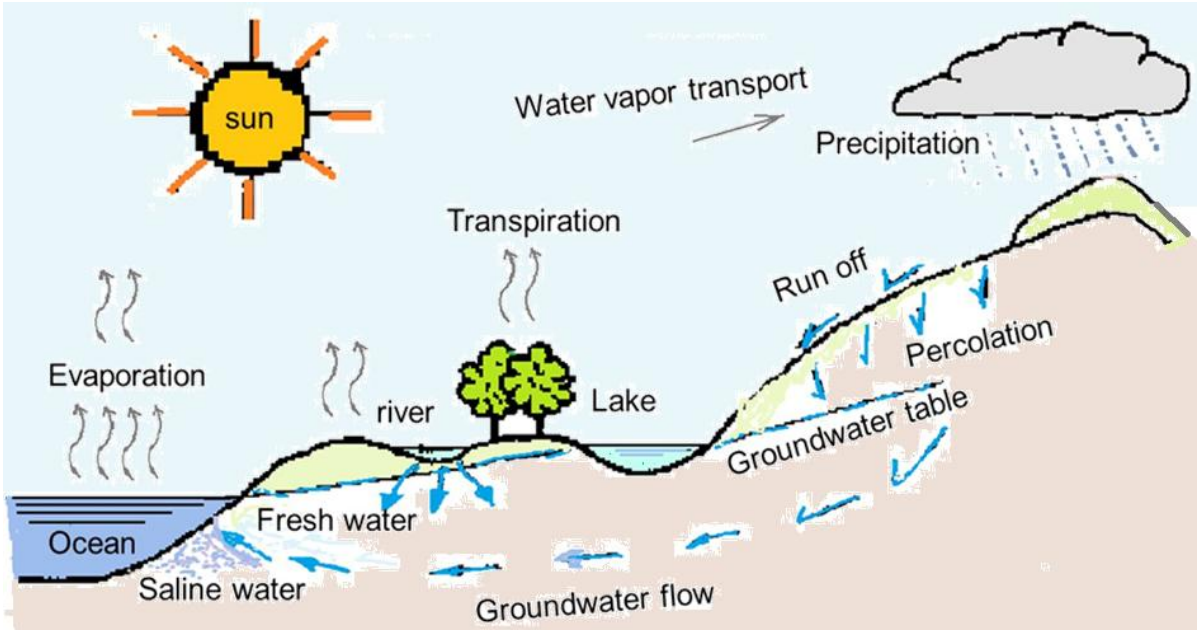
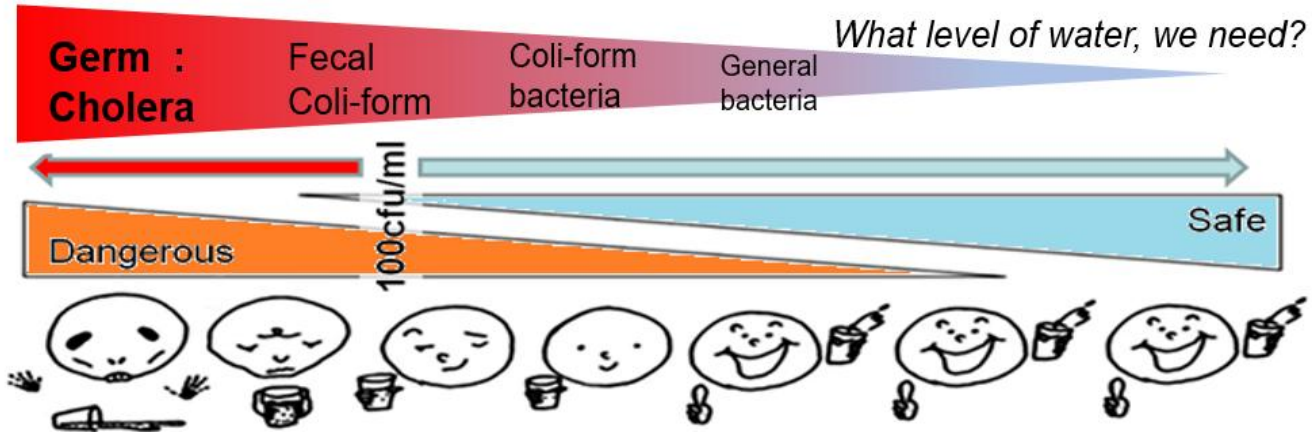
③ Water Cycle, Safe and Acceptable Risk.

We have to think about acceptable risk and treatment.



