

**DISASTER SANITATION:  
You Survive the Earthquake,  
But Die of Dysentery**

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Lamorinda CERT with Duncan Siebert

August 11, 2025

Merilee D. Karr, M.D., M.F.A.

# *Speaker:* Merilee D. Karr, M.D., M.F.A.

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- Retired Family Doctor
  - Interests in Patient Empowerment and Infectious Disease
- Science Writer (M.F.A.)
- Portland NET Team Leader
- Teaching Disaster Sanitation around the Northwest since 2019
  - Building, testing, and refining practical disaster sanitation equipment
- President, PHLUSH.org, all-volunteer 501(c)3, advocates for public restroom access, green sanitation, and disaster sanitation. We helped develop the Portland Loo.

# Etiquette

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- Please hold questions until the end. I mean it. Questions go in the chat.
- ALL questions will be answered. I live to teach.
- How to reach me: [merilee@phlush.org](mailto:merilee@phlush.org)
- Today's slides will be on my website soon: [www.MerileeDeborahKarr.com/disaster-sanitation/](http://www.MerileeDeborahKarr.com/disaster-sanitation/)



# Learning Objectives

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- **PART I. What makes people so sick after disasters?**
  - After large disasters, loss of sanitary facilities can cause dysentery and other infections.
  - Know **HOW** lack of sanitation makes people sick.
- **PART II. Actions to keep your people safe**
  - **The Big Picture:** Leadership. Case study NZ.
  - **Preparing:** Before – Build and distribute accessible, affordable alternative sanitation equipment.
  - **Managing:** During – Deploy and maintain equipment, enlist buy-in by users.
  - **Containment:** During and after – Maintain control of infectious materials to prevent sickness



# PART I

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What Makes People Sick  
after Natural Disasters?

# When Sanitation Systems Fail

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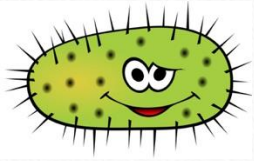
- Sanitation failure lets intestinal microbes like E. coli out into the environment
  - In the intestine, they were harmless, some even useful for digestion
- They reach the mouth via hands, dirty water, & food – the **Fecal-Oral route**
- The stomach doesn't want them in there!
- The digestive system expels the bugs with a rush of fluid called **dysentery**, or severe diarrhea. Worse than food poisoning.
  - The gut just wants to help
  - Thanks a lot.



# Why is there Sanitation?

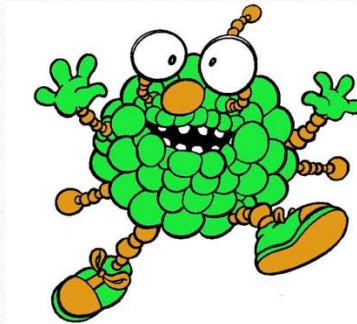
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- Millenniums before germ theory, people knew poop was dangerous. They built infrastructure to protect themselves from it
- Sanitation systems protect us from the pathogens in poop
- Substitute infrastructure can reduce illness and save lives
  - Especially if available quickly



## Without sanitation These critters in poo run free:

- E.coli
- Norovirus\*
- Salmonella
- Hepatitis A & E\*
- Cholera
- Typhoid



- Campylobacter
- Listeria
- Staph
- Shigella
- Cryptosporidium\*
- Polio virus\*



\* Hand sanitizer can't kill them

# Consequence: Dysentery

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- **For the patient:** Dehydration, electrolyte loss, misery, even death
- **For the community:** Germs in uncontained diarrhea reach more people, and cause more diarrhea, which reaches exponentially more people, etc.
  - Fecal-Oral Transmission
  - Sadly common in disasters, refugee camps, unhoused, developing world
  - Most vulnerable: **Children, Elderly, Pregnant**
  - Dysentery can kill more people than the original catastrophe
  - Sanitation Team can save more lives than Medical Team

# DON'T Make Toilet Seats Airtight

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Counterintuitive, right?

- You'd think pee & poo should be sealed away. But no.
- Because oxygen kills the worst bacteria
  - The most dangerous bacteria: called “anaerobes” meaning ‘without air’
  - Air circulation kills them

**HOW** do we replace sanitation systems?

***WITHOUT***

Clean running water?

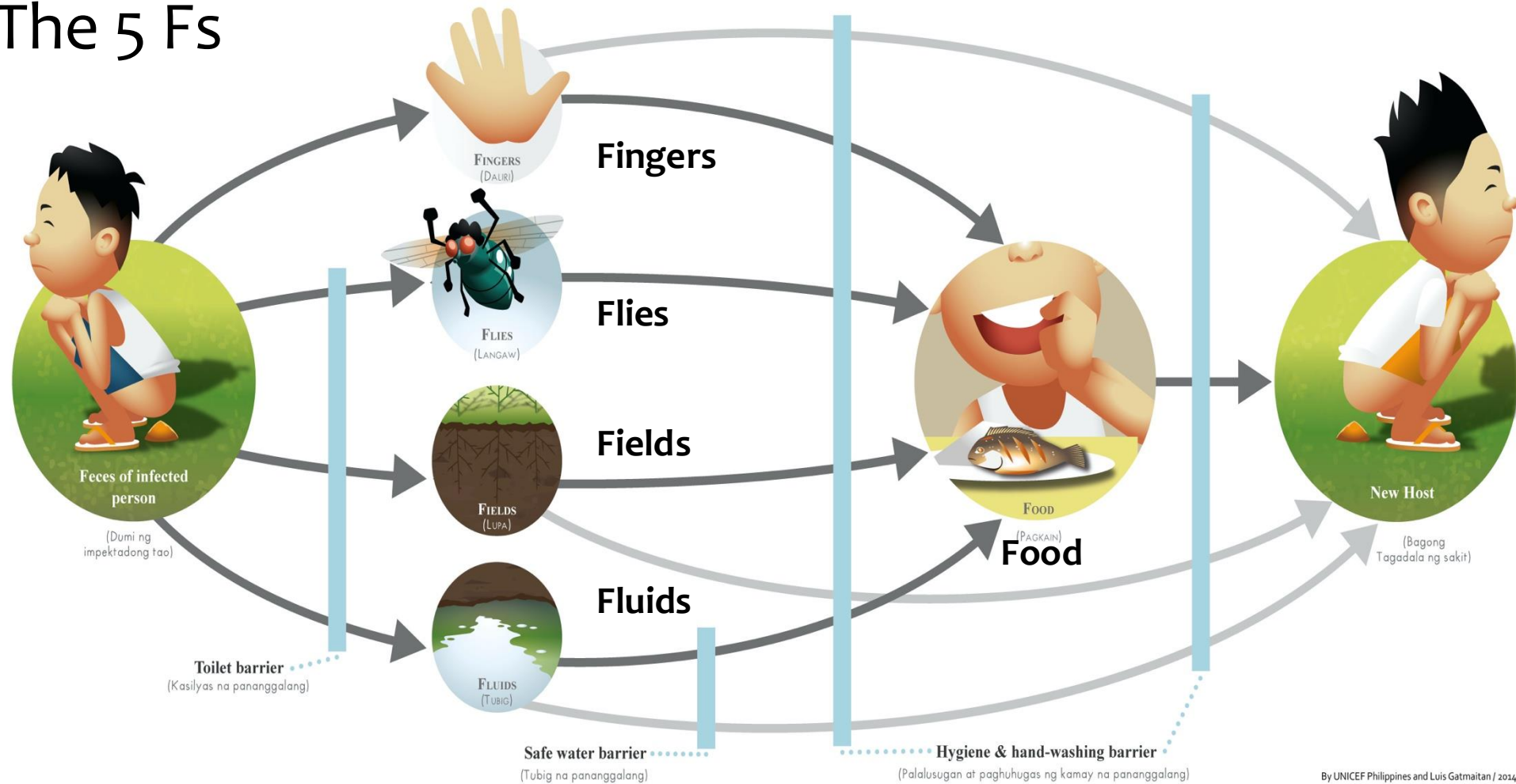
Sewers?

