

# Humanitarian Engineering

*Co-creating Just and Sustainable Solutions  
with Communities*

**Kevin L. Moore, Executive Director (presenter)**

Juan Lucena, HE Undergraduate Programs Director

Jessica Smith, HE Graduate Programs Director

Julia Roos, HE Associate Director

[kmoore@mines.edu](mailto:kmoore@mines.edu)

[humanitarian.mines.edu](http://humanitarian.mines.edu)



**COLORADO SCHOOL OF MINES**  
EARTH ♦ ENERGY ♦ ENVIRONMENT

# Colorado School of Mines

Located in Golden, Colorado, USA  
20 miles West of Denver

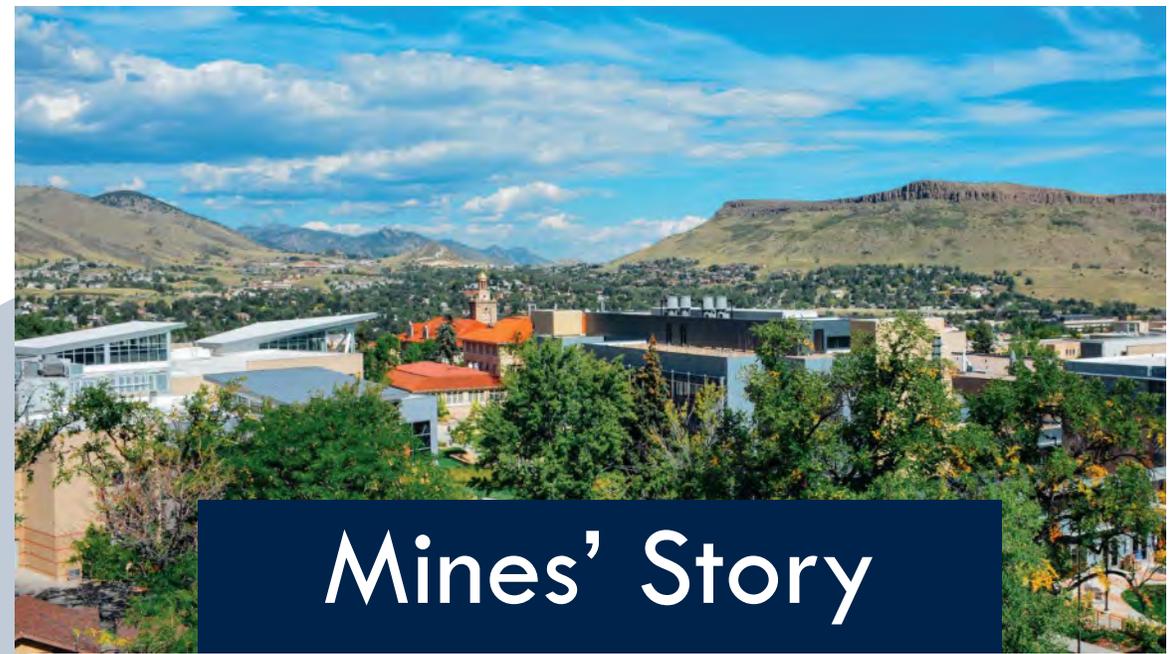


- Mines sits in the foothills of the Rocky Mountains
- Mines has about 320 faculty and 6500 students
- Mines is a 148 year old public R1 research institution focused on engineering and applied science, especially:

**Earth – Energy – Environment**

# Colorado School of Mines

Located in Golden, Colorado, USA  
20 miles West of Denver



- **Discovery and recovery** of the Earth's resources
- **Conversion** of resources to materials and energy
- Development of **advanced processes and products**
- Fundamental knowledge and technologies that support the **physical and biological sciences**
- **Economic, social and environmental systems necessary for a sustainable global society**



# A sustainable global society? What do you see in this image?

## A WORLD DIVIDED

### Above the Line

- Wealth and affluence
- Functional infrastructure
  - Transportation
  - Energy
  - Water/sanitation
  - Communication
- Access to education
- Access to health care
- Politically empowered

### Below the Line

- Poverty
- Poor-to-no effective infrastructure
  - Limited public transit
  - Sporadic energy access
  - WASH inequity
  - Marginalized in public discourse
- Less educational opportunity
- Little health care/reduced lifespans
- Politically disenfranchised

# A World Divided

Despite our technological prowess



Two in seven people on the planet are not able to have a safe, comfortable, and sanitary daily toileting experience



We need to do better than this  
and engineers should help!



# Humanitarian Engineering: A Response to the Need to Do Better



Motivated by  
social justice



Centered on  
community



For a sustainable  
global society

# What is Humanitarian Engineering?

- **Signature educational program** at the Colorado School of Mines
  - Started in 2003
  - Possibly first curricular program in the US with this name

**Mission: educate engineers and scientists to work as partners with communities seeking to enhance their social, environmental, and economic sustainability**

- **Different way of thinking** about and doing engineering
  - Not just about social context ...
  - ... instead, a true socio-technical integration, with social science and engineering faculty members who take each other seriously ...
  - eventually, possibly a new (engineering?) discipline with its own canon of fundamental knowledge

# Thinking about Engineering

- Three levels of technology – from Aubrey Wigner, Michigan State, based on ideas in *The Theory and Practice of Sustainable Engineering*, by Brad Allenby
  - **Technology as artifact** → Engineering education does well here
    - What is it, what does it do, what is it made of, who is it for, what are its impacts
    - Solutions by engineers, designers, scientists who solve for design parameters
  - **Technology infrastructure** → Engineering education does ok here
    - What other technologies does it rely on or impact, what is the associated supply chain
    - Solutions require tradeoffs and interdisciplinary collaborations
  - **System Complexity** → Engineering education does not do this well
    - Regulatory, social, economic, political considerations, user and non-user desires, equity and inclusion
    - Solutions require tradeoff negotiations between complex stakeholders and depend on power dynamics between them
    - **But, herein live the “wicked problems” facing society!**



# Conceptual Perspective: Towards Dealing with “Complex Global Challenges”

- Posit: without a complex and nuanced response to engineering education, it’s unlikely that we’ll prepare students well to deal with the complexity of global (inherently sociotechnical) problems
- Arguably, a “root cause” of engineering education’s inability to prepare students systematically to address “complex global challenges,” is a **highly reductionist approach to education**, separating
  - ▣ Social (and political, economic, cultural, environmental, etc.) from the technical
  - ▣ Context from the content (analytic tools)
  - ▣ Values from practice
- Further, we **often treat engineering education as a sequence of discrete, neutral analytic skills**
  - ▣ This leads us to believe (erroneously) that engineering education (as we do it) can contribute equally to any social outcome; it’s only a matter of the plugging in the specific goals/values the individual student chooses to work toward
- This **fallacy can be overcome through deliberate integrative education**, connecting engineering and social sciences, as we are doing in **Humanitarian Engineering**

# Facets of Humanitarian Engineering

1. Critical reflection about engineering
2. Engineering for Community Development (ECD)
3. Corporate Social Responsibility(CSR)
4. Socially Responsible Engineering (SRE)
5. Scholarship
6. Curricular programs
7. HE-in-Action and Humanitarian Technology



1. Meaningful “engineering” requires new ways of engaging communities, evaluating projects, and critically examining engineering practice



# 1. Critical Reflection and Questioning about Engineering

- Focus on the **politics of problem definition and solution**
- **What is engineering** for? Who gets to do it? Who receives the benefits of engineering? How do the answers to these questions determine who gets in and who stays out?
- Who gets to define **what is development and progress**? What are the assumptions, knowledges, practices that underlie development? How and who gets to do development? Who gets to receive development?

