

An Innovative Approach to Water Quality along the Amazon River Using Biosand Filters

Michigan State College of Osteopathic Medicine
Universidad Cesar Vallejo

Taylor Dickey OMSII, Katelyn Phelps D.O., Lorenzo Lim
D.O., Gary Willyerd D.O., Joseph Gorz D.O., Ruben
Kenny Briceno M.D., Raef Fadel OMSIII, Shane Sergent
D.O.



MSUCOM Peru Global Outreach

- Began in 2009
- 25+ medical students, 30+ Physicians
 - Family Medicine, Physical Health and Rehabilitation, Radiology, Dermatology, Emergency Medicine, Obstetrics & Gynecology, Pediatrics, Neurology, and Internal Medicine
- Public Health Outreach
 - Water Sanitation
 - Adequate Hygiene
 - Infectious Disease Prevention
 - Safe Household Practices Minimizing Childhood Diseases
- 50+ abstracts published
- \$1,000,000+ fundraised
 - Apx. \$20,000/year by students



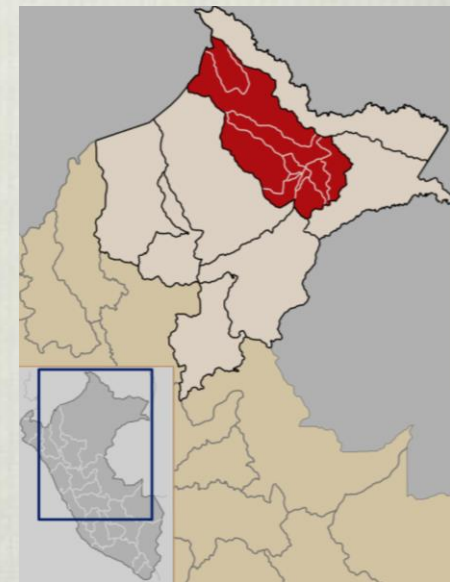
Location of Care

Peru – home of 3 basins

- *Costa* (coastal)
- *Sierra* (highlands)
- *Selva* (rain forest)

The Loreto Region

- The largest of the 25 regions of Republic of Peru
- Located in the *Selva* basin
- No roads connecting to the other basins
- Only accessible by plane or boat



Location of Care

Maynas Province

- 11 districts

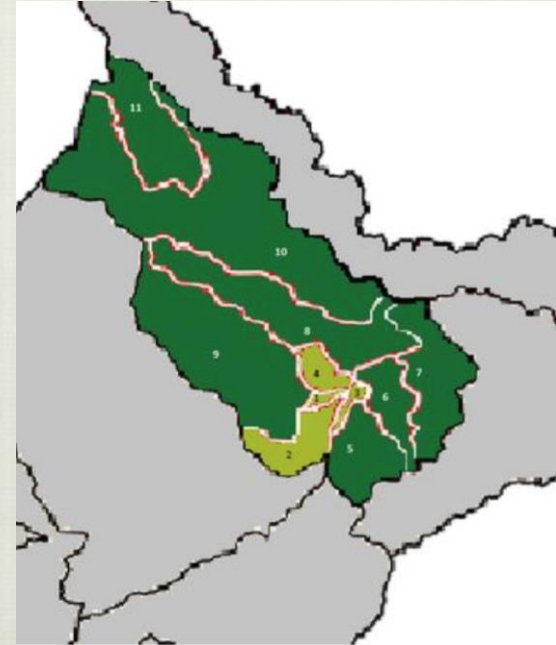
Peru Global Outreach

- Locations (1), (2), (3), (4) (Iquitos clinic)
- Locations (6), (8) (Travel Clinic)

Population

(6) Indiana: 163,549

(8) Mazan: 13,977



The Amazon River



OMED[®] 16

SEPTEMBER 17-20 | ANAHEIM, CA

The Amazon River

Plenty of water, but...

Contamination

Deforestation

Mining

Commerce

What resources do they have access to?

