



NSF NRT-InFEWS: Indigenous Food, Energy, and
Water Security and Sovereignty
Presents:



Food, Energy and Water (FEWS) Learning Modules

June 2021



THE UNIVERSITY
OF ARIZONA



Introduction to Water Within the FEWS Nexus

THE UNIVERSITY OF ARIZONA – INDIGE-FEWS
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PART 3:

Disinfection & Social Justice

Learning Objectives

- Describe disinfection
- Describe operational processes of the Solar Nanofiltration Unit
- Detail local social justice needs
- Describe ways to participate in a call to action.

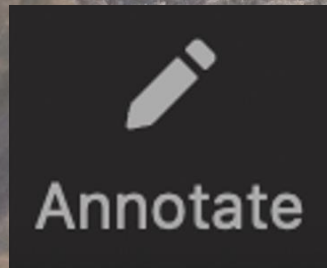
Be Iconic!

**Annotate
it!**

**Poll
it!**

**Chat
It!**

**Jam
board**



PART 3:

Disinfection & Social Justice

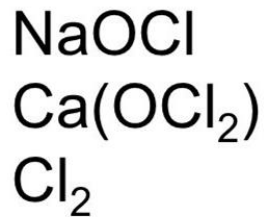
AGENDA

- Chlorine Disinfection
- Solar Nanofiltration Unit
- Environmental Justice

Main Disinfectant in the US is Chlorine

Hypochlorite and Cl_2 form hypochlorous acid (HOCl)

Hypochlorous acid kills pathogens!



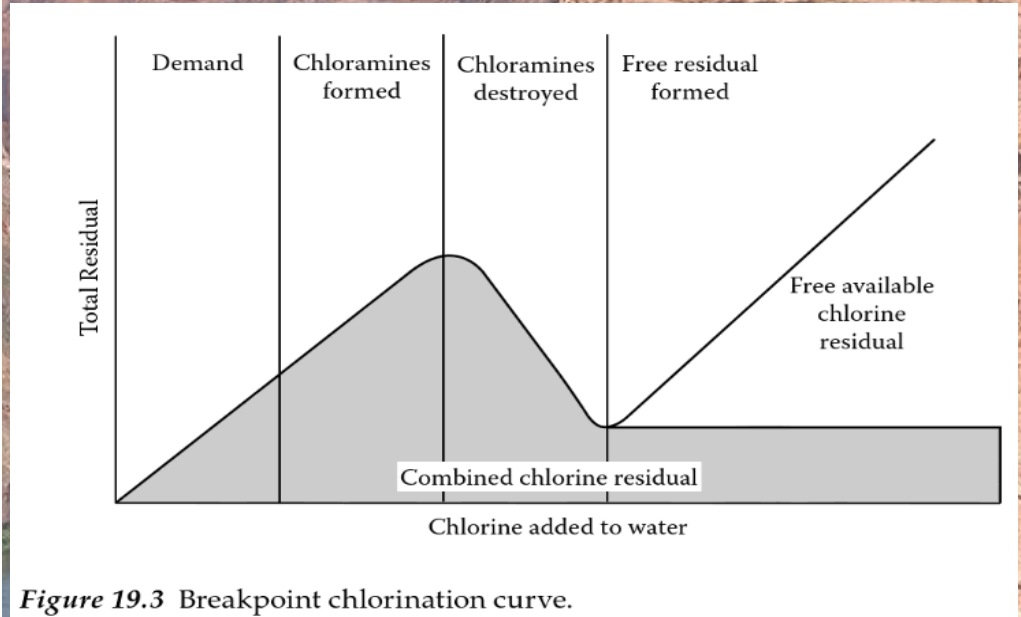
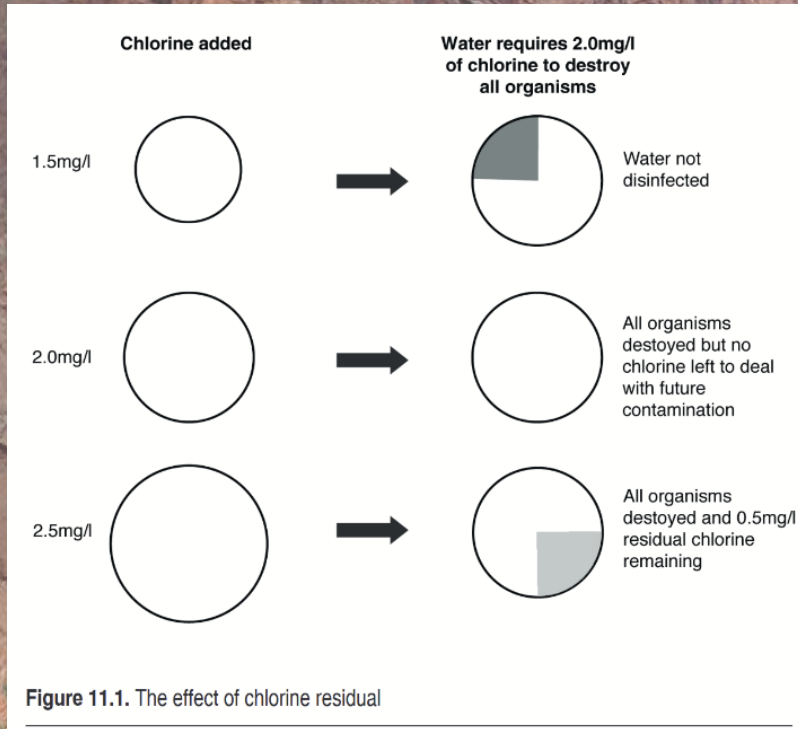
Chlorine Residual Test Strips