or Flush toilets?

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*We Stop the 5 Fs!*

# The 5 Fs



By UNICEF Philippines and Luis Gatmaitan / 2014 / Creative Commons

UNICEF

# 5 Paths to Infection – Block Them All!

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- **5 ways** germs get from one person's bottom to another's mouth.
  - **FINGERS** – *Wash Those Hands!*
  - **FLIES** – *Cover Poop in Bucket Toilets and Latrines! Cover food!*
  - **FIELDS** – *Latrines! Don't dig into water table! Cover poop deposits!*
  - **FLUIDS** – *Store clean water!*
  - **FOOD** – *Keep Flies Off Your Food! Wash Dishes!*

World Health Organization

# 1. Fingers



- Make it **easy** for everyone to wash their hands
  - If it isn't easy, and easily available, too often it won't happen
  - Don't blame people who don't wash
    - They're busy surviving.
    - Make it easy to do the right thing
- Set up handwashing equipment at toilets, food prep, eating areas, medical areas

## 2. Flies



- Flies carry germs from poop to food
- So, keep their tiny feet off the poop...
  - Cover contributions to poop buckets & latrines with dry materials
- And, off your food
  - Vigilance with food, plates, utensils
  - Dishwashing set ups must be easy to find and use

## 3. Fields

- Latrines
- Cover deposits to latrines, so flies can't give germs a free ride



## 4. Fluids

- **Store water**
  - For handwashing and dishwashing
  - Treating dysentery uses up a lot of precious water
- **Protect water**
  - **Dig** latrines where they won't contaminate water
  - **Know** how far down your water table is
    - Basic rule: If you dig and find water ... Dig somewhere else!



## 5. Food



- Isolate food from fly-carried germs
  - Teach how to protect food from flies
  - Provide easy access to dishwashing set-ups
- Protect food from other critters, too – Rats, raccoons, etc.

# Summary of Part I

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## The Danger

- A disaster that disrupts sanitation can sicken & kill
- Via dysentery, infectious diarrhea
- Caused by poop germs reaching mouths
- **In your power to prevent!**

## What We Can Do

- Block all 5 Fs
  - Fingers
  - Flies
  - Fields
  - Fluids
  - Food



# PART II

Actions to keep you and your community safe

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The Big Picture

Preparing: What to Get, Make, Store

The Nitty Gritty: How to Make What You Need

# The Big Picture



- ✓ Poop vs. Pee
  - ✓ Leadership and the Disgust Reflex
    - ✓ Case Study: New Zealand

# POOP vs PEE

## Different management challenges

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### POOP

- Poop is dangerous
- Even small amounts are packed with bad germs
- Good news: We don't produce much
  - < Half-pint/day/person. Compact. Lightweight.

### PEE

- Pee is not dangerous.
- It's even useful, as fertilizer
- Large volumes bad for bodies of water, high nitrogen & phosphorus cause dead zones
- Bad news: We make a lot of it
  - ~ 2 quarts/day, weight 4 lbs. Heavy

# Team Sanitation

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Who? Me?



# Leadership, Staffing, & the Disgust Reflex

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- The people who mind the poo & pee
  - Among the most important, essential, lifesaving people in the survivor community
  - **They may save more lives than the medical team.** For real.
- Problem: We have an instinctive disgust for poop. Good thinking, evolution!
  - But big mistake, evolution: Our disgust reflex extends to those who protect us from it
- Leadership will need to openly value sanitation volunteers
  - If this is a thankless job, it won't be done well. Or maybe at all

# Sanitation Innovation

## Christchurch, New Zealand, Earthquake 2011

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Technical innovation

*and*

Social innovation

# February 22, 2011

## Christchurch, New Zealand

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- Tuesday. 12:50 pm
- Only 6.3, but shallow epicenter, so very strong
- 185 deaths, but *massive* infrastructure damage
  - Water, power, roads, out for **many** months
  - Sewers took ~ a year to restore
- Response: Govt procured:
  - Porta-potties in neighborhoods
    - Too far away for most
  - Chemical toilets for homes
    - Smelly, toxic, carcinogenic
    - Depot tanks for effluent every few blocks. Spills en route. Elderly couldn't carry that far.
    - Flimsy. Some broke under users



← Tank heavy, Sloshing, Spilling

Flimsy →



## Chemical Toilets *Cause Problems in Disaster*

# Why did sewers take so long to restore?

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“The Christchurch earthquakes not only broke the pipes and disabled the pumps, the liquefaction flows filled sewer pipes with silts and other fine material, which is very hard to remove from underground pipes.”

