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CAWST is a Canadian non-profit organization focused on the principle that clean water changes lives. Safe water and basic sanitation are fundamentals necessary to empower the world's poorest people and break the cycle of poverty. CAWST believes that the place to start is to teach people the skills they need to have safe water in their homes.

CAWST transfers knowledge and skills to organizations and individuals in developing countries through education, training and consulting services. This ever expanding network can motivate individual households to take action to meet their own water and sanitation needs.

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This presentation is used with  
Lesson Plan 7: Household  
Water Treatment in the CHP for  
Trainers Trainer Manual.

Available at

[www.cawst.org/resources](http://www.cawst.org/resources)

# Household Water Treatment Options and Evaluation



# Learning Expectations

1. Discuss various household water treatment options.
2. List and describe the four main criteria for evaluating household water treatment options: *Effectiveness, Appropriateness, Acceptability, Cost.*

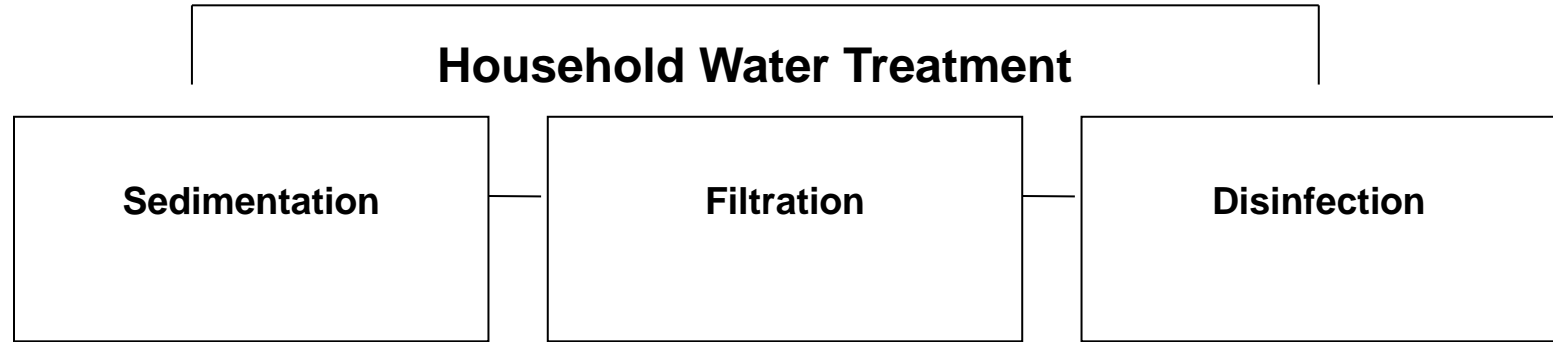


# What is Household Water Treatment?

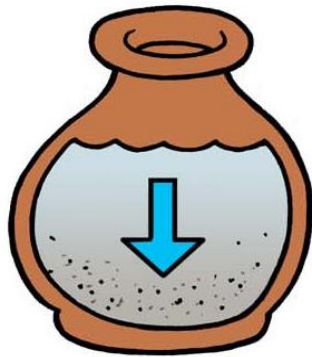
- Treatment process for contaminated water that is based in home or situated right where it will be used



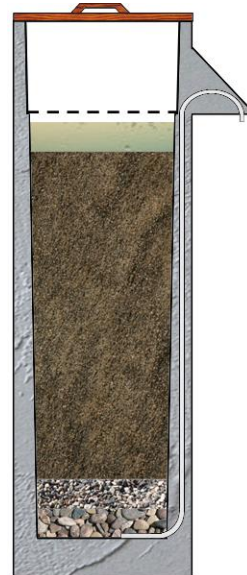
# What is Household Water Treatment?



Settling



Biosand Filter



Chlorine



# Review

- What are the three steps to household water treatment?
  1. *Sedimentation*
  2. *Filtration*
  3. *Disinfection*



