

# Engineering World Health Water Filtration Project

Team Leader: Brad Lindevig

Communicator: Nick Shiley

BSAC: Karin Rasmussen

BWIG: Claire Wardrop

Client: Dr. Shropshire and Evert Mangar

Advisor: Amit Nimunkar and Professor John Webster

# Problem Statement

- \* Many people in developing regions around the world have either limited access to purified drinking water due to contaminated water sources. This problem results in preventable diseases and even death. Water filtration systems are necessary to rid the local water from bacteria, pesticides and viruses. In order to make these systems effective in their respective regions they must be made from material found near the region of interest, require low maintenance and be efficient.

# Background

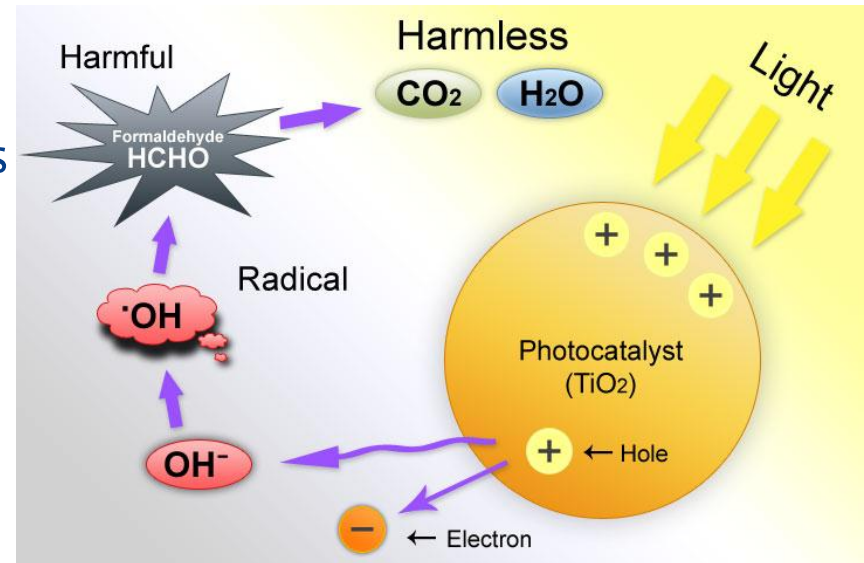
- \* 17.6 million die every year
- \* Caused by bacteria, viruses and other chemicals
- \* Current methods
  - \* Reverse Osmosis
  - \* UV Radiation
  - \* Chlorination
- \* Hillside Clinic in Punta Gorda, Belize

# Design Specifications

- \* Must rid water of bacteria, viruses, and other chemicals comparable to current methods
- \* Must be made from easy-to-obtain resources
- \* Low maintenance
- \* Environmentally friendly

# Overview

- \* Glass coated in  $\text{TiO}_2$  has been shown to purify water when reacted with UV light
  - \* Inactivates organic materials
  - \* UV light excitation
  - \* “nano” powder form
  - \* Two step process
- \* Create a water filtration system that effectively purifies water utilizing solar energy



<http://www.jgf.co.uk/touchclean.htm>

# Design Alternative #1

- \* Water bottles coated with  $\text{TiO}_2$ .
- \* Place on top of roofs
- \* Positives
  - \* Simple
- \* Drawbacks
  - \* Plastic
  - \* Not efficient



Example of water bottles coated with  $\text{TiO}_2$

# Common Features of Design

- \* Microcontroller
- \* Solar panel
- \* Valve
- \* Gravity acting as pressure
- \* Glass beads coated with  $\text{TiO}_2$

# Design Alternative #2

- \* Tube filled with glass coated beads controlled with solar panel
- \* Positives
  - \* Transportable
- \* Drawbacks
  - \* Inefficient due to low surface to volume ratio