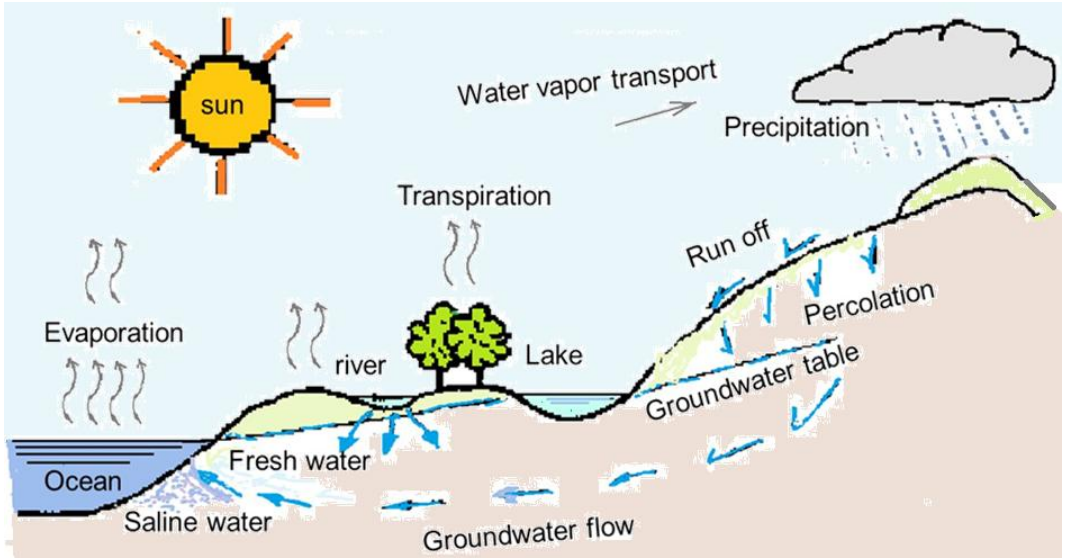
Traditional Welcome Ceremony of Kava Drink in a village in Fiji.



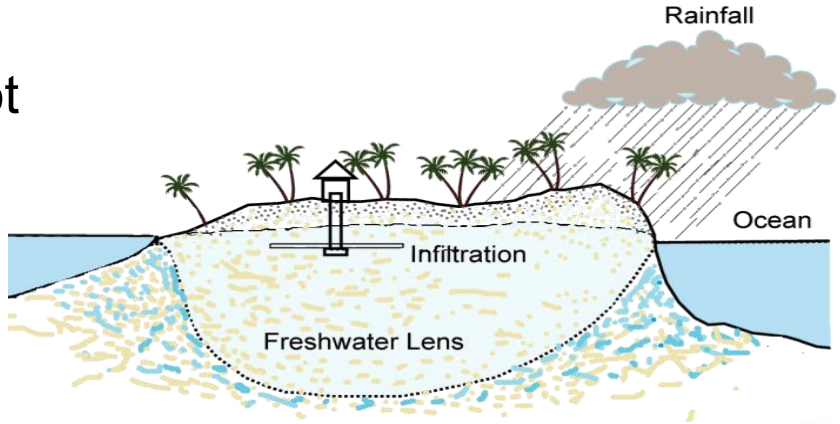
I could not say that bacteria free water is safe.

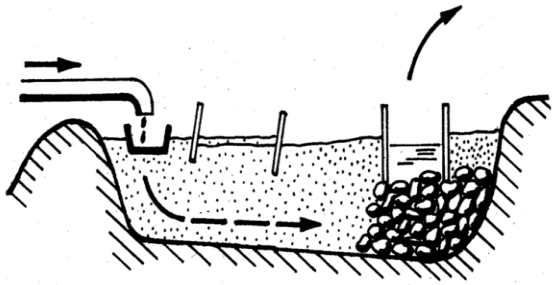
https://www.youtube.com/watch?v=vQxpxhUVkM8

49 seconds



Rain falls on mountains and islands. There is a lot of sunlight, clouds form, and rain falls. Rainwater seeps underground and comes to the surface as spring water. It is purified in the soil and becomes clean water.





Artificial clean subsurface water in a flood plain.

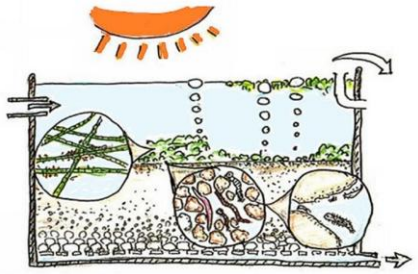
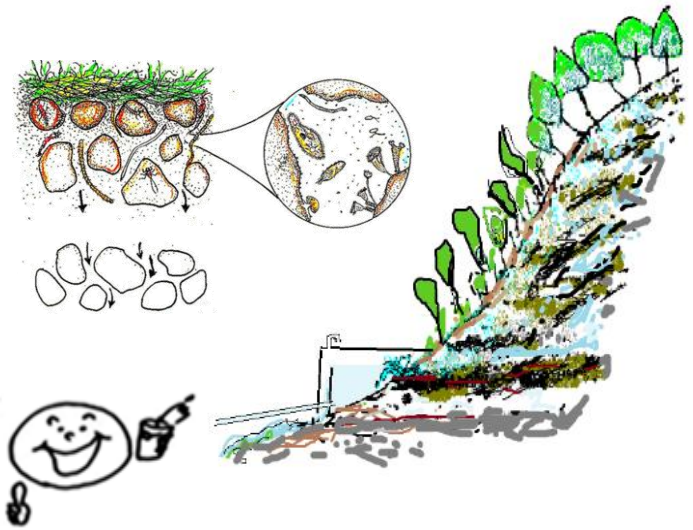


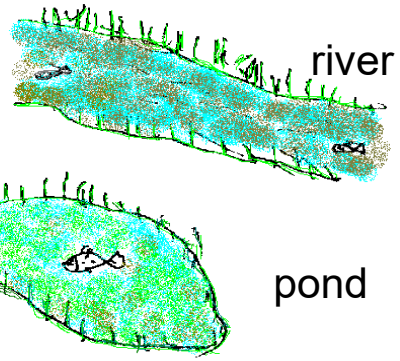
Image of Slow Sand Filter as Ecological Purification System (EPS).