- Rock
- Sand
- Charcoal
- Buckets
- Clay



OMED[®] 16

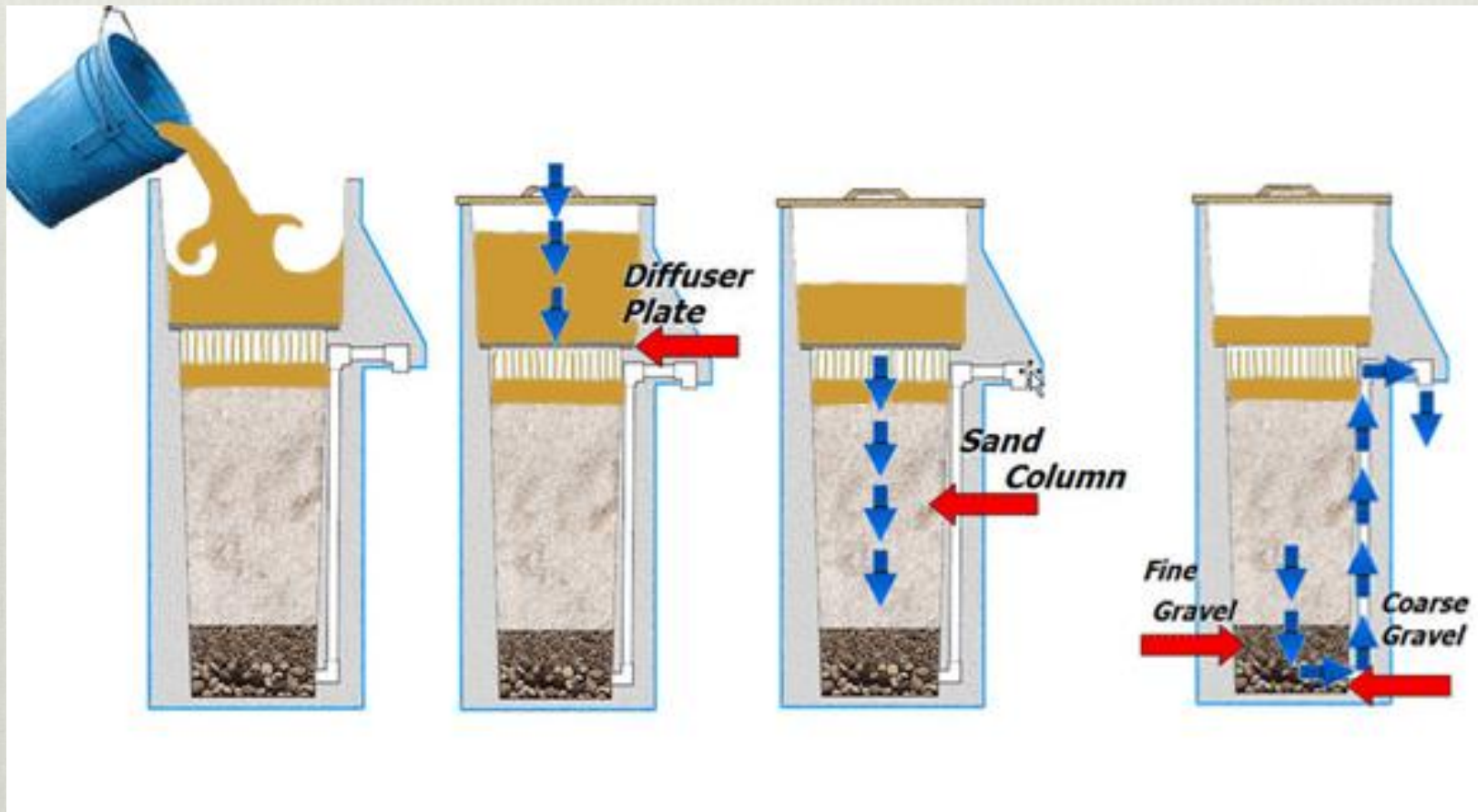
SEPTEMBER 17-20 | ANAHEIM, CA

The Biosand Filter

- ❖ Cheap
- ❖ Natural Resources + Bucket
- ❖ Reproducible
- ❖ Anaerobic bacteria
 - ❖ Compete for resources
 - ❖ Develop in response to bacterial competition and available nutrition
 - ❖ More effective with greater use