“Of all the infrastructure services (water, power, telecom, roads, transport), the sewer system is most vulnerable to damage in earthquakes and the most difficult to repair .... Identifying the damage is especially difficult (compared to power and water supplies, for example)...”

Gary & Emily Williams, *Waterscape Permaculture*, New Zealand

<https://waterscape.co.nz>

# New Zealand Permaculture Guild

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- Responded to popular discontent about sanitation
- Offered proven eco solutions
  - Separate pee from poo at the source
  - Pairs of buckets in homes
  - Offered workshops
  - Patient persuaders
- Months of twin-bucket toilet workshops
  - Individual interest slowly grew
  - Official interest clicked in at the 6-month mark, when sewers still not functioning
- NZPG won consensus that their method was best practice
- Endorsed by agencies & NGOs



**TWIN-BUCKET TOILET**  
Still found in New Zealand  
In off-grid homes  
and cabins



# Preparing

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What to Get, What to Make  
Where to Keep It

# NUMBERS

## How many, of what, will you need?

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- After the earthquake, your community will look like a refugee camp.
  - Dazed people. Broken buildings. No running water. No sewers. No electric grid.
- So, let's ask the refugee camp experts: the UN High Commission for Refugees.
- UNHCR **minimum: ONE TOILET UNIT for every 20 people.**
- Data: If toilets scarcer than that, more people get sick & die
- One Toilet Unit:
  - Containers for poop & pee OR latrine, Handwashing equipment, Privacy shelter

# Do the Math

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- **One Toilet per 20 people.**
- My neighborhood, South Burlingame, population **1750**
- We will need **87** toilets, with handwashing units
- Oregon City: 37,000 people, needs 1850 toilet units
- Big numbers. Do your best – will be way better than nothing
- Burning Man gets away with one toilet per 40 people
  - But they're all dehydrated

# What You Can Get for Not Much!



Sinks: Both hold 5 gallons

\$80 - \$130



\$850 - \$1200



Camp toilet

\$60 - \$150



Porta-potties

\$700 - \$1300

Hard to transport

# Knowing How Many You Need, What Do You Want?

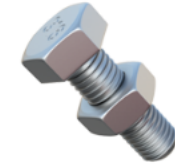
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- Gold toilets? Nope!
- Sanitation does more good, prevents more infections, if ready Day 1
  - Build and distribute **before** disaster
  - Portable toilets & sinks can be bought, but prohibitively expensive
  - Yes, FEMA will bring porta-potties. *Eventually*. Not soon enough to contain E. coli
  - Purchasing commercial is NOT a plan. You can do better



# The Nitty Gritty

## How to Make:



**Handwashing**



**Stations**

# DIY Handwashing Equipment

## *Hands-Free Operation Prevents Infection*

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2 Types that are affordable, sturdy, easy to make & use

Must be *hands-free*, or handle collects germs

- **Spigot** on a container – easy & cheap to make ahead in bulk
- **Tippy Tap** – easy to make in austere conditions without tools

## Turn-Spigot on Container *NOT Hands-Free – Germ Magnet!*

- Intuitive, easy to use, popular
- Handle **easily contaminated**
- **Wastes water** if left open
- Popular for camping, outdoor markets, etc.





# Hands-Free Flip-Spigot on Bucket

- Emergency Volunteer Corps of Nehalem Bay (EVCNB) gives these to residents
- Sanitary, because hands-free
- Water-efficient, because spigot closes when foot pedal is released – < 50 mls per wash, 80 washes per gallon
- Running twine up, sideways, & down keeps water off the twine.
  - Also, off your foot!
- (Ignore the bottom bucket, it's empty, just holding up the handwasher for use)

# Improved Flip-Spigot on Bucket

- I adapted EVCNB's design with drapery hooks to carry the twine, which makes it stackable
- < \$5, takes 15 minutes to make, with power drill
- DIY level Easy
- Need plan for falling water
  - Ground? Catch-bucket?
- On [Instructables.com](https://www.instructables.com)



# BUCKETS can be *FREE*

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- Food businesses receive bulk foods in 5-gallon buckets
- Most go to landfill
- Ask for used buckets at the deli, bakery, caterers, restaurants, even the olive bar. Get lids, if available.

# Tippy Tap

## How to Build

<https://tinyurl.com/Tippy-TapWaterAid>

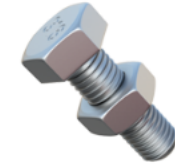
- Easy to build without power tools
- Hands-free
- Widely used in developing world
- Needs gravel at base, or you have a mud field
- Best for outdoors





# The Nitty Gritty

How to Make:



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**TOILETS, URINALS, LATRINES,  
and TOILET SEATS**

# The Twin-Bucket Toilet

- Developed in New Zealand after the 2011 Christchurch earthquake
- Still found in off-grid cabins there



# The Twin-Bucket Toilet

- One bucket for pee, one for poo
- Separation reduces odor
  - Manages both pee & poo, easier & safer
  - Promoted by RDPO, Regional Disaster Preparedness Organization



# Twin-Bucket Toilet

## Pro & Con

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### Pro

- Materials cheap, available
- Easy set up
- Poo lighter weight, smaller volume, without pee
- User separates pee & poo by moving between buckets
  - Easy for people w male anatomy
- Households can manage their own

### Con

- User separates pee & poo by moving between buckets
  - Tricky for people w female anatomy
- If mistakes:
  - Pee in poo bucket just makes it heavier, not a big deal
  - But if any poop in the pee bucket, have to manage as poop. More work

# Wait ... “*managing poop*”? What?

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- After a big pipe-breaking disaster, no pipes will whisk our poop away to a sewage treatment facility
- That’s right – WE’LL BE STUCK WITH IT!
- We will have to store poo, safely, in sturdy bags and containers
  - Roll Carts (for yard debris, recycling, garbage) hold many weeks of poo
  - Dumpsters (make sure bottom drain is capped, and no overhanging branches to give critters access) hold many, many, months of poo
- Must keep it isolated from people, and from rats, raccoons, and insects that can spread its germs
- Advantage latrines. Store our waste in the Earth, which takes care of it