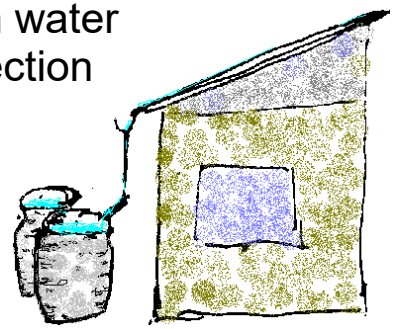
We have been used natural safe water which is natural spring water. This water is purified in nature without any chemical.

EPS is a new purification system to make artificial spring water. This system is wise application of natural phenomena.

Familiar surface waters are not always safe.　How to get safe water.

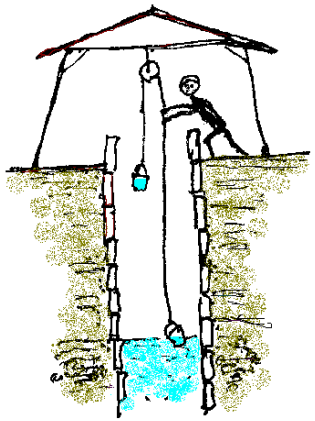


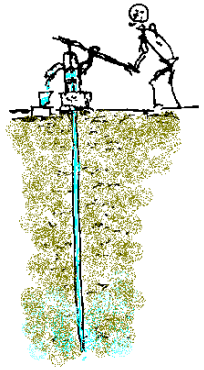
Rain water collection



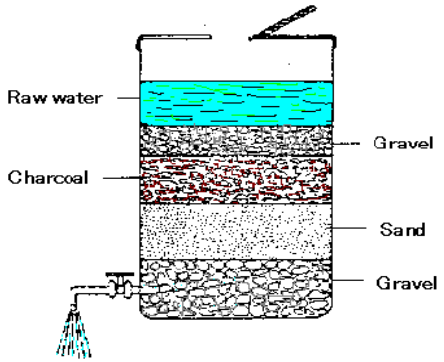
Surface water is easily contaminated by pathogens and other dangerous worms.
It is not always safe to drink directly.

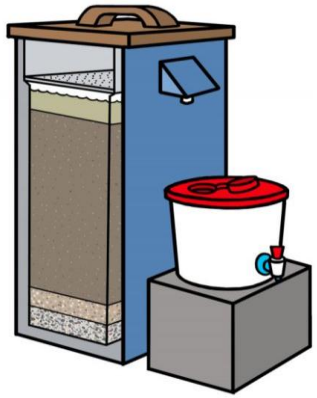
Fish is one of the indicator.



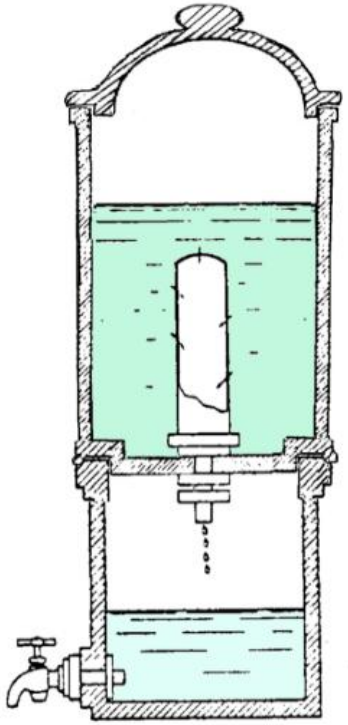


Heavy metals are easily dissolved in underground water. This water does not contain **enough amount of dissolved oxygen**.





Multiple layer filter, Bio-Sand Filter and Ceramic candle filter do not perform completely at removing pathogens. These can be reduced the risk.



Boiling　is the best way against pathogens.

Almost all pathogens may be removed by ceramic filter. The pore size is smaller than 1.5 micron.

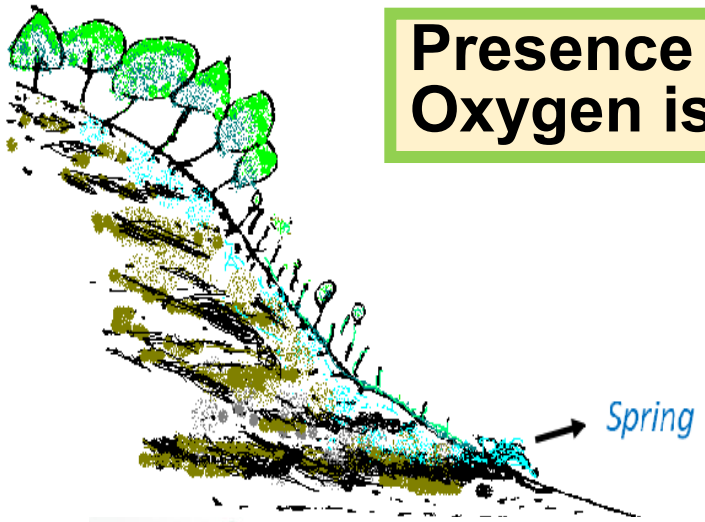
All the contaminated particulate matter can be removed by a membrane filter. But the running cost is so big.

