering, social, and physical sciences.

EDUCATION & TRAINING



MAJOR RESEARCH



Figure 1: Indigi-FEWSS overarching goals integrating training and novel research.





Objectives



1. Train graduate students to integrate fundamental materials and energy with unit and system concepts to problem solve while understanding the society in which they are working.
2. Enhance graduate student communication skills by providing teaching opportunities at tribal colleges and/or tribal professional development workshops.
3. Train graduate students how to work in Indigenous communities
4. Further the higher education of tribal college students interested in engineering, agriculture, and environmental sciences.
5. Develop community run and maintained water and agricultural systems





Enhancing Graduate Education



1. Integrating fundamental materials, hydrology, CEA, and Energy research with unit & system concepts
2. Teaching & Science Communication opportunities at TCU & Tribal Workshops
3. Hands-on opportunity to work collaboratively with Indigenous communities



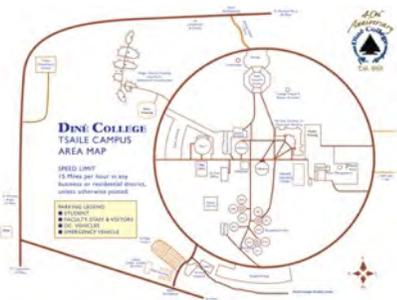


Diné College Partnership



Benita Litson, Director

Diné College Land Grant Office



Land Grant Mission:

“To increase the knowledge capacity of the Navajo Nation and other Native Americans in order to strengthen partnerships intended to empower people and foster communities of learning...”



EAB →

Team

← IAB



Kim Ogden
ChemEE



Torran Anderson
Outreach Coord.



Cara Duncan
Program Coord.



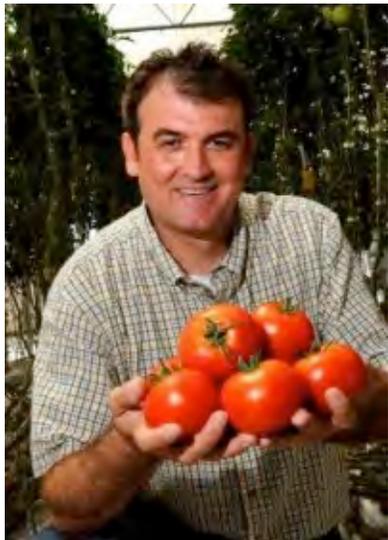
Benita Litson
Diné College



Jennifer Fields
Evaluator



Bob Arnold
ChemEE



Murat Kacira
ABE



Erin Ratcliff
MSE



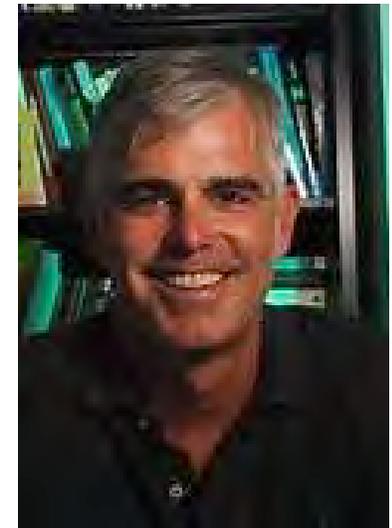
Kelly Simmons-Potter, ECE & OS



Valerie Shirley
Education



Karletta Chief
SWES



Ben Colombi
AIS

**Karletta
Chief**

Environmental
Science

**Kimberly
Ogden**

Chemical &
Environ.
Engineering

**Erin
Ratcliff**

Materials
Science &
Engineering

**Murat
Kacira**

Biosystems
Engineering

**Benedict
Colombi**

American
Indian
Studies

**Kelly
Simmon
s-Potter**

Electrical &
Computer
Engineering

**Valerie
Shirley**

Teaching,
Learning and
Sociocultural
Studies

**Robert
Arnold**

Chemical &
Environ.
Engineering

Trainees

Marquel
Begay (PhD)

JoRee
LaFrance
(PhD)

Nikki Tulley
(PhD)

Adrianna
Nicolay (MS)

-- Cohort 2 --
Sarah Abney
(PhD)

Alexandra
Trahan (MS)

William
Borkan (MS)

Trainees

Caitlyn Leo
(MS)

-- Cohort 2 --

Ailyn Brizo
(MS)

Ciara Lugo
(MS)

Trainees

Michael
Anderson
(PhD)