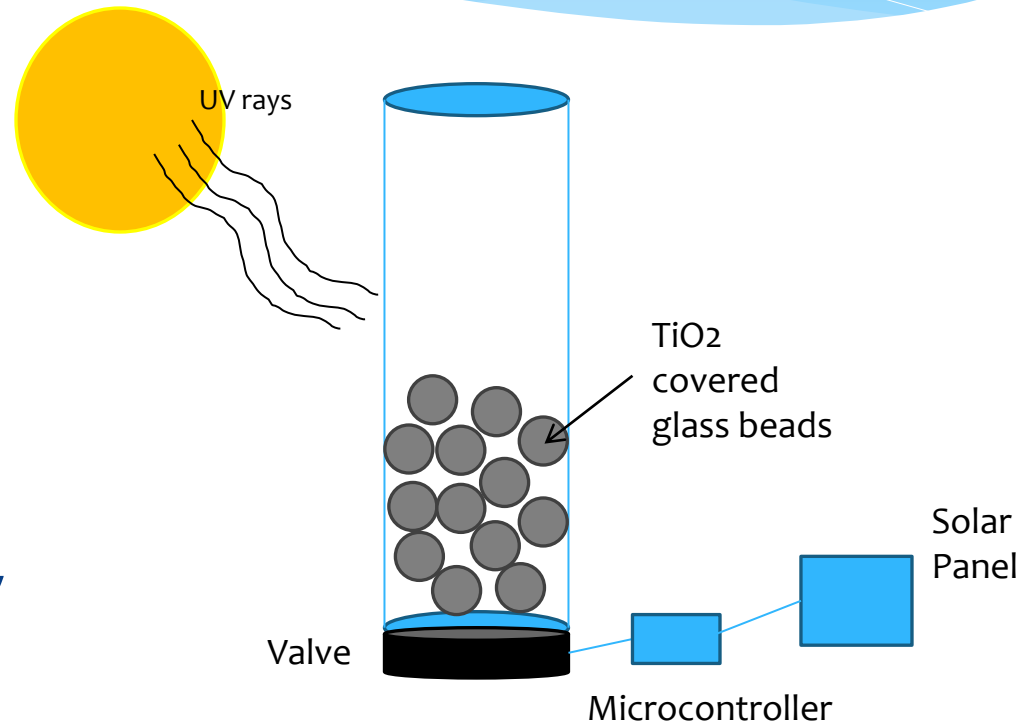


Diagram of the cylinder containing TiO<sub>2</sub> covered glass beads



# Design Alternative #3

- \* Trickle Down System
- \* One layer of  $\text{TiO}_2$  coated glass
- \* Positives
  - \* Efficient
  - \* Self sustaining
- \* Drawbacks
  - \* Cumbersome