Two key concepts: Engineers should

1. First be problem definers and second be problem solvers
2. Jointly define problems and co-create just and sustainable solutions with their stakeholders



- **Through critical reflection HE students learn:**
  - To understand problems in their social context
  - To ask the right questions
  - To listen contextually
  - To co-design as partners with the people they seek to serve
  - That solving real-world problems involves working with other professionals as a team (policy, law, business, and more) - technology alone is never the answer

HE considers the intersection of engineering with broader societal issues and often focuses on serving vulnerable communities



Humanitarian Engineering is part of a growing movement

# Engineering for Good

- A wide variety of programs might collectively be called “Engineering for Good”
- Recent report from Engineering For Change (E4C) highlighted programs related to **Global Development**
  - ▣ 3 BS degrees, 8 MS+PhDs, 14 Minors+Certificates, 29 Courses, 28 Research Centers, 22 Experiential Opportunities, and at least 15 conferences in North America
  - ▣ Other reports by E4C consider Latin America, Asia, Australia, and New Zealand
- No matter the name, the important role engineering can play in improving people’s lives is increasingly being recognized
- **Engineering for Community Development, both domestic and global, is an important aspect of Humanitarian Engineering**

**EGD Minors & Certificates**

Arizona State University Innovation in Society Minor Innovation for Impact Certificate	Colorado School of Mines Engineering for Community Development Minor Leadership in Social Responsibility Minor
Colorado State University Certificate in International Development	Duke University Global Development Engineering Certificate
Engineering Change Lab Global Engineering Certificate	Michigan Tech Humanitarian Engineering Minor
Ohio State University Humanitarian Engineering Minor	Oregon State University Humanitarian Engineering, Science & Technology Minor
University of Colorado, Boulder Global Engineering Minor Global Engineering Graduate Certificate	Penn State University Engineering & Community Engagement Certificate Entrepreneurship & Innovation Minor
University of Michigan Socially Engaged Design MS track (Design Science)	Purdue University Global Engineering Studies Minor
University of Toronto Global Engineering Certificate	University of Texas, Austin Humanitarian Engineering Certificate
	University of Oklahoma Water and Sanitation for Health and Sustainable Development Minor

Want to learn more?

# 2. Engineering for Community Development (ECD)

- At Mines we teach criteria for ECD informed by scholarship and critical analysis
- ECD projects should consider and honor criteria that puts **people first** by championing
  - ▣ Local economic diversity
  - ▣ Political self-reliance of communities
  - ▣ Reduction/reuse of energy & materials in locality
  - ▣ Enhanced biodiversity and careful stewardship of natural resources
  - ▣ Social justice



# 3. Corporate Social Responsibility

- Engineering for Good is often associated with NGOs, non-profits, Peace Corp, USAID, etc.
- Yet ... many (indeed the large majority) of our engineering students go to work in companies
- Humanitarian engineering precepts apply to corporate careers as well, though the concept of **Corporate Social Responsibility**



# Corporate Social Responsibility: A Tale of Three “Costs”<sup>1</sup>”



<sup>1</sup>As told by Phil Clark, former VP of Resource Development, BHP Billiton

# 1960-1970: Safety Matters!

Internalizing safety  
as a core value



Environment



Communities



# 1970-1980: Environmental Responsibility



What's good for the planet is good for the company

Communities



# Today: A new understanding



Community is recognized as crucial for garnering a corporation's "social license to operate"

# Why CSR? – One reason is the business case



# Corporate Social Responsibility (CSR)

- Like safety and environmental consciousness CSR will become **fully internalized as a core value** in business
- This has already been embraced in
  - ▣ Mining to a large extent
  - ▣ Oil and gas to a lesser extent
  - ▣ Construction
  - ▣ Aerospace/defense very recently
- Recently the Business Roundtable committed that responsibility of business is to its stakeholders (not just its shareholders)
- It is also becoming important in the business investment world via ESG requirements (Environmental, Social, Governance)

The “Triple Bottom Line:” People-Planet-Profits  
“What’s good for society is good for the shareholders”



# CSR is directly relevant to engineers

- Cynically, CSR can be viewed as the **domain of social scientists who garner support** for projects after damage to public opinion (i.e., “greenwashing”)
- However, true CSR can be achieved when **engineers design, build, and operate with the goal of community acceptance** in mind from the beginning
- At Mines we have introduced a CSR track in our Humanitarian Engineering program

Engineers in companies should embrace CSR  
as a way to manifest Socially-Responsible  
Engineering

# 4. Socially Responsible Engineering

- Students are exposed to **multiple and sometimes competing notions of social responsibility** that come from:
  - Global performance standards (Global Reporting Initiative, World Bank/IFC performance standards, etc.)
  - Society's aspirations, such as the UN Sustainable Development Goals
  - Professional codes and the law
  - Engineering ethics classes
  - Employer corporate social responsibility policies/programs
  - Expectations from communities, “the public,” and other stakeholders affected by their work
  - Their own sense of morals, self-ethics, identity, and professionalism

Humanitarian Engineering, through its ECD and CSR components, offers a framework from which students can make sense of this landscape

# Concepts in Socially Responsible Engineering

- **Understanding structural conditions and power differentials** among specific stakeholders of an engineering project
- **Contextually listening to all stakeholders**, especially those who are marginalized, to grasp their needs, desires, and fears surrounding a specific project, decision, etc.
- **Collaboratively identifying opportunities and limitations of creating shared social, environmental, and economic value** for all stakeholders, especially those who are marginalized
- **Adapting engineering decision-making to promote those shared values**, acknowledging situations in which this is not possible and engineering projects should not move forward
- **Collaboratively assessing activities and outcomes** with those stakeholders



Engineering students enacting SRE criteria in community engagement workshops

# Mindsets and Attributes of the Socially Responsible Engineer: Transcending the Technical

- **Socio-technically adept** and understand the concepts of socially responsible engineering
- **Multi-dimensional** mindset that honors
  - ▣ Multi-disciplinary contributions
  - ▣ Systems thinking
  - ▣ Global perspectives
  - ▣ Diverse contributors
- **Design thinker** who is
  - ▣ First a problem definer, second a problem solver (why engineer?)
  - ▣ Human-centered
  - ▣ An entrepreneurially-minded innovator (KEEN's 3 C's)
- Mindful of the **right motivation**, with intent to be
  - ▣ Socially-just
  - ▣ Focused on the challenges facing society

