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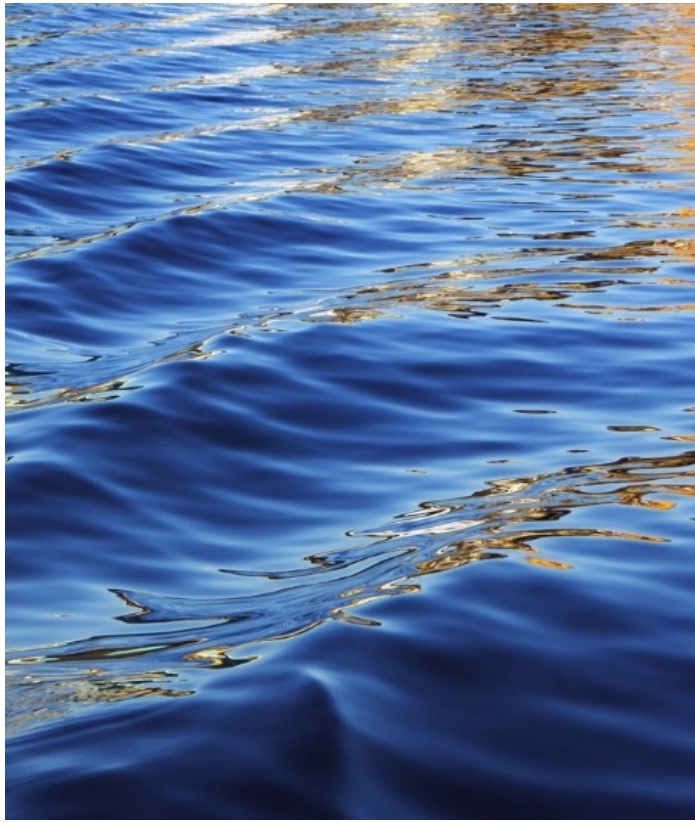
Introduction to Water system

Presented by: Eng. Chanel el Hifnawy



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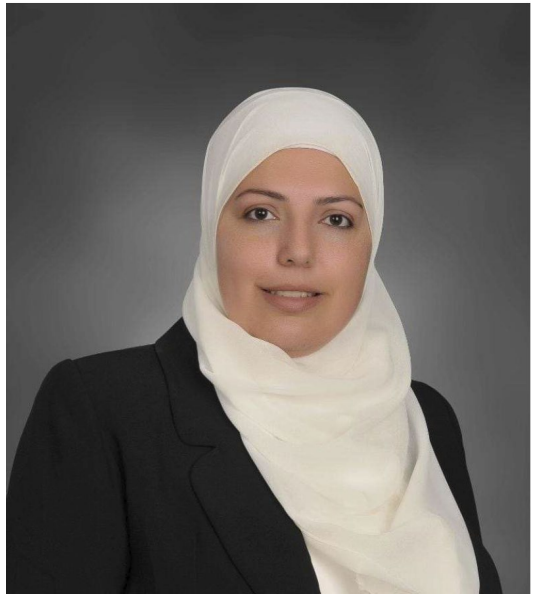

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At GCE, we're proud to deliver engineering services that innovate and implement sustainable solutions. Our clients trust us because of our expertise, which ranges from clean energy to water management to Green certifications and beyond. They value our common-sense approach that combines comprehensive engineering knowledge with practical on-site considerations.

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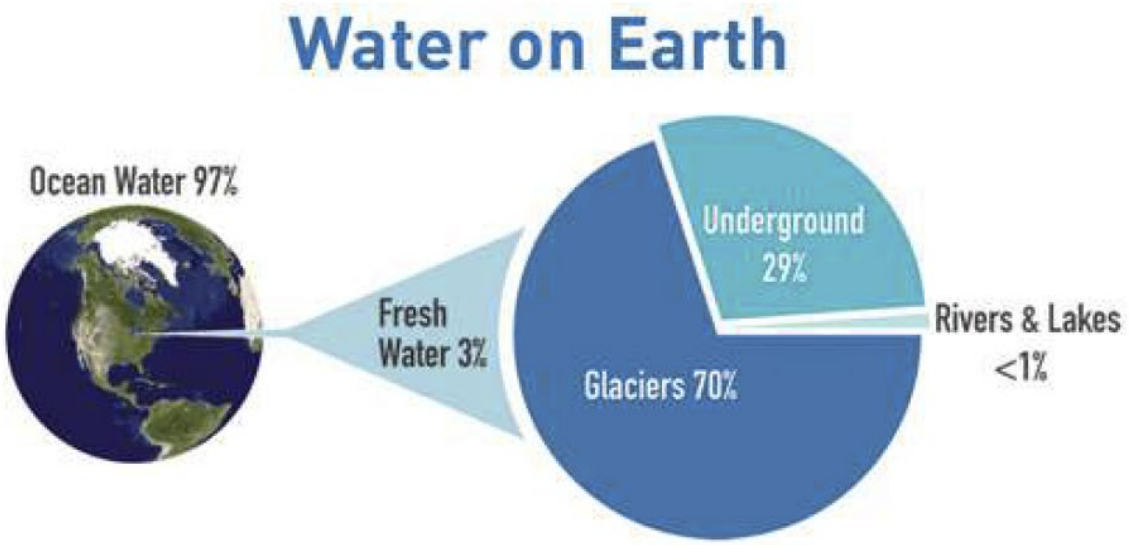
Outline

- Water resources
- Waster Supply infrastructure
- Water Distribution
- Water Treatment process
- Challenges
- Water Quality

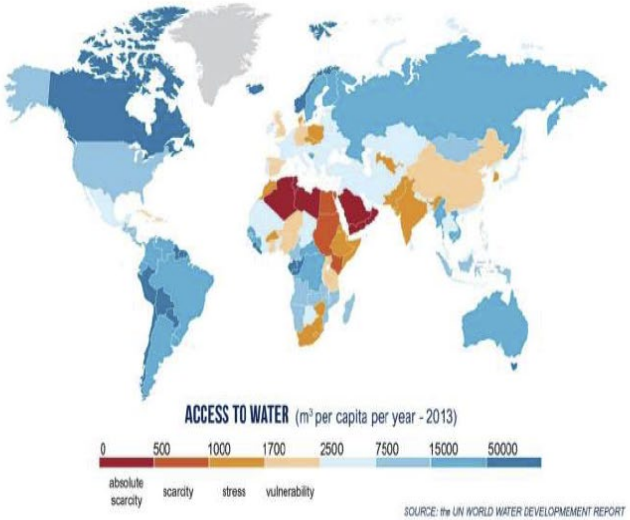
Water sources

THE **HUMAN RIGHT TO WATER AND SANITATION** (**HRWS**) WAS RECOGNISED AS A HUMAN RIGHT by the UNITED NATIONS GENERAL ASSEMBLY on 28 July 2010.

WATER: RENEWABLE RESOURCE, BUT NOT INCREASABLE AND NOT REPLACEABLE



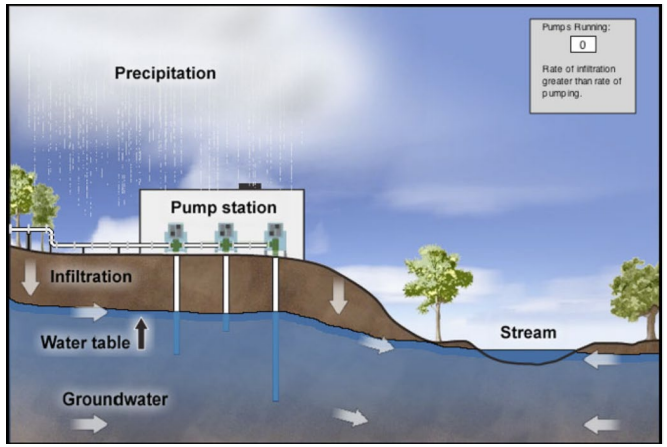
AVAILABILITY AND DISTRIBUTION OF WATER RESOURCE



Water sources

- 1-Surface water
- The drinking water for domestic use originates from surface waters such as rivers, reservoirs, lakes.

- 2-Groundwater



Water uses

1.Agricultural

- Estimated 69% worldwide used
- To produce food- vegetables, meat and etc

2.Industrial

- Estimated 22% worldwide used
- Exampled : Hydraulic dams-water used for cooling
- Manufacturing plant

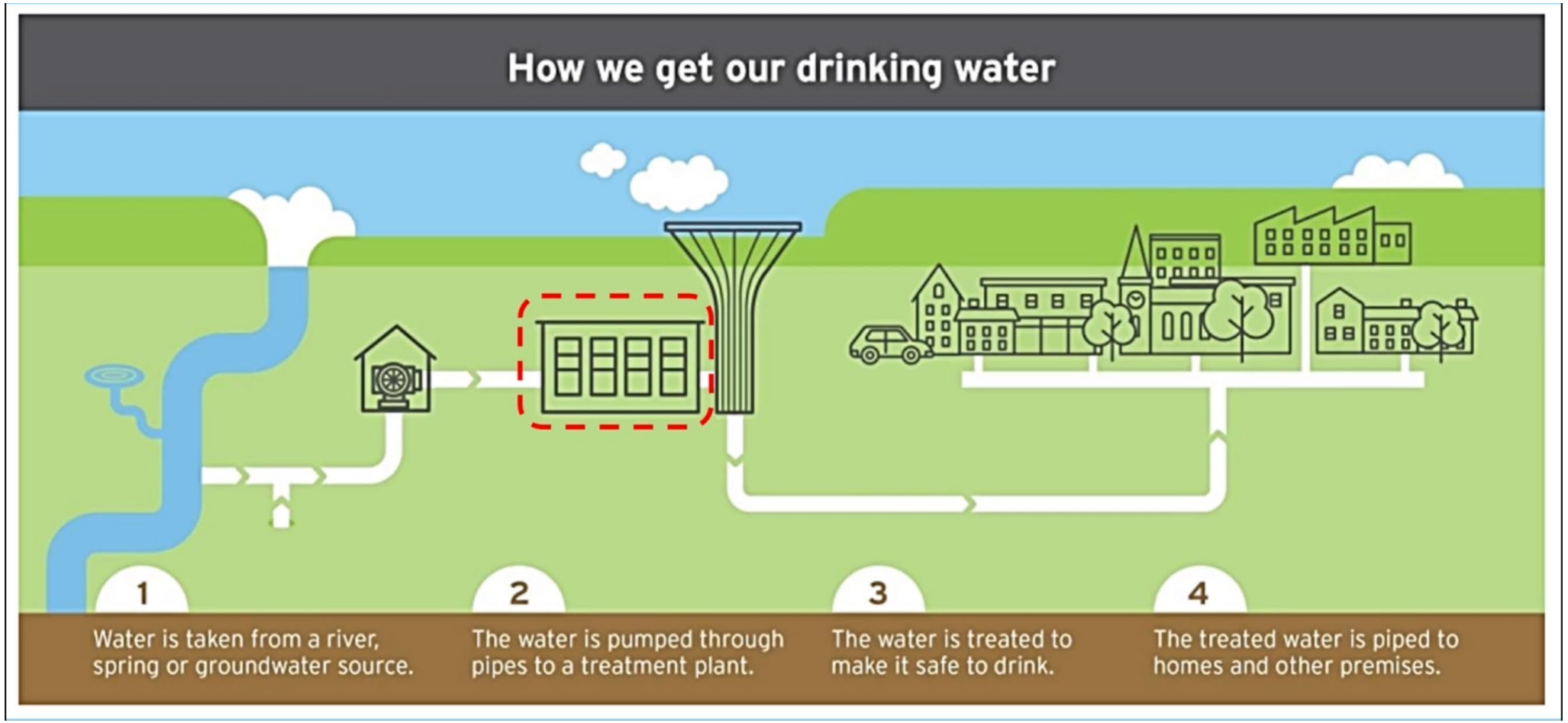
3.Household

- Estimated 8% worldwide used
- Exampled : Household activities

4.Recreation

- Very small percentage

Water infrastructure components



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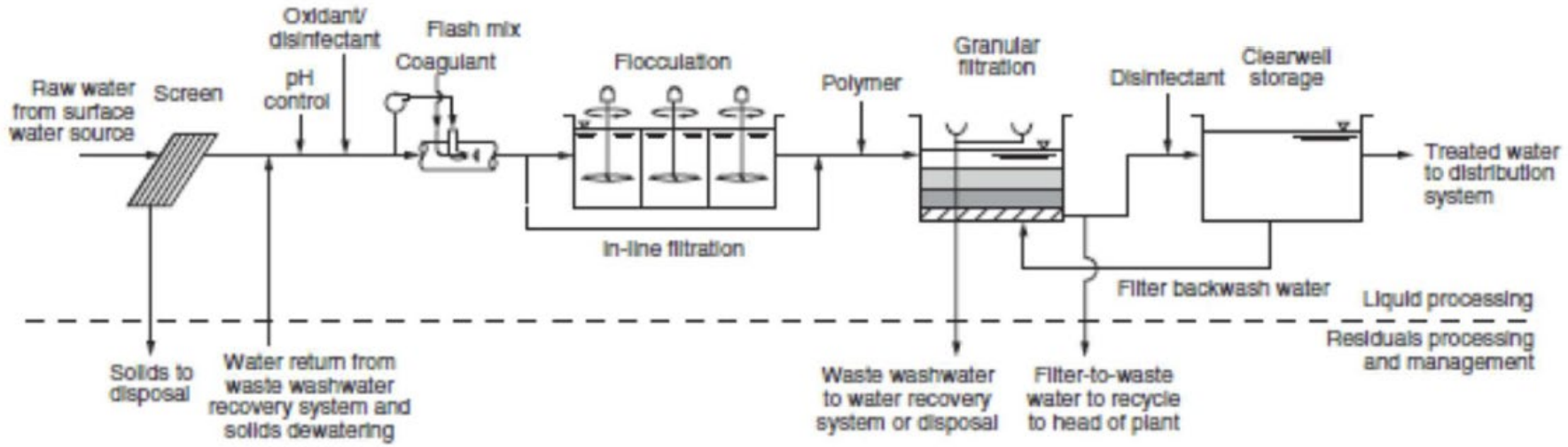
Pumping Station