Sweet drop (honey dew) Natural sweet and delicious water

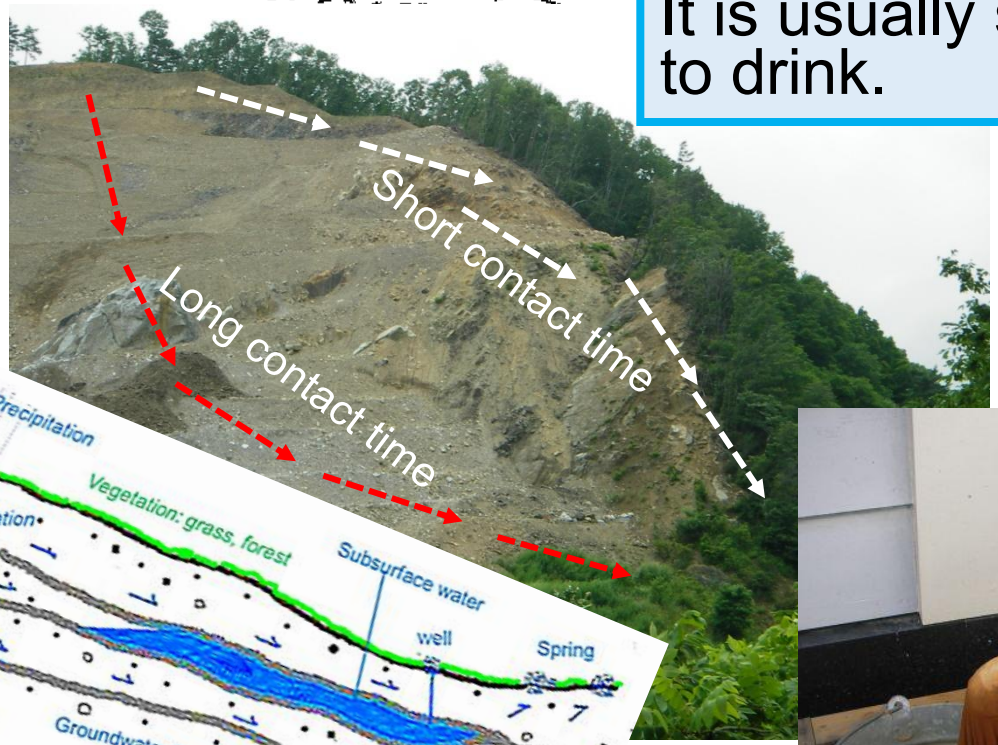
Natural spring water and rain water are usually sweet and delicious.

Rain harvesting

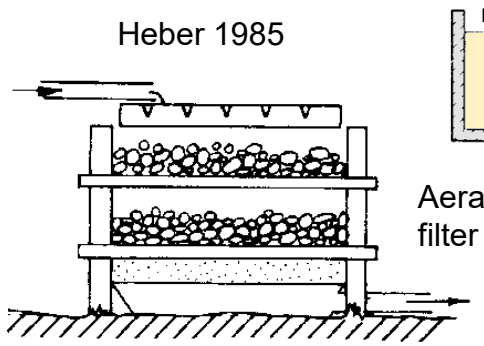
Presence of Dissolved Oxygen is Key.

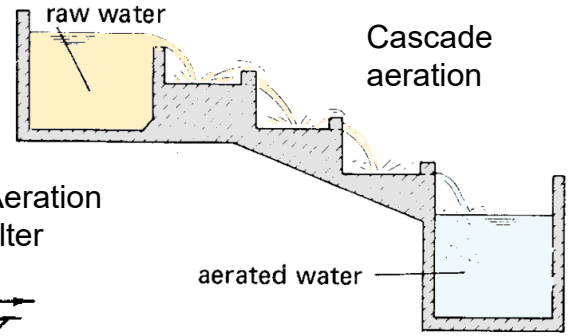


Natural delicious spring water contains enough amount of dissolved oxygen. It is usually safe to drink.



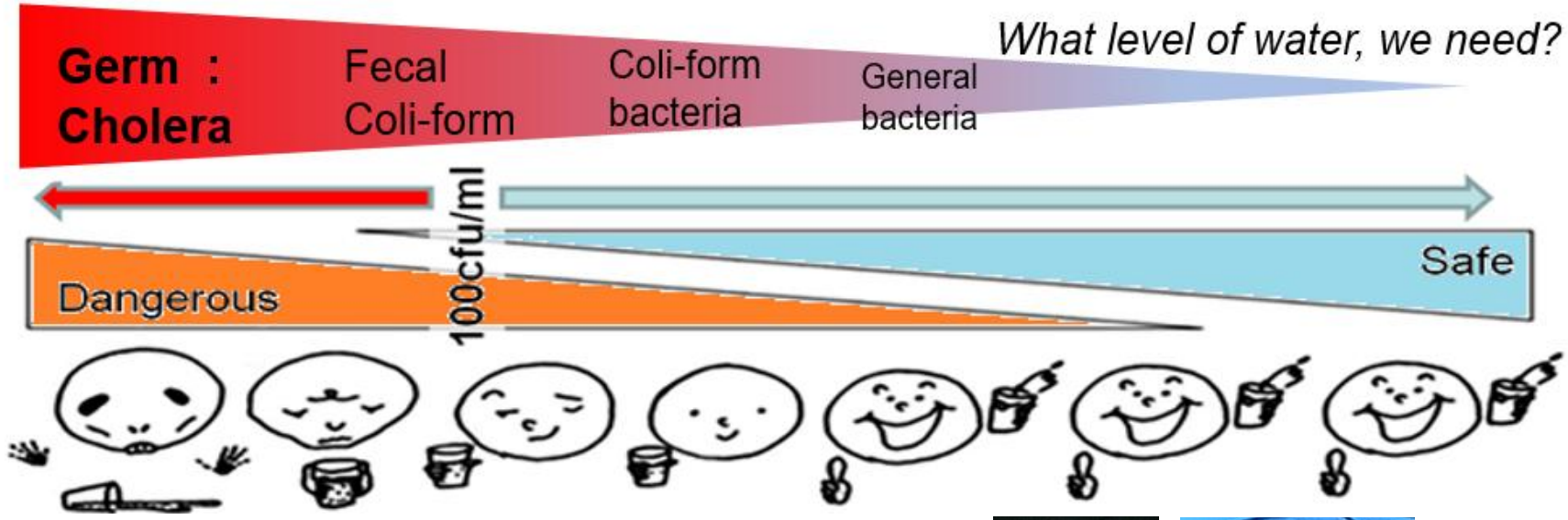
Addition of oxygen:
Aeration is frequently used for treatment of groundwater (reduction of unpleasant tastes and odors, discoloration, precipitation of iron and manganese).