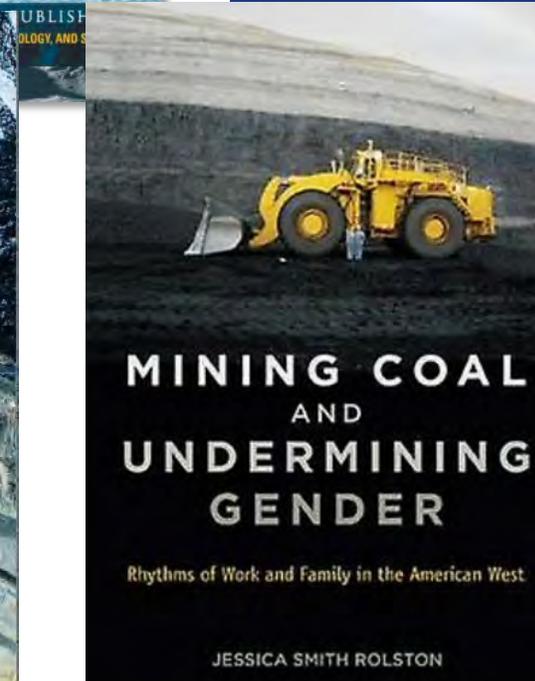
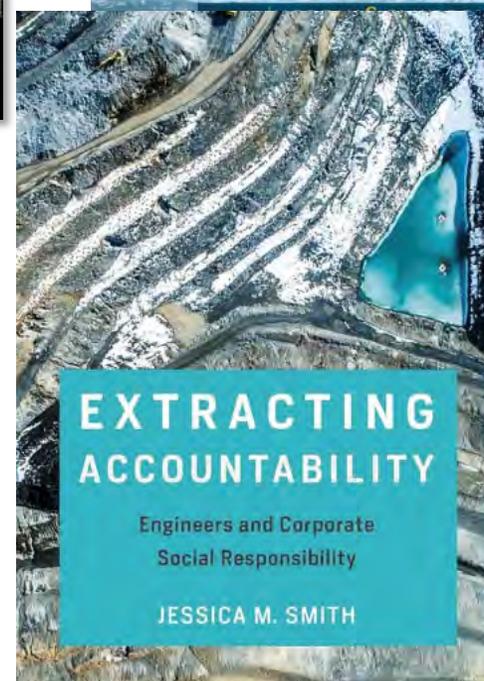
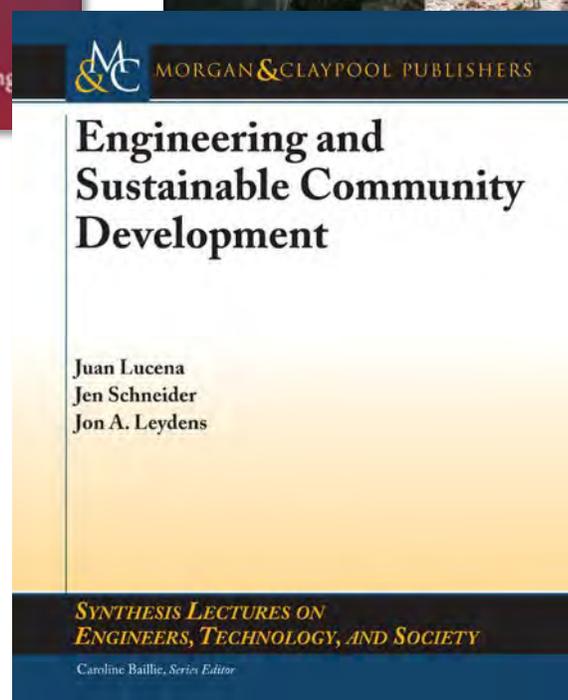
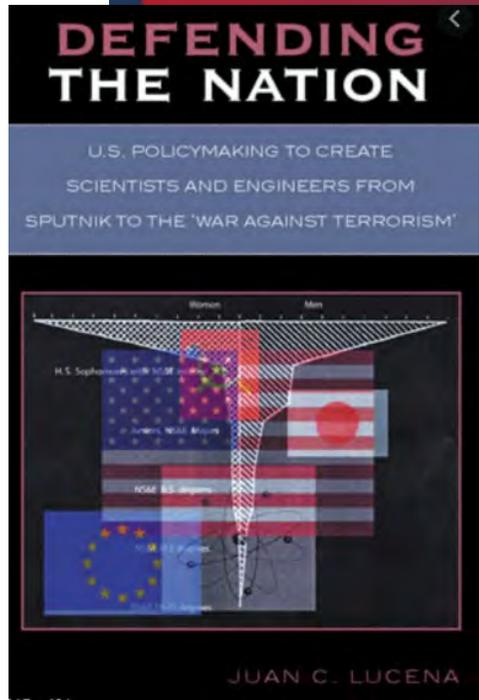
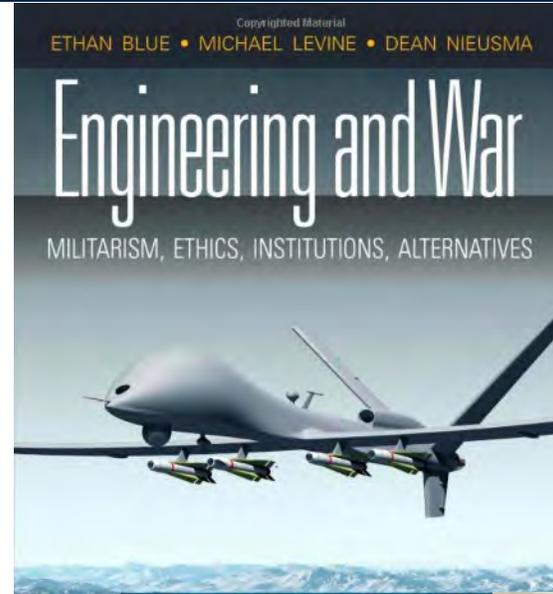
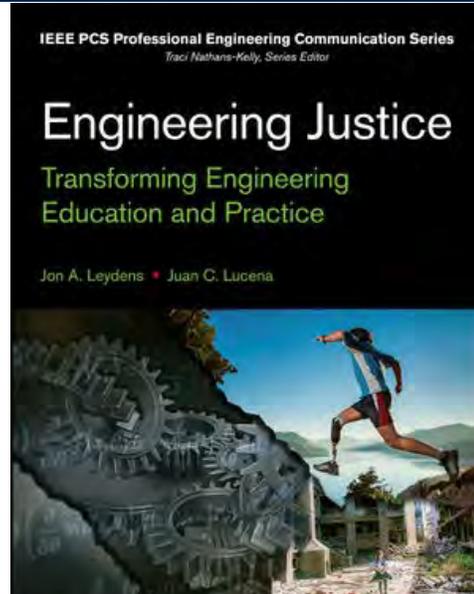
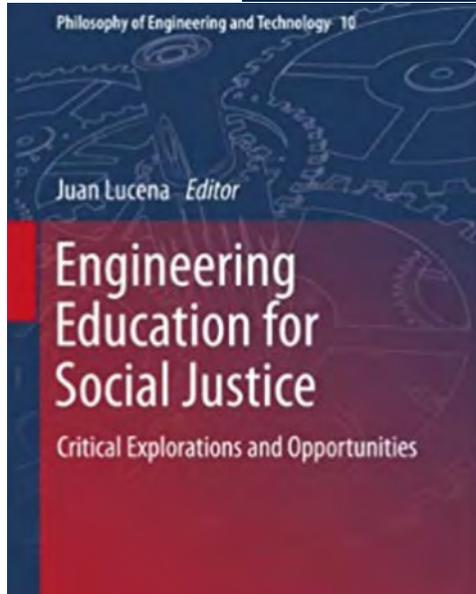


Mines students brainstorming at the Posner Center, a Denver-based NGO incubator for social entrepreneurs

# 5. Scholarship in Humanitarian Engineering

- Scholarship in HE is important to provide **foundational underpinnings** for the field
- HE is an exciting area of inquiry
  - ▣ Highly interdisciplinary intersection of social scientists and engineers,
  - ▣ Provides a space for deep and serious constructive critical reflection on “what is engineering for?”
- HE is a fertile ground for
  - ▣ Funding (our team has acquired >\$8.5M in federal grants since inception)
  - ▣ Publication
  - ▣ Conferences and networks of like-minded people

# Selected Books from Mines' HE Team





# Sample research project efforts

---

## ■ Domestic

- “Engineering with Communities” design studio
- Water related projects aimed at **servicing homeless** populations in Denver
- Joint projects with Western CO University for **sustainability of rural mountain communities**

## ■ International

- Community-based problem identification and solution related to **e-waste recycling** in Argentina and **construction waste recycling** in Colombia
- **Economic diversification in ASGM** communities in Colombia and Peru
- **Community empowerment** with global NGO PACT



**A current research project**



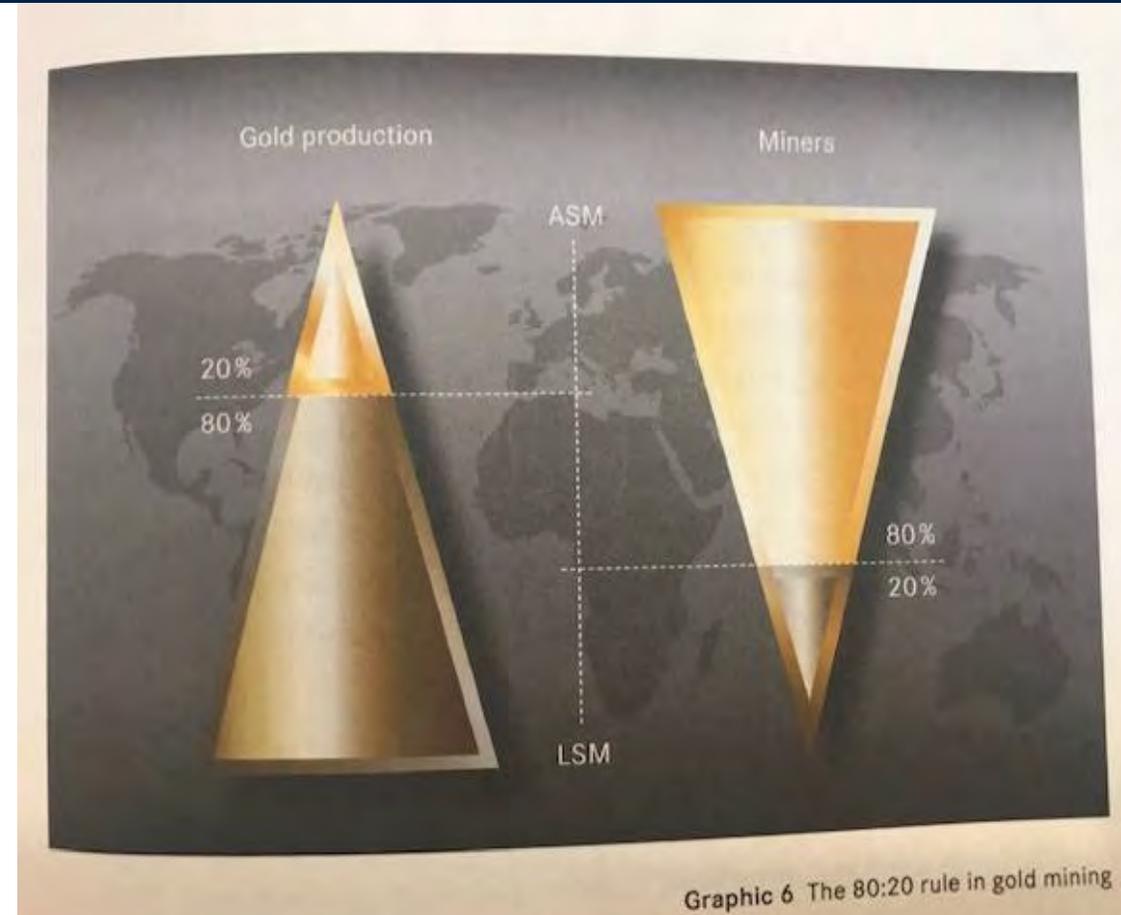
# Responsible Mining, Resilient Communities:

## International Research and Education to Develop Socio-Technical Competency

**NSF PIRE GRANT NUMBER 1743749**

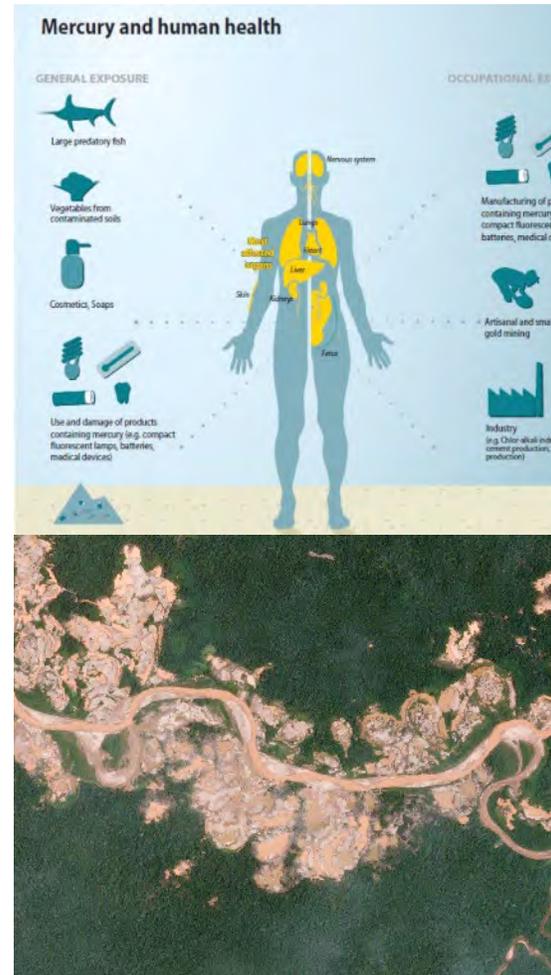
# Artisanal & Small-Scale Gold Mining (ASGM)

- Unrecognized contributor to world's gold supply (20%)
- Main source of anthropogenic Hg pollution
- Gold in everything we hold dear: electronics, jewelry, retirement funds, national treasuries
- Yet it also finances violent conflict and facilitates money laundering
- HE can make a difference here!



# ASGM – Key Challenges

- **Environmental**
  - Mercury and heavy metal pollution
  - Deforestation, water basin destruction
- **Social**
  - Financing organized crime, violent conflict
  - Forced labor, child labor, human trafficking, sex slavery
  - Land grabbing and displacement
- **Economic**
  - Poverty, tax evasion, money laundering



## The Weekly

A new TV series from The New York Times

PLAY TRAILER

EPISODE 12

Apple's iPhone, like many other phones, requires gold to work. Where does that gold come from and who profits from it?

"The Weekly" travels deep into Colombia's jungles to an illegal gold mine to trace the dangerous supply route for a key ingredient in Apple's best-selling product. The path from the jungle to Silicon Valley includes extortion, violence and a long line of murky middlemen. On FX and Hulu.

# Research goals

- **How do the social, environmental and technical dynamics** of ASGM systems in Colombia and Peru **intersect and influence one another**, posing both risks and opportunities for miners, communities, and environments?
- We seek to **identify knowledge and perceptions of risk** and already existing risk mitigation activities among ASGM communities
- We seek to **collaboratively design, implement and evaluate socio-technical innovations to mitigate those risks**

# Workshop: ASGM miners, anthropologists, engineers, Corporations, NGOs, students (Medellin, Dec 2017)



## Main lessons learned

- Legal framework is chaotic, complex, unrealistic, in limbo
- Mining communities mistrust most institutions (maybe even universities(!)) but we are changing this)
- Mercury is NOT the most important problem to be solved for miners
- Cyanide most efficient method but managing cyanide pools/tailings becomes new challenge
- Ideology of de-politization is very present and real
- Individualism of miners is a real challenge for collaborative problem solving but...
- Importance of gender dimension in ASGM

# Co-Creating a Shared Vision for ASGM (July 2018)



## **PIRE + MIT D-Lab + USD Market System Co-Design Workshop** July 23-24, 2018 Medellín, Colombia

### Multi-stakeholder participants included:

- 70+ attendees incl. miners, lawyers, non-profits, mining engineers, and government entities

### Sponsored by:

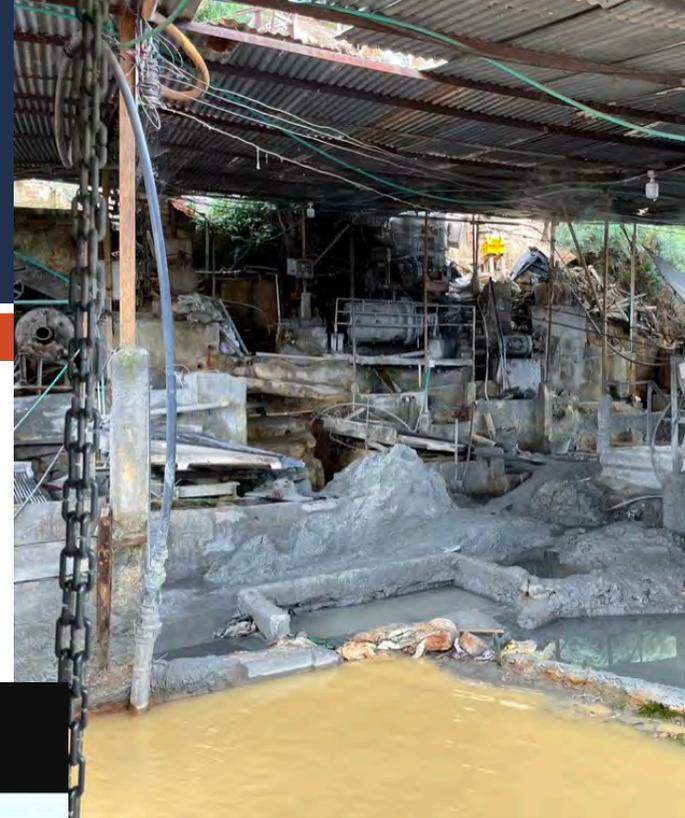
- NSF PIRE grant
- Universidad Nacional de Colombia

*Funding also provided by Newmont Mining Company gift to Mines*

# One Outcome from ASGM Project

## Thesis Project: Community-Owned Gold Processing Plants in Colombia

- MS student Mateo Rojas's co-designed community gold processing plant with ASGM miners
- Naples, one of Colombia's main gold commercializing companies, is discussing financing the building of a pilot





## 6. HE Curriculum+ @ Mines

- **HE is Courses and Curriculum**
  - 2 minors
  - 2 BSE Focus Areas
  - Capstone Design Studio in Engineering for Community Development
  - MS in Humanitarian Eng and Science - Interdisciplinary across four departments
- **HE is Students**
  - 120 minors graduated since 2003 (70 since 2012)
  - Graduate cohort rapidly expanding year-over-year in a brand new program
  - Average 300 students per year in 20 HE-related classes
  - Two student-led clubs (MWB, SRSE)
- **HE is Alumni**
  - Leadership in Social Responsibility Interest Group
- **HE is Scholars and Fellows and Postdocs (since 2003)**
  - 51 Shultz Undergraduate Scholars
  - 8 Shultz Graduate Scholars
  - 2 Postdocs
  - 8 Shultz Faculty Fellows
  - 20 Peace Corp Prep graduates
- **HE is Research and Engagement**
  - Over \$8.5 million in 14 federal research grants since program inception in 2003
  - 6-8 national speakers per year through the Shultz Lecture Series
  - ~20 undergrad and grad researchers/yr
  - ~30 HE-related design projects/year
- **HE is Faculty**
  - ~10 core faculty members
  - ~20 allied faculty members
  - Nearly 20% of the Mines faculty!