The Biosand Filter



OMED[®] 16

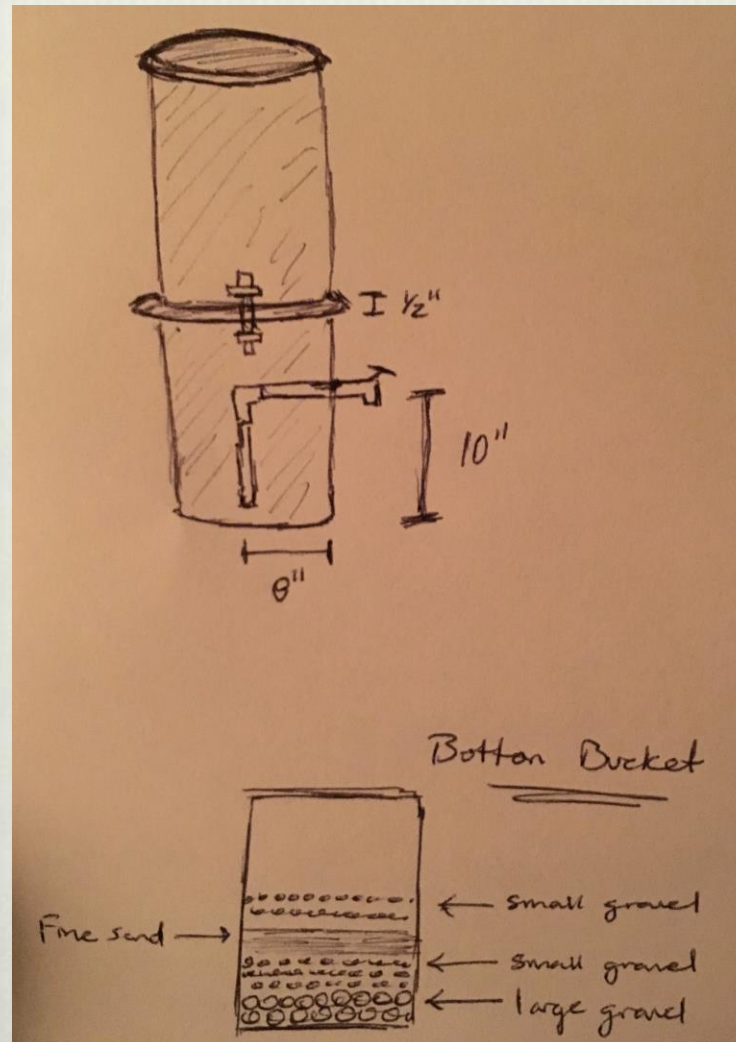
SEPTEMBER 17-20 | ANAHEIM, CA

The Biosand Filter

- ❖ Supplies for 1 filter
 - ❖ 5 gallon bucket (2x)
 - ❖ Air tight gasket
 - ❖ 1/2 inch x 1 1/2 inch galvanized steel nipple
 - ❖ 1/2 inch CPVC female adaptor (2x)
 - ❖ 3/4 inch CPVC female adaptor
 - ❖ 3/4 inch CPVC 90 degree elbow
 - ❖ 3/4 inch CPVC straight cut into 8 inch long pieces (2x)
 - ❖ 3/4 inch CPVC boiler drain
 - ❖ Washed fine sand x 1/2 gallon
 - ❖ Small gravel x 1 gallon
 - ❖ Large gravel x 1/2 gallon

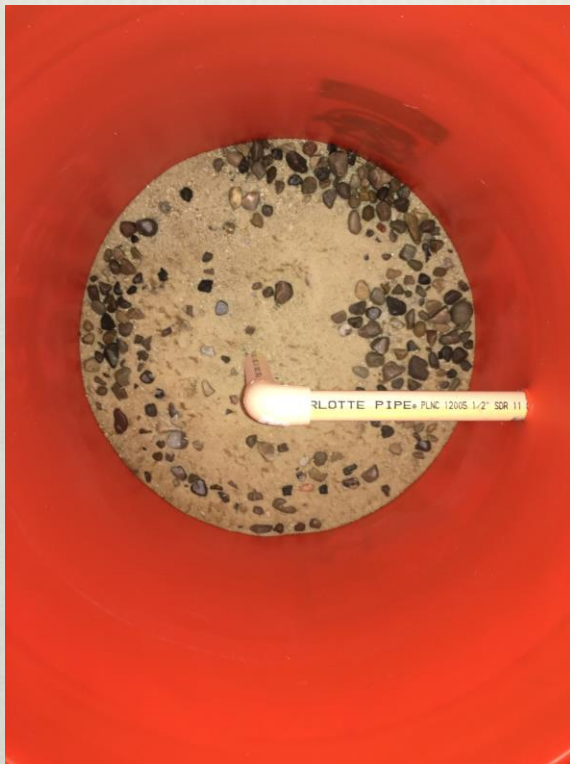
The Biosand Filter

Schematic



The Biosand Filter

❖ Prototype



Prototype Results: Pre-Filtration

System Name/Owner:	RED CEDAR RIVER	WSSN/Pool ID:	
Collection Address:	2929 HANNAH BLVD,EAST LANSING	Source:	Surface Water
Collected By:	TAYLOR DICKEY	Site Code:	RED CEDAR #1
Township/Well#/Section:	//	Collector:	Private Citizen
County:	Ingham	Date Collected:	07/29/2016 14:00
Sample Point:	RIVER	Date Received:	07/29/2016 16:01
Water System:	Public System Surface Water	Purpose:	Other

