IPRO 325B

2 Bucket Water Filtration System

Developing Affordable and Sustainable Water Solutions for the World's Rural Poor

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Problem:

Around 5 million people, 90% of whom were children, die each year as a result of water related diseases which are contracted from polluted water.

Objective:

-To design, build and test a prototype of a water filtration system costing $5 or less that can be implemented and maintained by local people using locally available materials
-Simply provide clear water for the community in need

Overarching ethical principle:

The team conducts itself professionally during the design and creation of our product; and act in a respectful manner whilst testing the product in the field.

The team:

Reema Paranthan
5th Year Architecture

Angela Gandhi
4th Year Psychology

Tomomi Tsukioka
5th Year Architecture

Robert Christo
4th Year Architecture

Suk Hwan Yun
3rd Year Chemical Engineering

Katrina Ongchangco
4th Year Architecture

Previous Semesters

- **FALL 2006**
  -Identified top ten causes of Global Poverty
  -Narrowed problem to Water
  -Began Campus Awareness
- **SPRING 2007**
  -Researched solutions to water problems
  -Increase IIT Awareness
- **FALL 2007**
  -Developed 2 bucket system solution to water problems
  -Implementation with in Peru and Nicaragua
- **SPRING 2008**
  -Developed composting toilet
  -Implementation in Sincape, Peru

RESEARCH METHODOLOGY
FALL 2007

PHASE 1: Obtain necessary resources

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PHASE 2: Set efficiency standards for filtration through extensive research

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PHASE 3: Design and Build a working Prototype

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PHASE 4: Test Prototype

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PHASE 5: Develop Field Manual for Presentation

RESEARCH METHODOLOGY
FALL 2008

PHASE 1: Research

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PHASE 2: Design and Build

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PHASE 3: Testing and Analysis

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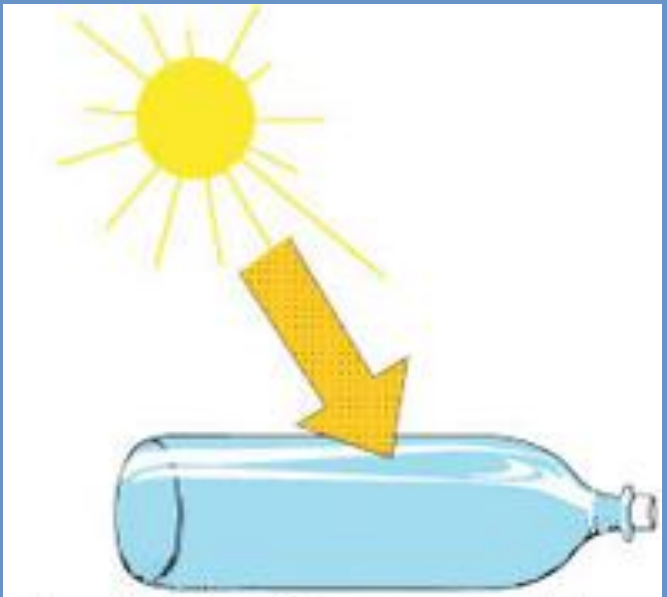
PHASE 4: Implementation Preparations

SODIS
(Solar Water Disinfection)

- Improves biological quality of water by solar UV-A **Radiation** in the spectrum of **UV-A** (wavelength 320-400nm) and **increased water temperature** to inactivate pathogens causing diarrhea
- SODIS requires relatively **clear water** with a **turbidity less than 30 NTU**.



Inactivation of microorganisms by UV-A-radiation and thermal treatment

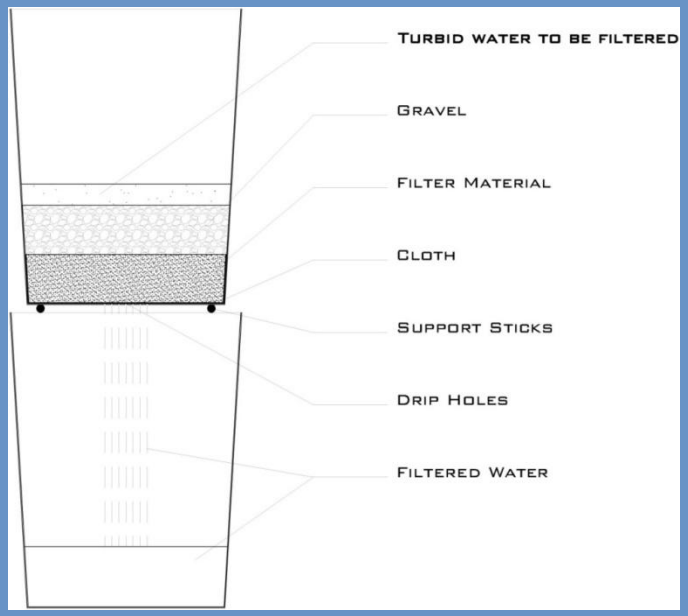
Research:

- Brita and Fish Tank Filtration Systems
  - Activated carbon
  - Filter media that acts as a strainer.
  - The finer the media, the smaller particles can be caught.
  - Coarser media will allow more particles through and will take longer to get plugged up.
  - Damage to the filter media can greatly reduce the filter efficiency

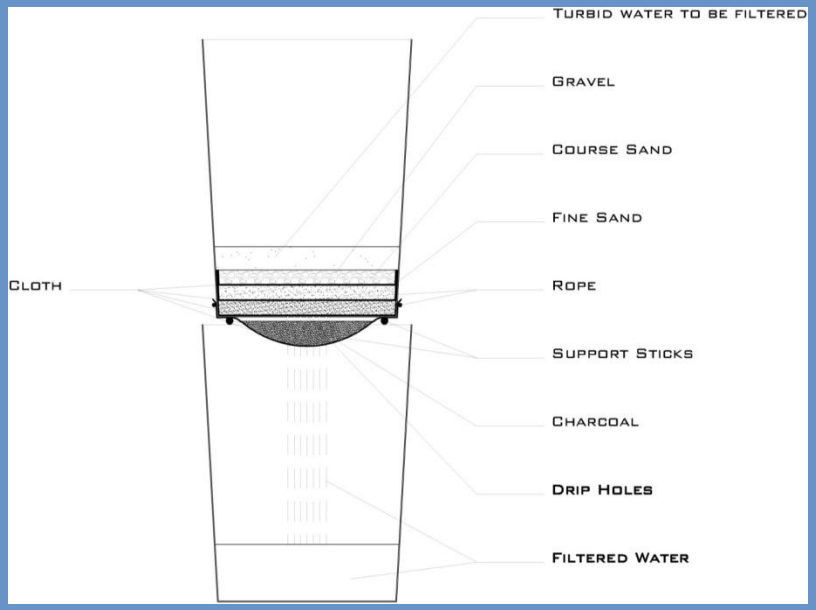
- Ethical Issues
  - Previous semester's experiences
  - Local contacts: Marisela Perez, Sara Mascola, Ursula Harman
  - In class discussions
  - Guest speaker: Raul Gutierrez

Experimental Process:

Fall 2007 Design



First Modification



Experimental Process:

- Tested:
  - Various types of sand
  - Various types of charcoal
  - Various cloths
  - Depths of filter media
  - Ratios of charcoal and sand
  - Order of layers

Materials:

Buckets

Stick

Cloth

4" washed sand

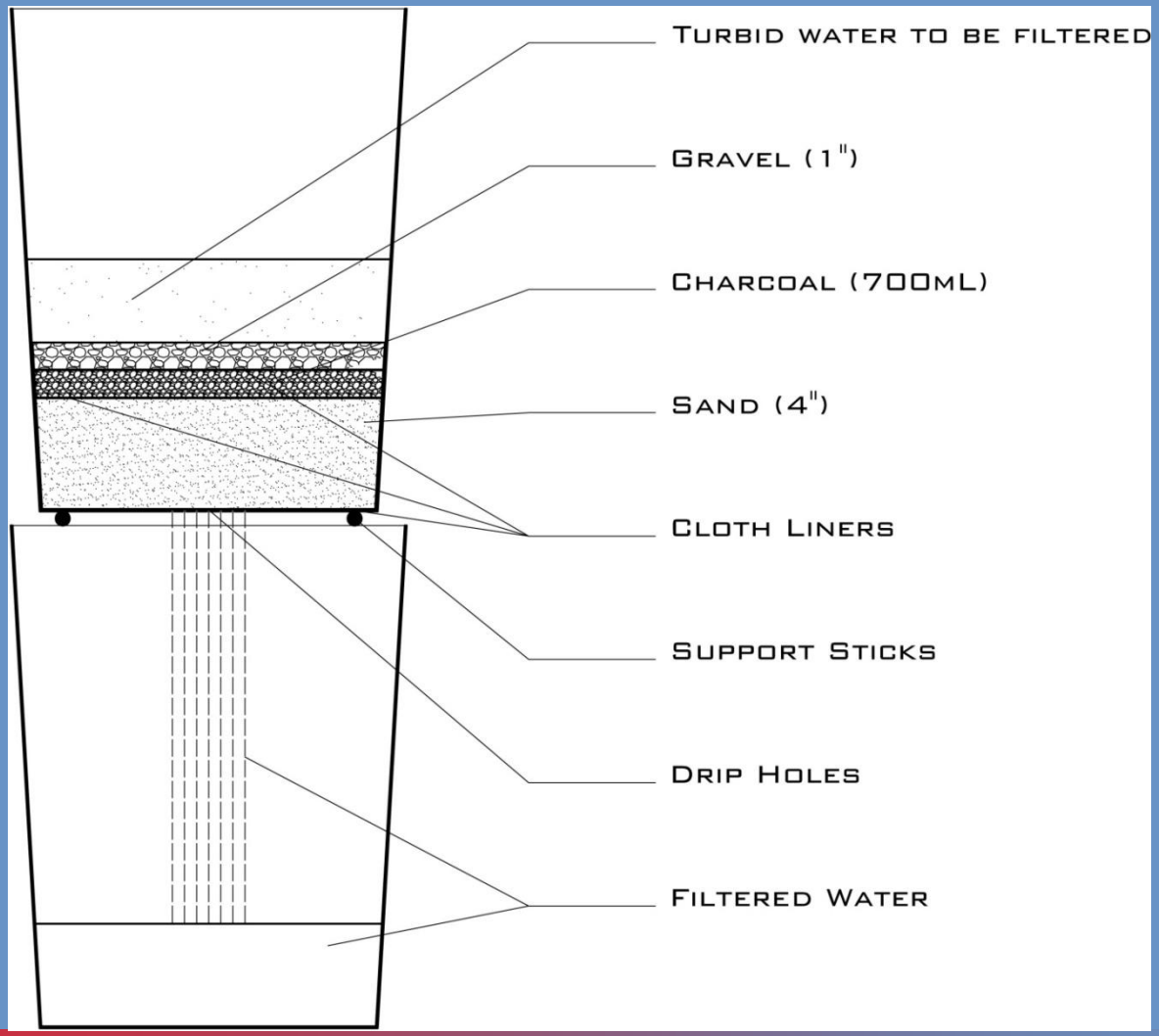
700 ml washed charcoal

1" washed gravel

300 ml dirt

5 gallons tap water

Design:


Turbid water to be filtered
Gravel (1")
Charcoal (700mL)
Sand (4")
Cloth Liners
Support Sticks
Drip Holes
Filtered Water

Construction:

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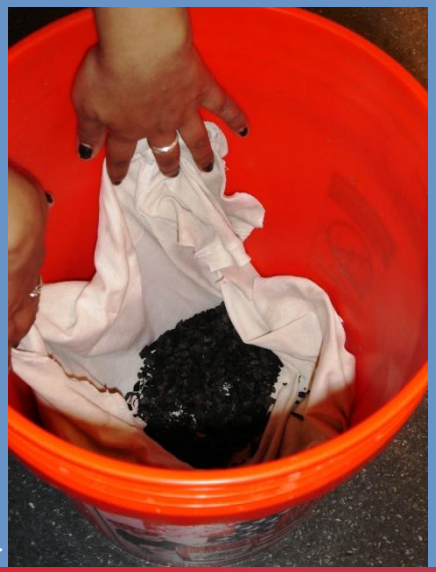

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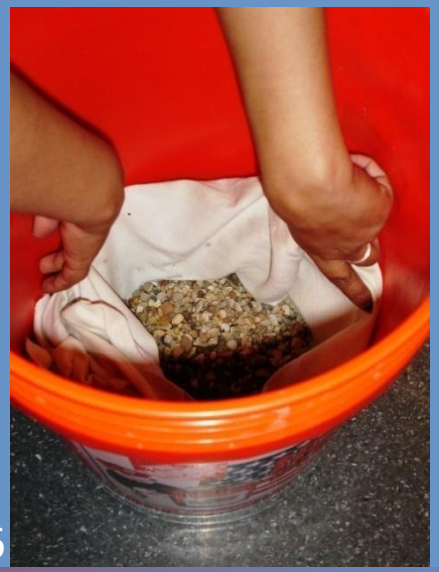