# HWTS in **Country**

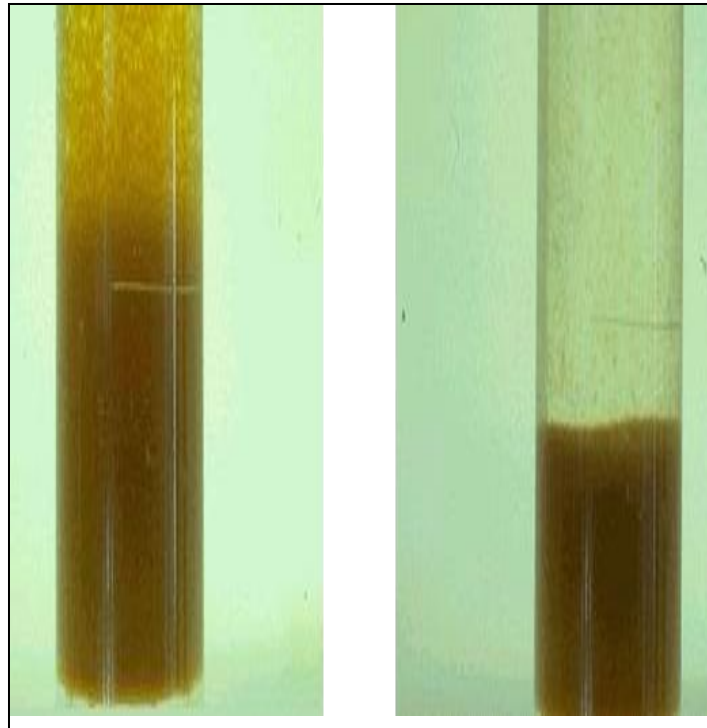
What HWTS options are currently being used in your country?