Iron and manganese are oxidized and form nearly insoluble hydroxide sludge. They can be removed in a settling tank (a coarse filter).

We have to think about acceptable risk and treatment.



Is this, safe or not?

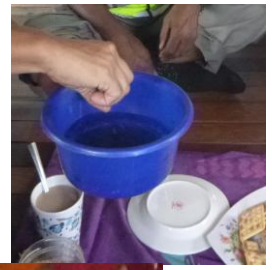
Which level of treatment, we need?



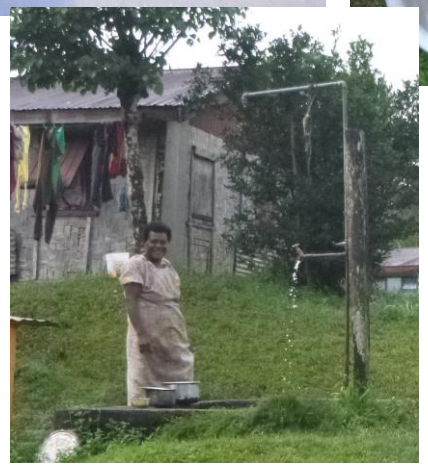






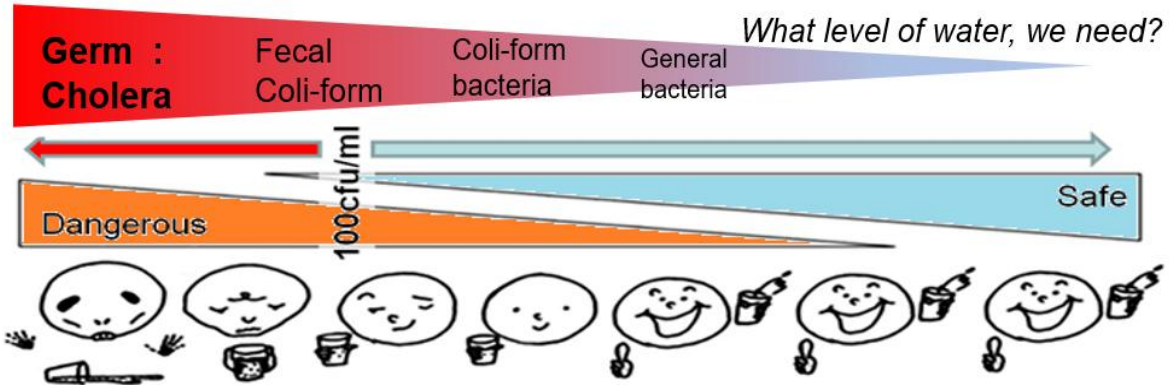


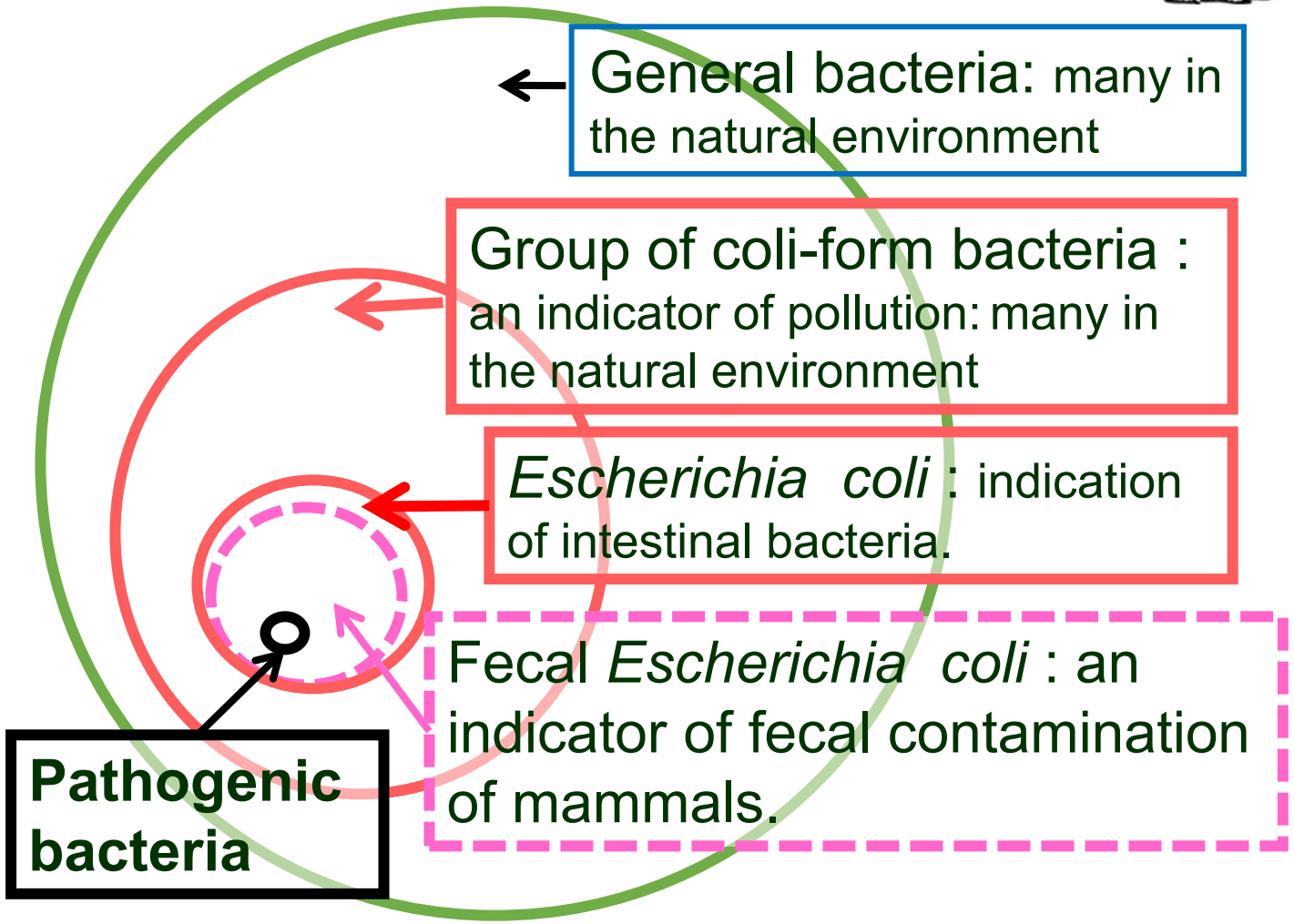






There are many kinds of bacteria in nature (in water and in the soil).