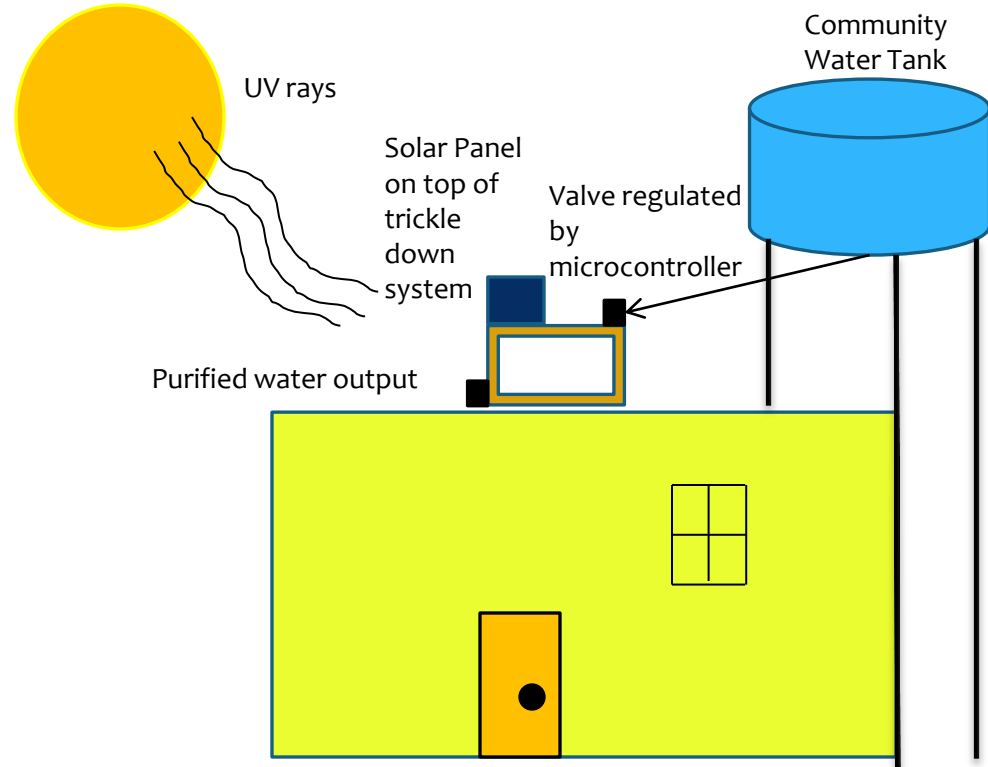


Diagram of the trickle down system

# Design Matrix

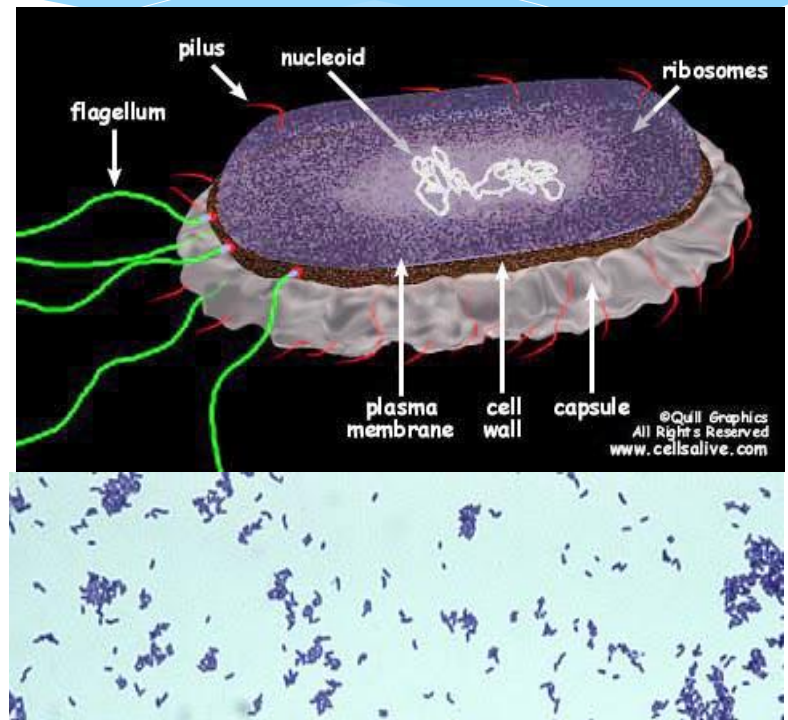
Design	Simplicity (10)	Effectiveness (10)	Usability (10)	Reliability (10)	Total (40)
Plastic bottles	10	6	3	6	25
Tube with beads	8	7	6	8	29
Platform	7	9	8	8	32

# Future Work

- \* Program microcontroller
- \* Calculate UV intensity to purification rate ratio
- \* Compare results with chlorinator experiments
- \* Obtain technical details from Belize trip

# Future Work

- \* Experimental Steps
  - \* Grow bacteria
  - \* Control test
  - \* TiO<sub>2</sub> Coated borosilicate dish test
- \* Analyze results
  - \* Bacteria viability test (agar)
  - \* Microscope
  - \* Test other chemicals with water testing kit



<http://medbankers.blogspot.com/2007/>



# References

- \* APEC. *Water Purification vs. Basic Filtration*. Retrieved from <http://www.freedrinkingwater.com/water-education/quality-water-purification.htm>.
- \* Home Water Purifiers and Filters. *Ultraviolet Water Purification*. Retrieved from <http://www.home-water-purifiers-and-filters.com/ultraviolet-filter.php>.
- \* GE Power & Water. *Chapter 27 – Chlorine and Chlorine Alternatives*. Retrieved from [http://www.gewater.com/handbook/cooling\\_water\\_systems/ch\\_27\\_chlorine.jsp](http://www.gewater.com/handbook/cooling_water_systems/ch_27_chlorine.jsp).
- \* Rapp, L. (n.d.). *Gram staining*. Retrieved from [faculty.stcc.edu/rapp](http://faculty.stcc.edu/rapp)
- \* Sunada, K., Watanabe, T., & Hashimoto, K. (2002). Studies on photokilling of bacteria on TiO<sub>2</sub> thin film. *Journal of Photochemistry and Photobiology*.
- \* *TouchClean Anti Bacterial Finish*. (n.d.). Retrieved 2 28, 2011, from <http://www.jgf.co.uk/touchclean.htm>
- \* World Health Organization. *Water supply, sanitation, and hygiene development*. Retrieved from [http://www.who.int/water\\_sanitation\\_health/hygiene/en/](http://www.who.int/water_sanitation_health/hygiene/en/).