-- Cohort 2 --

Anna Rich
(PhD)

Trainees

Rebekah
Waller (PhD)

Quentin
Benally
(PhD)*

-- Cohort 2 --

Jaymus Lee
(MS)

Amy Pierce
(MS)

Trainees

Doug
Morrison
(PhD)*

Mark Clytus
(PhD)

Charlene
Tramoni
(PhD)

Trainees

Manuelito
Chief (MS)

Kyle Boyer
(PhD)

-- Cohort 2 --

Frances
Willberg
(PhD)

Trainees

-- Cohort 2 --

Ruth Pannill
(MS)

Trainees

Chris Yazzie
(PhD)

Marisa
Gonzalez
(PhD)

Abolhassan
Mohammadi
Fathabad
(PhD)

* Indicates exited program before degree awarded



Research Theme



Development of novel and sustainable solutions for off-grid production of safe drinking water, brine management operations, and controlled environment agriculture systems.



Figure 7: Indigi-FEWSS research efforts concentrating on water, energy, and food systems.





Cost of Water



Q2: How much do you pay for your water? \$/100 gals?



Co-producing food and energy within controlled environments: Off-Grid Greenhouse Systems



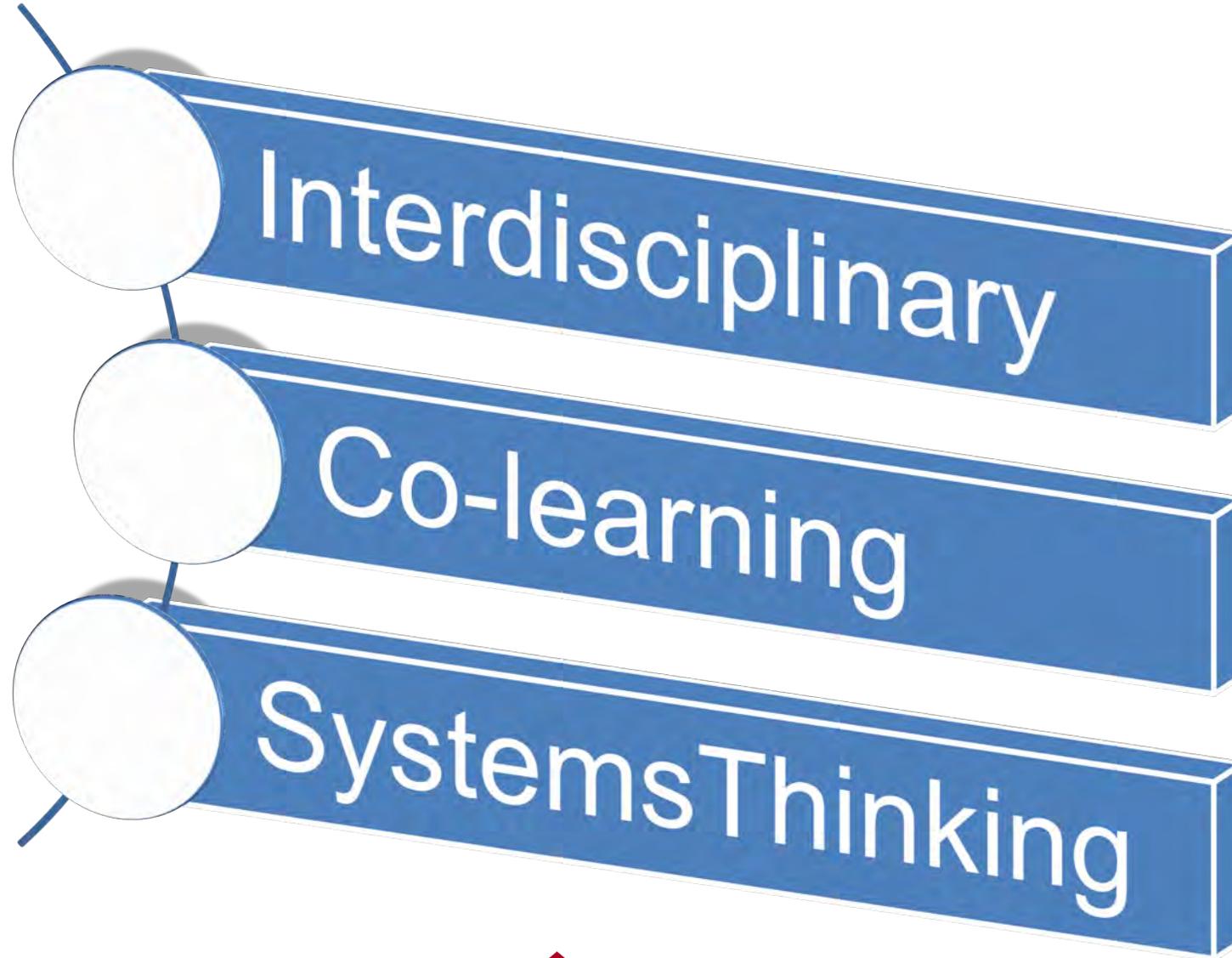
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Rebekah Waller, PhD Student-NSF/NRT Trainee attending to tomato crops grown in organic photovoltaics integrated greenhouse system for her research. (Advisor: Dr. Murat Kacira, Biosystems Engineering)