Water Treatment plant



Reservoirs

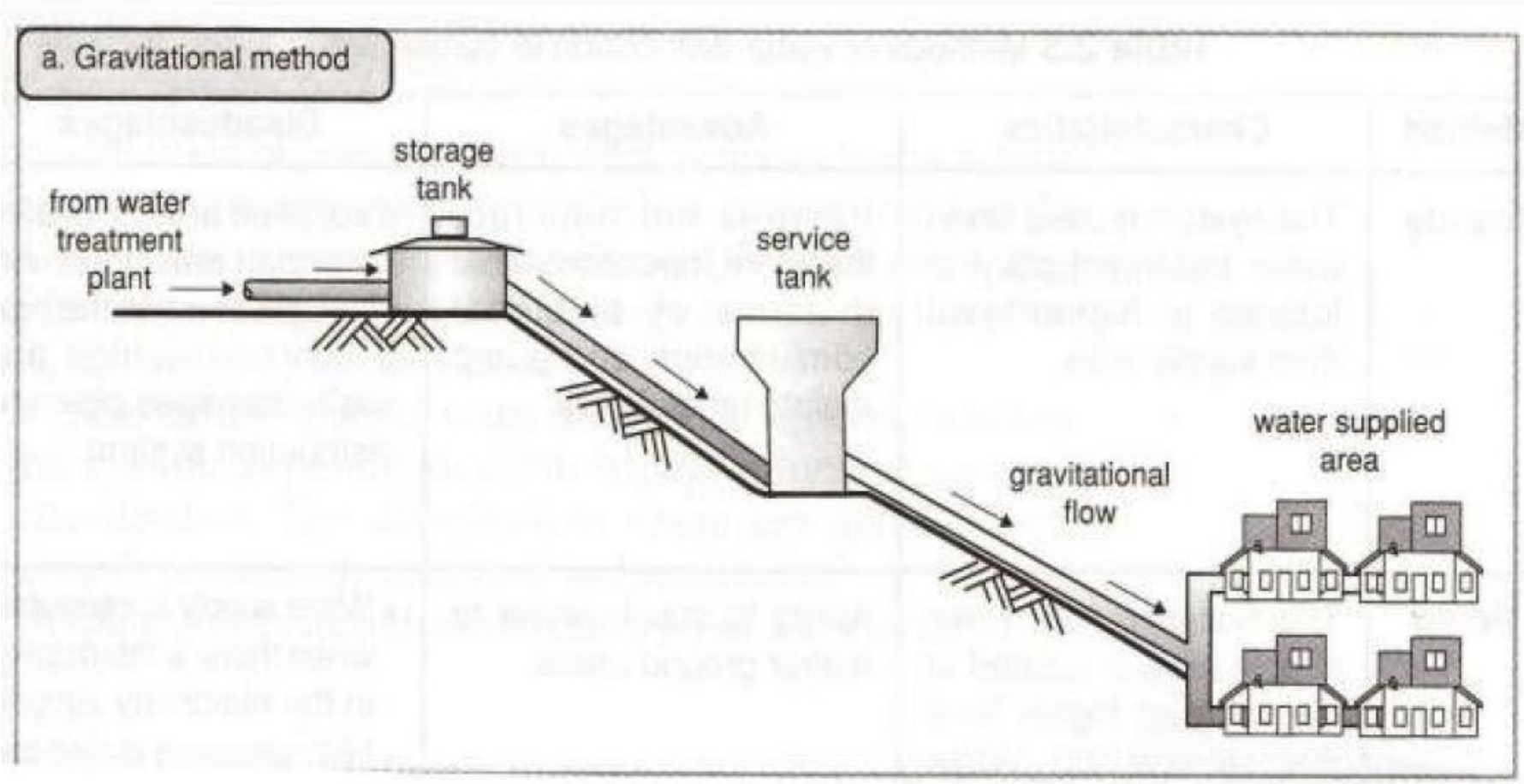
Water distribution system

- Water can be distributed by following the method:
  - Gravity
  - Pump
  - Pump and reservoir

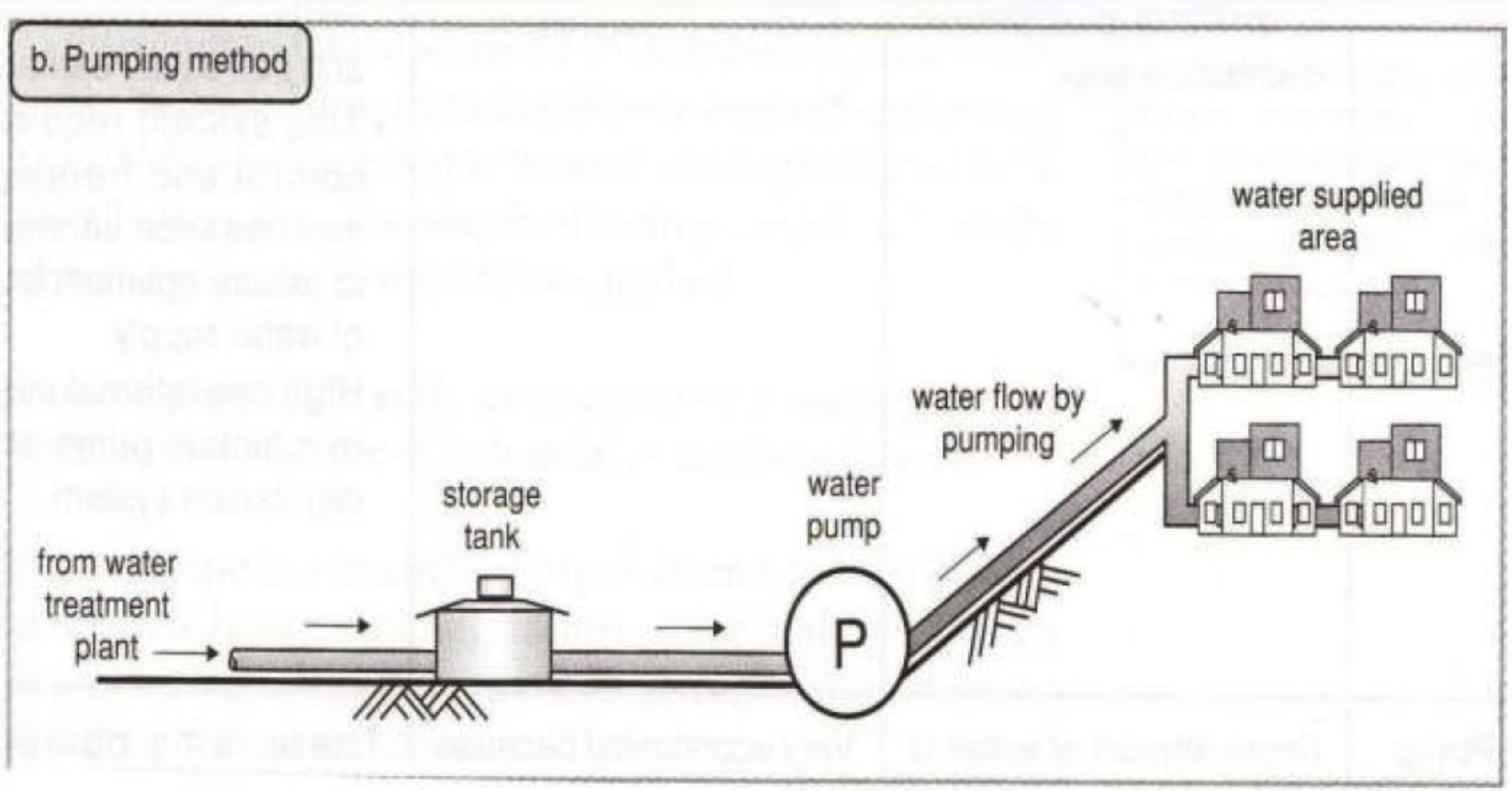
General characteristics of water distribution system are:

- Able to supply clean water sufficiently.
- Effective distribution system.
- Piping system can supply water continuously with minimum maintenance.
- Materials used in distribution pipe should be durable and do not give long term side effect to consumers.
- Distribution system should be economical, in terms of its design, layout and construction.

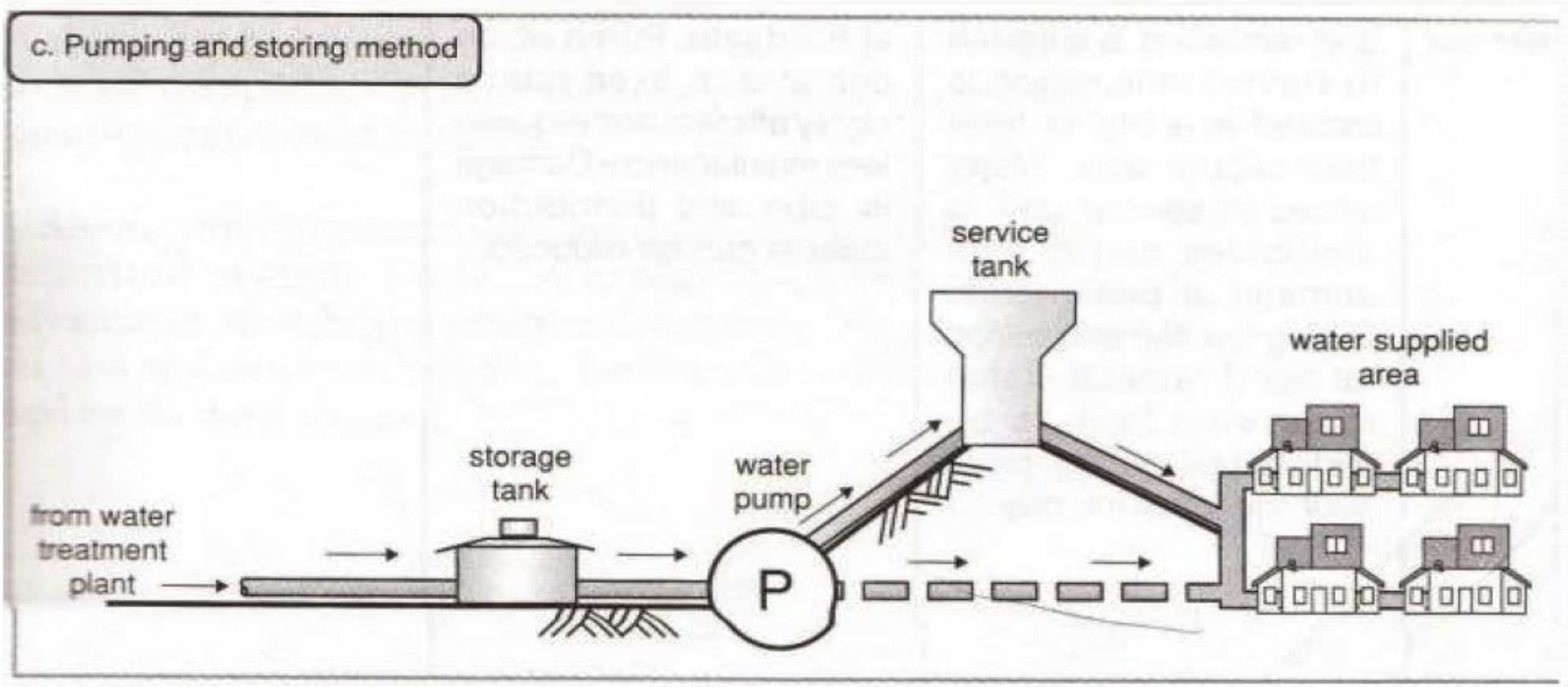
Gravity system



Pump System

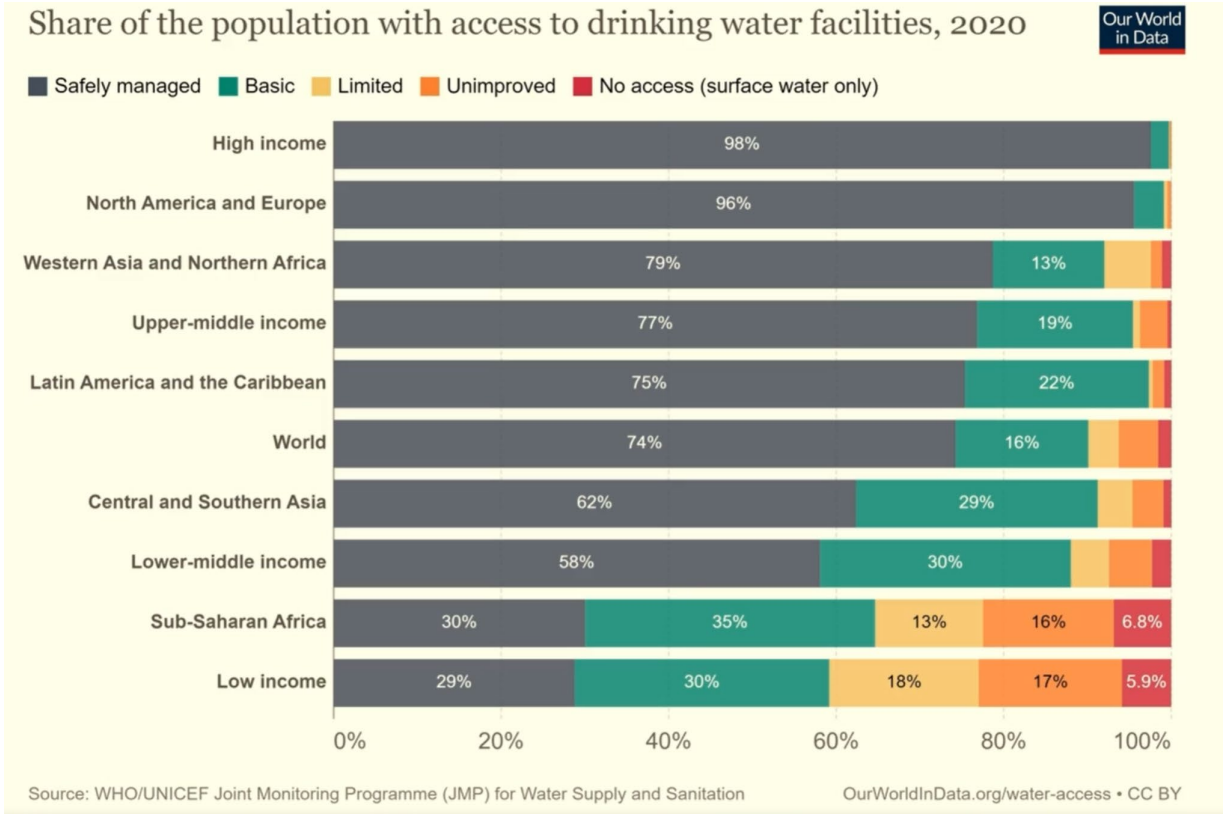

b. Pumping method
water supplied area
water flow by pumping
storage tank
water pump
from water treatment plant
P

Pumping and storing Method



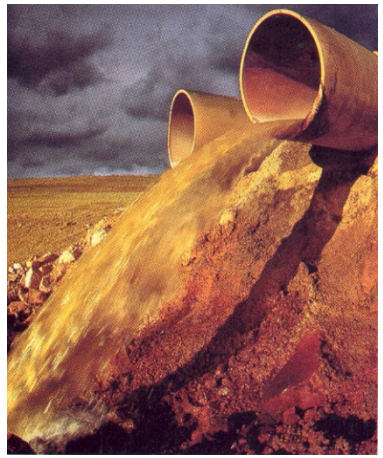
Access of drinking water

The following chart presents a breakdown of drinking water access Globally. It is clear how countries with higher income have more access to safely managed water, with percentages as high as 98%.
While for countries at the lowest incomes, only less than one third of the population have safe water.