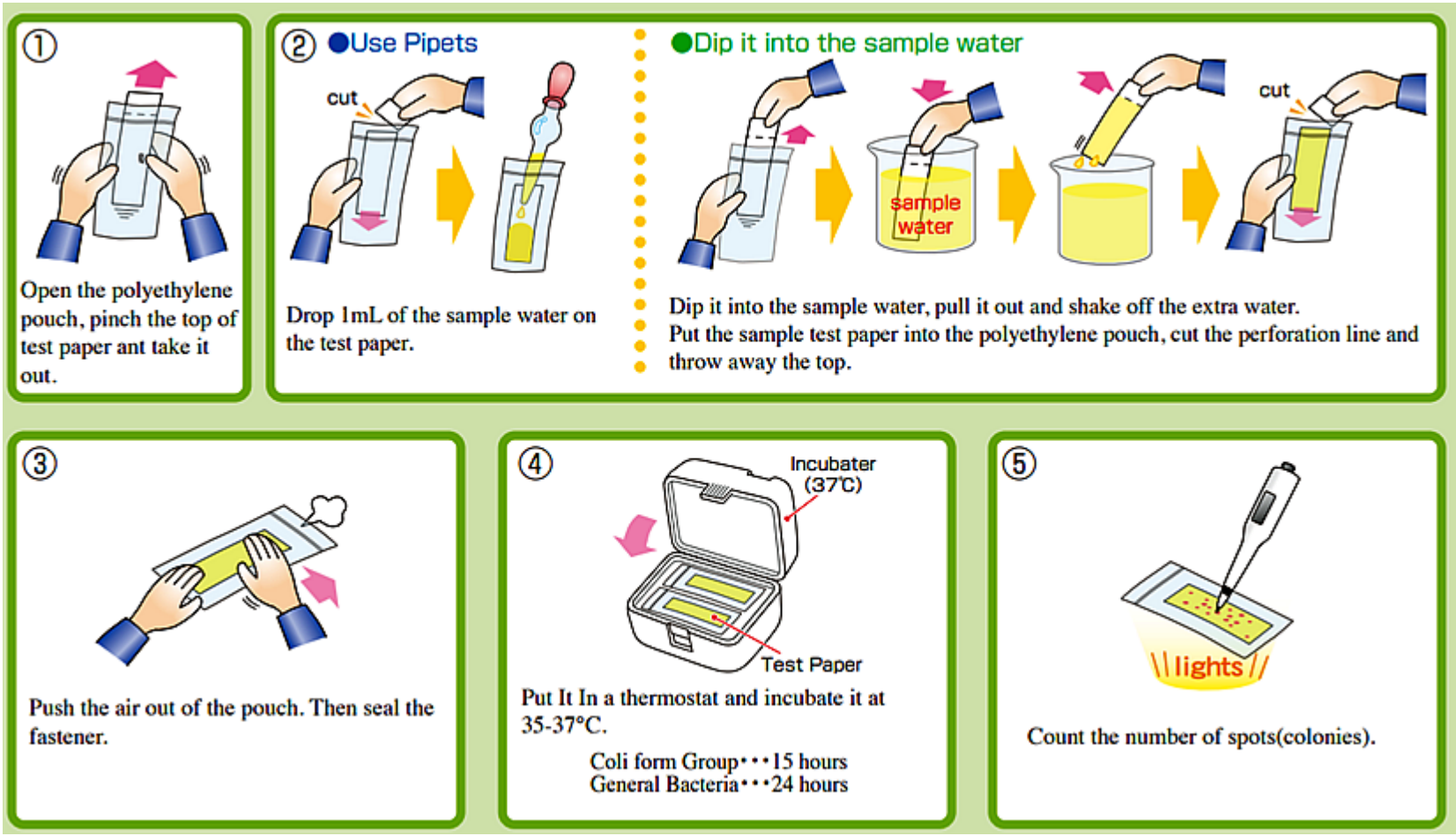


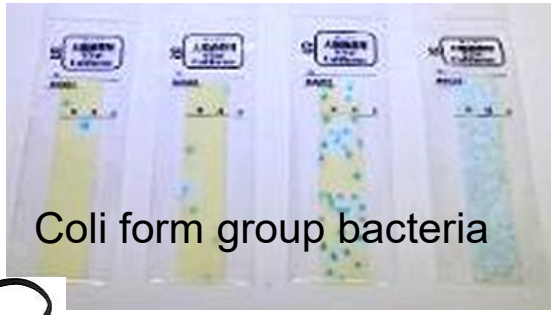


Wash hand!
Reduce the risk.

Easy bacteria test paper of SUNCOLI paper
https://www.sibata.co.jp/wpcms/wp-content/themes/sibata/en/pdf/test_paper.pdf

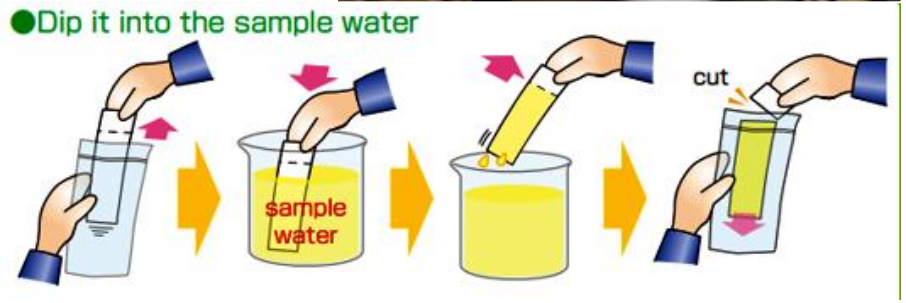
Incubate at 35-37 C.