	ECD Requirements (6 total courses)	LSR Requirements (6 total courses)
<b>Common Requirement (take all 3)</b>	<ul style="list-style-type: none"> <li>EDNS 315 Engineering for Social and Environmental Responsibility</li> <li>EDNS 478 Engineering &amp; Social Justice</li> <li><b>EDNS 479 Community-Based Research</b></li> </ul>	
<b>ECD/LSR Reqts</b>	<ul style="list-style-type: none"> <li>EDNS 477 Engineering and Sustainable Community Development</li> </ul>	<ul style="list-style-type: none"> <li>EDNS 430 Corporate Social Responsibility</li> </ul>
<b>H&amp;SS Elec (take 1)</b>	<ul style="list-style-type: none"> <li>Any McBride Honors course</li> <li>HASS 419 Environmental Communication</li> <li>HASS 425 Intercultural Communication</li> <li>HASS 427 Risk Communication</li> <li>HASS 468 Environmental Justice</li> <li>HASS 490 Energy and Society</li> <li>Or an H&amp;SS course approved by minor director as appropriate</li> </ul>	<div style="border: 1px solid black; background-color: #1a3d54; color: white; padding: 10px;"> <p><b>Comment:</b> this is a very important course for engineers, who typically have no experience with the mixed methods of inquiry used in the social sciences</p> </div>
<b>Elective (take 1)</b>	<ul style="list-style-type: none"> <li>EDNS 401 Projects for People</li> <li>PEGN 430/530 Environmental Law and Sustainability</li> <li>CEEN 401 Life Cycle Assessment</li> <li>CEEN 472 Onsite Water Reclamation and Reuse</li> <li>CEEN 477 Sustainable Engineering Design</li> <li>CEEN 479 Air Pollution</li> <li>CEEN 475 Site Remediation</li> <li>CEEN 556 Mining and the Environment</li> <li>MNGN 470 Safety and Health Management in the Mining Industry</li> <li>EBGN 340 Energy and Environmental Policy</li> <li>Or a course approved by minor director as appropriate</li> </ul>	<div style="border: 1px solid black; background-color: #1a3d54; color: white; padding: 20px; text-align: center;"> <h2>Courses in Mines Undergraduate HE Program</h2> </div>

# MS in HES – Program structure

HES core  
(15 credits)



Disciplinary  
track  
(15 credits)

## HES core courses (15 credits)

- EDNS479 Community-Based Research
- EDNS577 Advanced Engineering & Sustainable Community Development
- EDNS580 Risks in HES
- Elective from list of approved courses
- EDNS590 HES Capstone Practicum

Geophysics

Geological engineering

Environmental Engineering

Humanitarian Robotics

Data Science





## A truly interdisciplinary program

*Geophysics, Geological Engineering, Mining Engineering, Petroleum Engineering, Electrical Engineering, Mechanical Engineering, Civil Engineering, Environmental Engineering, Engineering, Design & Society, Humanities Arts & Social Sciences; Computer Science*



# shared areas of practice



Sustainable Community Development



Corporate Social Responsibility



Social Innovation



Risk Perception & Mitigation



Engineering for Social Justice

# 7. HE-in-Action and Humanitarian Technology

## Theory-to-Practice in HE Projects, such as

- ❑ Water-powered pumps in Niger
- ❑ Mountain bikes for quadriplegics
- ❑ Solar-powered pumps and post-harvest storage solutions for African farmers
- ❑ Schools for girls in Nepal and Nicaragua
- ❑ Footbridges over formerly impassable rivers
- ❑ Energy-efficient housing for Native American Sustainable Housing Initiative
- ❑ Low-cost geophysical instrumentation



# Hands On **HE** Opportunities

Undergraduate students get involved in **HE projects** through

- Undergraduate courses
- **HE student groups**
  - SRSE – Socially Responsible Engineers and Scientists
  - Engineers Mines without Borders
  - Geophysicists without Borders
- **Engineering with Communities Design Studio** in Capstone Senior Design



# Hands On **HE** Opportunities

- Thesis-based graduate students complete an **independent research project** that matches their interests with faculty expertise
- Non-thesis graduate students complete a **practicum** working with a community development organization of their choice



# What the HE Mindset Brings to Engineering

- HE attracts different people and viewpoints to engineering
  - e.g., ~75% female in HE
  - Social scientists (e.g., anthropologists)
- New approaches to problem-solving (e.g., socio-technical consideration) amplifies the impact of our students
- New sources of funding
- New dimensions to university-industry-societal collaboration



Challenge to Engineering Deans: consider ways to include the precepts of humanitarian engineering in your programs!



1. Critical reflection about engineering
2. Engineering for Community Development (ECD)
3. Corporate Social Responsibility(CSR)
4. Socially Responsible Engineering (SRE)
5. Scholarship
6. Curricular programs
7. HE-in-Action and Humanitarian Technology