Risk of unsafe water

- Pure and safe water is rarely found in nature.
- Both surface and groundwater can be contaminated by both anthropogenic and natural contamination and thus compromise its safety.
- A water contaminant is defined as any physical, chemical, biological or radiological substance or matter in water.
- Point Source Pollution :
  - Contamination discharged through a pipe or other discrete, identifiable location
  - Relatively easy to quantify and evaluate impact
  1. Factories and sewage treatment plants
  2. Landfills
  3. Underground and above-ground storage tanks



Water. 1993. National Geographic Special Edition

Risk of unsafe water

- Nonpoint Sources
  - Lawns, gardens,
  - Agricultural and forestry practices
  - Street refuse
  - Construction activities
  - Stormwater runoff

WATER quality-physical Parameters

- Temperature
- Dissolved oxygen (DO)
- pH
- Turbidity

النتيجة Result	Physical Parameters	الوحدة Unit	الطريقة Method	الحد الأقصى المسموح به Max allowable limit(mg/l)	الخصائص
	Temperature	°C	Thermometer		الحرارة
	Color	TCU	Spectro Hach8025	20	اللون
0.45	Turbidity	FTU	Color meter Hach	10	العكارة
553	Conductivity	µs/cm	Electrode	1.500	المنقالية
277	T.D.S	mg/l	Electrode	500	المو اد الصلبة

Dissolved Oxygen

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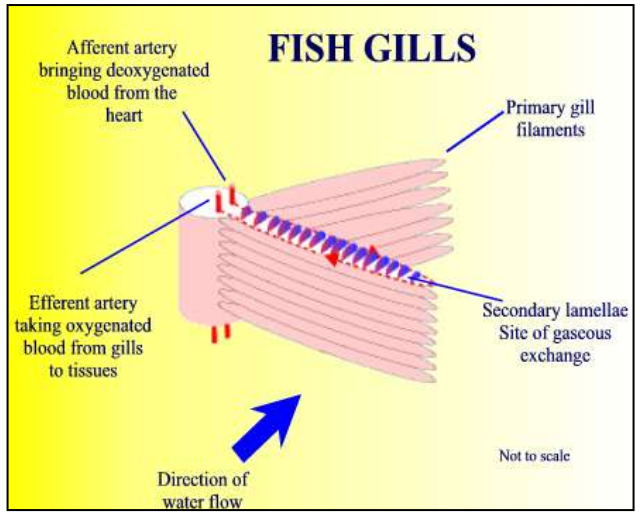
- Atmosphere consists of 21% O_2
- Water consists of <1% O_2
- When water and atmosphere come into *intimate* contact, O_2 tends to diffuse into water
  - Occurs as water passes over riffles, rapids, and falls and to a lesser extent in still water
- Aquatic plants also pump O_2 into water
  - During daytime when they are undergoing *photosynthesis*
- Fish depend on DO in water
  - O_2 diffuses from water to blood in gills
- When DO concentrations in water drop below 5 milligrams per liter (mg/L) most fish have trouble



pH

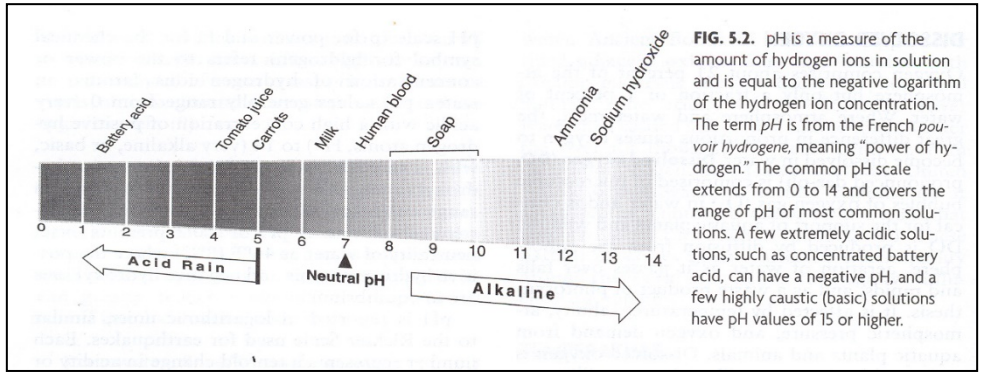
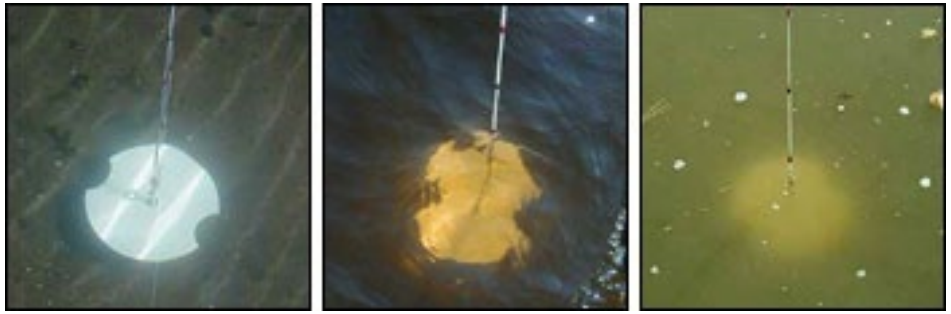


FIG. 5.2. pH is a measure of the amount of hydrogen ions in solution and is equal to the negative logarithm of the hydrogen ion concentration. The term *pH* is from the French *pouvoir hydrogene*, meaning "power of hydrogen." The common pH scale extends from 0 to 14 and covers the range of pH of most common solutions. A few extremely acidic solutions, such as concentrated battery acid, can have a negative pH, and a few highly caustic (basic) solutions have pH values of 15 or higher.

- pH = power of 10 for the H ion concentration (drop the minus sign)
- Pure distilled water has a pH of 7 (neutral)
    - $1 \times 10^{-7} = 0.0000001$ moles H^+ per liter
- Most rivers and lakes have a pH of 4 to 9
- Fish have a narrow range that varies by species
    - pH outside the range can cause damage to gills, eyes, skin, etc.

Turbidity

- Clarity of water
- Measured as light penetration in nephelometric turbidity units (NTU)
- Also measured with a Secchi disk
  - Record the depth at which you can no longer see the banded colors on the disk
  - Or We can use turbidity sensors



Secchi disk depth comparison from clear (left) to murky (right)
http://earthobservatory.nasa.gov/Study/WaterQuality/water_quality2.html

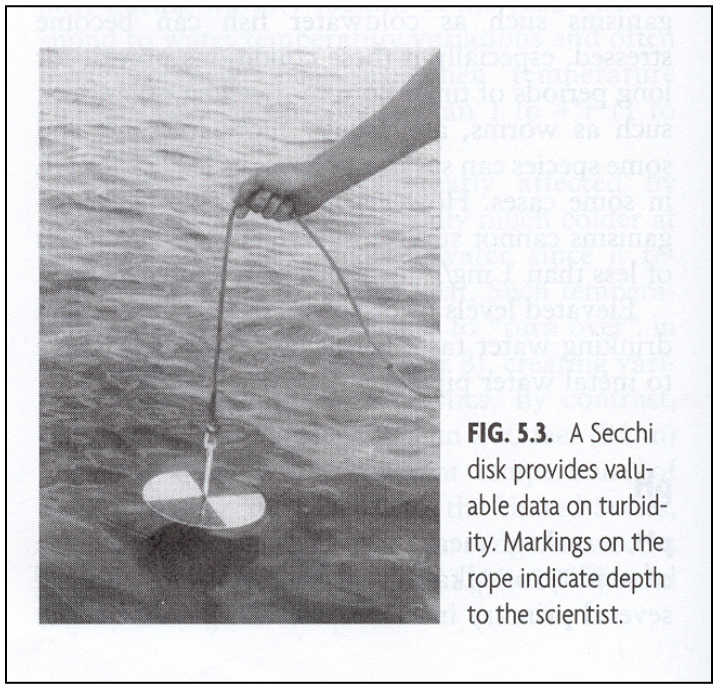


FIG. 5.3. A Secchi disk provides valuable data on turbidity. Markings on the rope indicate depth to the scientist.

Water quality-chemical parameters

- Compounds that <u>do not</u> contain carbon (C)
- Originally defined as compounds that do not originate in plants or animals
- Metals, minerals, and nutrients[1]

Chemical Parameters					الخصائص الكيميائية
7.12	PH		Electrode	6.5-8.5	أس هيدروجيني
20	Acidity	mg/l as $CaCO_3$	Hach Titration	45	الحموضة
260	Alkalinity	mg/l as $CaCO_3$	Hach Titration	350	القلوية
	DO	mg/l	Hach Titration	6	الأوكسيجين المذاب
0.01	Ammonia	mg/l as NH_3-N	Spectro Hach8038	0.5	النشادر -الأمونيا
0.013	Nitrite	mg/l as NO^-_2	Spectro Hach8507	0.1	النتريت
1	Nitrate	mg/l as NO^-_3	Spectro Hach8039	45	النترات
13.5	Chloride	mg/l as Cl^-	Hach Titration	200	الكلوريدات
186	TotalHardness	mg/l as $CaCO_3$	Hach Titration	350	العسرة
140	CalciumHardness	mg/l as $CaCO_3$	Hach Titration	250	عسر الكالسيوم
46	MagnesiumHardness	mg/l as $CaCO_3$	Hach Titration	100	عسر المغنيزيوم
5	Sulfate	mg/l as SO^{2-}_4	Spectro Hach8039	250	الكبريتات -السلفات
0.02	Iron	mg/l as Fe^{2+}	Spectro Hach8008	0.3	الحديد المذاب
	TotalPhosphate	mg/l as PO^{3-}_4	Spectro Hach	1	الفوسفات الإجمالي
0.025	Orthophosphate	mg/l as PO^{3-}_4	Spectro Hach8008	0.7	الفوسفات المتفاعل
	Sodium	mg/l as Na+	Flame photometer	150	الصوديوم
	Potassium	mg/l as k+	Flame photometer	12	البوتاسيوم
0.12	Zinc	mg/l	Hach Titration	5	الزنك
	Phenol	mg/l	Hach Titration	0.001	الفينول
0.4	Fluoride	mg/l(8-12°C)	Hach Titration	1.5	الفلوريد
		mg/l(25-30°C)	Hach Titration	0.7	

Water quality-chemical parameters -Metals

- Lead
  - Used in electrical conductors, pipes (soldering), paints, and a by-product of mining
  - *Lead poisoning* causes toxic reactions, brain damage, death
  - Especially harmful to brain development in children
- Arsenic
  - Found naturally in some rocks, in banned pesticides, wood preservatives, and as an industrial by-product
  - Causes neurological damage and cancers
  - Drinking water standard used to be < 50 ppb
  - Starting Jan 2006 it is < 10 ppb

Water quality-chemical parameters-Minerals

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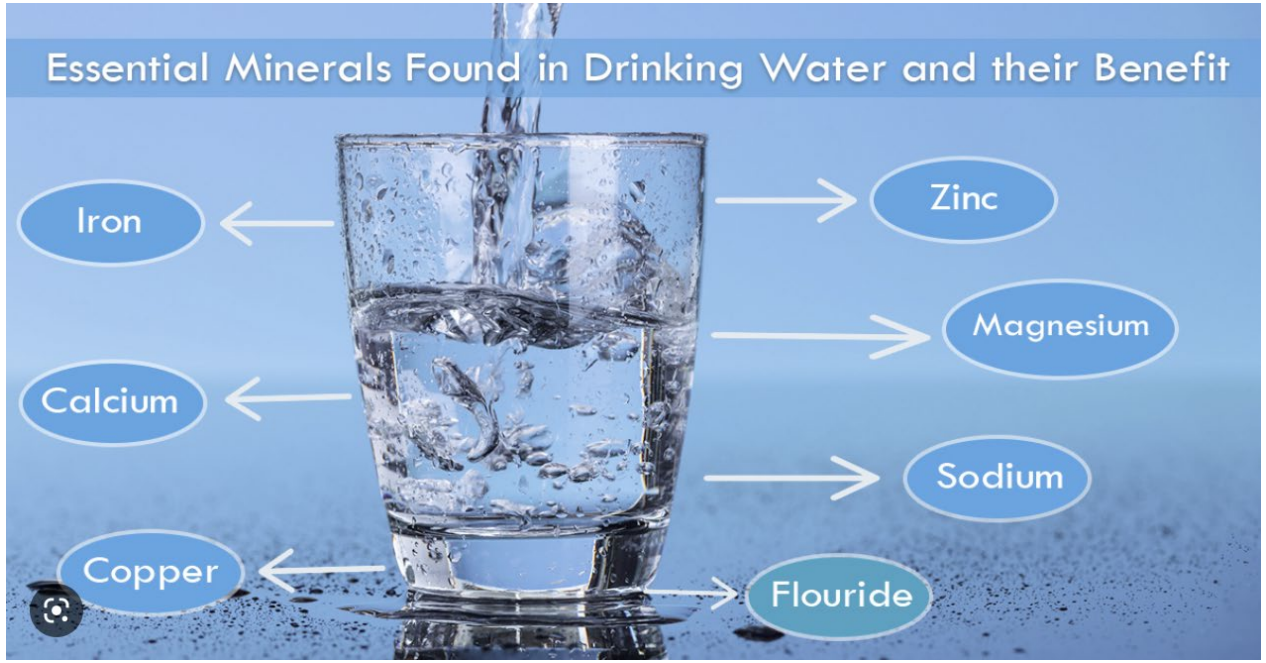
- All surface and groundwaters contain minerals
- At high concentrations they can cause adverse effects
- **Minerals that are often present in mineral water include:**
- calcium.
- magnesium.
- potassium.
- sodium.
- bicarbonate.
- iron.
- zinc.