Coli form bacteria: 15 hrs.
General bacteria: 24 hrs.





Fluorescence emitted when exposed to ultraviolet rays in case of Coli form bacteria paper.

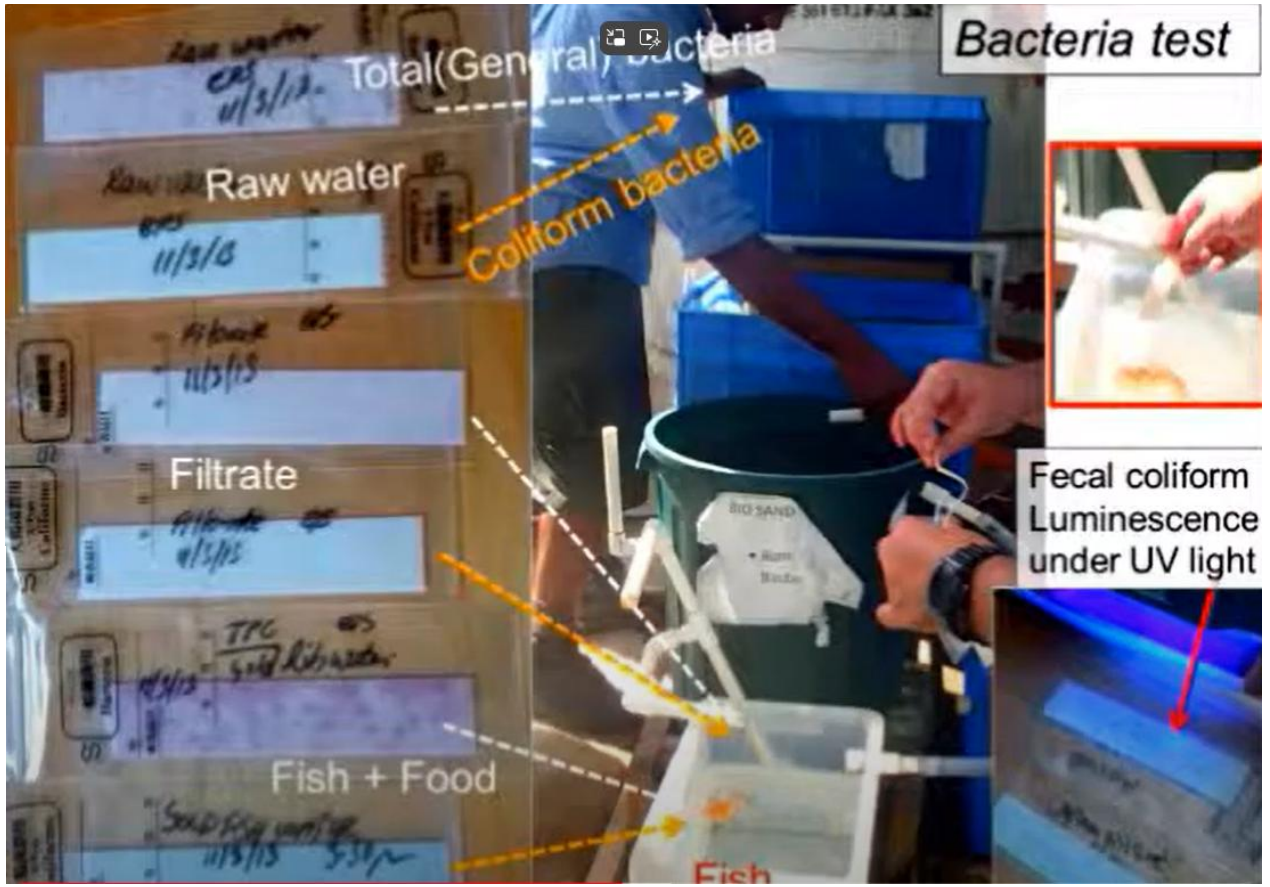
At the opening ceremony of Safe Drinking water for rural people in Fiji, January 13th. 2013.