TESTING INFORMATION			REGULATORY INFORMATION			
Analyte Name	Result (mg/L)	Date Tested	RL (mg/L)	MCL/AL (mg/L)	Method	CAS #
Coliform Organisms per 100 mL	EC POSITIVE	07/29/2016			SM 9223 B	TC-00-B
Explanation of Coliform Results:		Not Detected = Coliform and E. coli bacteria were not found Positive = Total Coliform <u>was found</u> and E. coli bacteria <u>was not found</u> EC Positive = Coliform and E. Coli bacteria were found				
Arsenic	0.004	08/02/2016	0.002	0.010	EPA 200.8	7440-38-2
Chloride	74	08/01/2016	4		SM 4500-CI E	7647-14-5
Fluoride	0.18	08/01/2016	0.1	4.0	SM 4500 FC	16984-48-8
Hardness as CaCO3	462	08/01/2016	20		SM 2340 C	HARD-00-C
Iron (automated)	0.2	08/01/2016	0.1		SM 3500 FeB	7439-89-6
Nitrate as N	0.8	08/01/2016	0.4	10	10-107-04-2-B	14797-55-8
Nitrite as N	Not detected	08/01/2016	0.05	1	10-107-04-2-B	14797-65-0
Sodium (automated)	35	08/01/2016	5		SM 3500 NaB	7440-23-5
Sulfate	49	08/01/2016	10		SM 4500 SO4E	14808-79-8

The analyses performed by the MDEQ Drinking Water Laboratory were conducted using methods approved by the U.S. Environmental Protection Agency in accordance with the Safe Drinking Water Act, 40 CFR parts 141-143, and other regulatory agencies as appropriate.

OMED[®] 16

SEPTEMBER 17-20 | ANAHEIM, CA

Prototype Results

Post-Filtration

System Name/Owner:	RED CEDAR RIVER	WSSN/Pool ID:	
Collection Address:	2929 HANNAH BLVD,EAST LANSING	Source:	Surface Water
Collected By:		Site Code:	FILTERED #1
Township/Well#/Section:	//	Collector:	Private Citizen
County:	Ingham	Date Collected:	07/29/2016 14:00
Sample Point:	RIVER	Date Received:	07/29/2016 16:01
Water System:	Public System Surface Water	Purpose:	Other

TESTING INFORMATION			REGULATORY INFORMATION			
Analyte Name	Result (mg/L)	Date Tested	RL (mg/L)	MCL/AL (mg/L)	Method	CAS #
Coliform Organisms per 100 mL	POSITIVE	07/29/2016			SM 9223 B	TC-00-B
Not Detected = Coliform and E. coli bacteria were not found Explanation of Coliform Results: Positive = Total Coliform <u>was found</u> and E. coli bacteria <u>was not found</u> EC Positive = Coliform and E. Coli bacteria were found						
Arsenic	Not detected	08/01/2016	0.002	0.010	EPA 200.8	7440-38-2
Chloride	64	08/01/2016	4		SM 4500-Cl E	7647-14-5
Fluoride	0.29	08/01/2016	0.1	4.0	SM 4500 FC	16984-48-8
Hardness as CaCO3	239	08/01/2016	20		SM 2340 C	HARD-00-C
Iron (automated)	Not detected	08/01/2016	0.1		SM 3500 FeB	7439-89-6
Nitrate as N	Not Detected	08/01/2016	0.4	10	10-107-04-2-B	14797-55-8
Nitrite as N	Not detected	08/01/2016	0.05	1	10-107-04-2-B	14797-65-0
Sodium (automated)	35	08/01/2016	5		SM 3500 NaB	7440-23-5
Sulfate	53	08/01/2016	10		SM 4500 SO4E	14808-79-8

The analyses performed by the MDEQ Drinking Water Laboratory were conducted using methods approved by the U.S. Environmental Protection Agency in accordance with the Safe Drinking Water Act, 40 CFR parts 141-143, and other regulatory agencies as appropriate.