# HWT: Sedimentation

- Reduces turbidity
- Removes protozoa, helminths and some bacteria



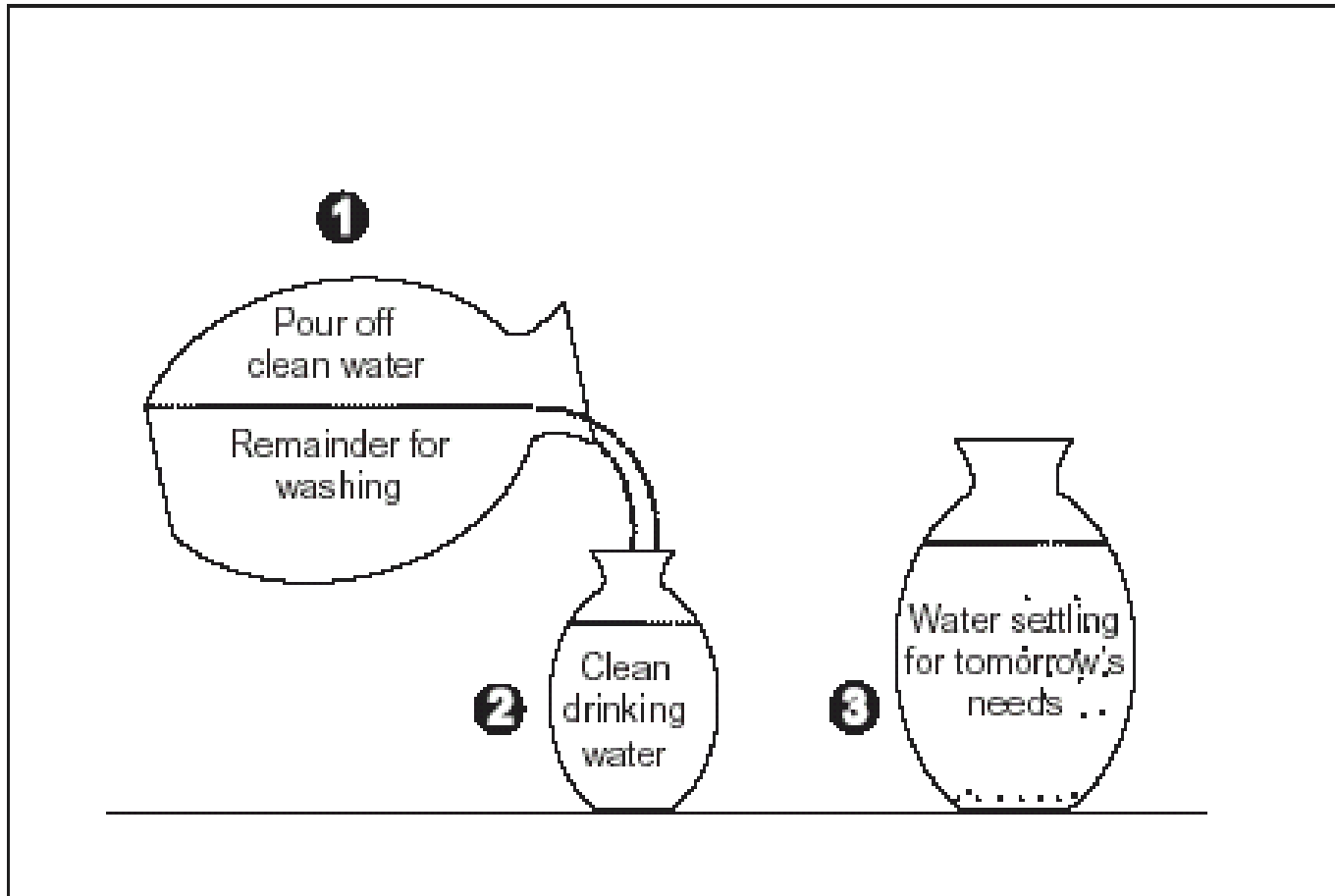
# Sedimentation

Options:

1. Settling
2. Natural Coagulants
3. Chemical Coagulants



# Sedimentation: Settling



# Sedimentation: Natural Coagulants



Dried clearing nuts  
(Credit: [www.farmwealthgroup.com](http://www.farmwealthgroup.com))



Prickly pear cactus  
(Credit: Tennant)



A. de Saint-Sauveur

**Moringa seeds in a pod**  
(Credit: [www.hear.org](http://www.hear.org))

**Moringa seed pods**  
(Credit: [www.moringanews.org](http://www.moringanews.org))



# Sedimentation: Chemical Coagulants



**Alum block (Credit: [www.cdc.org](http://www.cdc.org))**



**Alum potash  
(Credit: [www.germes-online.com](http://www.germes-online.com))**

# Review

- Describe the process of sedimentation and give two examples.
- *Reduce the turbidity of water*
- *Reduce pathogen content*
- *Settling, natural and chemical coagulants*



# HWT: Filtration

- Used after sedimentation to further reduce turbidity and remove pathogens
- Physical process that passes water through filter media





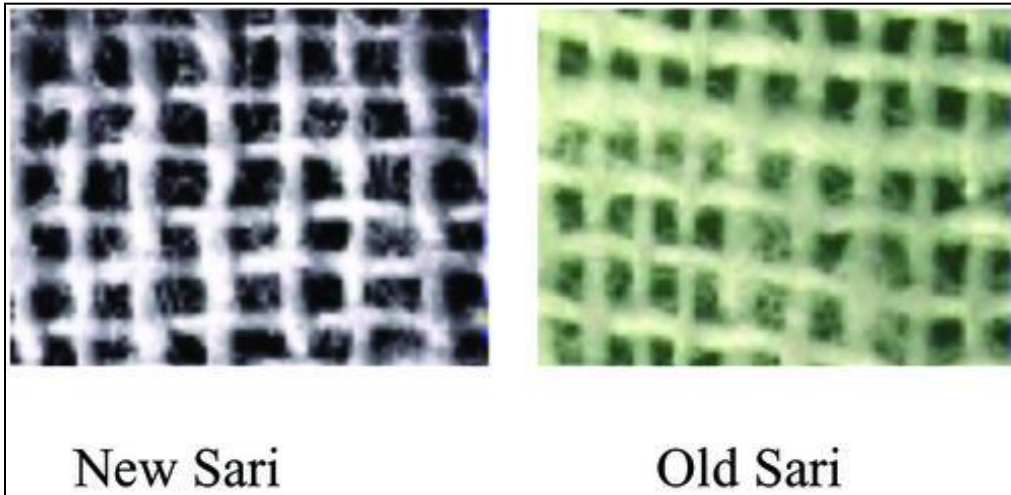
# HWT: Filtration

Options:

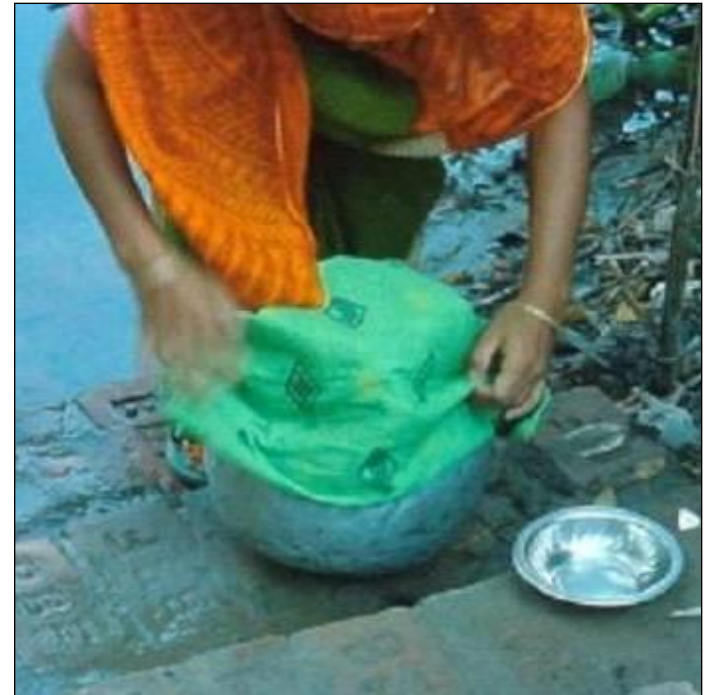
1. Straining
2. Biosand filter
3. Ceramic pot filter
4. Candle filter