Water quality-chemical parameters-Nutrients

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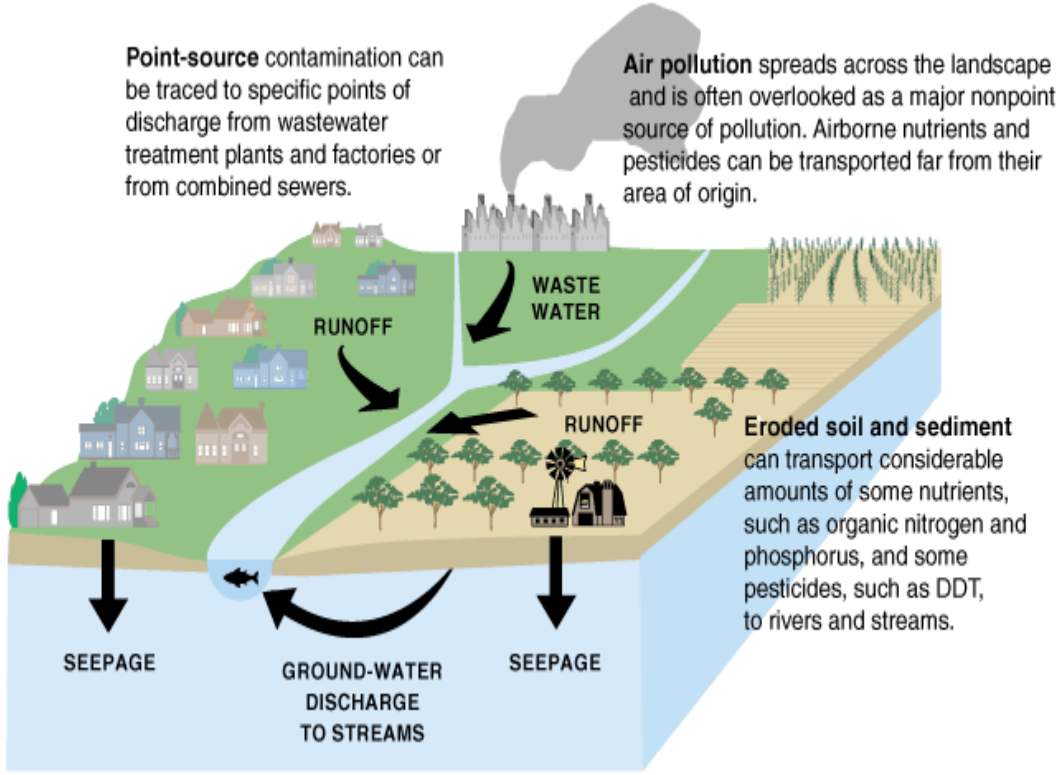
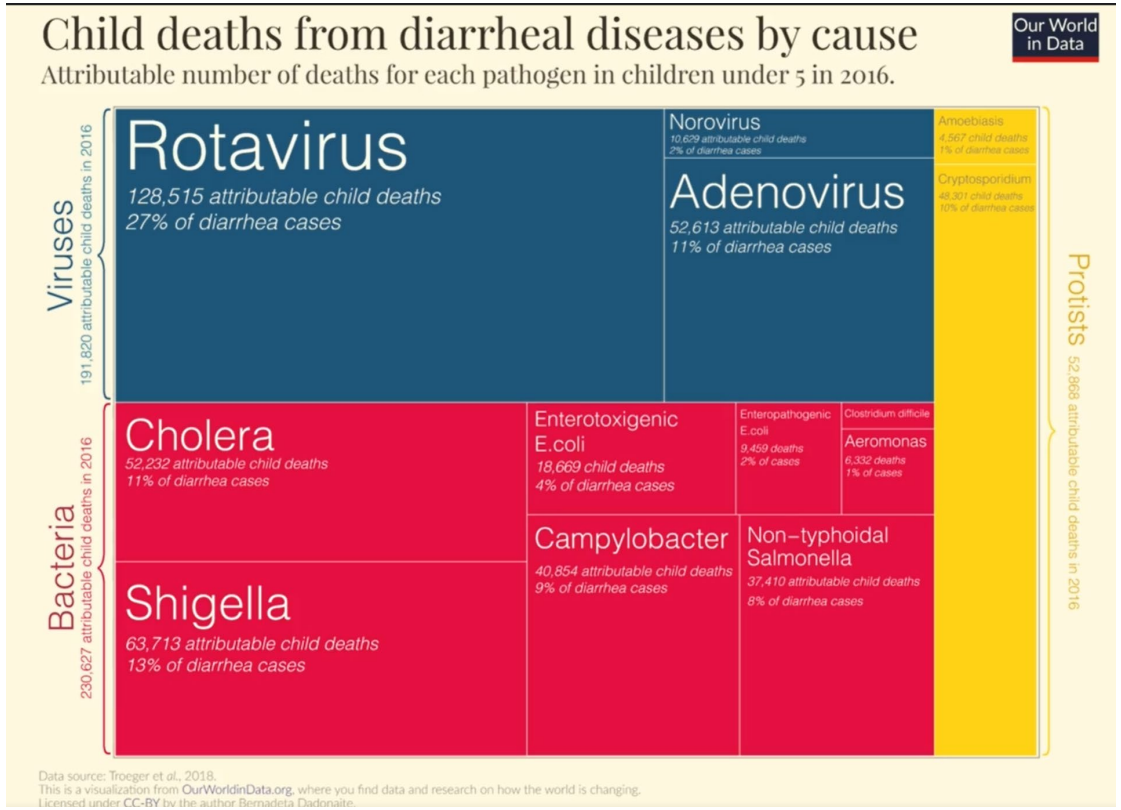
- Nutrient pollution affects water around the world. The impacts of nutrient pollution are found in all types of water bodies. Pollutants often enter upstream waters like streams and then flow into larger water bodies like lakes, rivers, and bays. Excess nitrogen and phosphorus can also travel thousands of miles to coastal areas where the effects of the pollution are felt in the form of massive dead zones.
- Major minerals important in animal and plant nutrition:
  - Nitrogen, phosphorus, potassium, calcium
- At high concentrations in streams and lakes they can cause problems



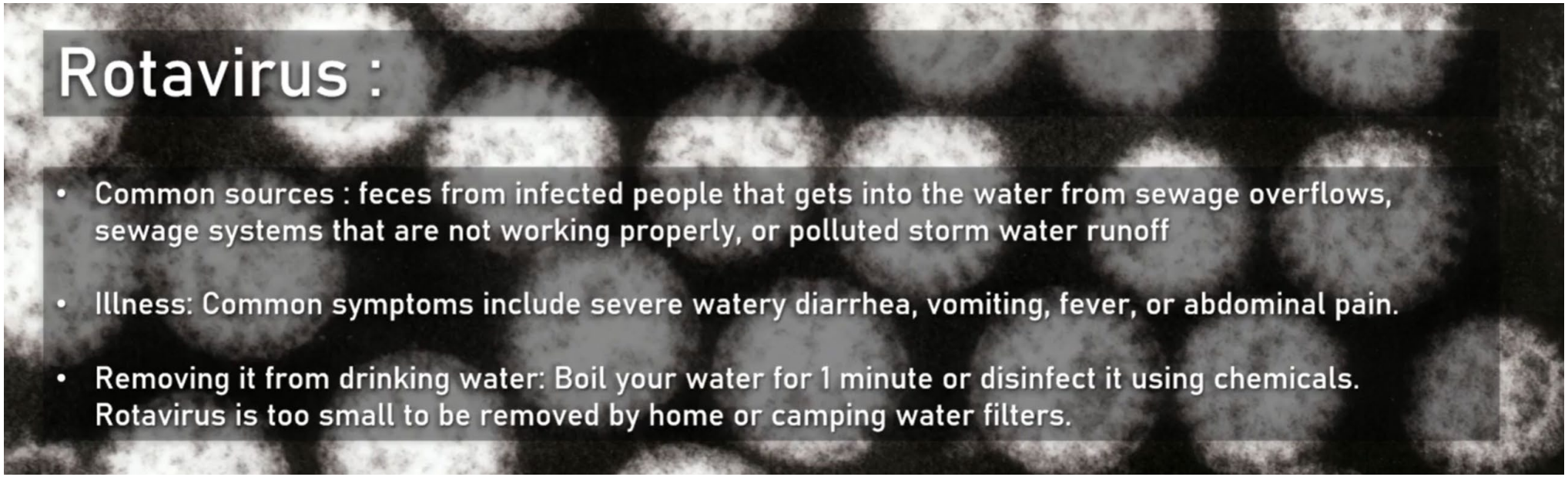
Water quality-Biological parameters

- Too costly and dangerous to test water for individual pathogens
- Instead, we test for *indicator organisms*
  - Harmless but indicate fecal origin
- Common indicator organism
  - *Total coliform bacteria* – seldom used today
  - *Fecal coliform bacteria* – most common today

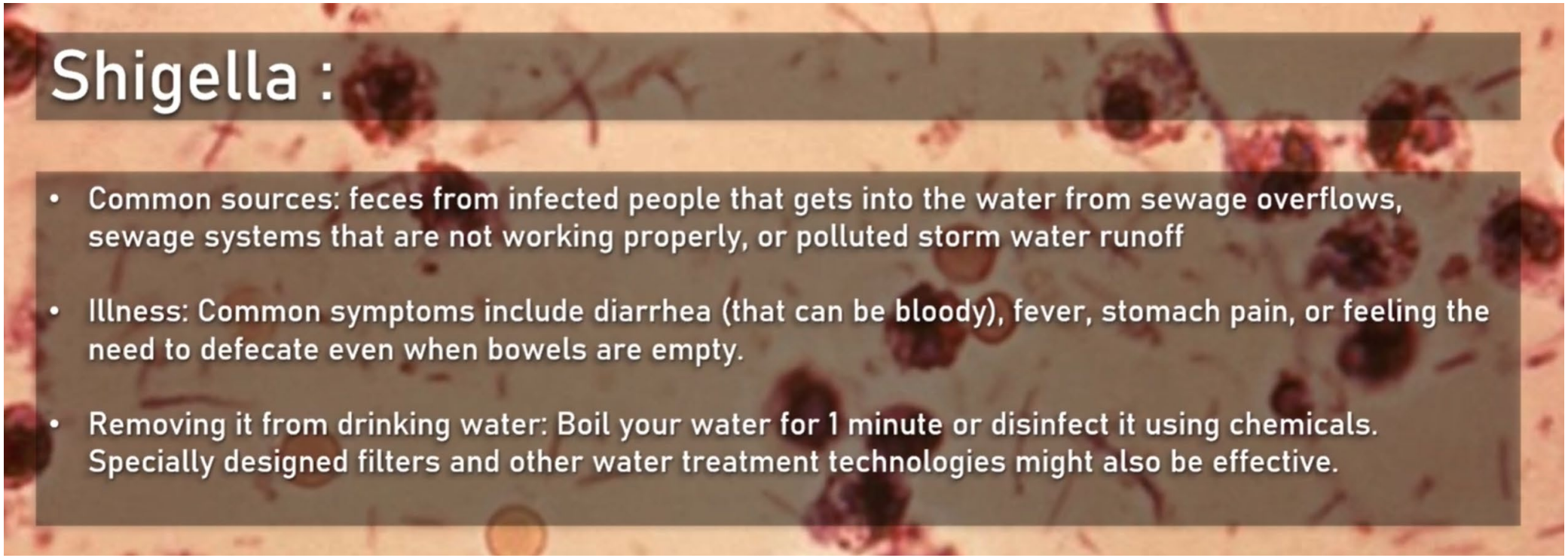


The Rotavirus alone is responsible for 27% of diarrhea cases and more than 128,000 attributable child death