0 0.3 0.5 1 2 5

ppm Chlorine

Chlorine Residual & Breakpoint Chlorination Plot



Hauling Water & Safe Chlorine Use

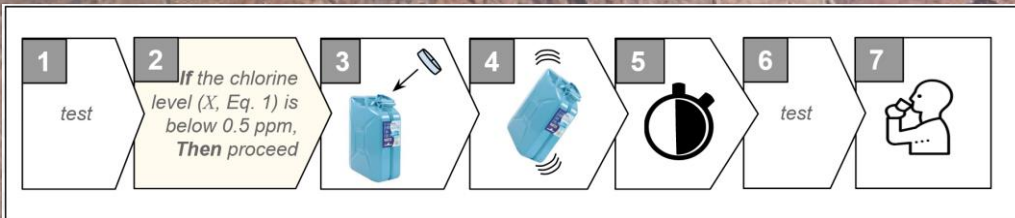
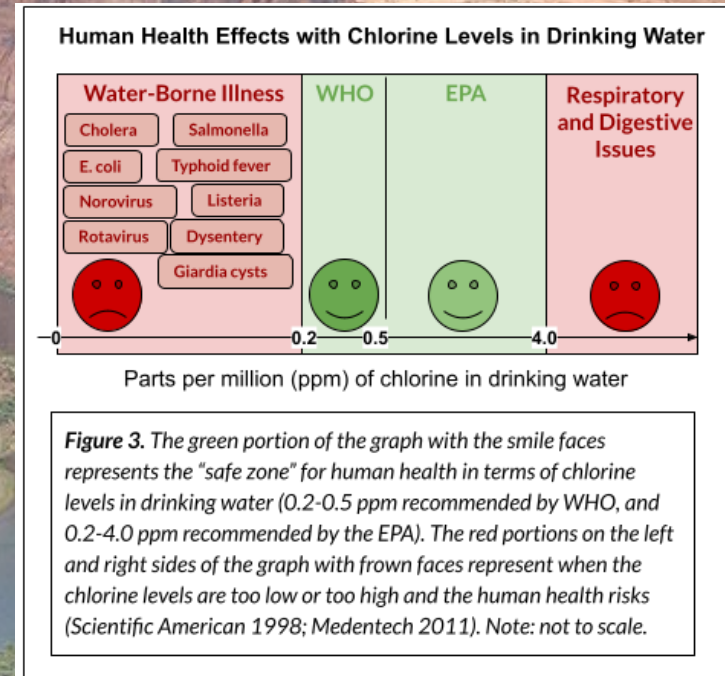


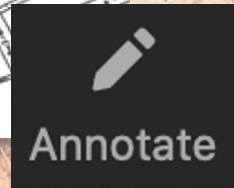
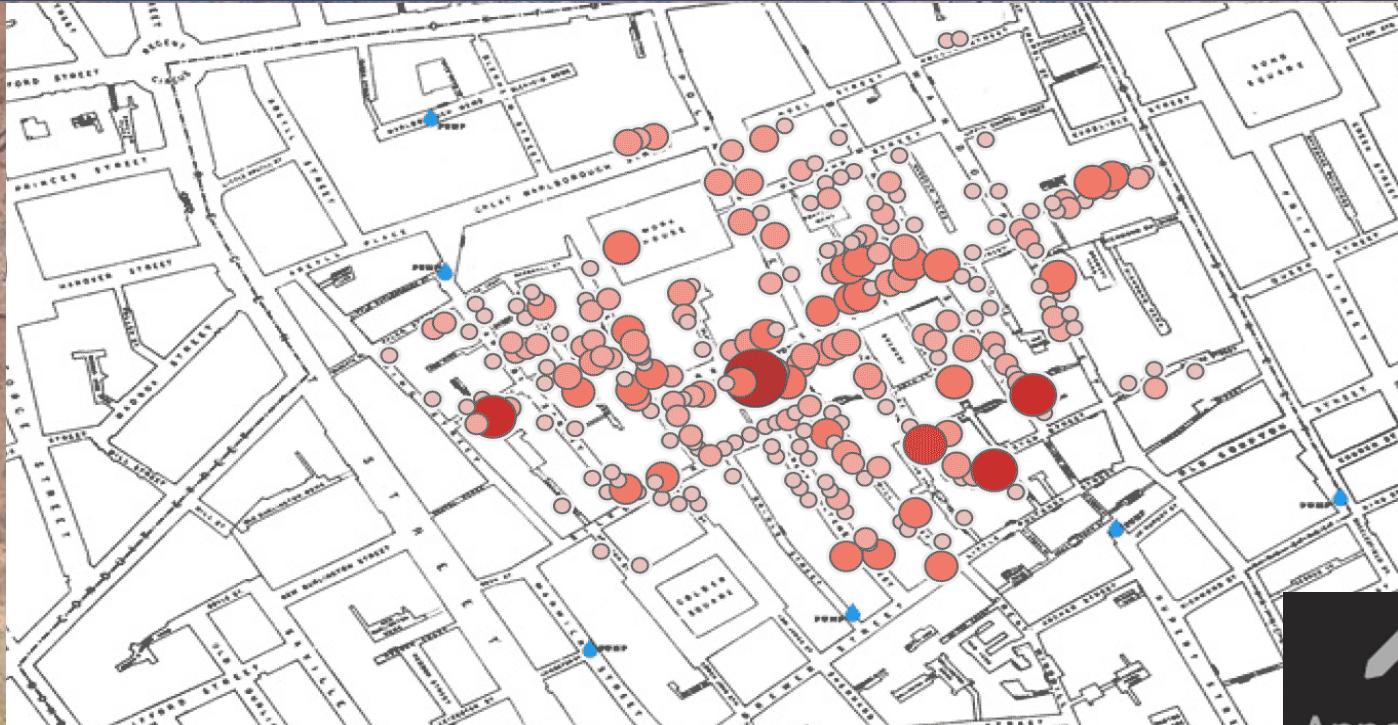
Figure 2. The process of sanitizing a 5-gallon Jerry can of water: (1) fill up the Jerry can with 5 gallons of clear water; (2) add one Aquatab tablet that is 67mg; (3) mix/shake/agitate the 5 gallons of water and tablet for 10 minutes; (4) after mixing for 10 minutes, let the sanitized and mixed Jerry can of water sit for 30 minutes; (5) it is safe to drink the water from the Jerry can