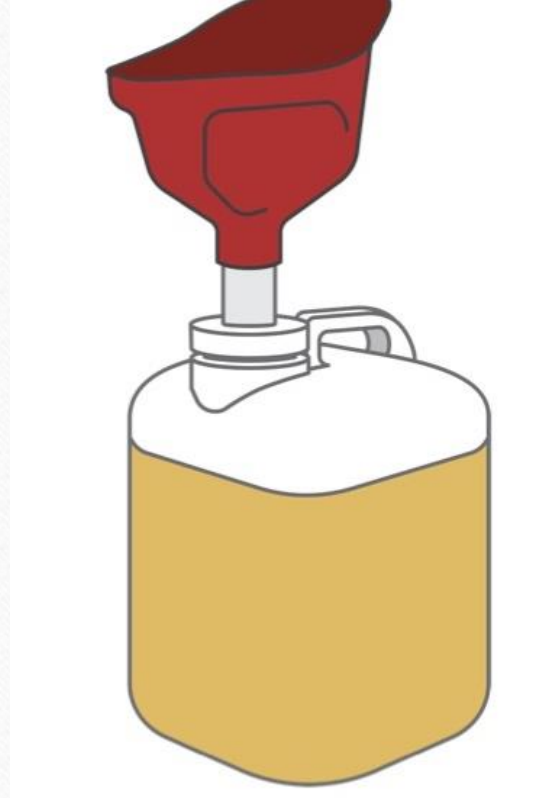
# Pee Buckets & Urinals – Why?

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- Mixed pee & poo is **heavier**, and ***stinkier***, than either by itself
- Poo is easier to manage if not mixed with pee
  - Smaller amount, lighter weight
- Collected pee is easy to manage
  - Lug it away from people, away from bodies of water, pour on ground, rotate sites
  - NOT down storm drains!

# Urinals – Many design options

Ping-pong ball in funnel keeps smell contained



# People w female anatomy can use urinals, too

- With pee funnels, aka Female Urination Devices
- Many commercial models
- DIY from a plastic bottle
- Takes practice using it



# LATRINES



WHERE, HOW, WHAT

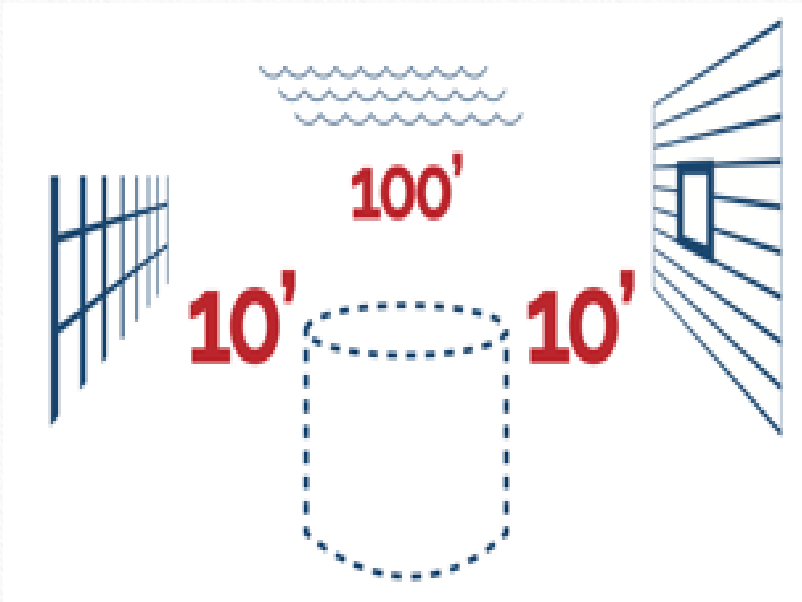
# Latrine 101

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- Dig hole, save dirt
- Poop & pee into the hole, including toilet paper
- Cover poop with saved dirt, or other dry material, so flies can't reach it
- Good idea: Add garden lime occasionally. More on this later
- When almost full, cover it well, mark site (!), dig a new hole

# Choosing a Site

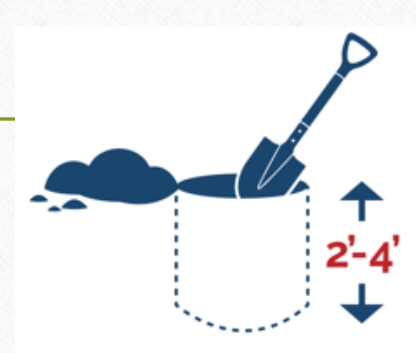
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- ✓ At least 100 feet from any body of water
- ✓ FAR above the water table
- ✓ 10 feet from dwellings
- ✓ **Choose site pre-disaster, if possible, to avoid utilities**

# Digging & Using a Latrine

- Dig a hole at least 2 feet in diameter, 2-4 feet deep.
- Save the dirt.
- (If you hit water, STOP, dig at another location. That's the water table.)
- Cover waste with dirt after each use.
- Good idea: Add garden lime occasionally. More on why later.
- Toilet paper goes in the latrine. PLASTIC BAGS DO NOT!



# When Full

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- When almost full –
- Cover well
- Mark the site!
- Dig a new latrine



# Latrines

## Making them More Pleasant

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- Add a commode, squatting board, or bench over the latrine
- Buckets of dirt, wood chips, lime, etc., and a scoop, to cover contributions
- Privacy structures, such as curtains, lightweight walls, weather protection
- Clear, non-hazardous pathway
- Extras
  - ‘Occupied’ indicators to prevent embarrassment: 2 sharp sticks, stuck in ground
    - VACANT = 2 sticks parallel. OCCUPIED = 2 sticks crossed in X
  - Path indicators for finding it in the dark

# SUMMARY

## Latrines

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- Choose site pre-disaster to avoid utility lines; far from people; very far from water; far above water table
- Dig. Save dirt
- Top with a commode or seat
- Cover deposits with dry materials
- When almost full, cover well, mark site

# Disposing of Pee

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- Pour on ground, far from bodies of water
  - Rotate sites
  - Dilute with graywater if possible
  - NOT down storm drains
- Buckets or Jugs for transport
  - Need tight lid or cap to prevent sloshing
  - Heavy. 8 lbs./gallon. Large volume, 1-2 quarts per day per person

# Disposing of Poo – **STOP!**

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It's Infectious. It's Dangerous.