**QUESTIONS?**

<https://humanitarian.mines.edu/>

# **BACKUP SLIDES:**

## Example Projects, Alumni, and Partners

# Low-cost GP Instruments (Mines Geophysicists Without Borders)

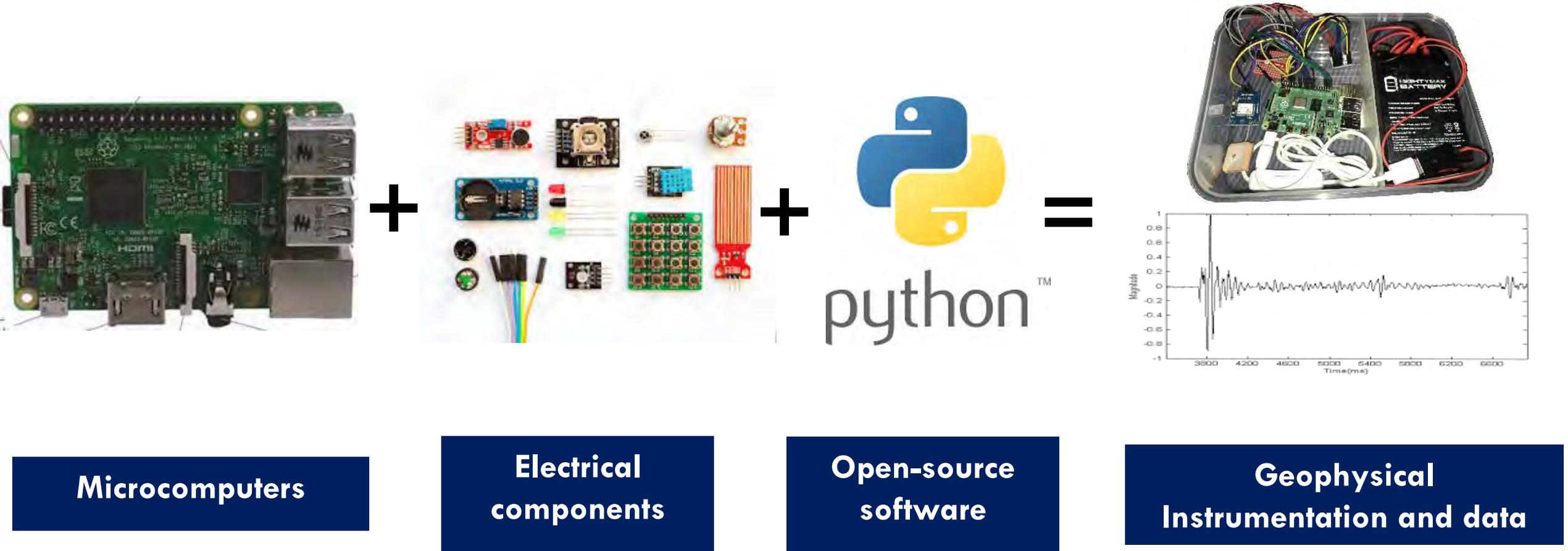


Commercial geophysical instruments

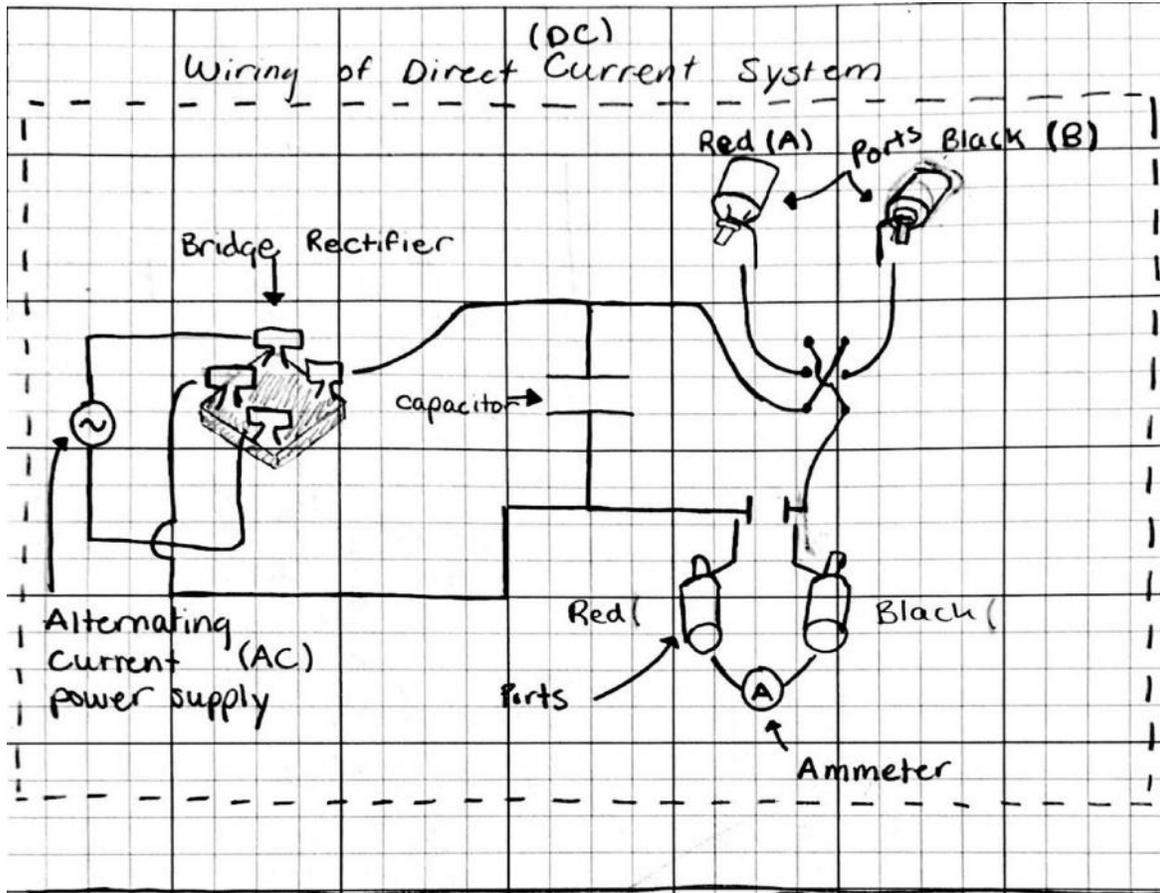
Two key questions:

1. How to **lower financial barrier** to entry for hydro-geophysical investigations?
2. How can we **build local capacity** to undertake such investigations?

# Design Philosophy



# Low-cost DC Res system w/ data logger



# Field testing

## Instrument construction



## Field validation



## Data acquisition



# Example: Casey Gibson's Thesis Activities: 2021-2022

## PIRE field session- Summer 2021

- Workshop on RAP



## Field Work: Andes & Medellin

- 65+ stakeholders
- 4 focus groups
- 31 interviews



## ACOFI Conference Presentation



- Sergio Arboleda (X2)
- UNIMINUTO
- Corporación Universitaria Republicana
- Community-Based Research

## MIT D-Lab Internship- Summer 2021

- **ASGM & food insecurity**



# Sofia Schlezak

## Risk reduction interventions within the informal e-waste recycling sector

- **Location**
  - ▣ Argentinian from an upper-middle-class family. Born and raised in Florencio Varela (Buenos Aires).
  - ▣ Education (elementary, middle, and high school) focused on St. Francis of Assisi.
- **Knowledge**
  - ▣ Policy & administration: Chemicals & waste at the international, regional (Latin American), and national levels.
  - ▣ Chemical Engineer. Specialized in Health & Environment.
- **Desires**
  - ▣ Promote decent/safe jobs for e-waste recyclers.
  - ▣ Inspire local, realistic, socially-just, accessible, affordable, sustainable, and enduring interventions.



# Mateo Rojas

## Community-Owned Gold Processing Plants in Colombia

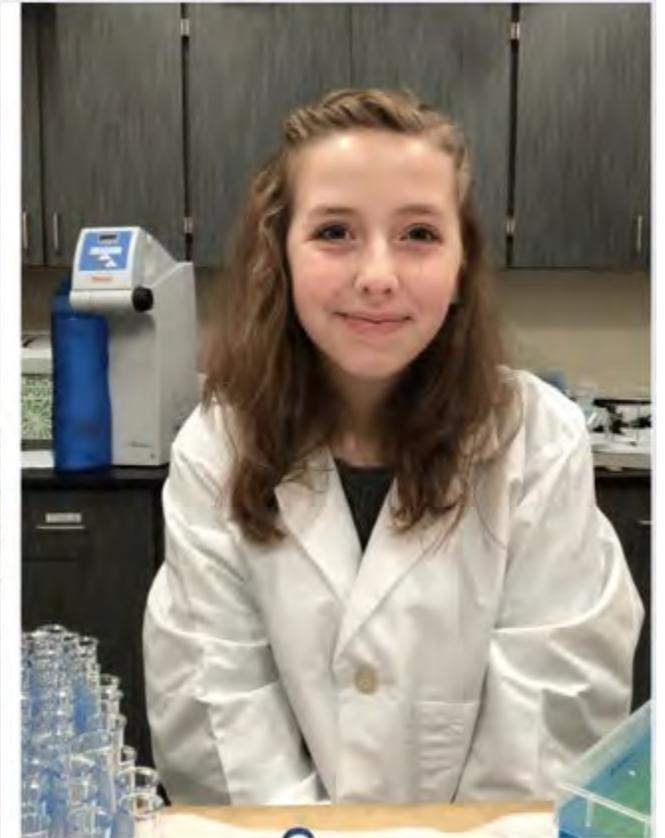
- **Location**
  - ▣ **Bicultural upbringing connected him with people from diverse backgrounds**
  - ▣ **Youth exchange program in Peru taught me about the pollution released into rural communities by LSM**
- **Knowledge**
  - ▣ **B.S. in Environmental Studies from UC Santa Barbara**
  - ▣ **Amigos de las Américas: leadership, community engagement, cultural exchange, Spanish**
- **Desires**
  - ▣ **Community-based initiatives to reduce power imbalance bet. LSM and mining communities.**
  - ▣ **Learning from failed community-owned gold processing to co-design and build sustainable plants in the future?**