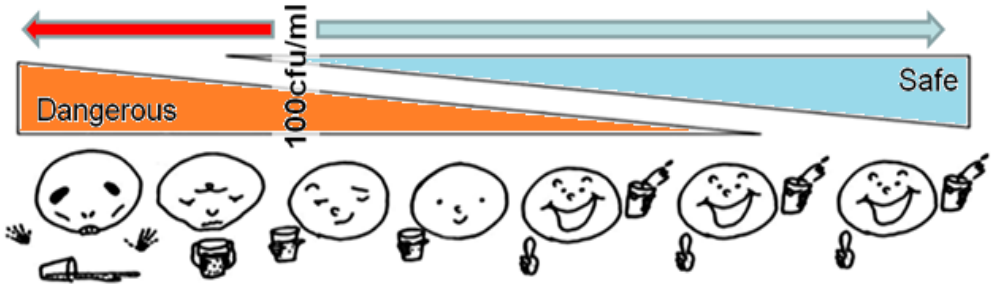
Bacteria Test by SUNCOLI test in Fiji **Watch 3:21- 4:22**

Total length **7:43**

https://www.youtube.com/watch?v=Vrr2EOS1PMA&t=49s



There are so many bacteria.
→Medical doctor touches with patients.
Medical Doctor is safe.



Logarithmic bacteria number in 1 ml

100,000,000 10,000,000 1,000,000 100,000 10,000 1,000 100 10 1 0.1 0.01 0.001 0.0001 0.00001

10^8 10^7 10^6 10^5 10^4 10^3 10^2 10^1 10^0 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5}

General bacteria — soil — Coli-form bacteria — Fecal Coli-form — Germ .. Cholera

Coli-form bacteria are abundant in soil and are not germ bacteria.

Wash hand

General bacteria — water — Coli-form bacteria — Fecal Coli-form — Germ : Cholera

Please compare the numbers of Cryptosporidium with bacteria in water. Risk?

Risk of germ bacteria in water.

Elimination **by chemical** — General bacteria — RSF — Coli-form bacteria — Fecal Coli-form — Germ : Cholera

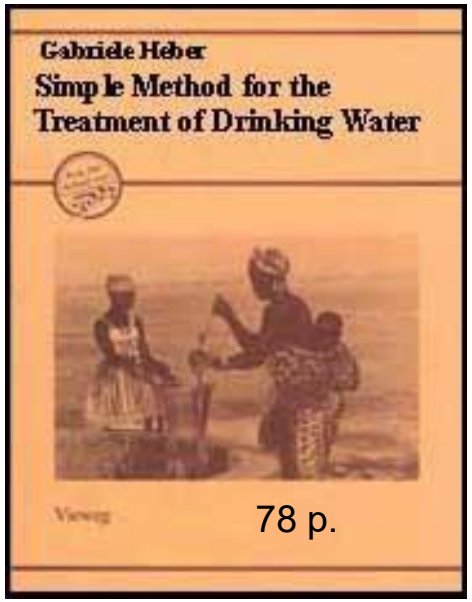
Sterilize by chlorine

Toxicity of chlorine?

Elimination **by biological community** — General bacteria — EPS (SSF) — Coli-form bacteria — Fecal Coli-form — Germ : Cholera

We have to think about acceptable risk.

Gabriele Heber 1985: Simple Methods for the Treatment of Drinking Water



https://www.nzdl.org/cgi-bin/library.cgi?e=d-00000-00---off-0hdl--00-0----0-10-0---0---0direct-10---4-------0-0l--11-en-50---20-about---00-0-1-00-0-0-11-1-0utfZz-8-10&cl=CL3.21&d=HASH175e57dd8f453120fc2d5d&gt=2

Turbidity, Average Values (NTU)	E. Coli (MPN/100 ml)	Processes and Combinations
Up to 10	10	No treatment necessary
10	100	Only disinfection
100	1,000	Slow sand filtration
250	1,000	Pretreatment + Slow sand filtration
250	10,000	Pretreatment + Slow sand filtration + Disinfection
1,000	100,000	Two pretreatment methods: e.g. sedimentation + coarse filtration or coagulation/fluctuation + sedimentation Subsequently: slow sand filtration + disinfection
100	2,000	Rapid filtration + disinfection
1,000	3,000	Pretreatment + rapid filtration + disinfection

Table 4: Treatment processes and combinations as a function of turbidity and E. Coli count in the raw water. Additional aeration generally helps to increase oxygen content in water. The turbidity values refer to the contents of settleable and non-settleable substances. The choice of pretreatment method thus depends on the type and composition of turbidity.

It is popular in the world to eat with our bare hands. We have to remove the contaminated small stones in food. This is a reasonable way.