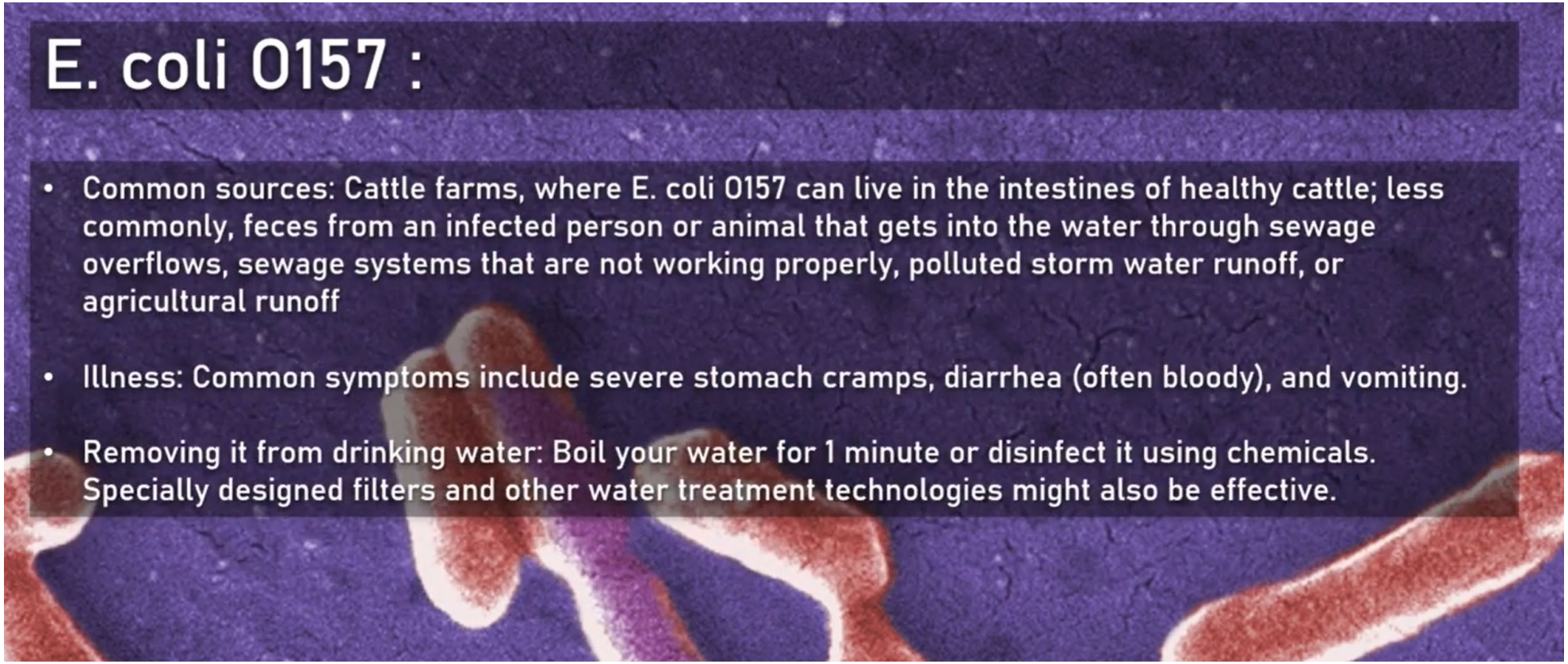
Water quality-Biological parameters



Water quality-Biological parameters



Water quality-Biological parameters



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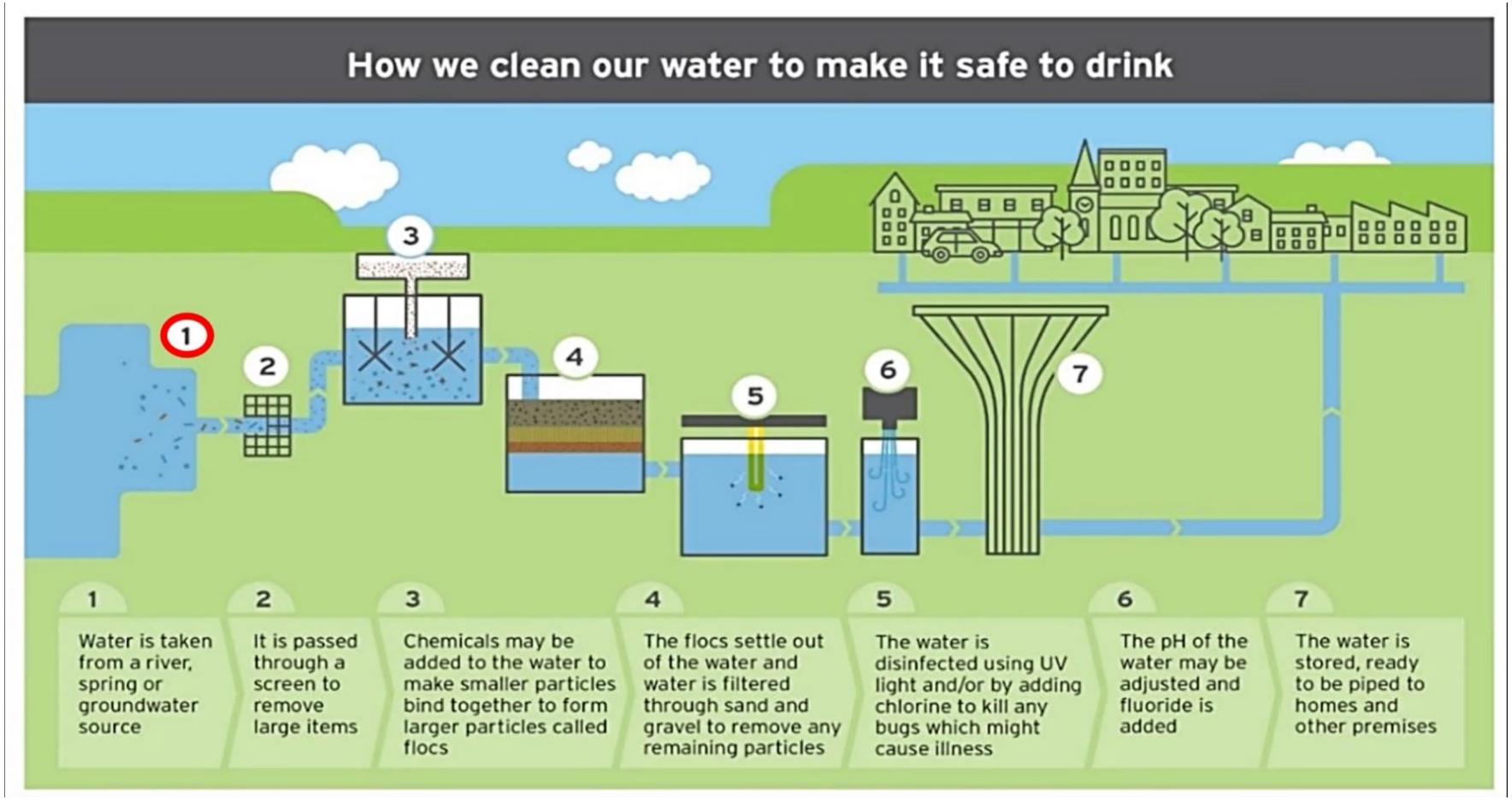
Water treatment process-step 1



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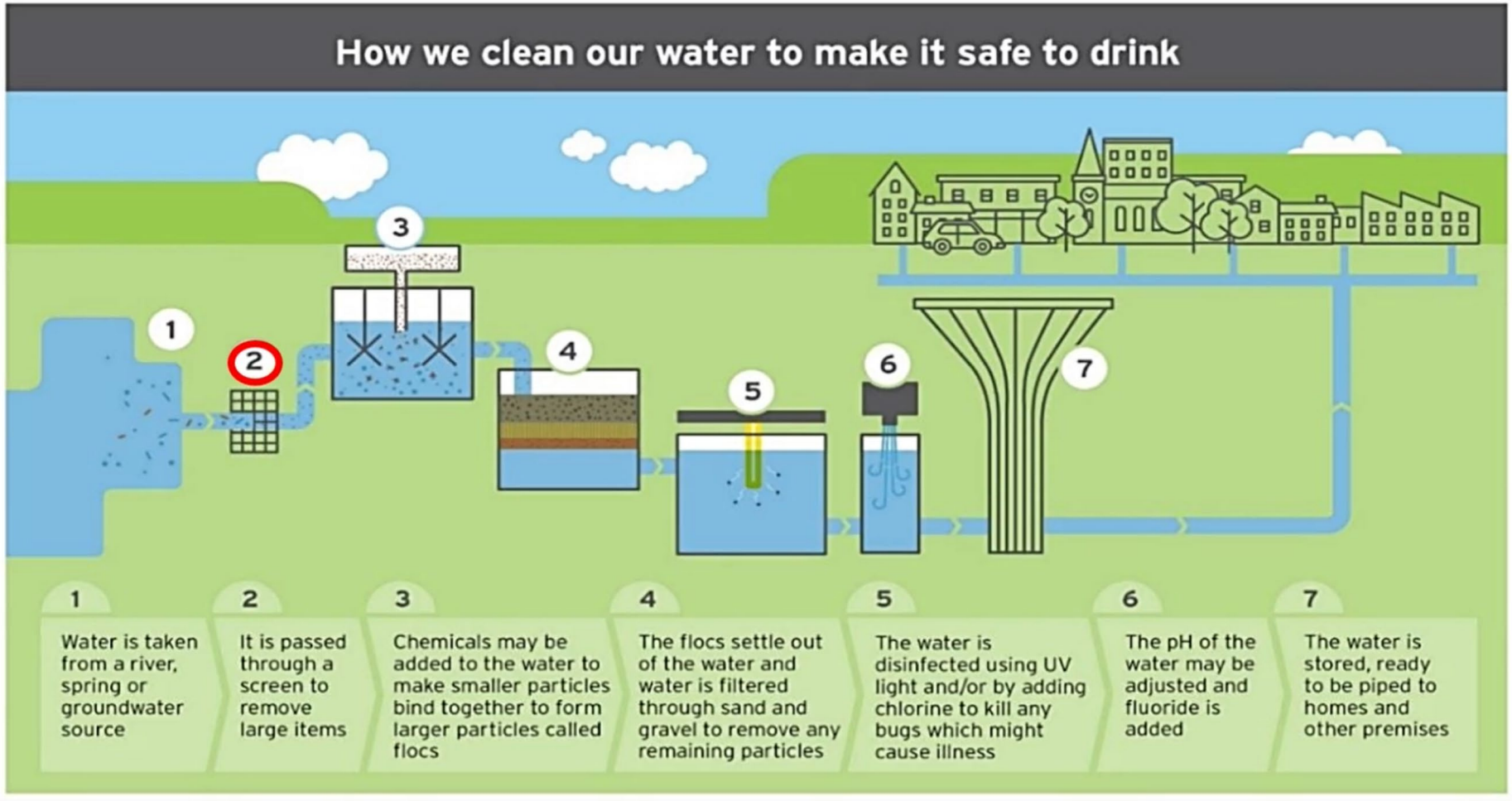
Water treatment process-step 2



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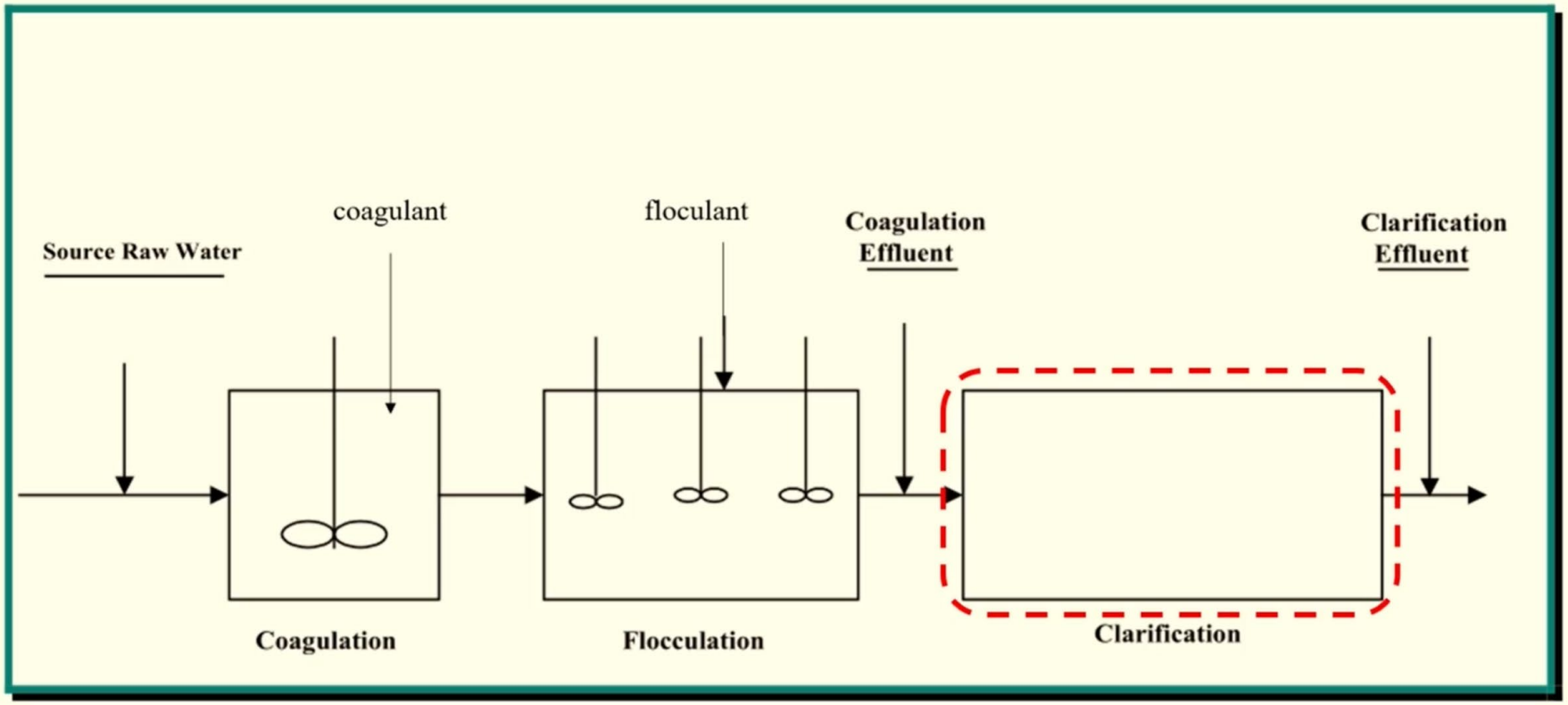
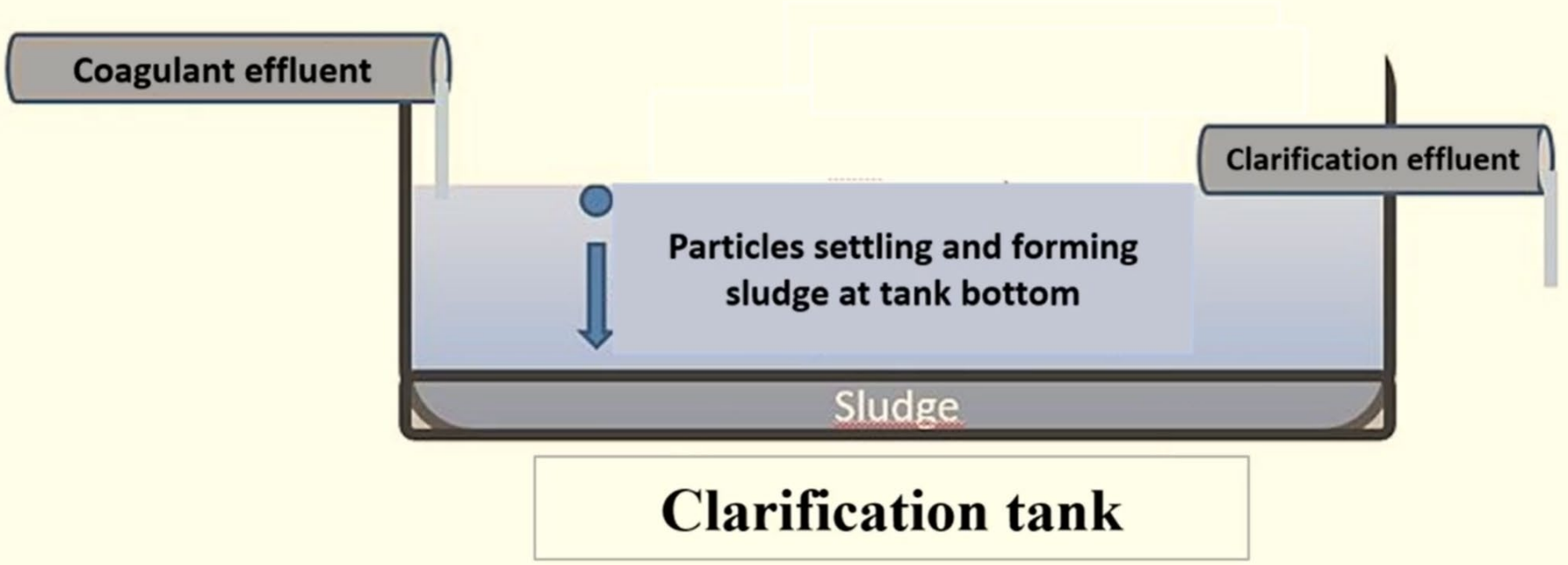
Water treatment process-step 3