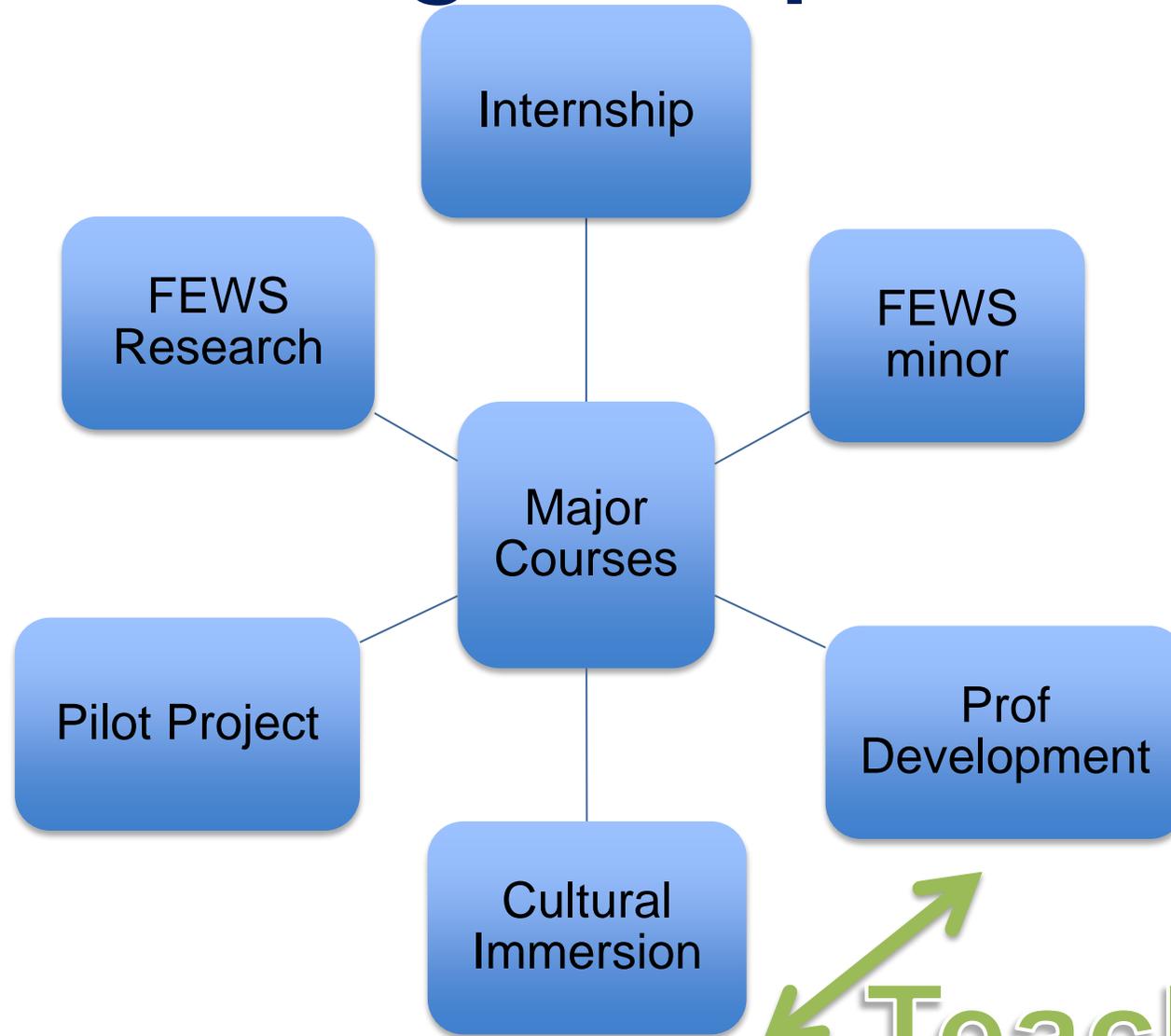


Educational Pedagogy





Training Components



Teaching





Orientation



- Introduction to faculty, staff, campus locations
- Tours of labs
- Lunch
- Introduction to research progress and cross-disciplinary opportunities