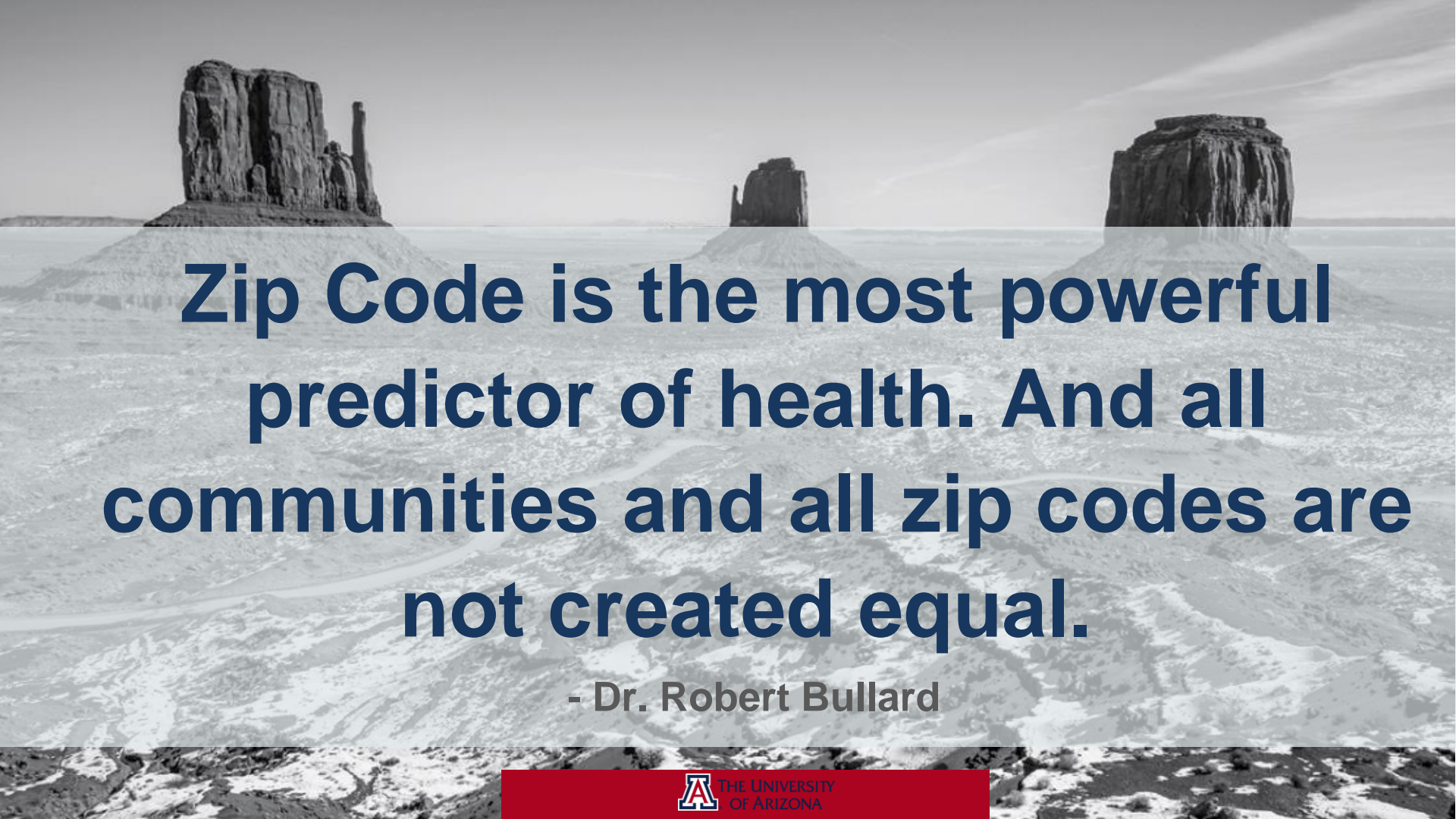


Chief, K., Vasiliki, V., Trahan, A., Wilberg, F. Water Chlorination: What it is, why you should do it, and how it's done. *The University of Arizona Cooperative Extension*

Cholera & John Snow: Where would you guess a point source of disease would be? (annotate)

Adapted From Hempel, B. 2021 CHEE 514 Unit Operations

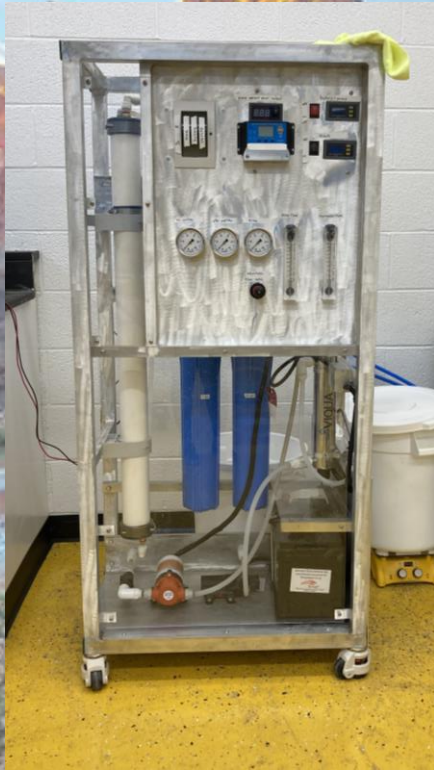




**Zip Code is the most powerful
predictor of health. And all
communities and all zip codes are
not created equal.**

- Dr. Robert Bullard

How to address water quality in off-grid communities?



One option: solar powered nano-filtration!