# Filtration: Straining

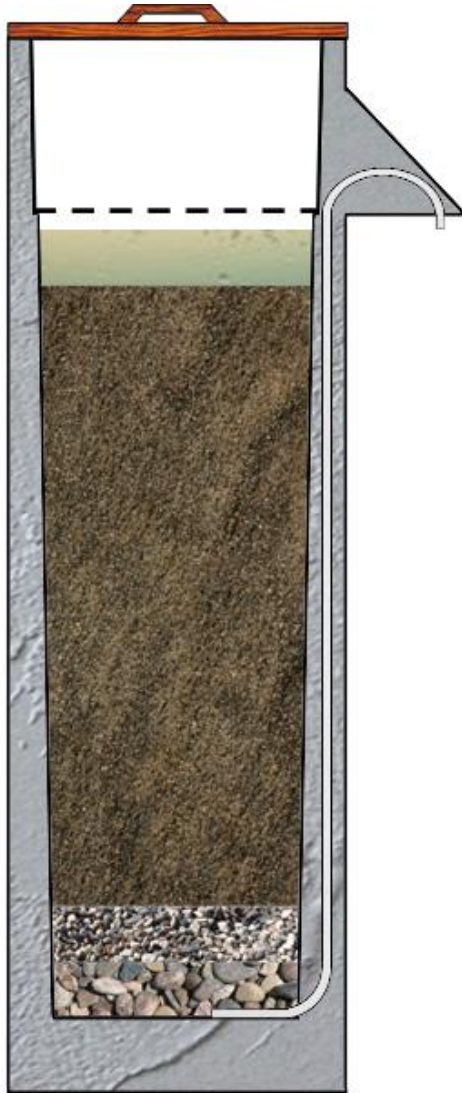


Electron micrographs of a single layer of sari cloth (Credit: Colwell et al., 2002)



Using a sari cloth to strain water

# Filtration: Biosand Filter



# Filtration: Ceramic Pot Filter



**Flat Bottom Ceramic Pot Filter  
(Credit: Potters for Peace)**



**Round Bottom Ceramic Pot Filter  
(Credit: Filter Pure Inc)**

# Filtration: Ceramic Candle Filter



**Different Ceramic Candles**



**Ceramic Candle Filter  
(Credit: BushProof)**

**Ceramic Candle Filter**



# Review

- Describe filtration and give two examples of options.
- *Effective pathogen removal*
- *Biosand filter*
- *Ceramic pot filter*
- *Ceramic candle filter*



# HWT: Disinfection

- Last step in household water treatment process to remove or kill any remaining pathogens
- Does not reduce turbidity





# HWT: Disinfection

Options:

1. Boiling
2. Chlorine
3. Solar Disinfection (SODIS)
4. Solar Distillation





# Disinfection: Boiling

- Pathogens are killed at 100 degrees Celsius
- Boiling water for 1 minute deactivates all pathogens



**Boiling kettles (Credit: Philtar)**

# Disinfection: Chlorine

- Protection against recontamination
- Affected by turbidity, organic matter, ammonia, temperature and pH
- High turbidity = sedimentation and filtration first
  
- Some protozoa and helminths are resistant to chlorine
  - *Toxoplasma*, *Cryptosporidium parvum*,
  - *Ascariasis lumbricoides*, *Schistosoma*



# Chlorine: Sodium Hypochlorite

- Chlorine concentrations range from 0.5 to 10%
- Various products available, including household bleach



Air Rahmat, Indonesia  
(Credit: Tirta/JHUCCP)