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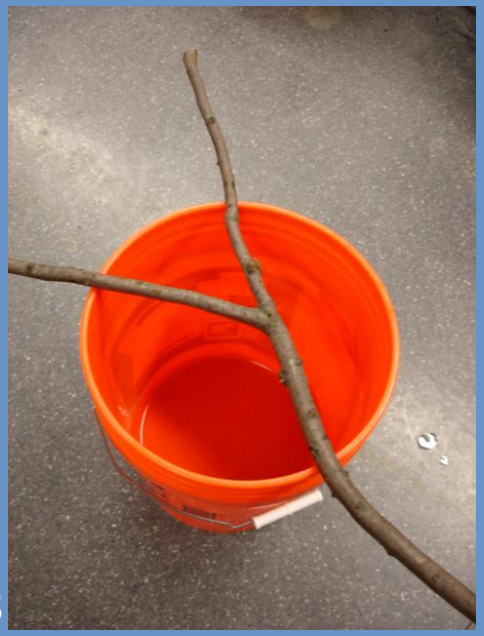

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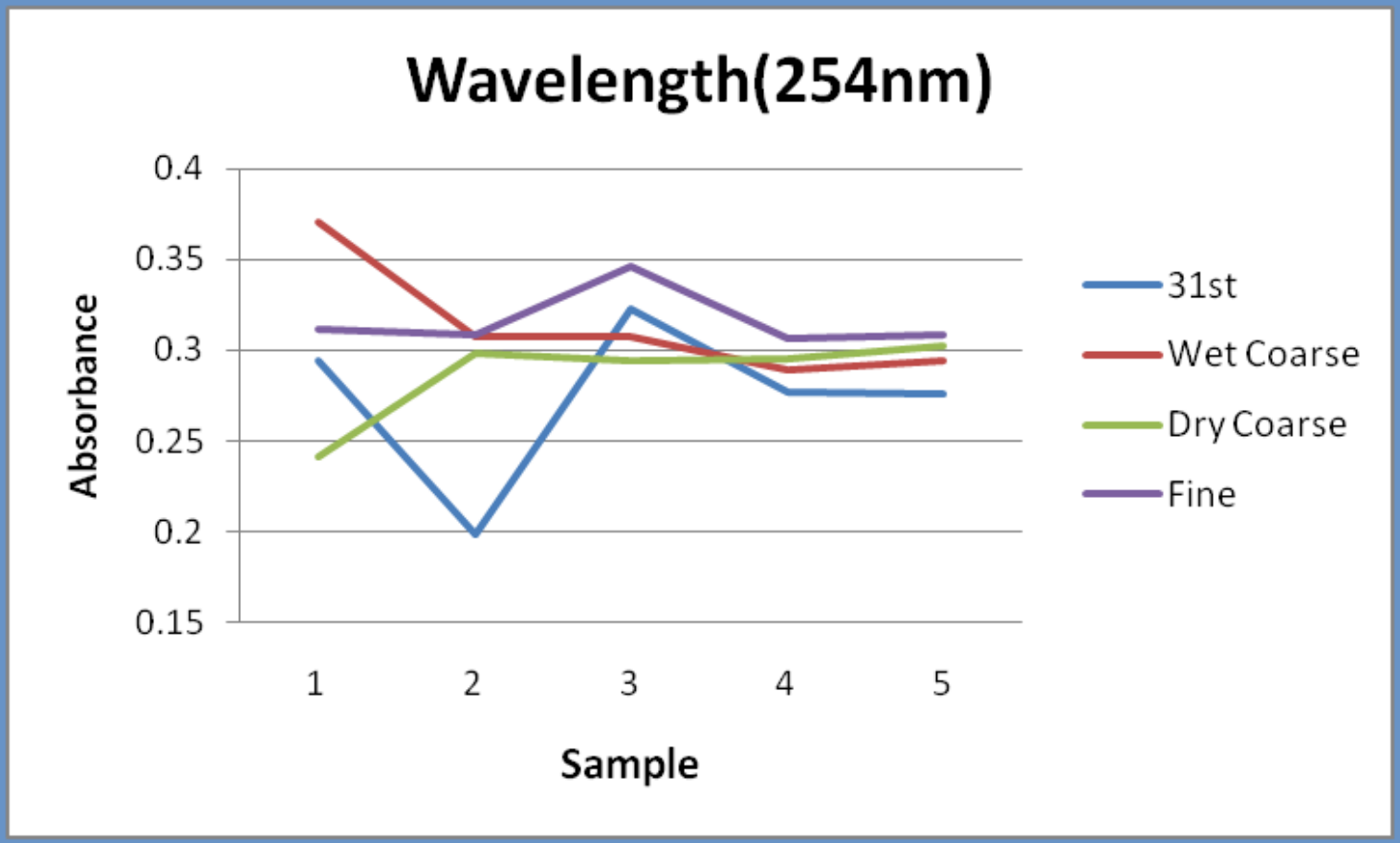
Test : UV- SPECTROMETER