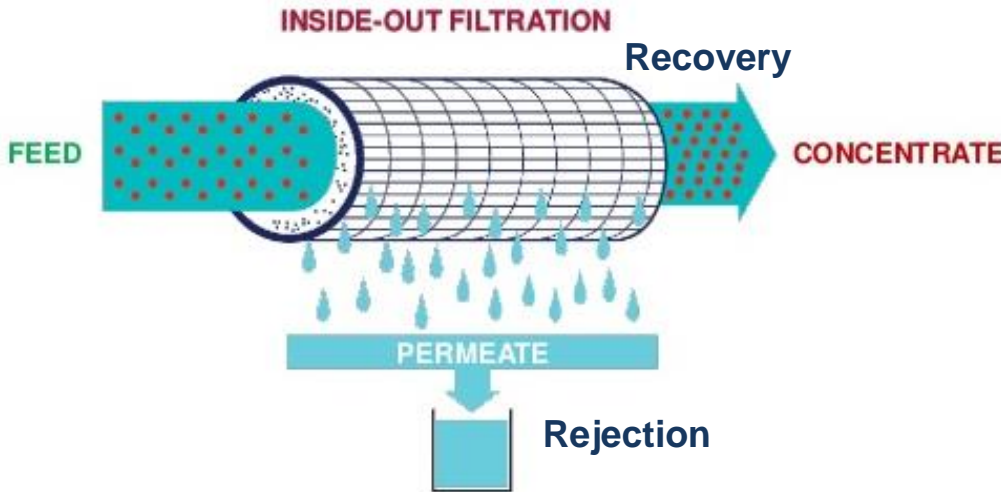
May effectively remove contaminants like uranium and arsenic

Does not need to be connected to electric grid

Community Scale and Household Scale Solar NF Unit



Rejection and Recovery



Rejection measures percentage of NaCl rejected by the membrane

$$P_{Rejection} = \left(\frac{[NaCl]_{Feed} - [NaCl]_{Permeate}}{[NaCl]_{Feed}} \right) \times 100$$

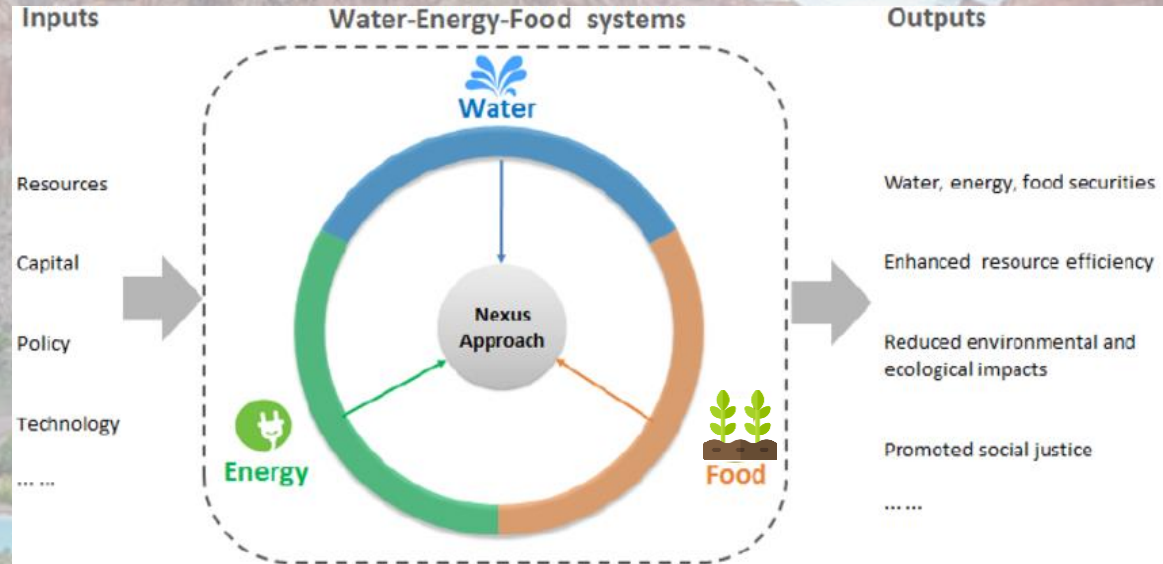
Recovery measures percentage of NaCl recovered in the brine

$$P_{Recovery} = \left(\frac{[NaCl]_{Brine} - [NaCl]_{Feed}}{[NaCl]_{Brine}} \right) \times 100$$

Food-Energy-Water Security & Sovereignty

Alleviating insecurities require allocation of resources (FEW), capital(\$\$), policy support and technological innovation.

Inputs to natural resource resiliency includes **YOU!**



Off Grid Technology with Economic Benefits

Cost of water in Arizona:
\$ 0.20-0.40/100 gal



Cost of hauling water:
\$13.3/100 gal (NNDWR, 2011)



NTUA residential:
\$0.459/100 gal

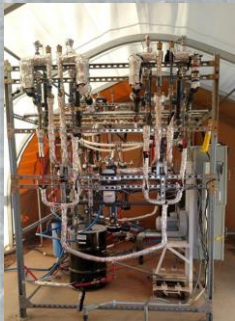


Brita Filter:
\$29.15/100 gal

Here's What Brita®
 Reduces or Removes
 from Tap Water

	Pitcher & Dispenser Filters	
	Longlast	Standard
Chlorine (Taste & Odor)	Blue drop	Blue drop
Lead	Blue drop	Blue drop
Mercury	Blue drop	Blue drop
Cadmium	Blue drop	Blue drop
Benzene	Blue drop	Blue drop
Asbestos	Blue drop	Blue drop
Particulates	Blue drop (Class I)	Blue drop
Copper	Blue drop	Blue drop
Zinc	Blue drop	Blue drop
1, 2, 4 - Trichlorobenzene	Blue drop	Blue drop
TTHMs, Atrazine, Lindane, Trichloroethylene (TCE)	Blue drop	Blue drop
Additional contaminants	Blue drop **	Blue drop