Indige-FEWSS PhD Minor



- AIS 503 - Globalization and Indigenous People
- AIS 518 - Southwest Land and Society
- AIS 426A - Principles of Indigenous Economics
- AIS 531A - Traditional Ecological Knowledge
- AIS 537A - Nation Building I
- AIS 541A - Natural Resource Management in Native Communities





Indige-FEWS PhD Minor

Fundamentals (block 2)

Society (block 3)

Capstone (block 4)

Systems (block 1)

ECE/OPT 514A PV Solar Eng Sys
 ECE/MSE/OPTI 534 - Opt & Elect. Mat
 MSE 530 Org Electr Mat & Dev
 MSE 550 Mat Sel Env

AIS 503 Globalization & Indigenous
 AIS 518 SW Land & Society
 AIS 526A Indigenous Economics
 AIS 531A TEK
 AIS 537A Nation Building
 AIS 541A Tribal Nat Res Mangmt

CHE 541 En Eff Proj Design

GEOG 596J Water Management & Policy

ABE 579 Applied Inst for CEA; ABE 582 Int Eng Sol in FEW Nexus

Legend:



Hard STEM



Soft STEM

More Info: <https://grad.arizona.edu/catalog/programinfo/IFEWSMING>





ENVS 696N



Required Seminar

1 hour per week

Wednesdays @ 10:00

Location: ENR2 – S215

Overlaps Monthly with NRT Campus Wide Seminar





Native Voices in STEM



Indigenous Food, Energy, and Water Security & Sovereignty

Indige-FEWS

Seminar Series

FALL 2018

Wednesdays @ 10:00MST ENR2 - S215

September 12



Nexus Thinking, Nexus Tools, Nexus Solutions: Origins and Prospects for Food-Energy-Water Systems

Christopher Scott, Director - Udall Center for Studies in Public Policy; Professor - School of Geography & Development; University Distinguished Scholar

October 10



Indigenous Rights to Water and State Responsibility Under International Law

James C. Hopkins - Associate Clinical Professor, Indigenous Peoples Law and Policy Program; Affiliated Professor of American Indian Studies & Latin American Studies

November 7



Arizona Tribal Extension Overview

Trent Teegerstrom - Associate Director for Tribal Extension Programs; Extension Specialist in the Department of Agricultural and Resource Economics

December 5



Native Seeds/SEARCH Title TBA

Joy Hought, Executive Director—Native Seeds/SEARCH

Join via Zoom: <https://arizona.zoom.us/j/667862706>

Grant #08174511
Any opinions, findings and conclusions or recommendations in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



Spring 2019 Seminar Series

Indigenous Food, Energy & Water Security and Sovereignty

Wednesdays @ 3:00MST ENR2 - N595 or Zoom <https://arizona.zoom.us/j/667862706>

- January 16th** **Sandra Begay**, Sandia National Laboratories
A Navajo Engineer's Perspective on Walking in Beauty on an Ever-changing Path
- February 13th** **Mark Sorensen**, Star School
Title TBA
- March 13th** **Joan Timeche**, Native Nations Institute, Udall Center for Studies in Public Policy
Title TBA
- April 17th** **Ronson Chee**, Riley Engineering
Title TBA



Grant #DGE1735173 Any opinions, findings and conclusions or recommendations in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

SPRING 2020 SEMINAR SERIES

NATIVE VOICES IN STEM

JOIN US REMOTELY @ [HTTPS://ZOOM.ARIZONA.EDU/J/667862706](https://zoom.arizona.edu/j/667862706)