We have to STORE IT –

in those trash-compactor sturdy plastic bags

Latrines have the advantage of built-in disposal

# Where do we store it?

Priority: Protect people

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- Flies must be kept away from fresh poop
- Rats must be kept away from bagged poop
- Plastic roll carts hold 64 gallons
  - ~500 **person-days** of bagged poo
  - Store plastic roll carts in rat-resistant enclosures
  - Inside ¼-inch hardware cloth, or similarly secure building

# Dumpsters are huge

- Dumpsters hold 2 – 40 cubic yards
- 1 cubic yard = 1600 person-days poo
  - 2 weeks for 100 people
- Dumpsters have drains in the base. Close it, or rats get in
- Avoid overhanging branches or structures that critters can use to jump into the dumpster



## 2 Yard Dumpster

**Holds:** 400 pounds

**Frequency:** Up to 5x a week

**Best Use:** The perfect size for small restaurants and companies with up to 25 employees

[See 2 Yard Dumpster Details](#)



## 3 Yard Dumpster

**Holds:** 600 pounds

**Frequency:** Up to 5x a week

**Best Use:** Ideal for businesses with up to 50 employees

[See 3 Yard Dumpster Details](#)



## 4 Yard Dumpster

**Holds:** 800 pounds

**Frequency:** Up to 5x a week

**Best Use:** Best for midsize restaurants and companies with up to 100 employees

[See 4 Yard Dumpster Details](#)



## 6 Yard Dumpster

**Holds:** 1,200 pounds

**Frequency:** Up to 5x a week

**Best Use:** Ideal for mid to large businesses with up to 250 employees

[See 6 Yard Dumpster Details](#)



## 8 Yard Dumpster

**Holds:** 1,800 pounds

**Frequency:** Up to 5x a week

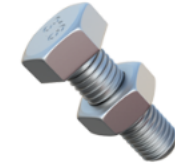
**Best Use:** Our largest recurring size — best for large businesses with up to 500 employees

[See 8 Yard Dumpster Details](#)



# The Nitty Gritty: **SUPPLIES**

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The Disposables

# SUPPLIES for SANITATION

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## For Handwashing

- Clean stored water, lots of it
- Soap
  - Removes more germs
- Hand sanitizer
  - Convenient

## For Toilets & Latrines

- Liner bags - in poo bucket only – Trash compactor bags
- Gloves for the Sanitation Team
- Dry materials for covering poop – wood chips, sawdust...
- Toilet paper

# Soap vs Hand Sanitizer

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## Hand Sanitizer

- Kills most bacteria. But NOT:
  - Norovirus (Diarrhea)
  - Rhinovirus (Common cold)
  - Poliovirus (Polio)
  - Protozoa, a diverse group

## Soap

- Removes ALL germs
  - Doesn't kill, rinses them away
  - Dissolves skin oil germs attach to
- Dissolves oil and grease

# Poo bag liners

- At least 2 mil thick, unit of thickness
- 7-20 gallon, to fit buckets
- Not useful:
  - **Too big:** Contractor Bags 3 mil, 42 gallon, too huge
  - **Too thin:** Kitchen Trash Bags 0.34 mil, 10 gallon, bags will leak
- Just right: **Trash Compactor Bags**  
Size & thickness fit the bill. Stock up!



# Dry Covering Material

## To cover poop

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- Many choices, best is what's available. Container & scoop by poo bucket
- Wood chips, shavings, pellets; Sawdust, Ashes, Dirt, Straw, Coffee grounds, Mulch, Coir, Shredded paper, etc.
- Clay cat litter hardens and swells – but better than nothing
- Lime (slide soon) can be combined with any of the above



# EQUIPMENT

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## HANDWASHING

- Spigot-on-a-bucket model
  - Easy, cheap to mass produce
- Tippy Tap
  - DIY on-the-spot, no tools
  - But best outdoors

## TOILETING

- Bucket Toilets
- Latrines
- Urinals
- Toilet Seats

# SUPPLIES

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## HANDWASHING

- Clean stored water, lots of it
- Soap
  - Removes most germs
- Hand sanitizer
  - Convenient

## TOILETING

- Liner bags for poo bucket
- Dry materials for covering poop in latrines & poo buckets
  - Wood chips, soil, garden lime
- Toilet paper

# QUESTIONS?



Contact me to present this material to your group

# Curious? Concerned? Want to Learn More?

Disaster Sanitation Webpage



PHLUSH.org



[merilee@phlush.org](mailto:merilee@phlush.org)

# Disaster Sanitation Classes at NET Camp Sept. 14

*NET is Portland's CERT*

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## Disaster Sanitation I

- This class

## Disaster Sanitation II

- Advanced Workshop – 2 Tracks



- Teaching Disaster Sanitation
- Building affordable, practical sanitation equipment for communities



# Additional Topics

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If we have time

# Twin-bucket toilets adopted in Turkey After the Feb. 2023 earthquakes

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- RDPO – Distributor of the Pee & Poo bucket stickers – received this email:

*“I am İlker Kayı from KOç University School of Medicine, İstanbul Turkey, and I am writing to you about your emergency toilet guidelines. As a group of medical students, we have translated your guide into Turkish to be distributed among the people affected by the two consecutive earthquakes that happened on Feb 6th, which affected 14 million people living in 10 different cities.*

*“There is a huge need for sanitation at the moment and we found your guide very useful. We are grateful to those who prepared it and immediately translated it into Turkish and will be distributing it with your Logo and information in the document.”*

Also: Reuters-- “Disease the new threat as Turkey faces post-quake water shortage,” Feb. 15, 2023



# Sanitation Justice / Implicit Bias in Disasters



- Economic status affects disaster survival
- Richer, whiter neighborhoods have more camping equipment
- What about everyone else? Sanitation is life and death
- ***Affordable sanitation equipment, in bulk, is a moral imperative***
- Additional benefit of collaboration: Long-term resilience
  - Volunteers feel in control. Counteracts feelings of helplessness

# Implicit Bias of the Wait-for-FEMA paradigm

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- Waiting for the professionals to bring in fleets of porta-potties
  - Doesn't consider people at higher risk of dysentery:
    - Don't have camping equipment or experience
    - Don't have leisure, or disposable income, to prepare for emergencies
    - Health unstable to start with
- Disasters expose social structure
- *And when did infectious disease ever wait for you to be ready for it?*

# Supportive Toilet Seats and Commodes

Must  
switch  
buckets  
under  
chair



Urine  
Diversion:  
Pee funnel  
in front,  
pipe to  
container

Source: EVCNB

The image features a dense, vibrant green background of evergreen trees, likely cypresses or junipers, with fine, needle-like foliage. A central white rectangular box with a thin green border contains the text. Two dark brown horizontal bars extend from the left and right sides of the white box, partially overlapping its edges. A thin green horizontal line is positioned below the text within the white box.