Cost of water with Solar Membrane
 Distillation System: **\$5.6/ 100 gal**



5T-529
Leupp, AZ



Cost of water with Solar
 Nanofiltration: **\$0.8/ 100 gal**



Includes operation and maintenance

LifeStraw:
\$36.92/100 gal

FILTERS

- LEAD & HEAVY METALS
- BACTERIA & PARASITES
- CHEMICALS
- MICROPLASTICS



PLASTIC
 BPA-FREE

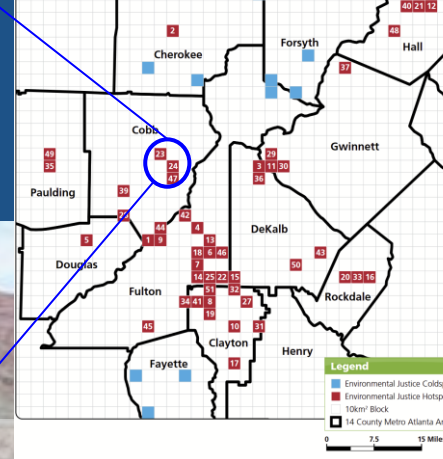
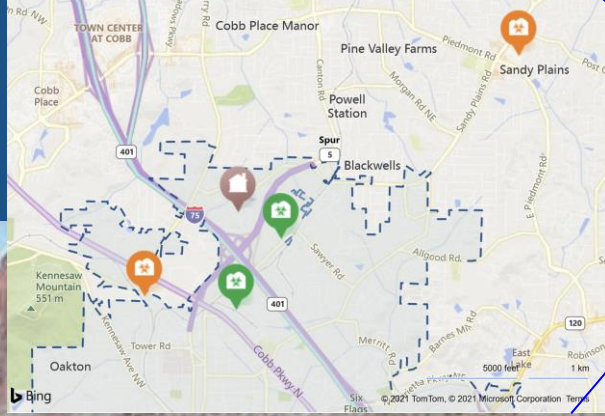
Environmental Racism in Georgia



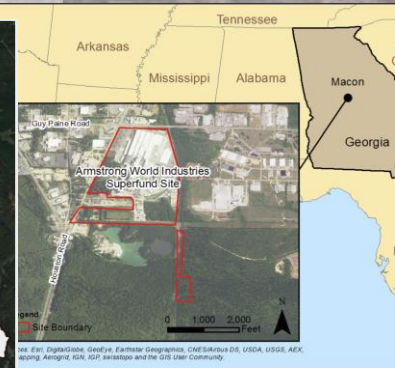
Cancer-Linked Contaminants Found In Marietta Water: Report

A new study found drinking water is often less safe than what the federal government may deem legal.

Geoff Dempsey, Patch Staff
Posted Wed, Oct 23, 2019 at 12:23 pm ET



I grew up in a neighborhood where surrounding areas subjugated to unclean air and dangerous road conditions from nearby factories as nearby land was being sold off to large developers and went to undergrad where I witness similar circumstances.

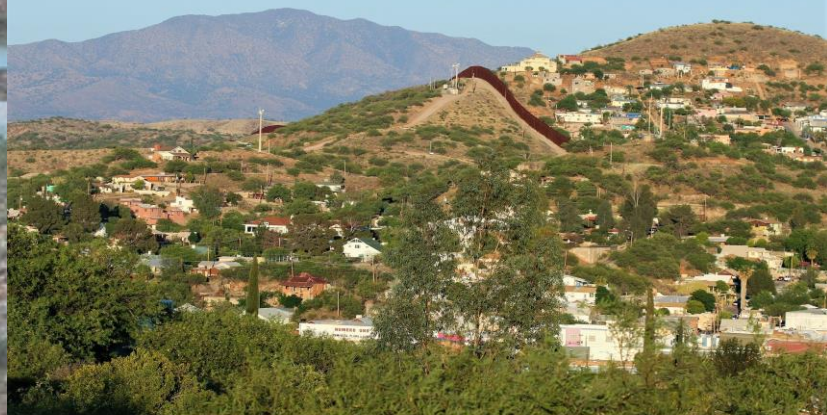
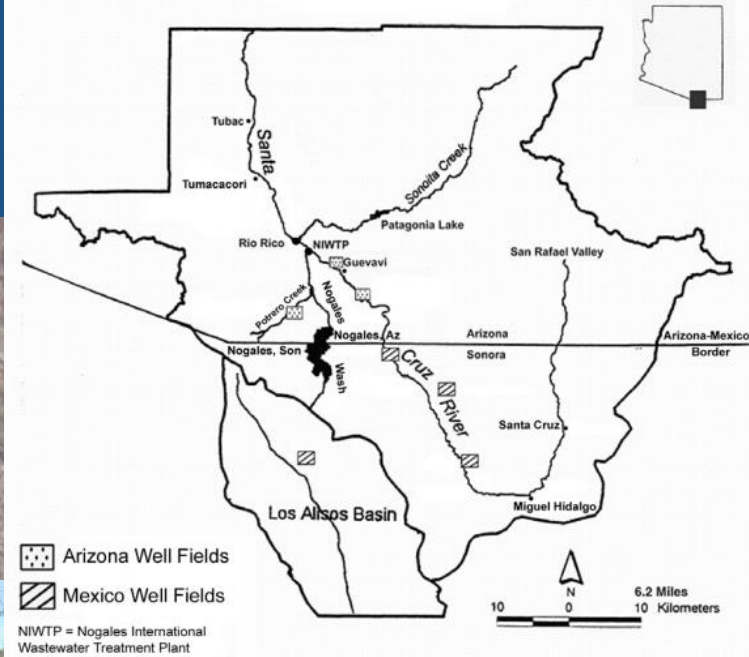


Tests of private drinking wells have found hexavalent chromium at levels \odot under, \ominus exceeding and \bullet at least 50 times higher than levels deemed safe by public health thresholds in North Carolina (one of only two states with such guidelines).

Armstrong World Industries Superfund site is located in Macon, Georgia.

Environmental Racism in Nogales, AZ

Sprouse, Terry W.
"Equitable
Management of
Mexican Effluent in
Ambos Nogales."
Journal of the
Southwest 45.4
(2003): 595-610.



Environmental Racism in Tucson, AZ



Environmental Racism in Navajo Nation

> J Cancer Educ. 2020 Jul 22. doi: 10.1007/s13187-020-01831-0. Online ahead of print.