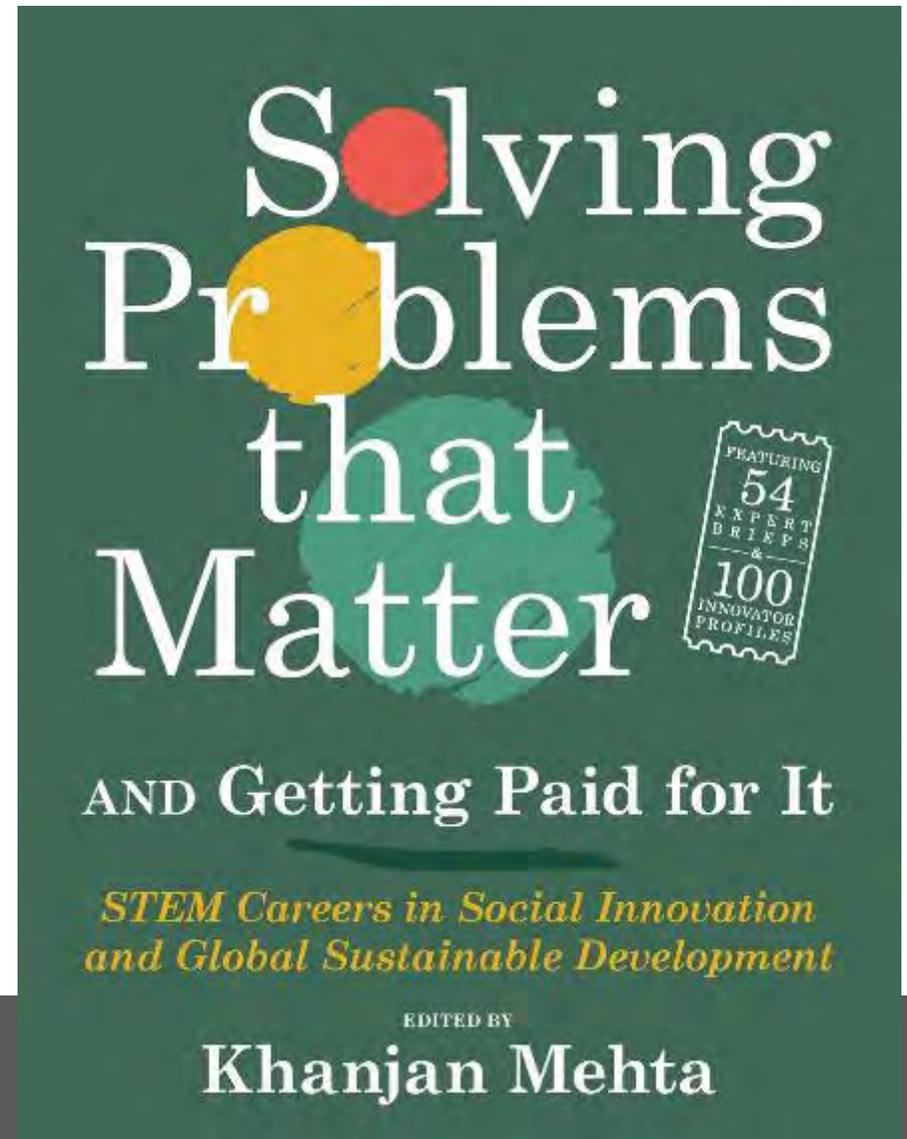
# Emma Chapman

## Water Access Technologies for Portland's Houseless

- **Location**
  - ▣ Born, raised in Portland, OR, to religious family with long history of serving houseless persons
- **Knowledge**
  - ▣ Env eng, water filtration research, Grand Challenge Scholar but...
  - ▣ Service and houseless outreach
- **Desires**
  - ▣ Alleviating hardships experienced by houseless, esp. water insecurity



Examples of pathways  
for **HE** graduates



# Micaela Pedrazas '17

MSc in Hydrogeology '20  
University of Texas

## Pathway

- BS in Geophysical Engineering and minor in Humanitarian Engineering, Mines
- Geoscientists Without Borders, Summer 2017
- MSc research in Bangladesh mapping aquifers around poor communities
- MSc research in Alaska understanding permafrost thaw underwater in a lagoon
- Accepted offer as hydrogeologist at LRE Water, Austin, Texas



# Liz Tomon '18

Process Engineer  
Procter & Gamble

## Pathway

- BS in Chemical Engineering and minor in HE at Mines
- Engineer at P&G in Georgia where she coaches low-income kids to play basketball and mentors foster children
- Goal: Go back to grad school to learn to design feminine hygiene products for women in developing world



# David LaPorte '18

Geological engineer  
Cornforth Consultants Inc.,  
Portland, OR

## Pathway

- BS in Geological Engineering, South Dakota School of Mines
- MS in Geological Engineering with HE thesis on landslide risk reduction in vulnerable communities
- Engineering and Social Justice Teaching Assistant
- EWB student/professional volunteer and Oregon state representative



# Dot Walch '19

Civil Engineer  
Economic Development Administration (EDA),  
Department of Commerce

## Pathway

- BS in Civil Engineering and Humanitarian Engineering minor at Mines
- Peace Corps volunteer math teacher in Guinea (until evacuation due to COVID-19)
- At the EDA, Dot provides technical assistance to communities receiving grants for infrastructure and construction projects
- Goal: Make the perfect french omelette and also continue learning how to promote and facilitate equity through community based development projects. Maybe grad school in urban development?



# Cassidy Grady '20

MS Candidate in  
Geological Engineering

## Pathway

- BS in Geological Engineering and minor in Engineering for Community Development at Mines
- Currently pursuing a MS in Geological Engineering and Certificate in HE at Mines while performing research on geological hazards in Arequipa, Peru
- Goal: Work to mitigate geologic and environmental risks in vulnerable communities through participatory methods



# Seamus Millett '20

Geotechnical Engineering  
BGC Engineering

## Pathway

- BS in Civil Engineering and a minor in Engineering for Community Development at Mines
- Geotechnical Engineer at BGC Engineering where he works to mitigate the impacts earth science problems have on communities and various essential industries
- Goal: To continue working with communities around the world to help them to solve their earth sciences problems



# Paige Kadavy BS '20, MS '21

Community Development Specialist  
Self-Help Enterprises

## Pathway

- BS in Mechanical Engineering and minor in Engineering for Community Development at Mines
- MS in Humanitarian Engineering and Science: Environmental Engineering track
- Practicum: Mentoring model between graduate and undergraduate humanitarian engineering students in community development projects
- Goal: Ultimately I would love to work in the urban planning space in a big city to help make large cities more socially just through way of city planning



# Dot Walch

Civil Engineering with a minor in Engineering  
for Sustainable Community Development at  
Colorado School of Mines

Contact: [dotwalch@gmail.com](mailto:dotwalch@gmail.com)



## Humanitarian Engineering

### Colorado School of Mines Capstone Design Project – Humanitarian Engineering

### Bio Itza Eco Cottages in Northern Guatemala



Internship Experience

CDOT

Central 70 project

Critical Lens of development



## Peace Corps Volunteer

Taught math to 7<sup>th</sup> and 8<sup>th</sup> graders in Guinea, West Africa

Worked with other teacher and a community member with a lot of books to start a library for the middle school