# TOILET SEATS



**TOILET SEATS  
JUST BECAUSE!**

# DON'T Make Toilet Seats Airtight

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Counterintuitive, right?

- You'd think pee & poo should be sealed away. But no.
- Oxygen *kills* the most dangerous bacteria
  - They're called "anaerobes" meaning 'without air'
  - Air circulation kills them

# Remember, We'll Need a LOT of these

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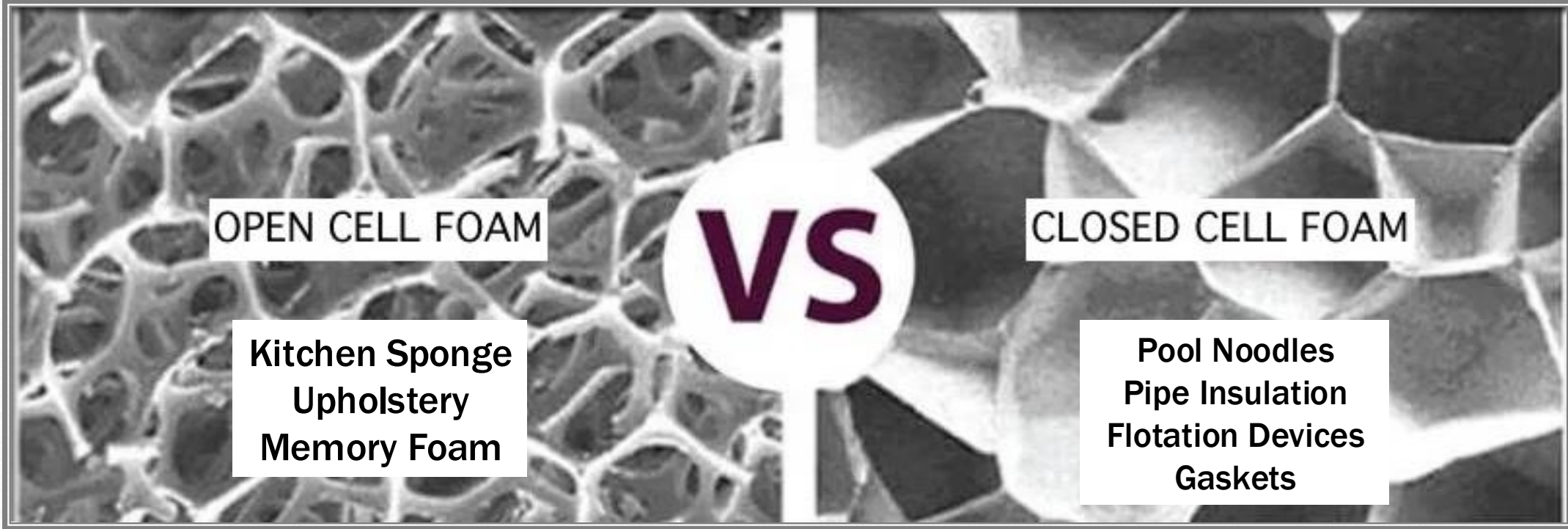


- Plastic toilet seat, made to snap onto a 5-gallon bucket
- Cost: \$14 - \$30 each, cheaper in bulk

## Pool Noodles: Obvious choice for toilet seat, but

- Pool noodles are discouraged as toilet seats by one local preparedness agency, on grounds that they are **porous**, and therefore will harbor bacteria.
- People will use them.
- How bad are they?





OPEN CELL FOAM

Kitchen Sponge  
Upholstery  
Memory Foam

VS

CLOSED CELL FOAM

Pool Noodles  
Pipe Insulation  
Flotation Devices  
Gaskets

Pool noodles are made of CLOSED CELL polyethylene foam  
Every cell closed off from every other

**Not Porous**

# Have there been any cases of infected pool noodles?

(Citations on request)

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- One case found in literature search
  - Bacterial colonization of polyethylene foam pool toys, bacteria in resistant biofilms
  - In a pool program, always wet, never cleaned
- Biofilms can only form on objects that are constantly damp or wet
- Pathogens (including biofilms) can be removed by cleaning (**removing** dirt) and sanitizing (**killing** germs)
- Conventional toilet seats of wood and plastic can also harbor isolated surface microbes. Anything can.
  - That's why we clean and sanitize conventional toilet seats.