- Analyze concentration of compound from difference of absorbance
- Optical Absorbance Method
- Wavelength : 200nm-800nm
- ABS = $\log(I_o/I)$

Data and Analysis:

- First tests



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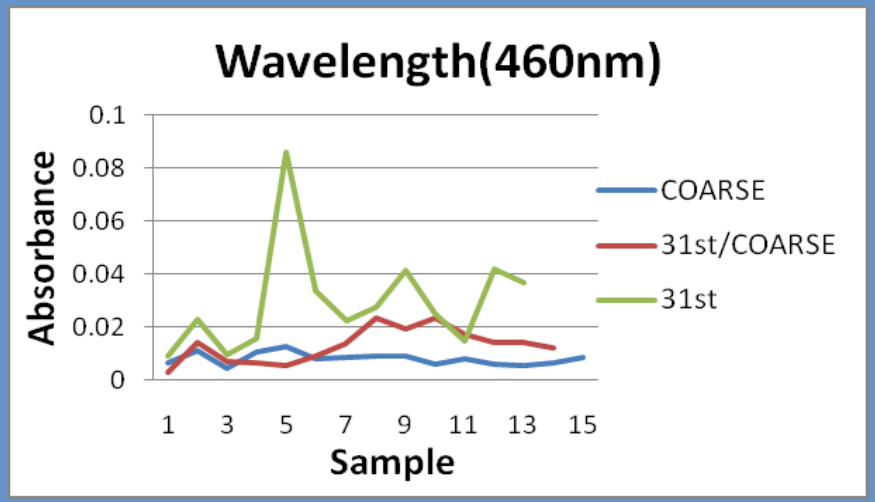
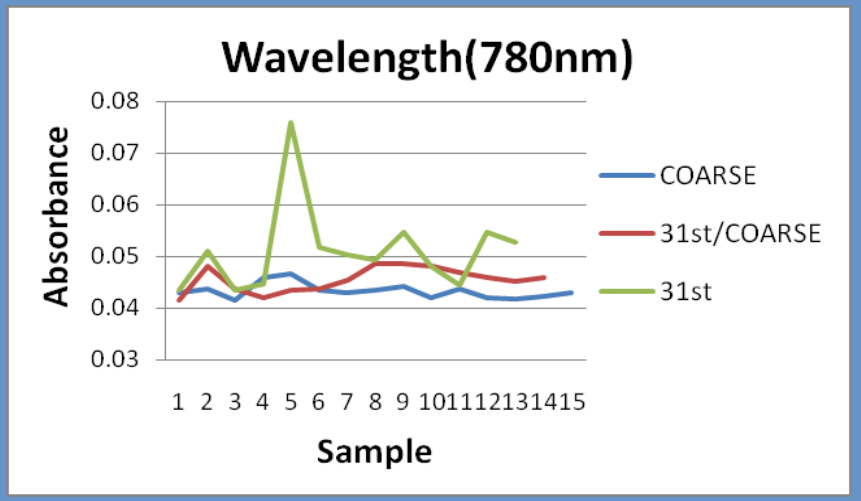
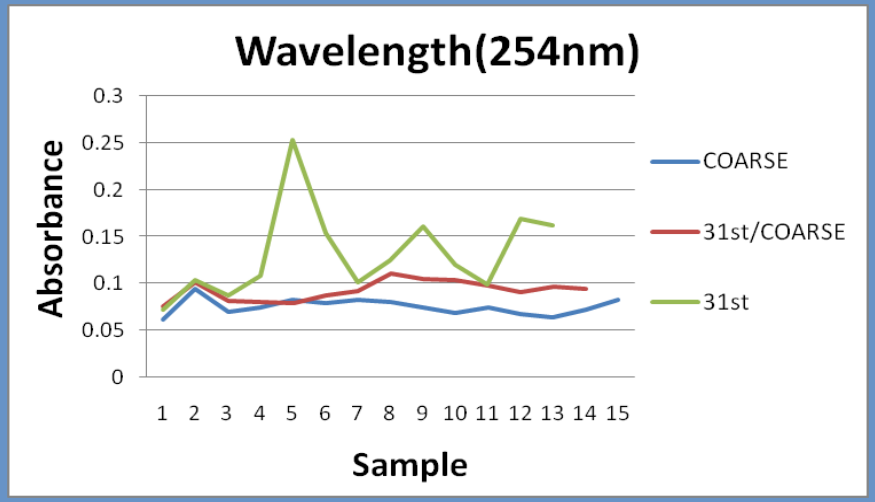