OMED[®] 16

SEPTEMBER 17-20 | ANAHEIM, CA

The Biosand Filter

Lima, Peru



The Biosand Filter

Iquitos, Peru



The Biosand Filter

Pucallpa, Peru



The Biosand Filter



Key Points for Successful Installation

- ❖ Patient Education
 - ❖ “See one, do one, teach one” mentality
- ❖ Village Leadership
- ❖ Building Key Relationships
- ❖ Maintenance & Troubleshooting
- ❖ Health Tracking
- ❖ Cheap, Easy-To-Find Resources



Survey

Patient ID: _____ Date Seen: _____
Age: _____ Gender: M F

¿Cuántas veces ha consultado usted con un médico en el año pasado?
0 1-2 3-4 Más que 5

¿Cuánto tiempo necesita viajar para ver un médico?
Menos que 30 minutos 1-2 horas 3-4 horas Más que 5 horas

Durante los pasados 6 meses ¿ha sufrido de diarrea o nausea?
Sí NO

¿Está experimentando algún problema cuando orina - dolor, sensación de quemadura, orina más seguido?
Sí NO

¿Ha notado algún anomalidad con su orina? Por ejemplo, olor fuerte, espumalidad, color abnormal.
Sí NO

¿Hierve su agua antes de tomarla?
Sí NO

¿Siente que tiene acceso a bastante agua?
Sí NO

¿Cuántas tazas de agua toma usted diariamente? (círculo uno)
1-2 3-4 5-6 7-8 Más que un litro

¿De dónde consigue su agua? (círculo uno)
Río Agua embotellada Pozo Agua de la lluvia

¿Ha usado un filtro de agua?
Sí NO

Filter? YES NO
Explain: _____

CC: _____
Dx: _____
Weight (kg): _____ BP: _____ HR: _____

Relevant history/physical findings: _____

Volume status: HYPOVOL EUVOL HYPERVOL

Urine dipstick results:
Color CLEAR LIGHT YELLOW DARK YELLOW BROWN

pH _____ Spec Gravity _____ Leuk _____ Nitrite _____ Gluc _____ Ketones _____
Protein _____ Blood _____ Billrubin _____

iSTAT results  iCa: _____
AG: _____

Please turn in completed forms to Katelyn at the end of your shift

Survey

- ❖ How many times within the past year have you seen a doctor?
- ❖ How long does it take for you to travel to see a doctor?
- ❖ 30 minutes or less 1-2 hours 3-4 hours 5 or more hours
- ❖ Within the past 6 months, have you been experiencing episodes of vomiting or diarrhea?
- ❖ Are you currently experiencing any problems with urination - pain, burning, increased frequency?
- ❖ Have you noticed any abnormalities with your urine? For example, strong smell, bubbles, abnormal color?
- ❖ Do you boil your water before drinking?
- ❖ Do you feel as though you have access to enough water?
- ❖ How many glasses of water do you drink per day?
- ❖ Where do you get your drinking water?
- ❖ River/Stream Bottled water Well Rain water
- ❖ Have you used a water filter before?

Difficulties

- ❖ Leaking
 - ❖ Moving from a 2 bucket to 1 bucket system
 - ❖ Working with MSU-EWB for next year's prototype
- ❖ Suppliers
 - ❖ Knowing when and where to ship

Finishing Touches

- ❖ 2 installed in Pucallpa, Peru (MSU1 and MSU3)
- ❖ 23 finished filters in the process of installation/GPS tracking
- ❖ Additional filters continually being installed/tracked
- ❖ Results from Renal Function Research Study
- ❖ Pre- and Post-filtration water labs
- ❖ Biofilm analysis using PCR

Future Potential

- ❖ Tailoring the water filters towards the endemic water sources
- ❖ Community impact
- ❖ Integrated educational component
- ❖ Health parameters and filtration efficacy
- ❖ Replication of process in other developing nations

Questions?

❖ Contact Information

- ❖ Taylor Dickey OMS-II
- ❖ Email: dickeyt1@msu.edu
- ❖ Phone: 248-860-6894
- ❖ Websites:

<https://www.peruglobaloutreach.com/>

<https://www.gofundme.com/MSUCOMPPeru/>