# Bottom Line:

## Pool noodle toilet seats are safe & cheap

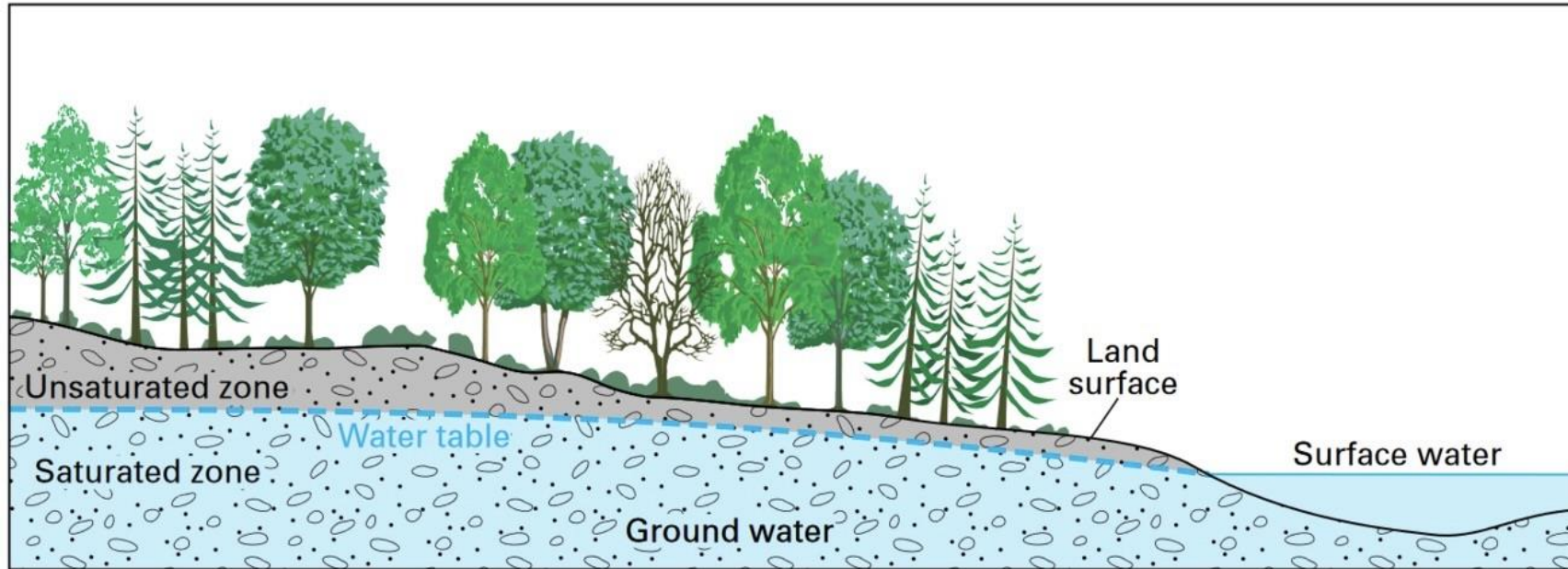
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- But less durable, and somewhat less sanitary (because surface irregular), than plastic or wood
- Clean and sanitize all toilet seats regularly
  - Clean indentations, nooks, crannies
- Soaps, scrubbers, sanitizers won't damage the foam
  - Polyethylene foam is tough stuff, inert to household solvents



# The Water Table

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# What's a Water Table?

## *How do you know how far down the water table is?*

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- On the beach it's right below your feet. So never dig a latrine on the beach.
- Land next to bodies of water (rivers, lakes) may have a water table within reach of a shovel.
- In the Portland area, that includes Hayden Island, Smith & Bybee Wetlands, beaches, airport, etc.
- The higher the hill one lives on, the farther down the water table. Nearly all of metro Portland is at least 20 feet above the water table, too far to reach with a latrine.
- Most of metro Portland is at least 100 feet above the water table.

# Water Table at the Beach

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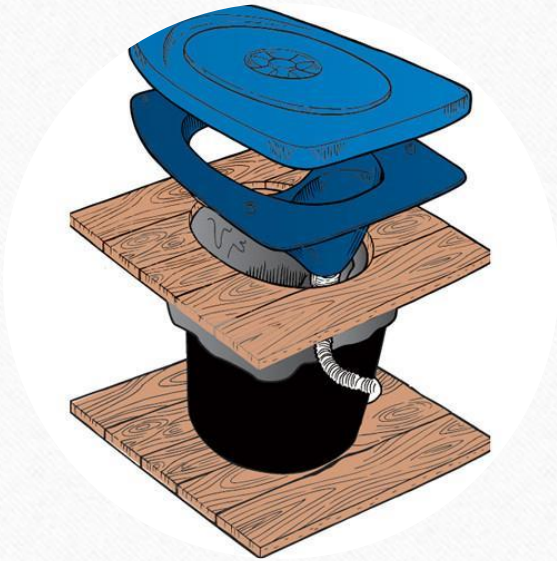




# Urine-Diverting Toilets

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# Urine-diverting one-bucket toilets



- Single bucket, seat modified with a funnel in front, sending pee to separate jug
  - Poo falls down the back, into a plastic-bag-lined bucket
  - Pee falls down the front, into a funnel, that leads to a jug outside the bucket
- Solves bucket-hopping challenge for people with female anatomy
- Used in Haiti before the 2010 earthquake, still in use to produce humanure
- Used in Japan after the 2011 earthquake

# Sources for Urine-Diverting Toilet Seats

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- Either DIY, or \$20 - \$100. Lots of people working on this, emerging tech
- DIY designs in vans & boats, built of buckets and funnels
- Commercial sources, links in Class Handout
  - Johnny Compost Toilets, Separett, Free Range Designs, and others
- Or: White plastic “hat” for urine collection, under front of toilet seat, pour into pee bucket when done

# “White hat” collects pee to pour into urinal or pee bucket

Outside bucket,  
under front half  
of toilet seat



In front half of  
bucket,  
but can't  
fit snap-on  
toilet seat over it





# Handwasher w Foot Pump

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Hands-free

Harder to make, easier to set up

Best for indoors



# Foot-Pump Handwashers

- 2 Buckets
  - Clean Water in Bottom Bucket, Used Water in Top
  - Foot-pump sends water from Bottom Bucket to Top
- Cost < \$20. DIY skills Moderate, takes < 1 hour
- Operational Advantages:
  - No spillage. Best option for indoors
  - Stable in place
  - Easy to refill bottom bucket

# Foot-Pump Handwasher Instructions

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Foot-pump Handwashing Station on Instructables.com



[Instructables.com](https://www.instructables.com)





# WATER

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Storing emergency water

Filtering raw water

# STORING WATER

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# STORING WATER

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- Most important task in emergency preparedness
  - Store emergency water. 1 gallon per day, per person, for 2 weeks = 14 gallons
  - Not everyone can do that. Encourage doing what works for them
- One option: Purchase bottled
  - Bottled water has freshness dates, 6 months - 2 years, probably safe much longer
- Another option: Sanitize containers, fill, add bleach, cap & store
  - Safe for YEARS, can test chlorine level
  - Depending on how clean the container was when filled, and how it's stored
- Another option: Hot water heater

# STORING WATER

## 2 Ways to Clean Containers

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### 1. When canning fruit & veggies

- Glass jars must be *sterile*
- Boiling water bath for jars & lids
- Pull from water bath, fill & seal immediately
- Boiling water fine for glass, **not** for plastic. No glass containers for emergency water!