"Nobody Is Talking About It": Diné (Navajo) Communities Speak About Stomach Cancer and Helicobacter pylori Infections

Carmenlita Chief ¹, Priscilla R Sanderson ², Angela A A Willetto ³, Alfred Yazzie ⁴, Alexis McKinley ², Fernando P Monroy ⁵, Robin B Harris ⁶, Eyal Oren ⁷

Affiliations + expand

PMID: 32700241 DOI: 10.1007/s13187-020-01831-0



DOI: [10.1007/s13187-020-01831-0](https://doi.org/10.1007/s13187-020-01831-0)



Running water

Percentage of homes without

30%



1 in 3 homes:
No sink or toilet



Electricity

Number of homes without

15,000



Total:
55,000 homes



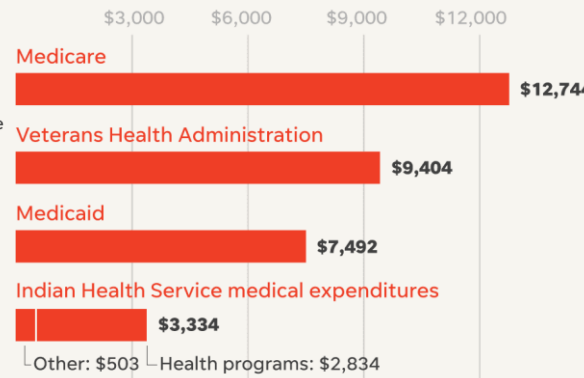
Grocery stores

in area about the size
of West Virginia

13

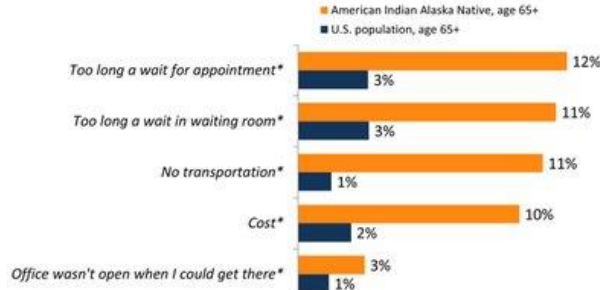


162 supermarkets
in West Virginia

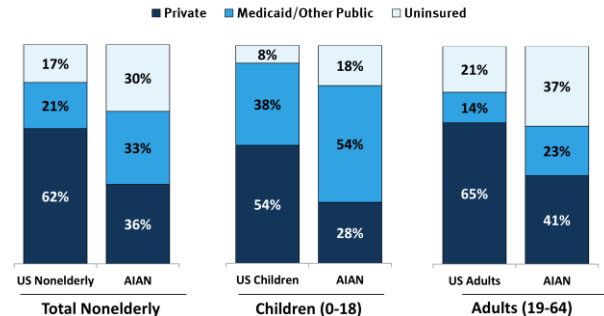


Elderly American Indians and Alaska Natives experience greater barriers accessing care

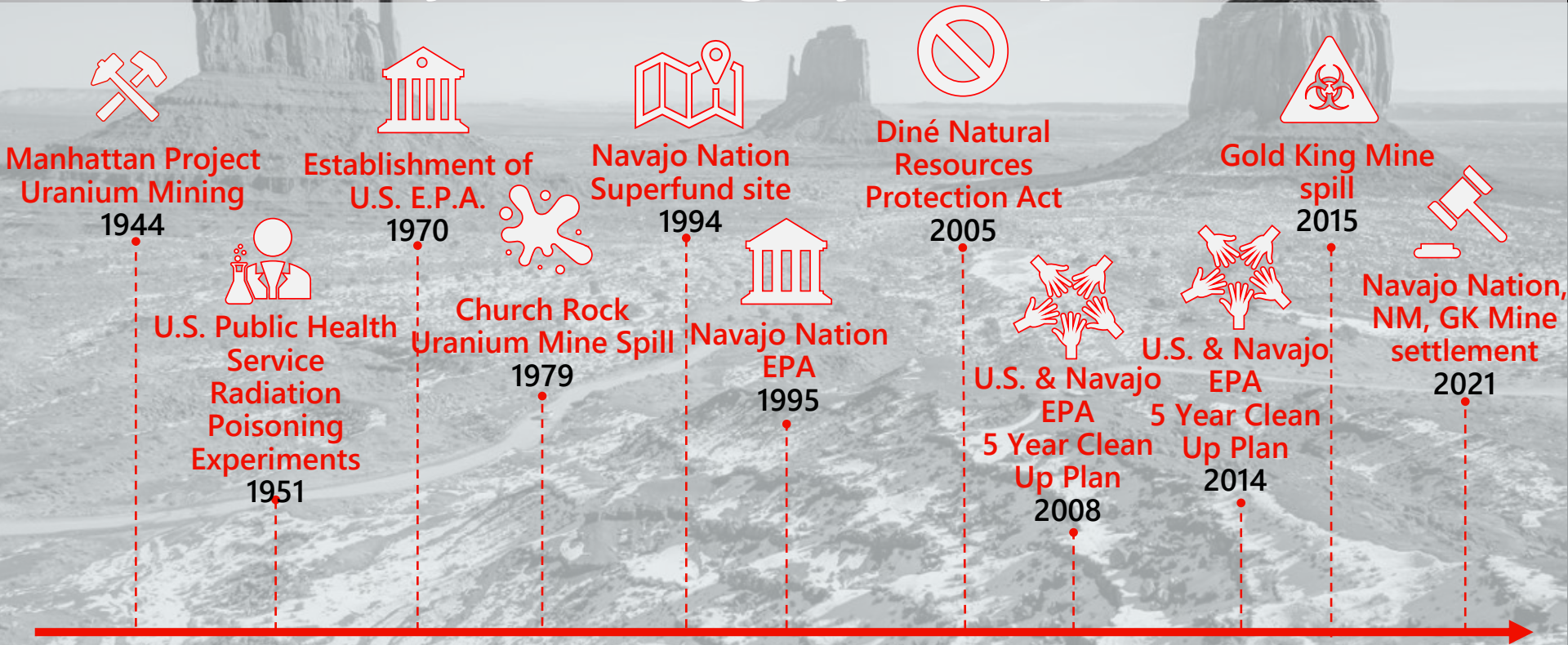
Have any of the following kept you from medical care in the past 12 months?