Water treatment process-step 3



COAGULATION-FLOCCULATION-CLARIFICATION PROCESS

Water treatment process-step 3



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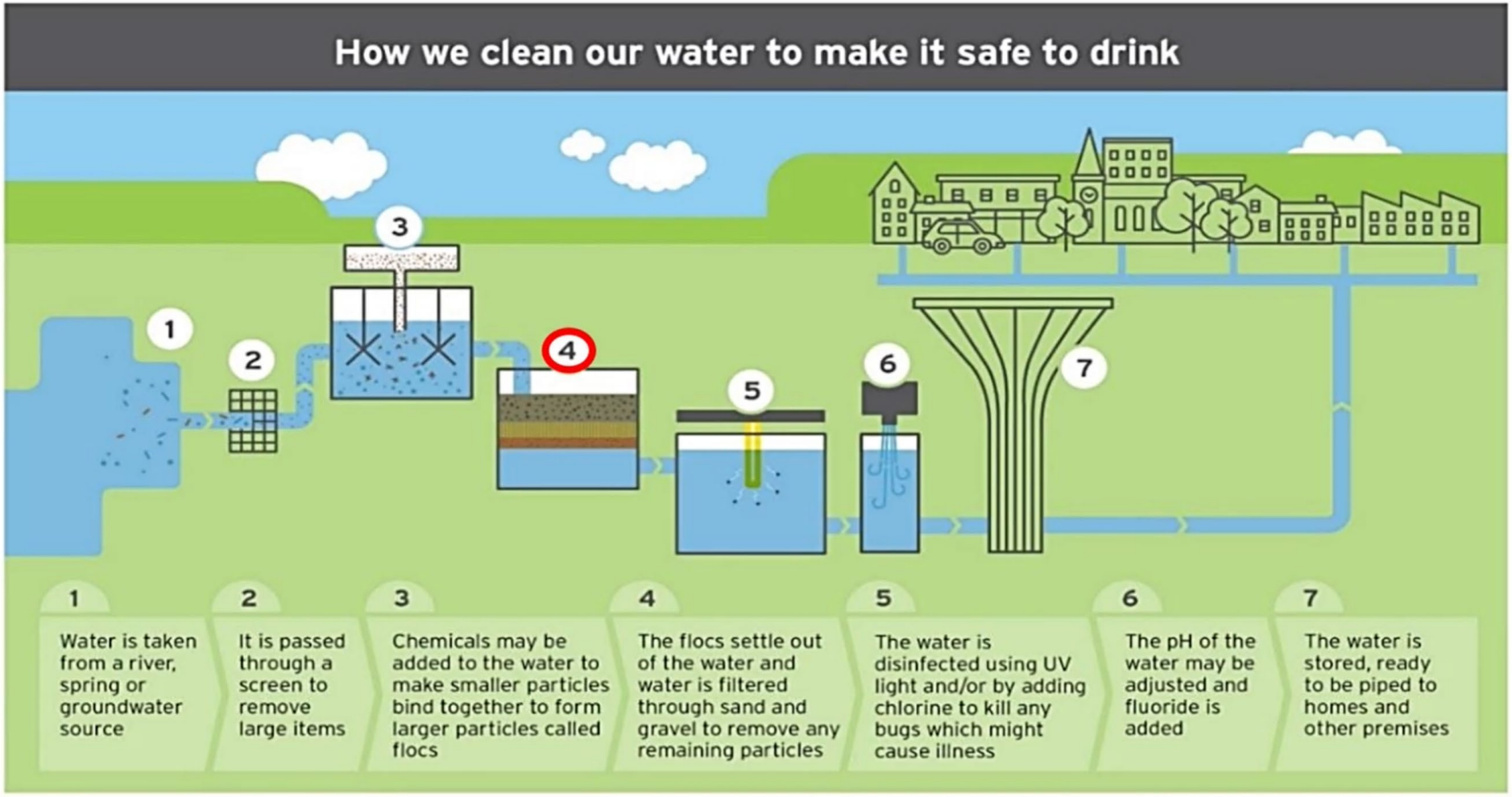
Water treatment process-step 4



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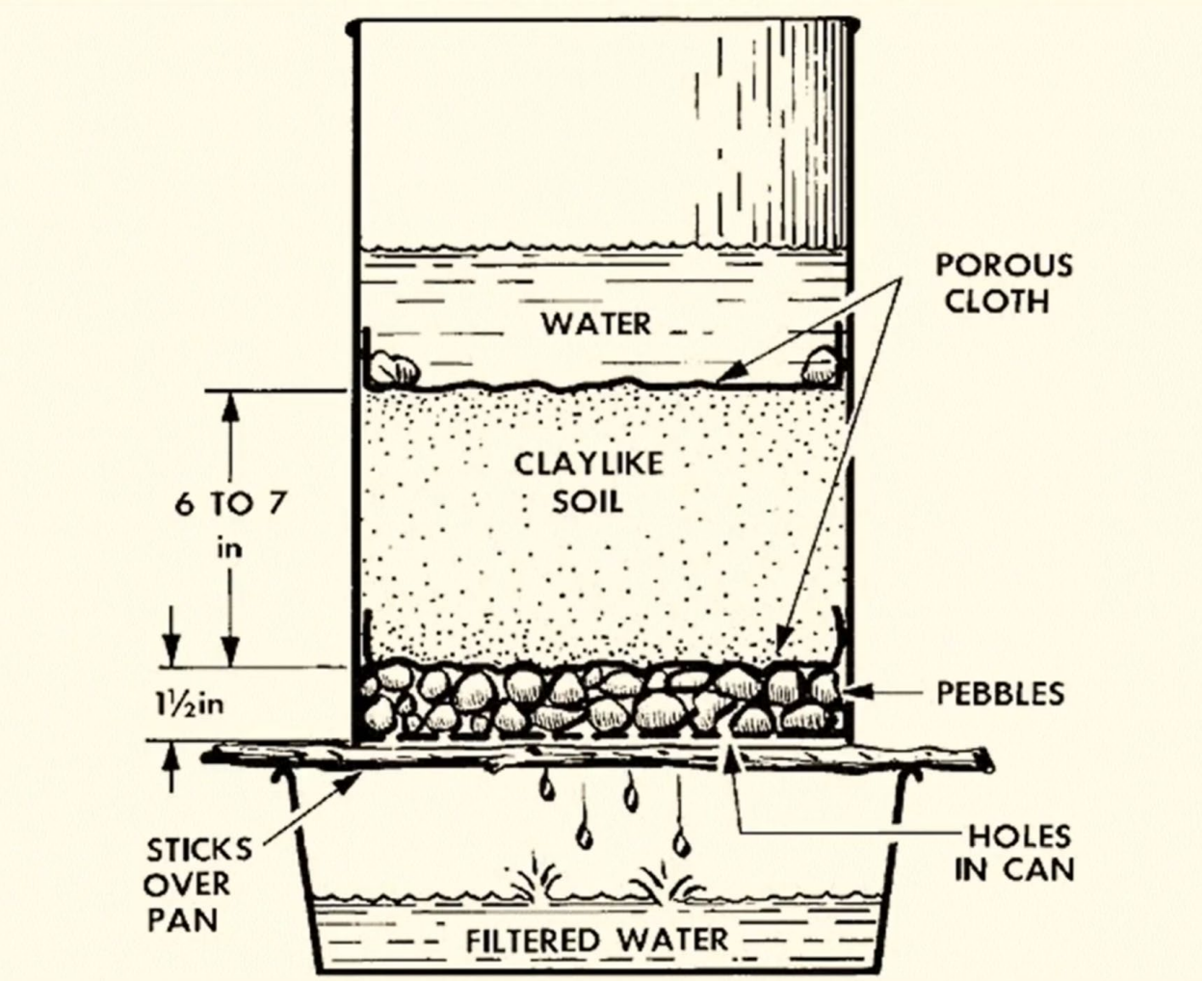
Water treatment process-step 4

- During filtration, the clarified water passes through filters that have different pore sizes and are made of different materials such as sand, gravel and charcoal.
- These filters remove the salt particles and germs such as dust, chemicals, parasites, bacteria and viruses.
- Activated carbon filters also remove any bad odors



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Water treatment process-step 4

- Water treatment plants can also use a process called ultrafiltration in addition to or instead of traditional
- During ultrafiltration, the water goes through a filter membrane with very small pores.
- This filter only lets through water and other small molecules.
- Reverse osmosis is another filtration method that removes additional particles from water.

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WATER TREATMENT PROCESS-STEP 5

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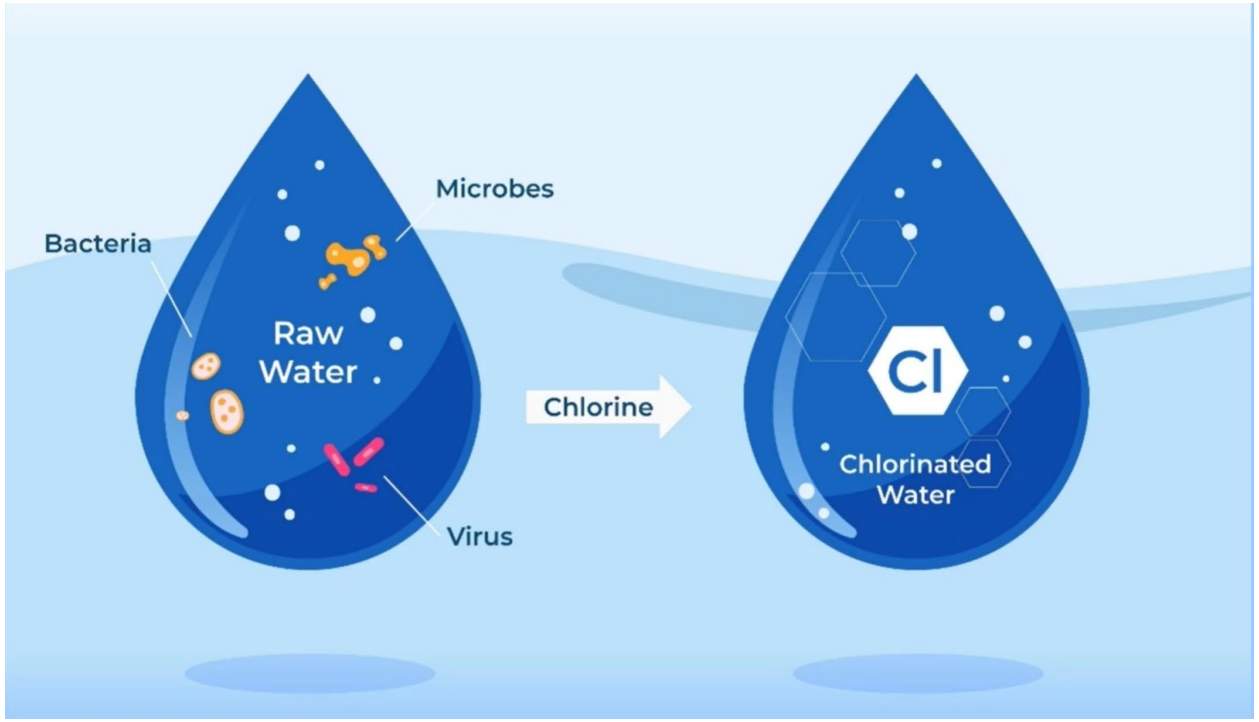
WATER TREATMENT PROCESS-STEP 5

In addition to or instead of adding chlorine, can also disinfect water using ultraviolet light or ozone.
UV light and ozone work well to disinfect water in the treatment plant.
But these disinfection methods do not continue killing germs as water travels through the pipes between
treatment plants and our tap.