FEBRUARY 21ST @ 12 PM
HARVILL RM. 332A

DR. PETER LITTLEHAT
INDIAN HEALTH SERVICES

MR. JAMES CALABAZA
TREES, WATER, & PEOPLE NATIONAL PROGRAM COORDINATOR

MARCH 4TH @ 2 PM
ENR2 RM. S210

MARCH 19TH @ 12 PM
LOCATION TBA

DR. JOSEPH BREWER
DIRECTOR OF INDIGENOUS STUDIES & ENV. STUDIES FACULTY
UNIVERSITY OF KANSAS

DR. SUZANNE SINGER
CO-FOUNDER OF NATIVE RENEWABLES

APRIL 1ST @ 2 PM
ENR2 RM. S210

APRIL 28TH @ 12 PM
LOCATION TBA

DR. CASEY THORNBRUGH
TRIBAL CLIMATE LIAISON
NORTHEAST CLIMATE ADAPTATION CENTER

DR. MARTIN AHUMADA
PRESIDENT OF SAN CARLOS APACHE COLLEGE

MAY 6TH @ 2 PM
ENR2 RM. S210

FOR MORE INFO, VISIT [HTTPS://ENERGY.ARIZONA.EDU/EVENTS](https://energy.arizona.edu/events)

THE UNIVERSITY OF ARIZONA
OFFICE FOR RESEARCH & DISCOVERY
Institute for Energy Solutions

SPONSORED BY:
INDIGENOUS FOOD, ENERGY, WATER SECURITY & SOVEREIGNTY PROGRAM
ARIZONA- SLOAN INDIGENOUS GRADUATE PARTNERSHIP





Cultural Immersion



- Learning about daily life on the reservation
- Listening to community members share their experience and ideas for solutions
- Immersion experience will inform research and projects





Critical Thinking
(Nitsáhákees)

Reflection
(Siih hasin)

**Diné
Fundamental
Philosophy:
Hózhó**

Planning
(Nahat'a)

Implementation
(liná)





***“We need our own data to communicate to the world our own perspective on our own crises and trauma.”
- Teach-In***





Native Science



Q3: Do you know what Native Science is?





Lived experiences in Science



- Every theoretical and *scientific practice grows out* of and remains supported by the forgotten ground of our *directly felt and lived experience*, and has value and meaning” (Abram 1996)
- “*Native Science* is a broad term that includes metaphysics and philosophy, art and architecture, practical technologies, and agriculture, as well as ritual and ceremony practiced by indigenous peoples past and present. Native Science encompasses astronomy, farming, plant domestication, plant medicine, animal husbandry, hunting, fishing, metallurgy, geology—*studies that related to plants, animals and natural phenomena, yet extend to include spirituality, community, creativity, and technologies which support essential aspects of human life.*” (Cajete, 2004)





Traditional Knowledge



- Bringing scientists and indigenous people together to collaborate and exchange knowledge
- Benefits through mutual learning and mutual generation of knowledge
- Focus on social contexts of exchange
- Less recognized are implications of multiple cultural, legal, risk-benefit and governance contexts





Differences between worldviews



Example time:

Western science views time as an invariable means for measurement – clocks and calendars



July 2015 Calendar

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	3	4	
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

TKs – time is tied to events and their significance to resource availability, cultures and lifeways





CHEE 514: Sustainable Water Supplies for Remote Communities



Dr. Byron Hempel





Role Models for Native HS





2020 STEM FOR ALL VIDEO SHOWCASE

Learning from Research and Practice, May 5-12



Indigenous Food, Energy and Water Security and Sovereignty



Hydroponics Crop Production Intensive Workshops



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Diné College/Land Grant Office, Navajo Technical University, Tsaile Water Users Staff participating in UA-CEAC Intensive Hydroponics Workshop





Diné College TCUP STEM Training



“Environmental Methods & Monitoring” 10-week REU-model





FEWS Learning Modules



- Independently packaged study units and can be modified and adapted to different learning scenarios and objectives
- Benefits are hands-on activities, incorporation of technology, student involvement, discussion, and exchange of ideas
- Contents Include:
 1. **Instructional Guide** on FEWS Topic
 2. **Comprehensive PowerPoint Lecture** to supplement instructional guide
 3. **Hands-on Activity** using technology tools
 4. **Assessment Tool** (discussion/exam questions)