Health Insurance Coverage for Nonelderly American Indian and Alaska Natives Compared to U.S. by Age, 2009-2011



Resiliency Road: Security, Sovereignty & Reparations



3K-5K Diné people working in mines (1944-1986)

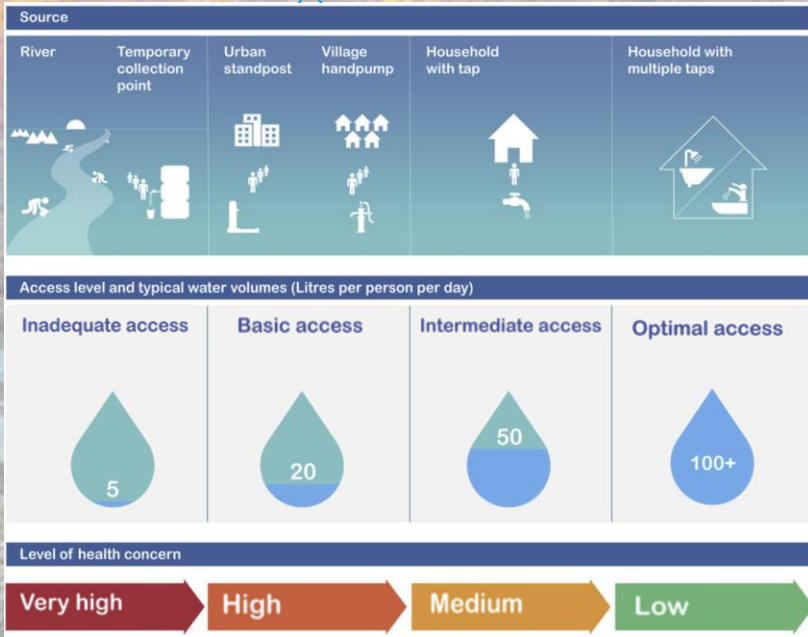
3.9M Tons of Uranium ore mined (1944-1989)

Reparations Road: Envisioning Resource Equity

Activity	Rate of consumption per day	Per person day use (Approx gallon)
Drinking	9-10 glasses	0.396301
Handwashing (water off)	4 times	2.113606
Handwashing (water on)	4 times	8.916777
Flushing (low flow)	2 times	5.284016
Flushing (High flow)	2 times	12.15324
Bathing	2 times	63.40819
Shower (5 min.)	1 time	25.09908
Cooking	3 times	1.585205
Washing vegetables fruits and utensils	2-3 times	9.511229
Brushing teeth (water off)	2 times	0.528402
Brushing teeth (water on)	2 times	5.284016
Washing clothes		21.13606
Laundry one load		39.89432
Dishwasher		5.019815
Washing dishes by hand		30.11889

Activity	Per person day use (Approx gallon)
High Water Use Daily Total	126.354
Conservative Water Use Daily Total	44.51783
Housekeeping Water Use (High)	121.2682
Housekeeping Water Use (Low)	66.0502

Reparations Road: Envisioning Resource Equity



Location	Per person day use (Approx GALLON)	Per person day use (Approx LITRES)
U.S. Avg	82	310.37
Tucson	112	423.92
Navajo Nation	7	26.49

Water Reparations & Economic Significance



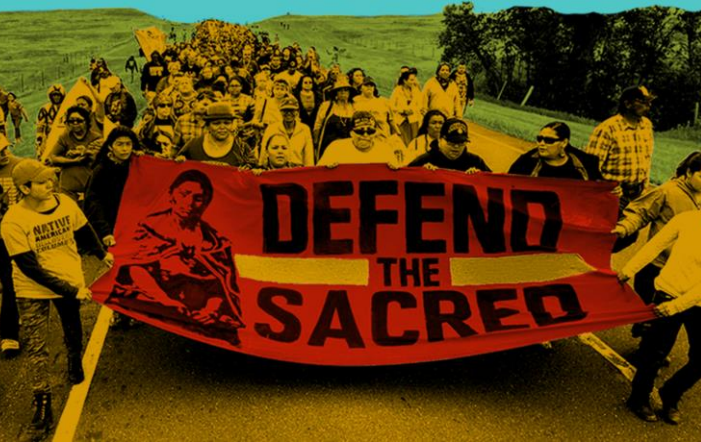
Navajo Nation Water and Wastewater Funding Sources

Price per Acre Foot

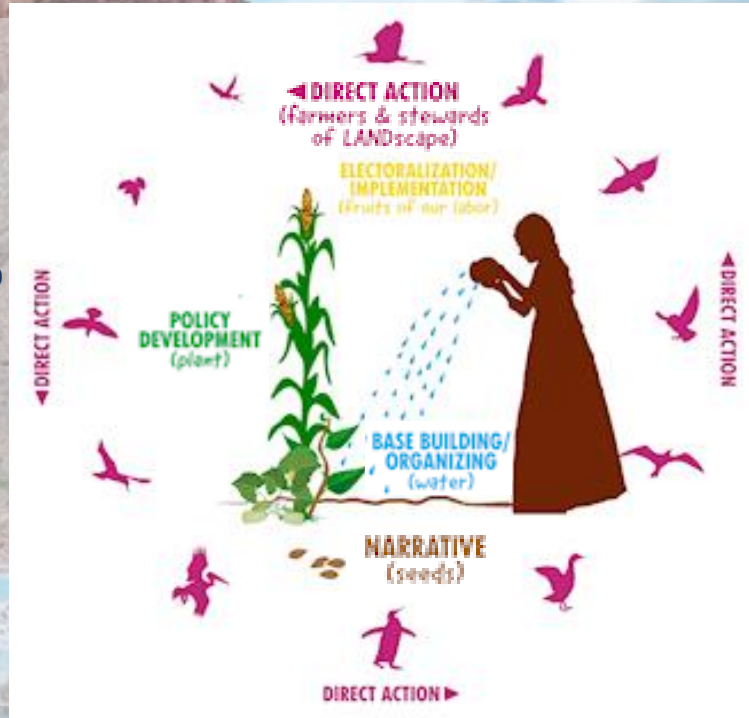
Water Allocation	AFY		San Diego (\$474)	Los Angeles (\$111)	AZ (\$25.38 avg)
<i>Surface water</i>					
Little Colorado River	162,900		\$77,214,600.00	\$18,081,900.00	\$4,134,402.00
San Juan River	1,620,000		\$767,880,000.00	\$179,820,000.00	\$41,115,600.00
<i>Groundwater</i>					
San Juan Colorado River Basin, Utah	81,500		\$38,631,000.00	\$9,046,500.00	\$2,068,470.00
San Juan River Basin, New Mexico	633,000	Diversion	\$300,042,000.00	\$70,263,000.00	\$16,065,540.00
	327,000	Depletion	\$154,998,000.00	\$36,297,000.00	\$8,299,260.00
Total	2,824,400		\$1,338,765,600	\$313,508,400	\$71,683,272