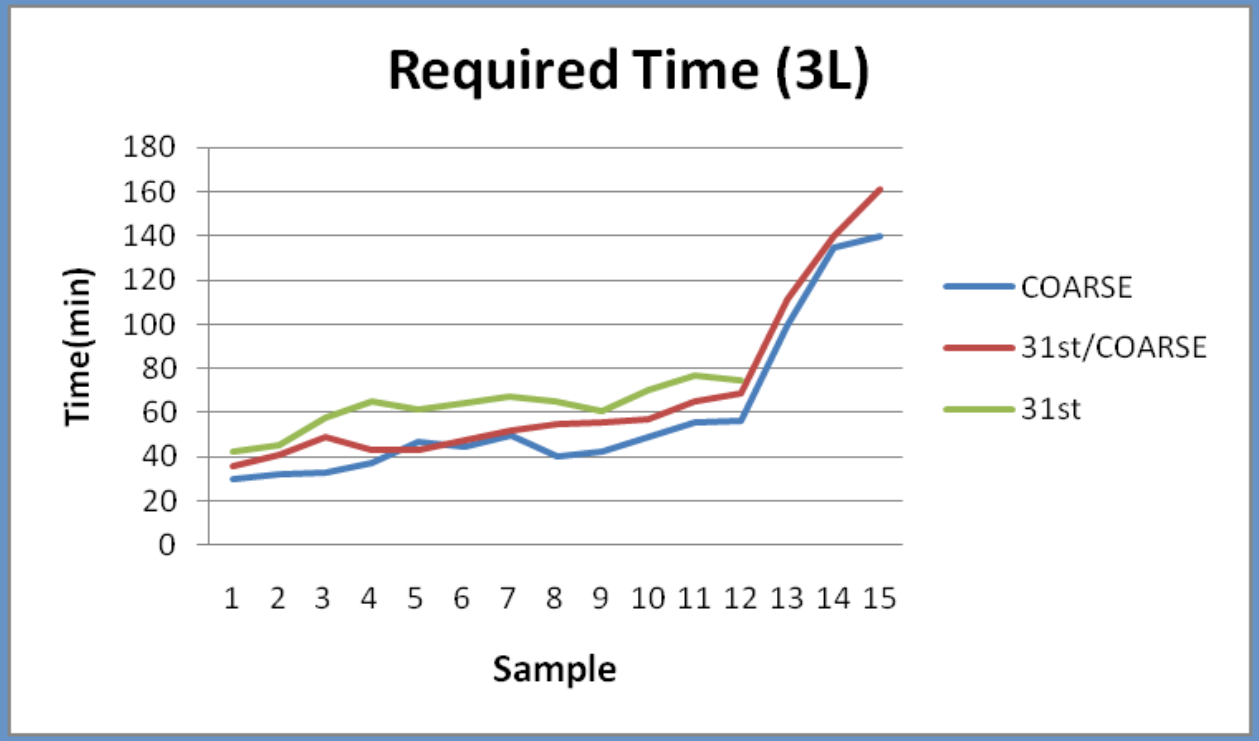






Water Treatment Procedure (254nm)	
Secondary effluent	0.10-0.24
Micro-filtration effluent	0.04-0.10
Reverse osmosis effluent	0.01-0.05

Data and Analysis:



- Amount of water : 10L / 1 day for 5 people (standard family)
- Recommendation : Wash system at least once a week

Budget:

ITEM	QUANTITY	COST
50 lb Gravel	2 @ $3.26	$6.52
50 lb Coarse Sand(1152)	4 @ $2.57	$10.28
50 lb Wet Play Sand(1113)	1 @ $3.08	$3.08
50 lb Fine Play sand	2 @ $3.99	$7.98
Pantyhose	2 @ $3.29	$7.25
5 gallon Bucket	10 @ $2.78	$27.80
Wood Charcoal	2 @ $10.96	$21.92
Lighter Fluid	1 @ $5.49	$5.49
Sifter	1 @ $4.99	$4.99
Strainer	1 @ $2.99	$2.99

TOTAL=$98.30

Major Obstacles:

- Lack of legible and consistent record from previous semesters
- Lack of experience in chemistry field
- New design failure
- Revision of new design to correct failure

IMPLEMENTATION:

Peru trip Jan. 5th – Jan. 19th

- Members traveling: Suk Hwan Yun & Katrina Ongchangco
- University of Massachusetts at Lowell (Professor Duffy & students.)
- Conjunction with SODIS system

Pre-trip preparation

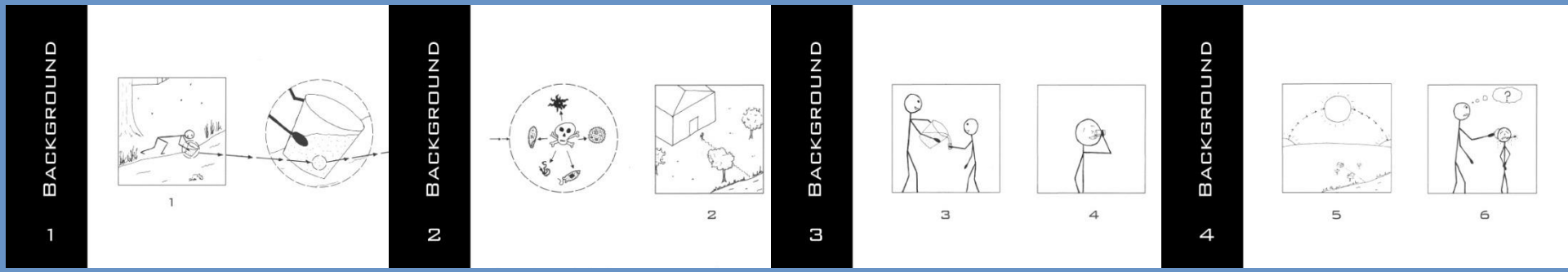
- Ensure system is functioning properly
  - -Testing prototypes and collecting samples
- Research cultural implications
  - -Professor Raul Gutierrez
- Finalize workshops & manuals

Plans in Peru

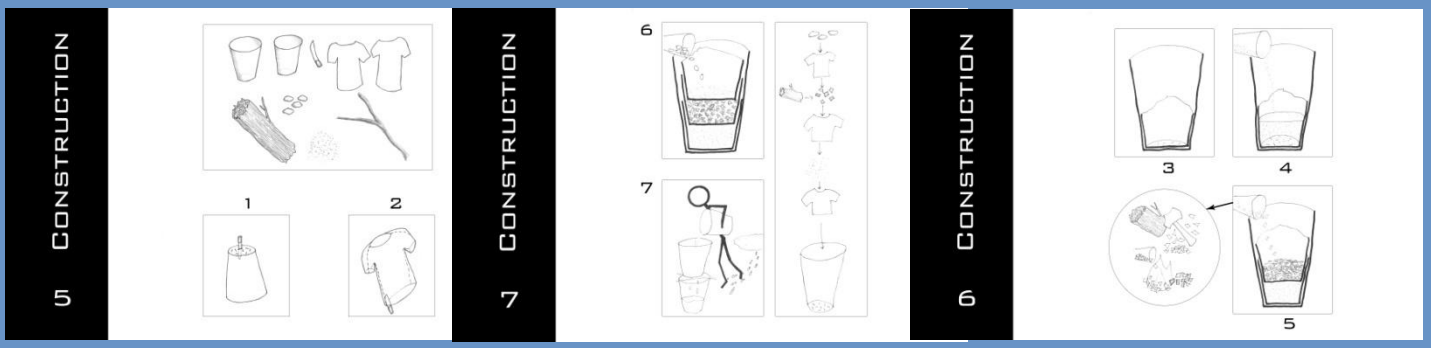
- Test 2-bucket system using local materials
- Plan workshops to present system and show how to construct
- Present the construction manual to leave in Peru
- Make contacts for future Peru trip in Summer 2009