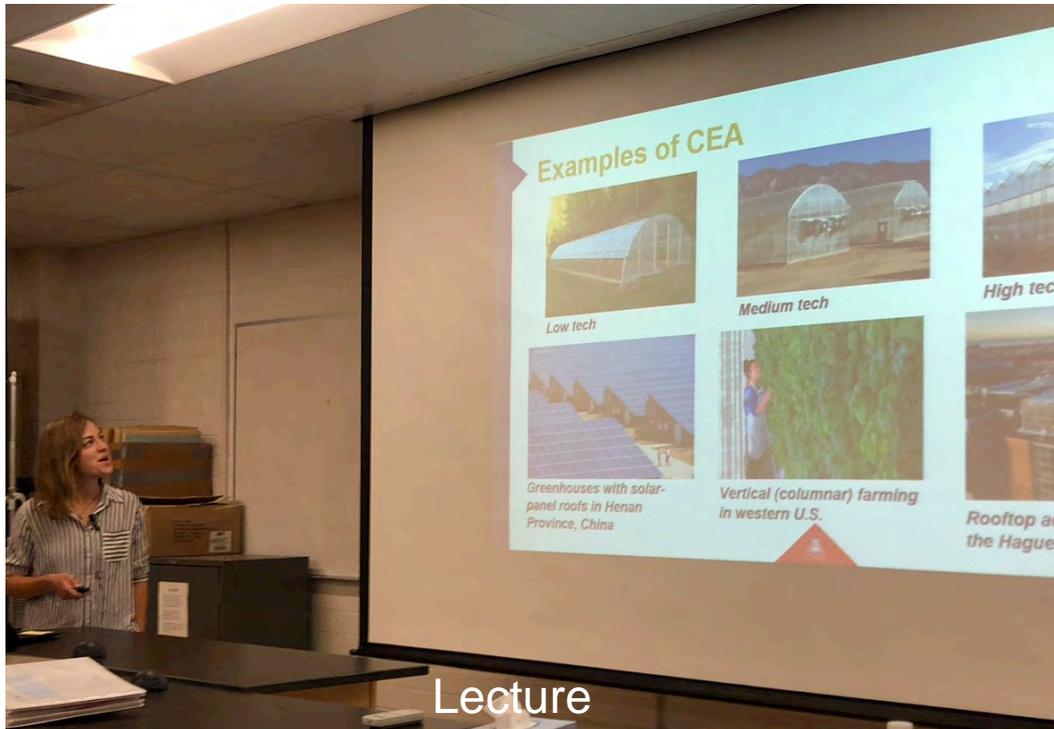


Food: Intro to Greenhouses



Learning Objectives:

- Learn basic structure and design of greenhouse systems & its application around the world
- Learn CEA's advantages and constraints
- Identify primary environmental variables in a greenhouse to be monitored and controlled



Lecture



Hands-on Activities





Energy: Solar Desalination



Learning Objectives:

- Learn about a water treatment technology
- Learn water quality parameters



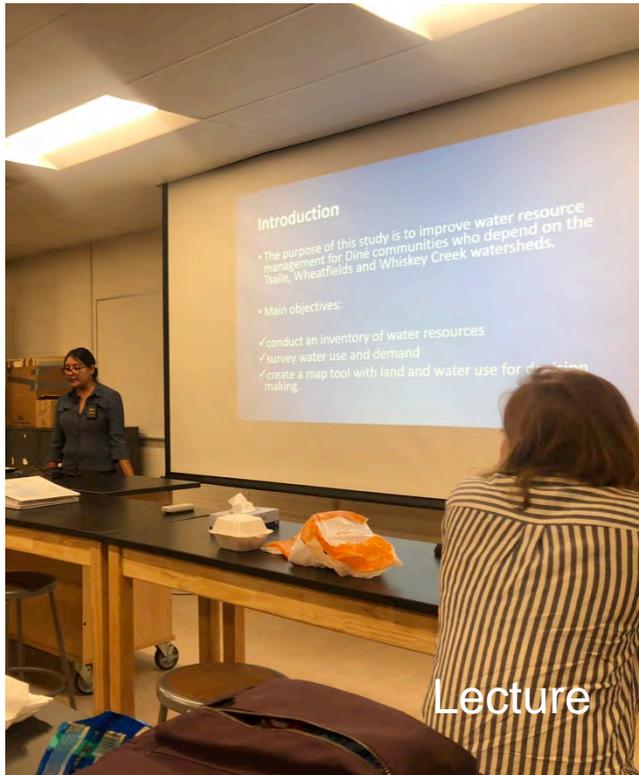


Water: Watershed Hydrology



Learning Objectives:

- Learn about drinking water challenges in the Tsaile Watershed
- Learn about water sampling methods & data collection
- Learn the basics of watershed hydrology



Lecture



Hands-on



TCUP Hands-on Internship with Students at Diné College



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Indigenous Food, Energy, and Water Security and Sovereignty (Indige-FEWS)