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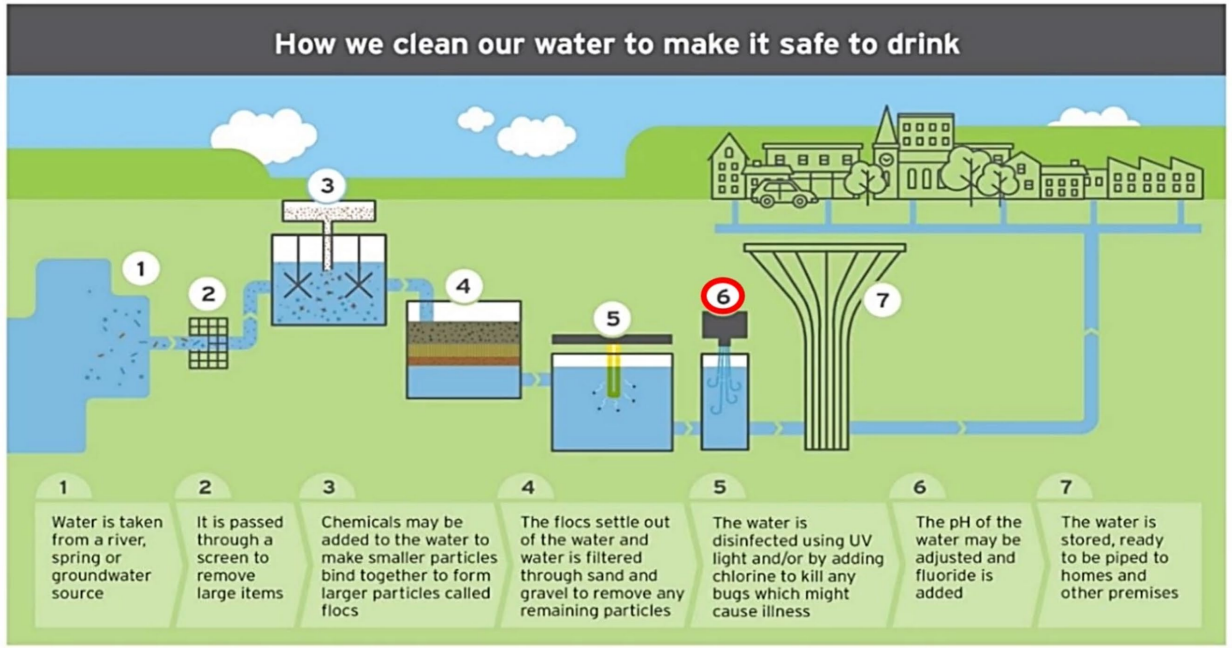
WATER TREATMENT PROCESS-STEP 6

- Water can have extensively fluctuating pH values, depending on the geology of the water aquifer or basin, and they have an impact on the contaminant's involvement.
- Drinking water needs to have a reasonable pH around seven and eight for the safety of the consumer and for the protection of pipelines and equipment's.



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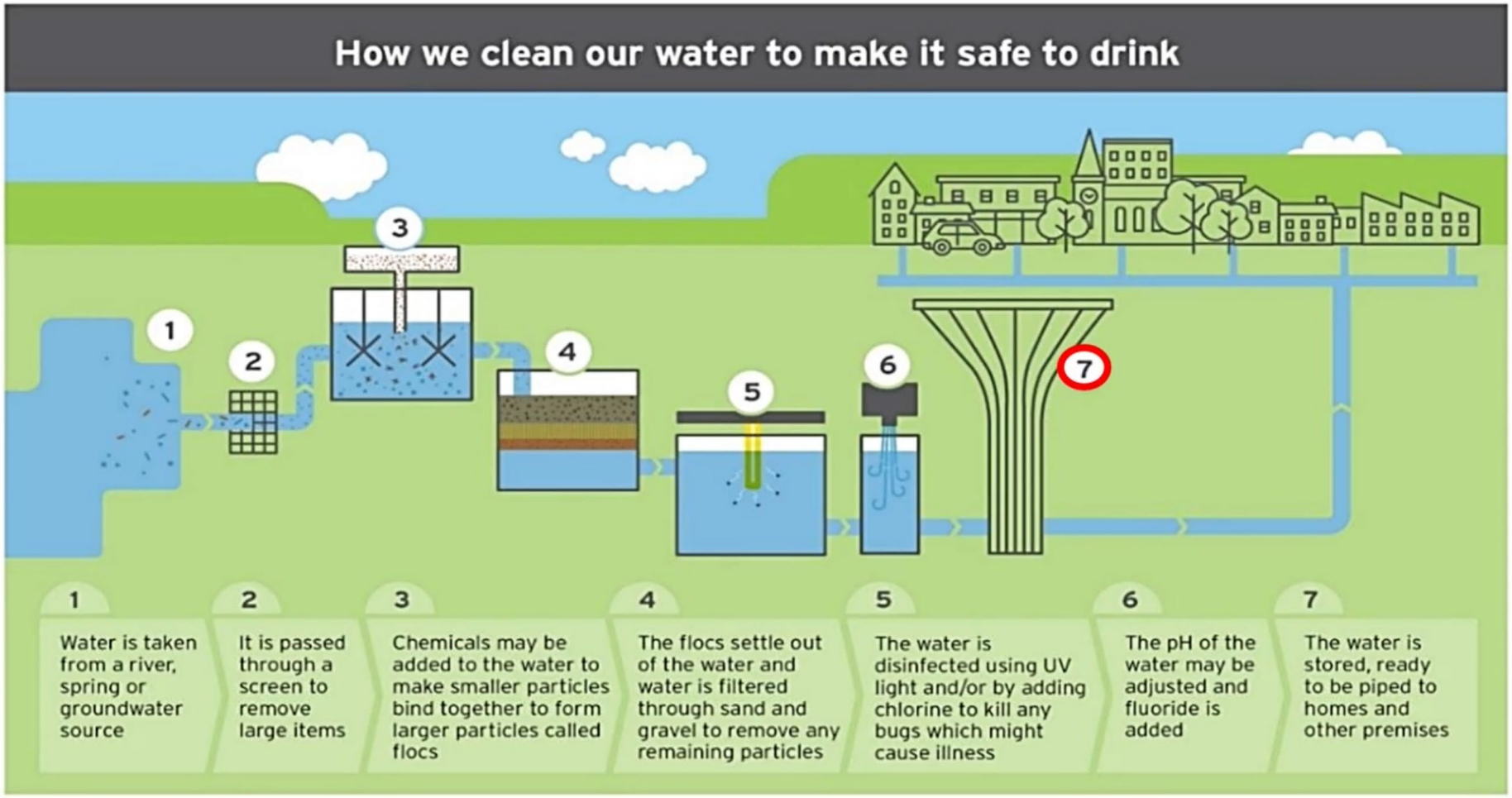
WATER TREATMENT PROCESS-STEP 5



Water Treatment process

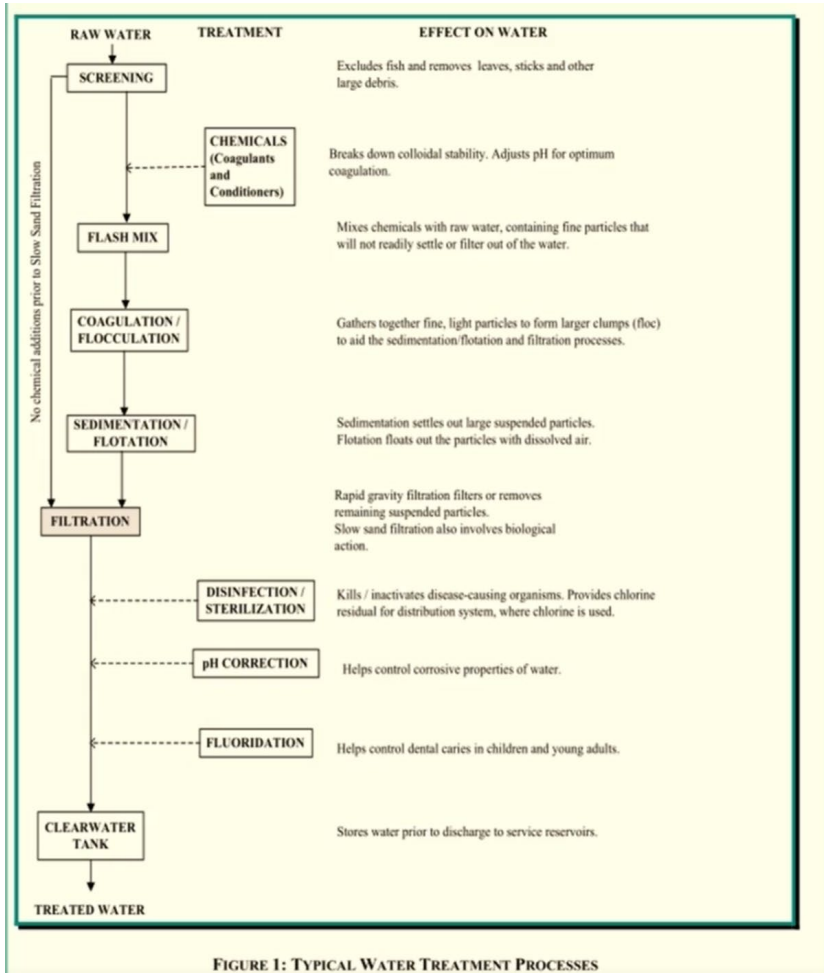
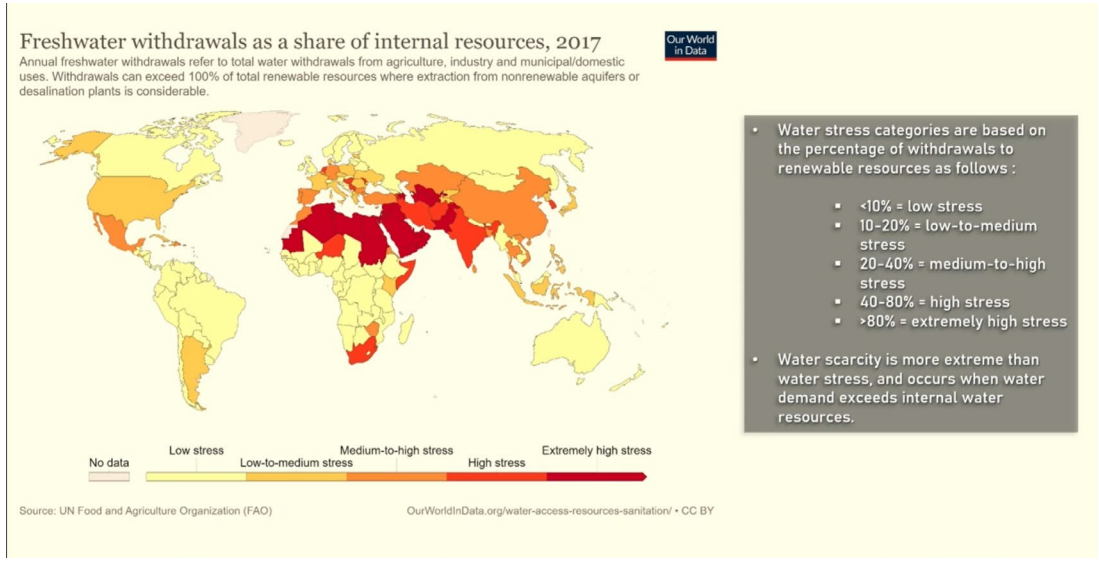
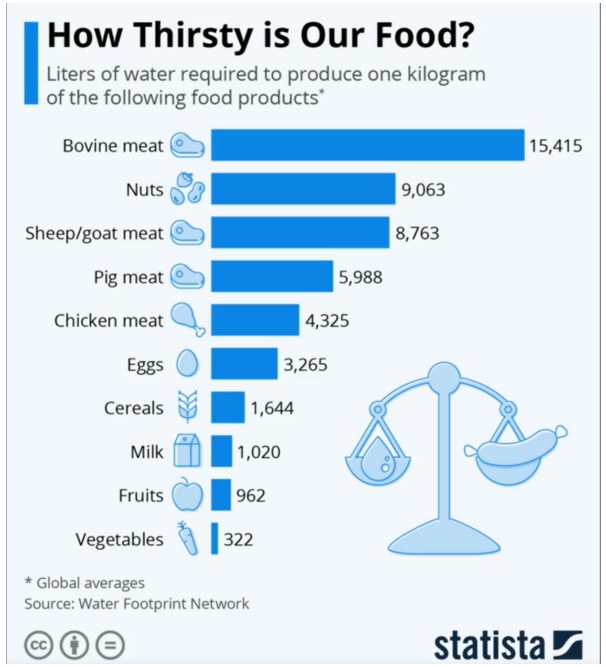


FIGURE 1: TYPICAL WATER TREATMENT PROCESSES

Water challenges-water stress

- Providing safe drinking water is becoming a challenging task year after year because of many factors.
  1. The first challenge is water stress.





We can see how much water is needed to supply humanity with food.
Producing one kilogram of bovine meat requires more than 15,000 litres of water, and producing one kilogram of nuts requires more than 9000 litres of water.
We can see that meat consumes a lot of water compared to cereals, vegetables and fruits.
We certainly need a more sustainable farming and to rethink our meat consumption lifestyles.

Water challenges-Pollution and water quality

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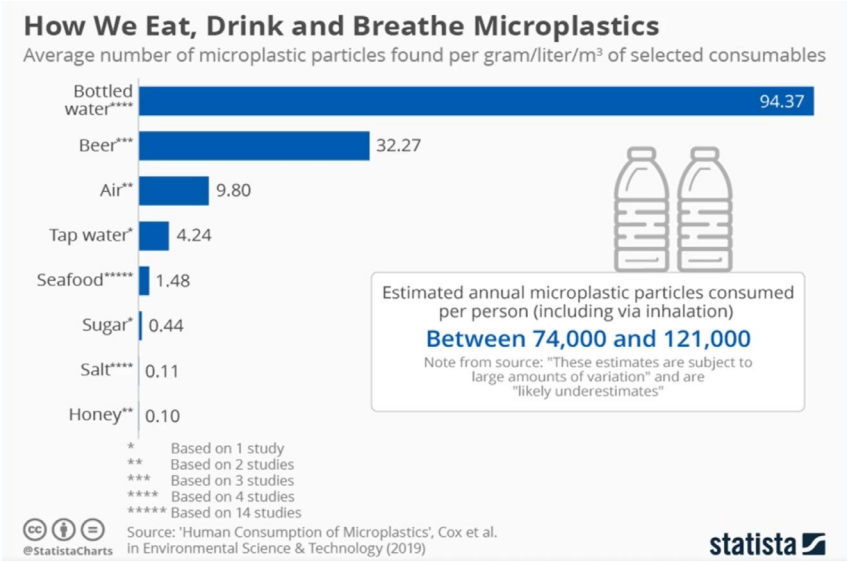
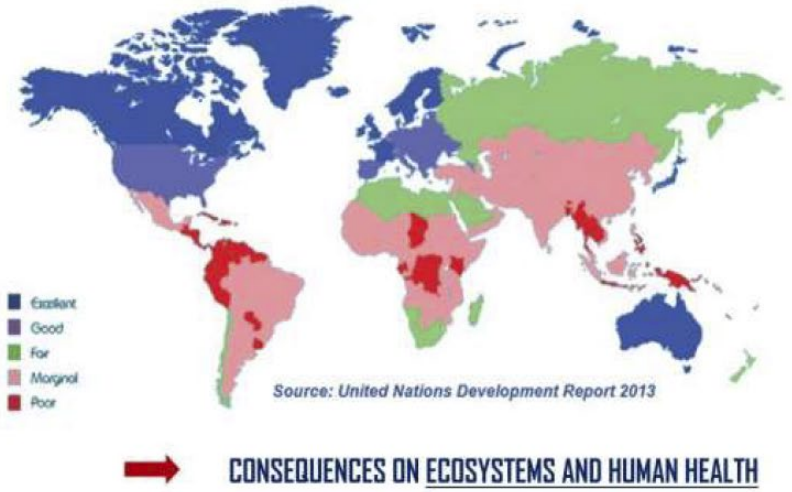
- Providing safe drinking water is becoming a challenging task year after year because of many factors.