Challenges with languages, teaching



## Current Position

Department of Commerce – Economic  
Development Administration

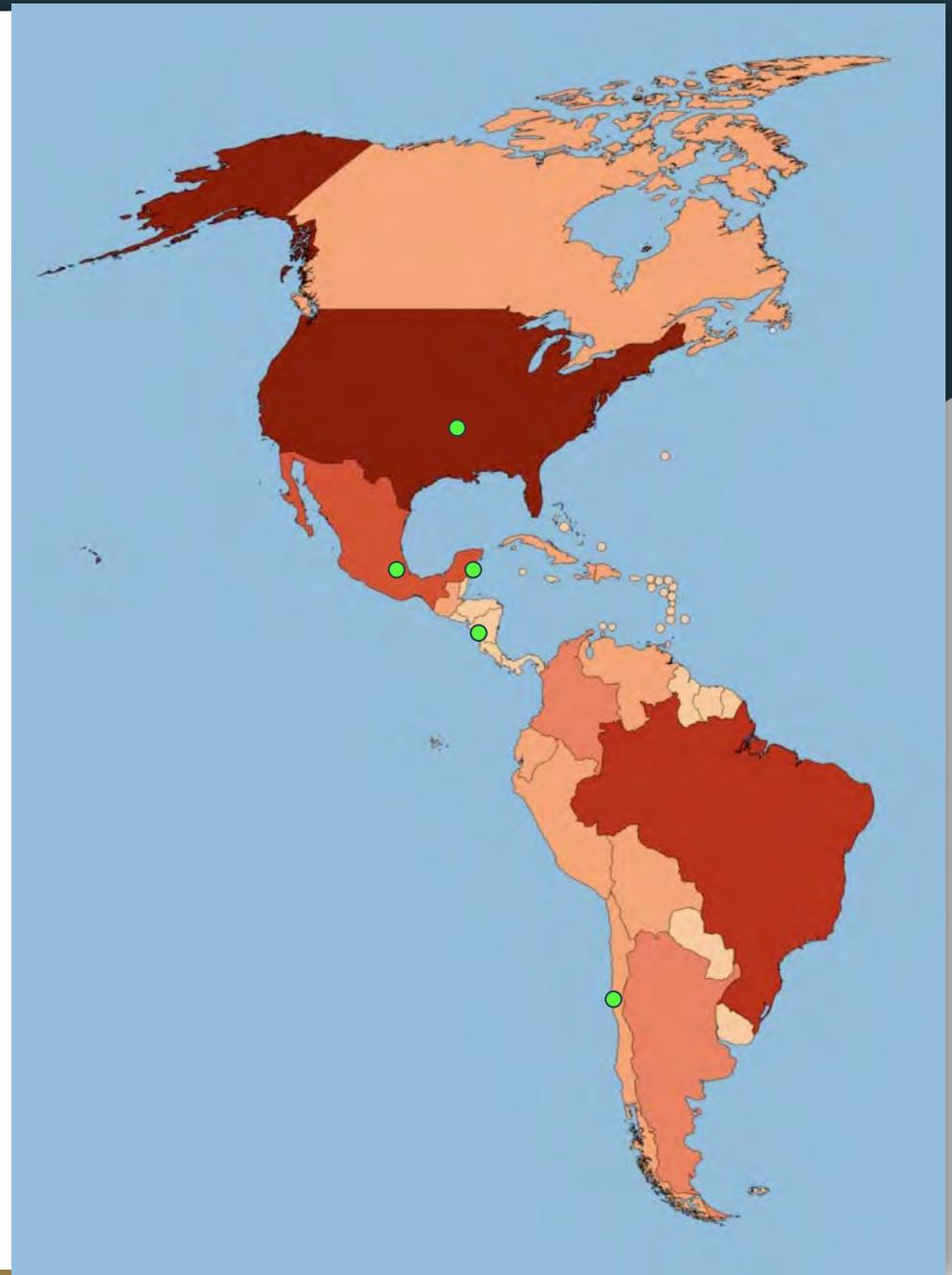
Civil Engineer on CARES Act Projects

Technical Assistance and Grant Management  
for locally driven sustainable economic  
development infrastructure projects



# Casey Gibson

- From Tennessee/Arkansas
- University of Arkansas class of 2018
  - B.S. Biological Engineering & B.A. Spanish
  - Minor in Foundations of Sustainability
  - Created my own interdisciplinary program: e.g. applying concepts from biology to the colonization of the Americas
  - NSF REU Program, study abroad programs
  - Travel grants
- Fulbright-Garcia Robles program to Mexico
  - 2018-2019 English Teaching Assistant in Chetumal, MX
  - 2019-2020 ETA Mentor in Puebla, MX



# What brought me to Humanitarian Engineering?

- A random series of connections
- I didn't know it existed!
  - You all are already a step ahead
- A good fit for the program
  - Background in engineering, interest in education/interdisciplinary studies, desire to travel, language skills
  - Project in Colombia
- Visited Mines and loved it
  - Small program with like-minded people
  - For me, smaller >> larger programs
  - My advice: just follow your interests

# My research

- Developing a “tool kit” to assess the feasibility/safety of growing food in mining areas
  - Combination of tools/methods from anthropology, local knowledge evaluation/integration (ecology), and environmental engineering
- Started by looking at the ag/mining intersection
  - Context of ASGM in Andes-- ag dominates
  - Project evolved from mining to food by listening to stakeholders
  - Food insecurity during COVID-19
- Project evolved by focusing on problem definition vs. solution-oriented approach
  - A lot of projects happen the other way around



# What is humanitarian engineering to me?

“Application of engineering to improve the well-being of marginalized populations” -Wikipedia

- Examples of what humanitarian engineering *isn't*
  - E.g. Robert Moses-- engineer who designed the overpasses in Long Island, NY to discourage buses
- “Searcher” mindset
  - “A Planner thinks he already knows the answers; he thinks of poverty as a technical engineering problem that his answers will solve. A Searcher admits he doesn’t know the answer in advance; he believes that poverty is a complicated tangle of political, social, historical, institutional, and technological factors. A Searcher hopes to find answers to individual problems only by trial and error experimentation. A Planner believes outsiders know enough to impose solutions. A Searcher believes only insiders have enough knowledge to find solutions, and that most solutions must be homegrown” (Easterly, 2007, p. 6)
- Unlearning technocentric mindset from undergrad engineering school
  - The most efficient solution is not always the humanitarian solution

## Larkin Martini

- From: Calistoga, California
- Undergraduate: Geologic Engineering (exploration)
- Currently: 2<sup>nd</sup> year Humanitarian Engineering
- Hobbies: world building, theater, photography, DnD, going for walks
- Overarching Research Goal: Helping better bridge the sociotechnical divide in engineering education



# Research

1. How does macroethics and corporate social responsibility education differ between single track and multi-track programs?
2. What are courses in multi-track departments where students see CSR and macroethics?
3. What ways do students think CSR and macroethics can be integrated into department courses? Do they think it is even necessary?
  1. How does this compare to professor opinions and limitations of CSR and macroethics integration into department courses?



# Environmental Engineering

- Safe drinking water
- Water resource management
- Environmental remediation and monitoring
- Effective sanitation
- Air quality management

# Shuthi Baskaran

Innovation Consultant

UN World Food Program

Salary: ~ \$75K

Passion: Providing food security in poor communities

## Pathway

- BS, Civil & Env Engineering, Penn State
- Humanitarian Engineering, Penn State
- Boston Consulting group, Houston
- UN World Food Program



# Rick Johnston

World Health Organization (WHO)  
Technical Officer, Joint Monitoring for Water  
Supply & Sanitation  
Salary: ~ \$140K  
Passion: Drinking-water quality in low-income  
settings

## Pathway

- MS, Env Engineering, Johns Hopkins
- PhD, Env Engineering, U of North Carolina
- UNICEF in Bangladesh
- Swiss Federal Institute of Technology
- WHO



# Jennifer Schmeltzle

US ARMY Corps of Engineers

Project Engineer

Salary: ~\$90k

Passion: Community buy-in, participation and capacity building in civil infrastructure projects

## Pathway

- BS, Civil Engineering, Lehigh University
- Project Engineer, Humanitarian Assistance in Serbia, Albania, Togo, Kenya, etc.
- Program Manager for Europe District



# Steve Dennis

Corporate Social Responsibility Training  
Institute

East Africa Coordinator

Salary: varies per month

Passion: Training organizations on how to  
engage everyone in projects, from local  
communities to external funders

## Pathway

- BS, Civil Engineering, U of Toronto
- MA, International Relations, U of Toronto
- Logistician and Project Manager, Doctors  
Without Borders in Sri Lanka, Kenya and  
South Sudan





# POSNER CENTER FOR INTERNATIONAL DEVELOPMENT

One of the country's largest community development hubs... in downtown Denver!

---

Home of Engineers Without Borders-USA, Bridges to Prosperity, Elephant Energy, and more.

# MIT D-Lab

## DCC# 2 SANTA RITA DE ANDES LOS 6 PROYECTOS



En equipos, los participantes diseñaron y prototiparon los siguientes proyectos:

1. Horno tostador de Café
2. Filtro de agua
3. Embolsador de Plátano
4. Picador de fruta
5. Armario
6. Comedor de pollos

- Specialists in social innovation and entrepreneurship in marginalized communities around the world
- Ongoing projects in Colombia and Peru
- The MIT D-Lab Monitoring and Evaluation Fellowship

# Universidad Minuto de Dios (Colombia)



- Central mission in social justice and deepest reach into poor communities in Colombia
- Scientific Park for Social Innovation as site for linkages and outlet for HES projects
  - Social innovation in ASGM communities
  - STEM education in rural communities
  - Teaching engineering to Venezuelan refugees
- New problem-areas to explore
  - Land-slide hazard mitigation
  - Soil, water remediation in farming communities
  - Low-cost instrumentation for rural communities

# Universidad Nacional de Colombia - Medellin



- Medellin: The city of eternal spring
- Ongoing projects with mining communities
- Community-based research opportunities in all 3 tracks of our MS program

# Swansea University, Wales (UK)



- MSc in Sustainable Engineering Management For International Development Program
- Course exchange or joint project participation
- Sample classes
  - Engineering Technology, Innovation & Application
  - Engineering in Development Practice
  - Circular Economy and Sustainable Engineering
  - Leadership and Complexity Management
  - Monitoring & Impact Evaluation for International Development
  - Tools for International Development

# Western Colorado University



- HE Practicum and Thesis opportunities on sustainability and mountain communities
- Future partnership for research and study in Mexico
- Joint fellowship opportunity for students from both universities to do research