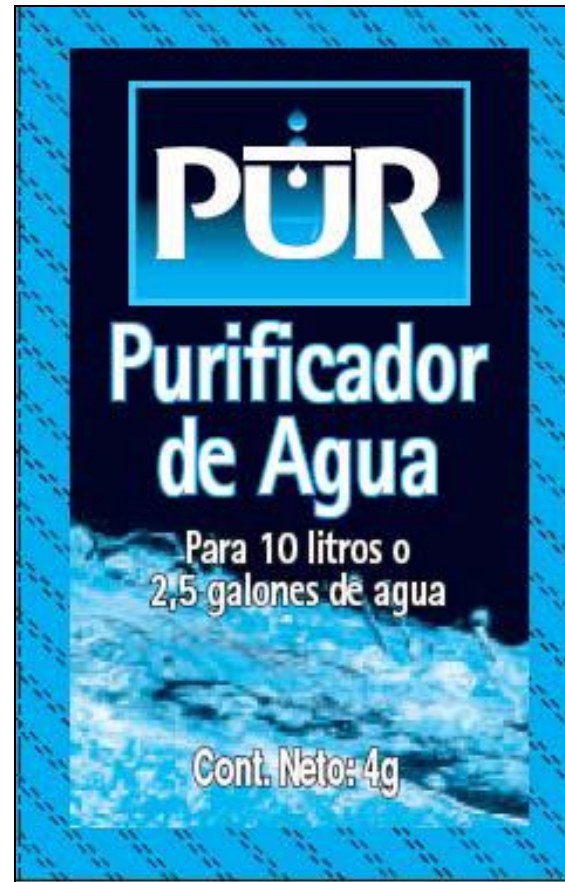
# Chlorine: NaDCC Tablets

- Often used in emergencies
- Different NaDCC contents (e.g. 3.5 mg to 8.68 g) to treat different volumes of water (e.g. 1 to 2,500 litres)



# Chlorine: PuR

- Coagulant + chlorine
- Reduces turbidity and disinfects





# Disinfection: Solar Disinfection (SODIS)



# Disinfection: Solar Disinfection (SODIS)

- Uses solar radiation and temperature to kill pathogens
- Disinfects small quantities of water with low turbidity
- Transparent, non-coloured 1-2 litre plastic bottles
  - Made from polyethylene terephthalate (PET)
- Exposed to sunlight for a minimum 6 hours



# Disinfection: Solar Pasteurization



Using a solar panel to pasteurize water  
(Credit: [www.smc.edu](http://www.smc.edu))



Water Pasteurization Indicator (WAPI)  
(Credit: Solar Cooker International)

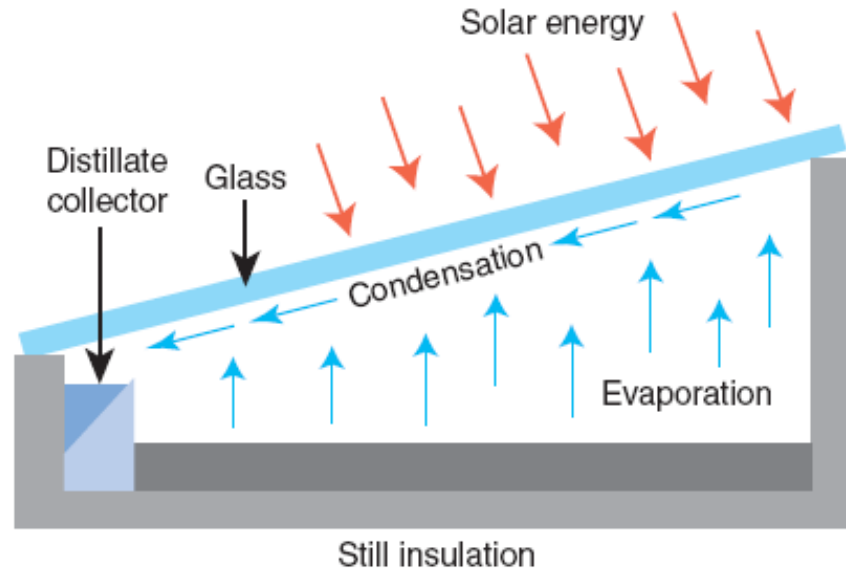


# Disinfection: Solar Pasteurization

- Process of disinfecting water by heat or radiation
- Same effect as boiling, but at lower temperatures (usually 65-75°C), over a longer period of time
- Simple method of pasteurizing water is to put blackened containers of water in a solar cooker
- Thermometer or indicator is needed