<https://www.youtube.com/watch?v=Hgujp19nNP0>





No running water. No electricity. On Navajo Nation, coronavirus creates worry and confusion as cases surge



Despite calls for help, Navajo Mountain mother, son can't be saved



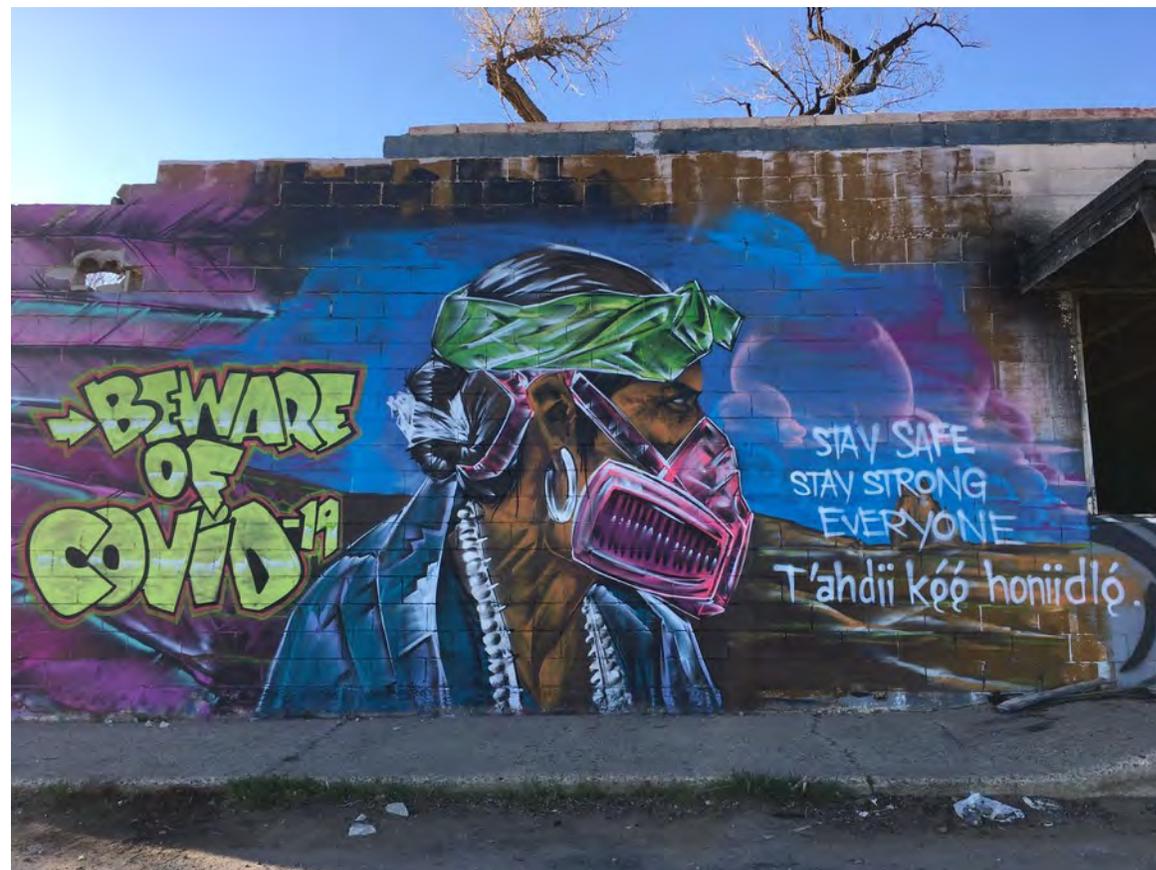
<https://www.nhnews.com/news/2020/apr/14/despite-calls-help-navajo-mountain-mother-son-cant/>

https://www.heraldmailmedia.com/news/nation/no-running-water-no-electricity-on-navajo-nation-coronavirus-creates-worry-and-confusion-as-cases/article_84619162-563d-5cb9-aef8-a19579c07edb.html