  2-Another threat to water security is pollution.



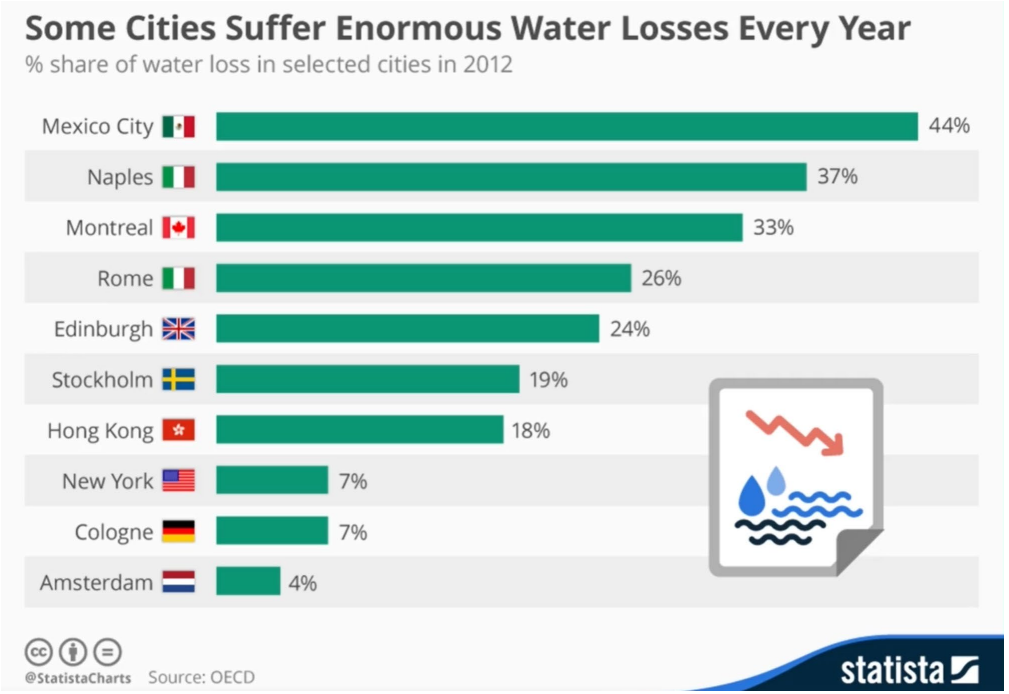


CONSEQUENCES ON ECOSYSTEMS AND HUMAN HEALTH

Water challenges-Water Leaks

- Providing safe drinking water is becoming a challenging task year after year because of many factors.

3-Another challenge of drinking water is water loss in piping and leaks.



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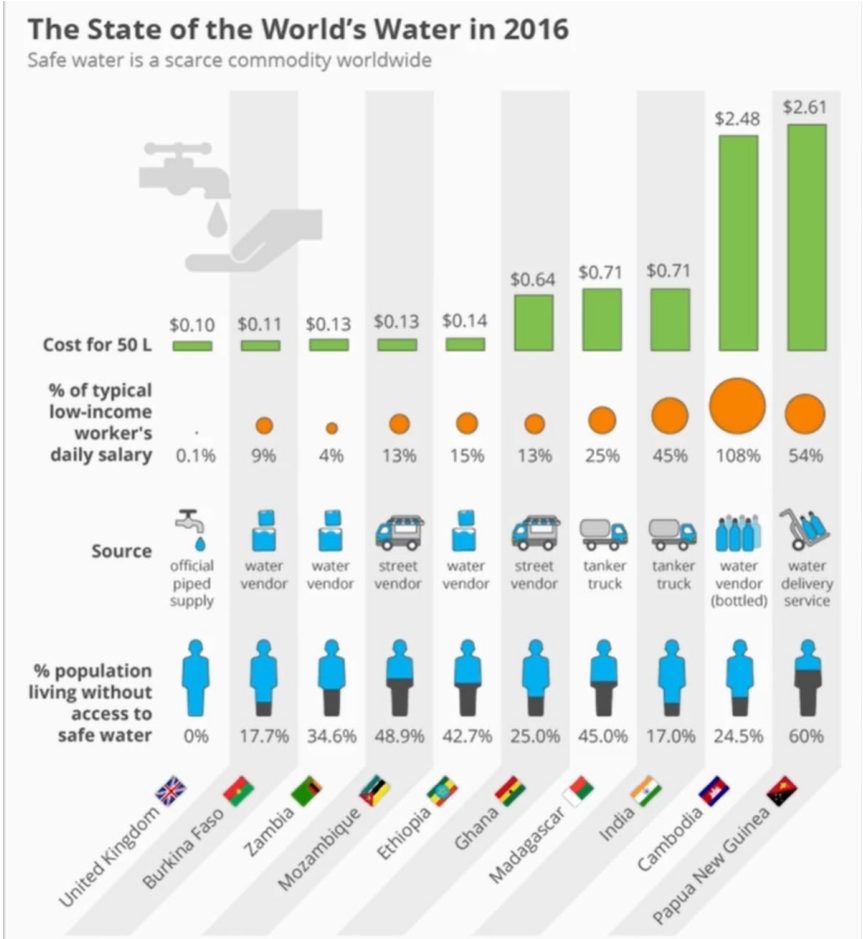
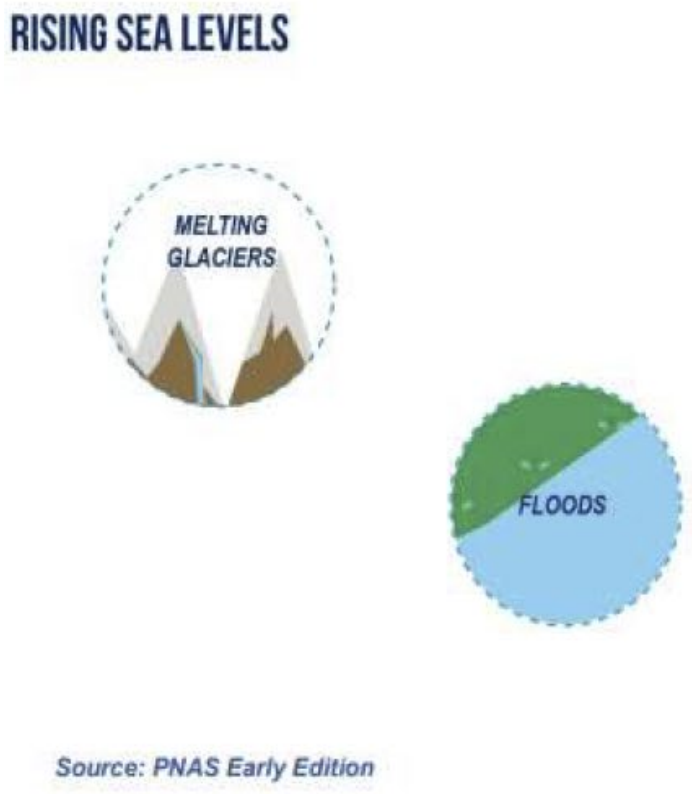
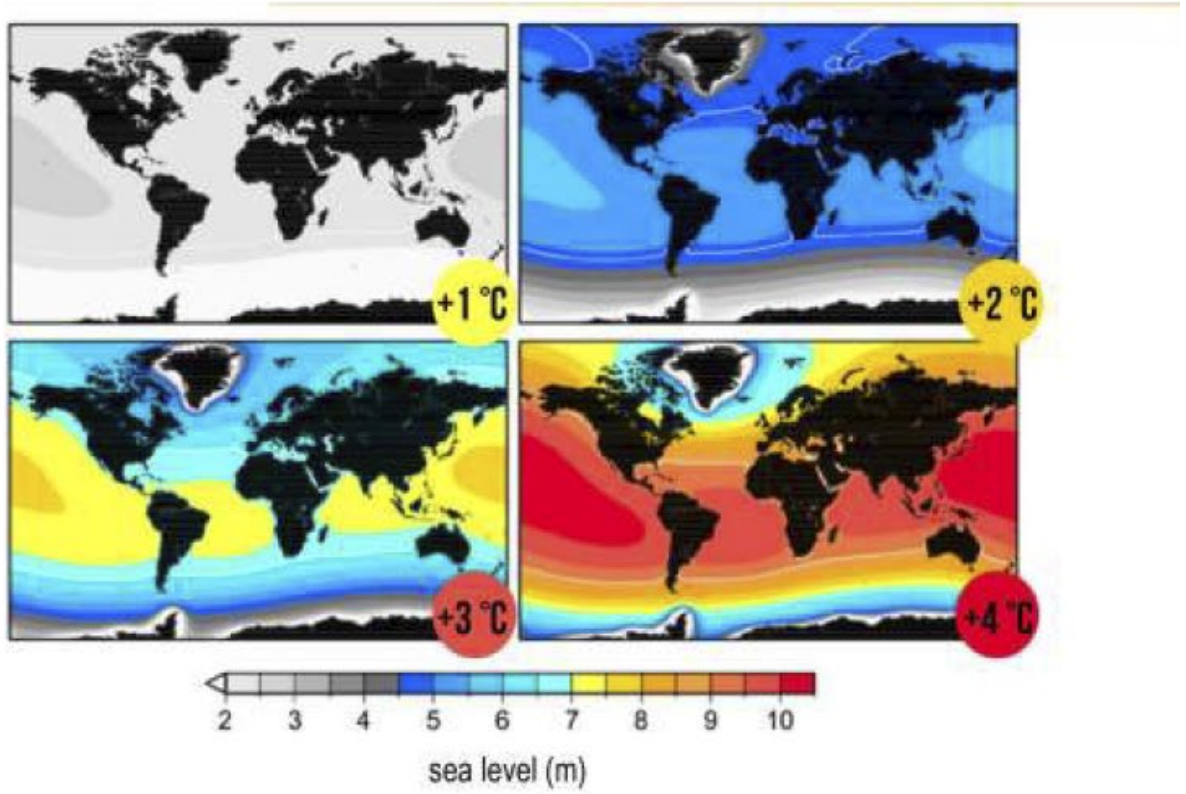
Water challenges-High Cost

Generally speaking, the cost of water becomes higher the more the country is poor and vice versa.
The cost gets cheaper if the country is rich.
The percentage of cost, for 50 liters of drinking water of the typical daily salary varies between countries.
While it is only about 0.1% in the UK, it is much higher in many countries like India and Papua New Guinea.
It can even be higher than the daily salary like in Cambodia.

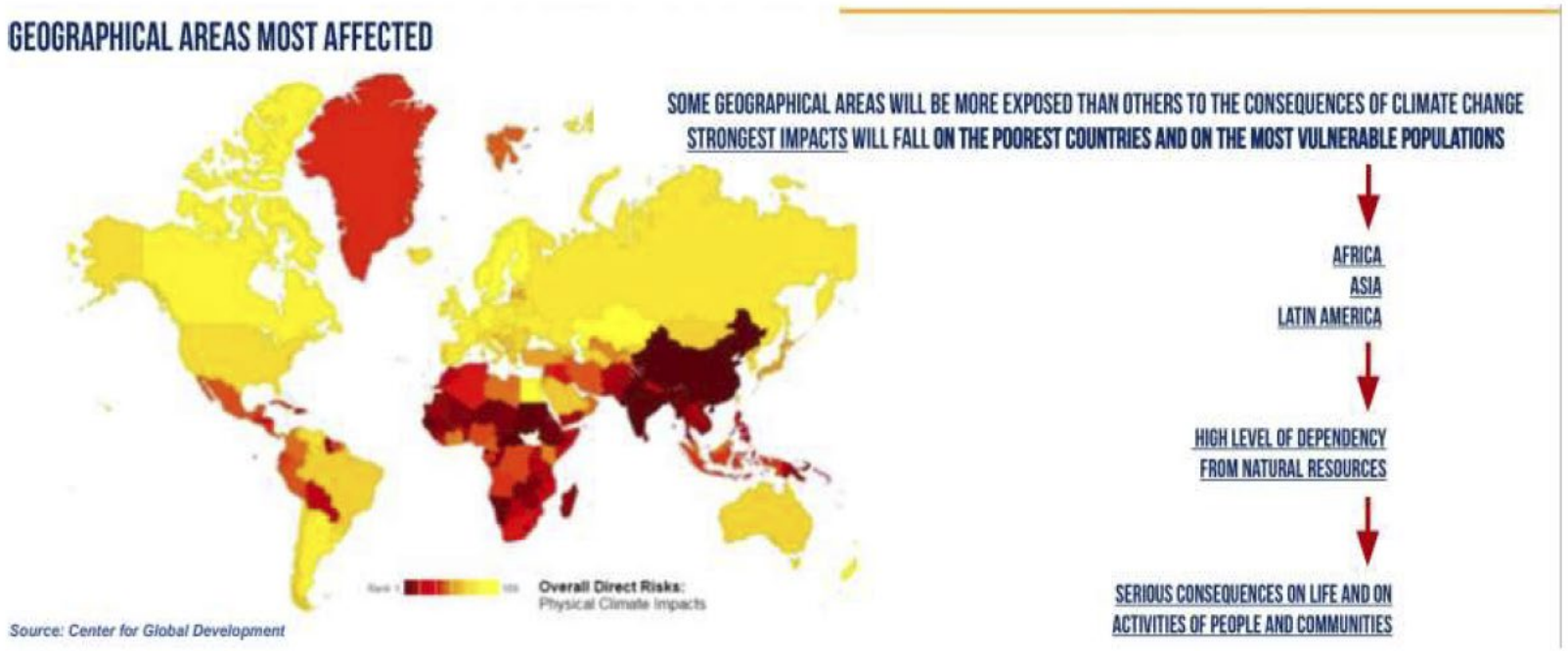


Water Challenge-Climate Change





Water Challenge-Climate change



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Thank You for your attention !