# Disinfection: Solar Distillation



**Box Still (Credit:  
Smith, 2005)**

## Function



# Disinfection: Solar Distillation

- Evaporation → vapour → condensation
- Any contaminants are left behind
- One of the few options for treating saline/brackish water



# Review

- Why is disinfection important to do after sedimentation and filtration?
- *Prevents recontamination*



# Review

5. Give three options that you could recommend for disinfection?

- *Boiling*
- *Chlorine*
- *Solar Disinfection*
- *Solar Pasteurization*
- *Solar Distillation*



# Criteria for Evaluation of HWT Options

- Evaluation of each option in order to choose the one that best suits the needs of the household or community by looking at:
  - *Effectiveness*
  - *Appropriateness*
  - *Acceptability*
  - *Cost*

*\*\*Use Fact Sheets in Participant Manual*



# Effectiveness

- Evaluates the quality and quantity of the water that can be treated

## Example: Biosand Filter

- Quality: Very effective in removing turbidity and pathogens
- Quantity: Can filter 12-18 litres each batch; recommend to use 1-4 times each day to ensure effective pathogen removal
- Local water: Can be used with any water source, may need to sediment water before filtering



# Appropriateness

- Evaluates availability, time for treatment, work involved and lifespan of the technology

## For Example: Biosand Filter

- Local availability: Concrete filters can be constructed any where in the world
- Time: Concrete filter flow rate is 0.4 litres/minute
- Operation and maintenance: Simple maintenance when the flow rate slows down
- Lifespan: Concrete filters 30+ years; lids and diffusers may need to be replaced





# Acceptability

- Evaluates the acceptability of the users or user perception and buy in

## For example: Biosand Filter

- Taste, smell, colour: Usually improved
- Ease of use: Easy for adults; may be difficult for small children to pour water into the filter



# Cost

- Evaluates based on the initial and ongoing costs

## For Example: Biosand Filter

- Initial purchase cost: US\$12-40 for concrete filters; US\$75 for plastic filters
- Operating cost: None



# Review

- Use the Fact Sheets in the Participant Manual to evaluate which sedimentation HWT Option would be best for you.
- Discuss why you would choose that one.



# Multi-Barrier Approach to Safe Water

- What could be done to water before and after the steps to household water treatment that would help to reduce the risk of illness and disease?



# Multi-Barrier Approach to Safe Water

## Household Water Treatment

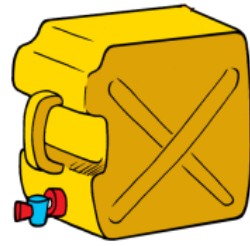
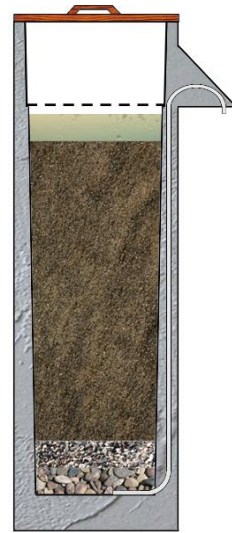
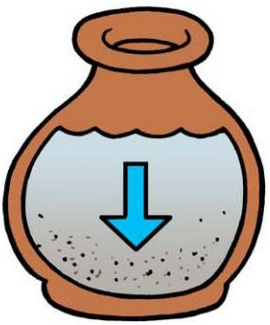
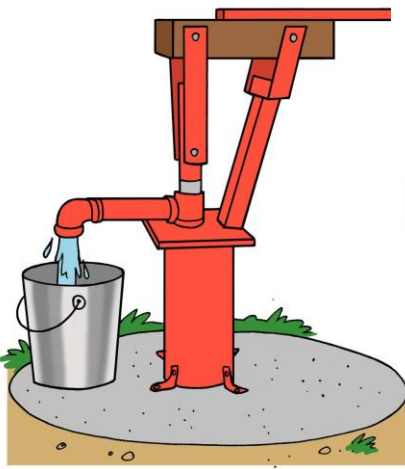
Source Protection

Sedimentation

Filtration

Disinfection

Safe Storage



*Each step provides an incremental reduction in the risk to health.*



# Multi-Barrier Approach to Safe Water

*“Can lead to dramatic improvements in drinking water quality and reduction in diarrheal diseases.”* - World Health Organization

[http://www.who.int/household\\_water/en/index.html](http://www.who.int/household_water/en/index.html)



# Review

- Why is safe water storage at the end of water treatment so important?
- *To prevent recontamination after all the effort gone in to make the water safe to drink*