COVID-19 on Navajo: FEWS Insecurity Amplified





Indige-FEWSS Response to COVID-19 on Navajo



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Sustainability



Diné Techs & Professionals

Ed & Training Materials

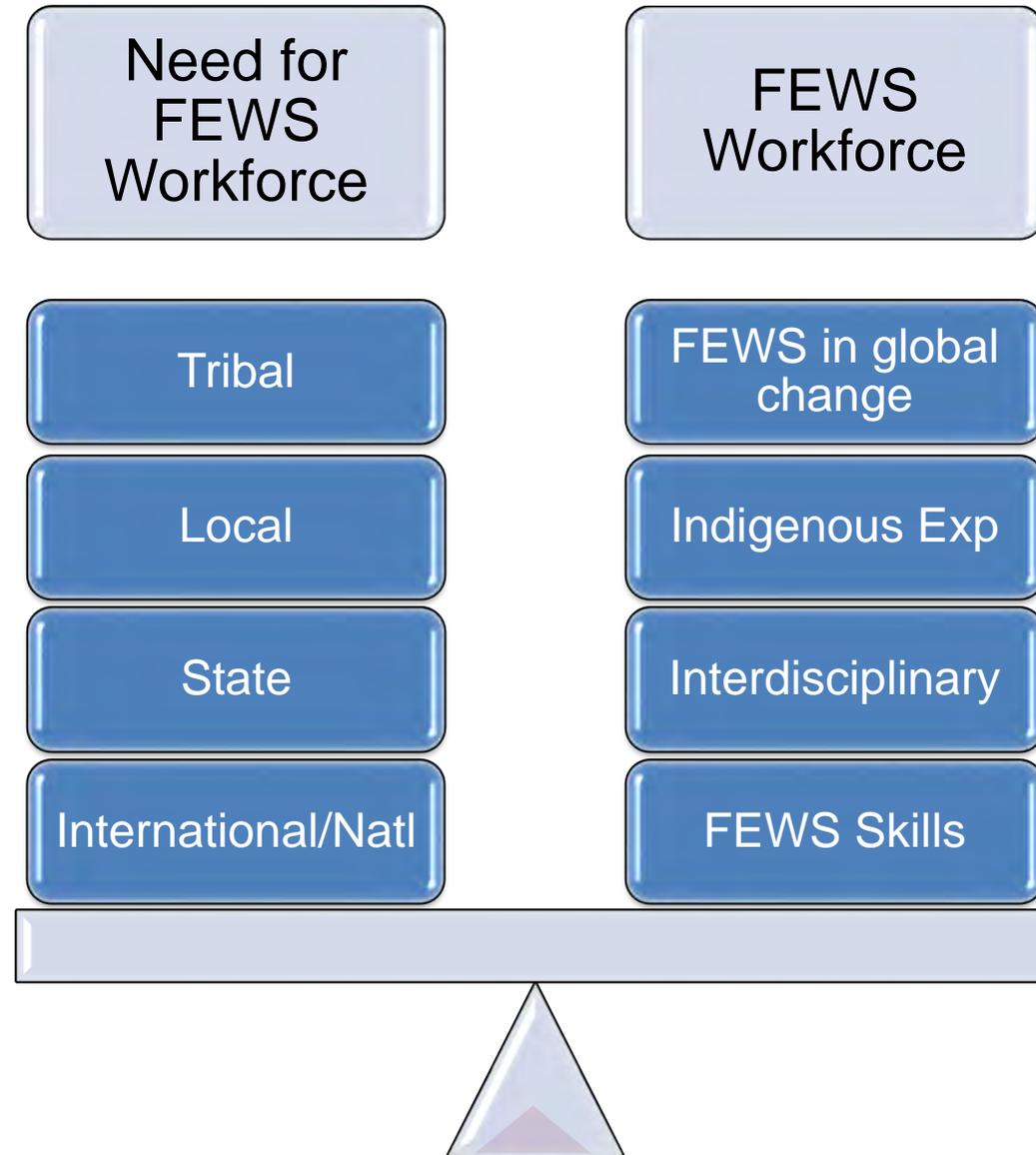
TCU-UA STEM Pipeline

Tech Demos for Duplication





Meeting a Critical Need





Agnese Nelms Haury

Program in Environment and Social Justice

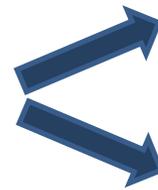


Hoop House at Diné College



New SNF System

Chapter House +



One unit well treatment
Point-of-use per household treatment



A scenic view of a river flowing through a canyon. In the foreground, a waterfall cascades over a rocky ledge into a pool of water. The river continues to flow downstream, surrounded by lush green vegetation and a dirt path. The canyon walls are composed of reddish-brown rock, and the overall atmosphere is peaceful and natural.

Ahé'hee!

Thank you!