### 2. CDC on storing emergency water

- a. Wash plastic container & lid with soap, rinse well
- b. Mix 1 teaspoon bleach per quart of water, pour into container
- c. Cap container, shake to cover all inner surfaces, then pour out bleach water
- d. **Air-dry your empty sanitized container**
- e. Fill the container with tap water

**Anyone see a problem?**

# *Air-drying?*

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- Air-drying, like in your dish drainer?
- Exposed to all the bacteria, viruses, dust, & schmutz in the air?
- So I called a food scientist.
  - Sarah Masoni, Senior Faculty Research Associate, OSU Food Innovation Center
- Answer: No, NOT like drying a dish in the kitchen
- Air-dry for NO MORE THAN 15 MINUTES. Food industry standard.
- Then, dry or not, fill with food product (in this case, water)

# Bleach Keeps Stored Water Germ-Free

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1. Clean the container well – soap & hot water, rinse really well

Optional: Shake bleach water in the container, drain

2. Fill with tap water

3. Add **2-3 drops** of bleach per quart or liter of tap water  
(5 drops, if untreated water from a natural body of water, aka “raw water”)

Unscented chlorine bleach. 5.25%. Use fresh bleach, it expires

4. Label with date, keep in **cool, dark** place

Because bacteria love heat, and UV light degrades plastic

Safe for YEARS, depending on container cleaning, and how cool & dark its storage place

# How Long is Stored Water Safe? You Can Test It

Source: EVCNB.org

- Bleach = Chlorine => Dead Microbes
- You want a smidge of circulating chlorine, to zap any bug that manages to get into your stored water
- Scientific term for “circulating chlorine” is **“Free Chlorine”**
- Use a test strip to measure Free Chlorine
  - \$19 for 50 strips, “SenSafe Free Chlorine”



# How Much Free Chlorine is Enough?

## TARGET CHLORINE LEVELS FOR DIFFERENT PURPOSES

1. Storing Tap Water: 0.5 – 1.0 ppm
2. Treating **Clear** Raw Water: 3 – 5 ppm
3. Treating Cloudy Raw Water: 5 – 8 ppm
4. Handwashing & Cleaning Eating Utensils: 100 ppm
5. Cleaning toilets/diarrhea: 1000 ppm

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I tested my Portland tap water.  
The strip turned a very faint blue, matching ~0.10 ppm.  
So, when I store this water, I do need to add bleach.



# Containers for Emergency Water Storage

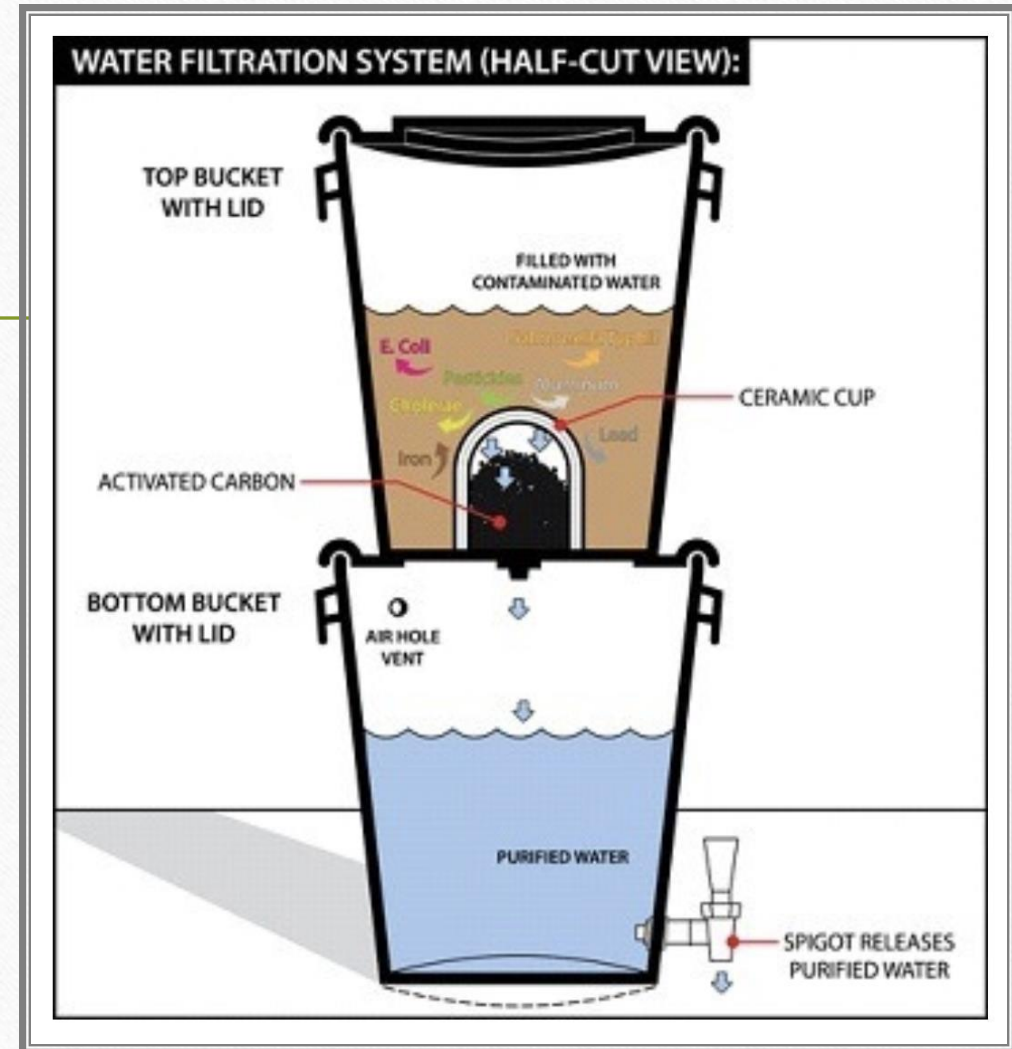
## “Food-grade” plastic

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- Best choice: #2, HDPE, High Density Polyethylene.
  - Jugs, jerry cans, barrels, buckets, any size.
  - **NO MILK or FRUIT JUICE JUGS**, can't clean out milk fat or fruit sugar
- Best source: **Green Concepts Container**, Gresham. On Facebook
  - Example: 55-gallon drum for water. \$30 Green Concepts, \$150 Amazon
  - Joe Dodd started GCC because he saw the food industry sending millions of plastic containers to landfills. He collects & cleans them to as-new. Sells at **huge** discount.

# Raw Water Filtering and Treating

- Can filter up to 35 gallons/day
- Filter kit at <https://www.justwater.me>
  - 0.2 micron filter
  - Must call, have conversation, to order



Source EVCNB