Manual:

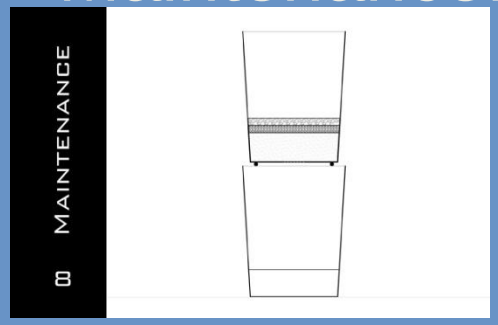
Background:

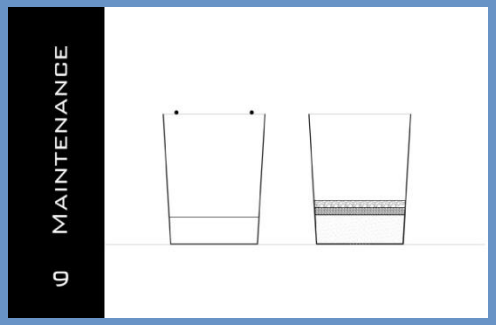


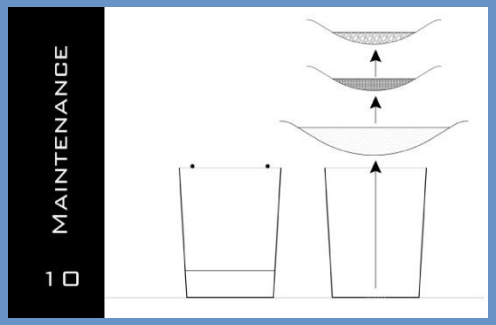
Construction:

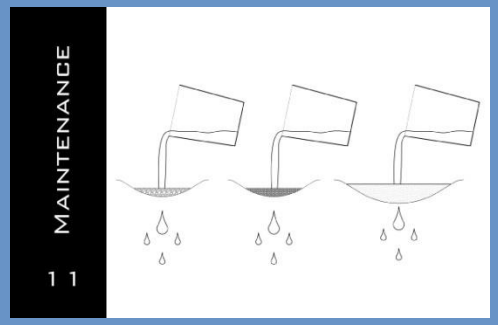


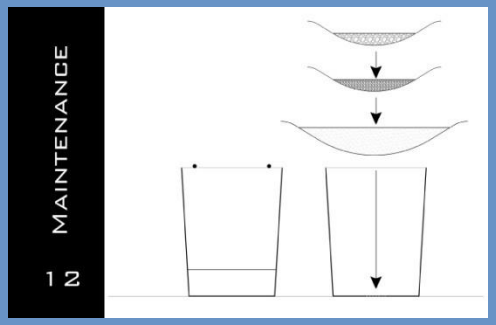
Maintenance:

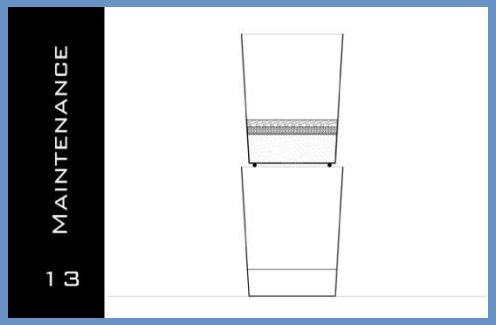




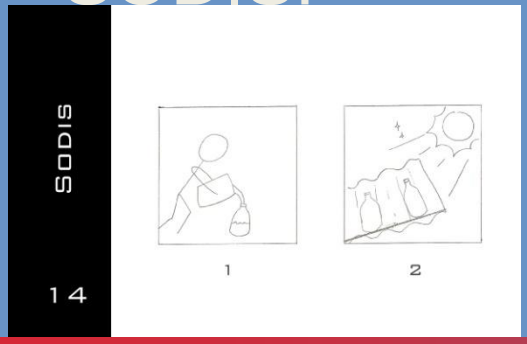








SODIS:



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- Peter Johnson: *Chemistry Faculty*
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- Margaret Huyck: *Psychology Faculty*
- Ken Schug: *Chemistry Faculty*
- Anthony Mihovilovich: *Chemistry Student*
- Dave Curtin, Ryan Whittans, Brian Schiller: *Fall 08*

Sources:

- WHO: World Health Organization
- Solar Water Disinfection

Questions??