Environmental Justice Movement

ENVIRONMENTAL JUSTICE: INDIGENOUS COMMUNITIES



We acknowledge that we are on the original homelands of indigenous peoples who have stewarded this land, **environmental and economic justice movements** since time immemorial.



<https://www.ienearth.org/regenerativeeconomy/>

Navajo Nation Water Security & Sovereignty



COPE
Community Outreach &
Patient Empowerment



SIXTH * WORLD
S O L U T I O N S



Native Voices in FEW & STEM



MICHAEL KOTUTWA JOHNSON, PHD



DANIEL R. WILDCAT, PHD



JOSEPH BREWER, PHD

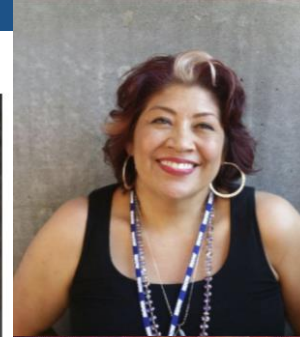


NONABAH LANE

**The Navajo Nation and Clean Water:
The Story of Two Sisters**



Ph.D student Nikki Tulley in the Office of Research, Innovation & Impact short documentary "Navajo Hydrologist Aims to Safeguard the Resources of Her People." (Photo: Mari Cleven)



KIM TALLBEAR, PHD



Dr. Carrie Nuva Joseph



Dr. Len Necefer

<https://videohall.com/p/2071>



**Rising to the Call: Indige-FEWSS
Navajo COVID-19 Response**

Nikki Tulley



ANDREW CURLEY, PHD



SELSE VILLEGAS, PHD

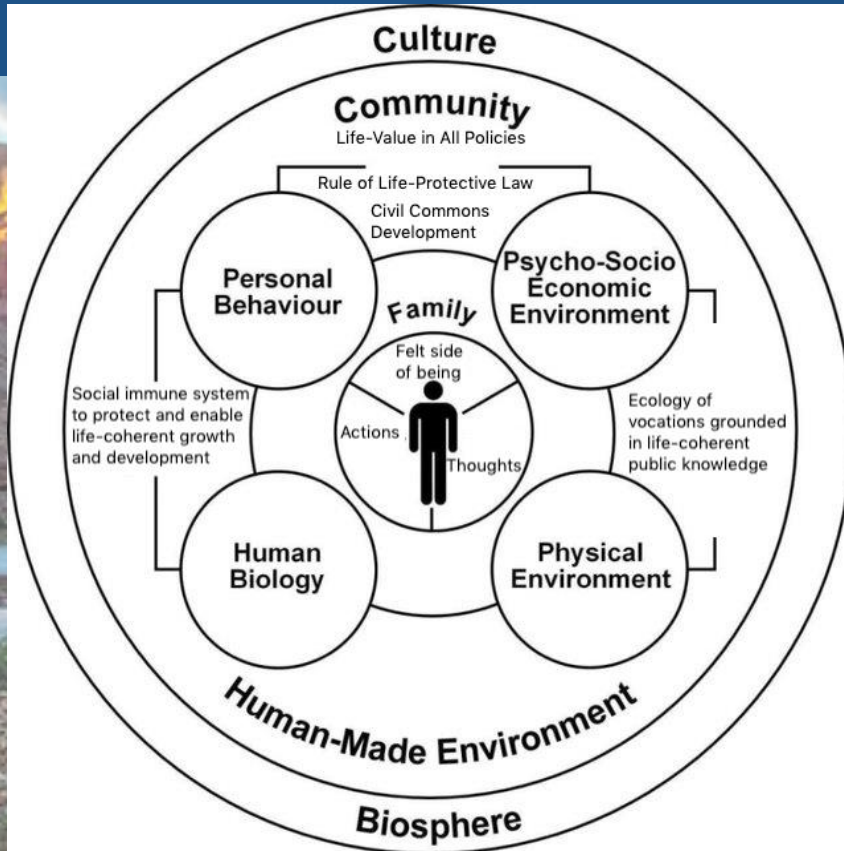
Shift to Indigenous Centric Research

Quality in research practice requires a shift from the current extractive model to studies by and with Indigenous community members.

Contractual	Consultative	Collaborative	Collegial	Indigenous
Community members contracted to perform tasks, researchers make all decisions	Community members asked for opinions and consulted, decisions made by researchers	Community members and researchers work together, researchers have primary authority over the process	Community members and researchers work together, community members have primary authority over the process	Process is centered in Indigenous value systems & historical context, community members have authority over the research process



Individual Within The Whole



Culture, Community and Family are all connected by the individual.

Identifying your strengths are the greatest thing to do oneself and others.

There are MANY ways to address Environmental Racism

- Have uncomfortable conversations and start a dialogue
- Create maps on areas where we have seen environmental racism
 - Identify stakeholders who are already doing the work
- Advocate for Policy
 - Contact your Representative
- Identify stakeholders who are already doing the work
 - ID issues, have conversations, protests/lobbying, get public attention, make noise!
- How to make our technical skills available to what is already going on in the community
- Participate in local issues and give your input:
 - Listening and planning sessions
 - Chapter House meetings





Indige-FEWSS Team



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RESEARCH, INNOVATION & IMPACT
Arizona Institutes
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