WATER BACTERIOLOGY

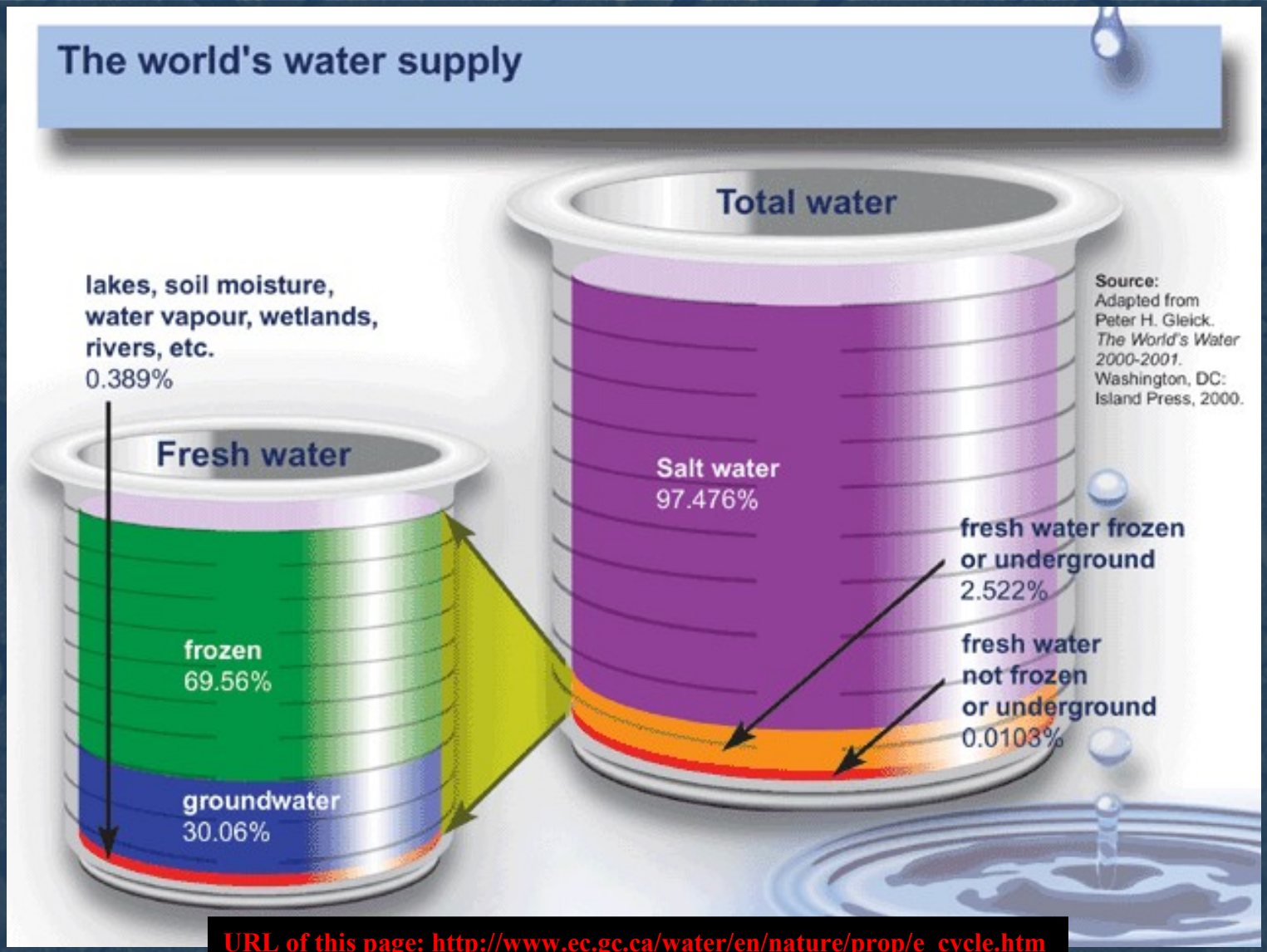
Training Course 2008

A. S. Altomi

Please shut down your phone or keep it on silent mode

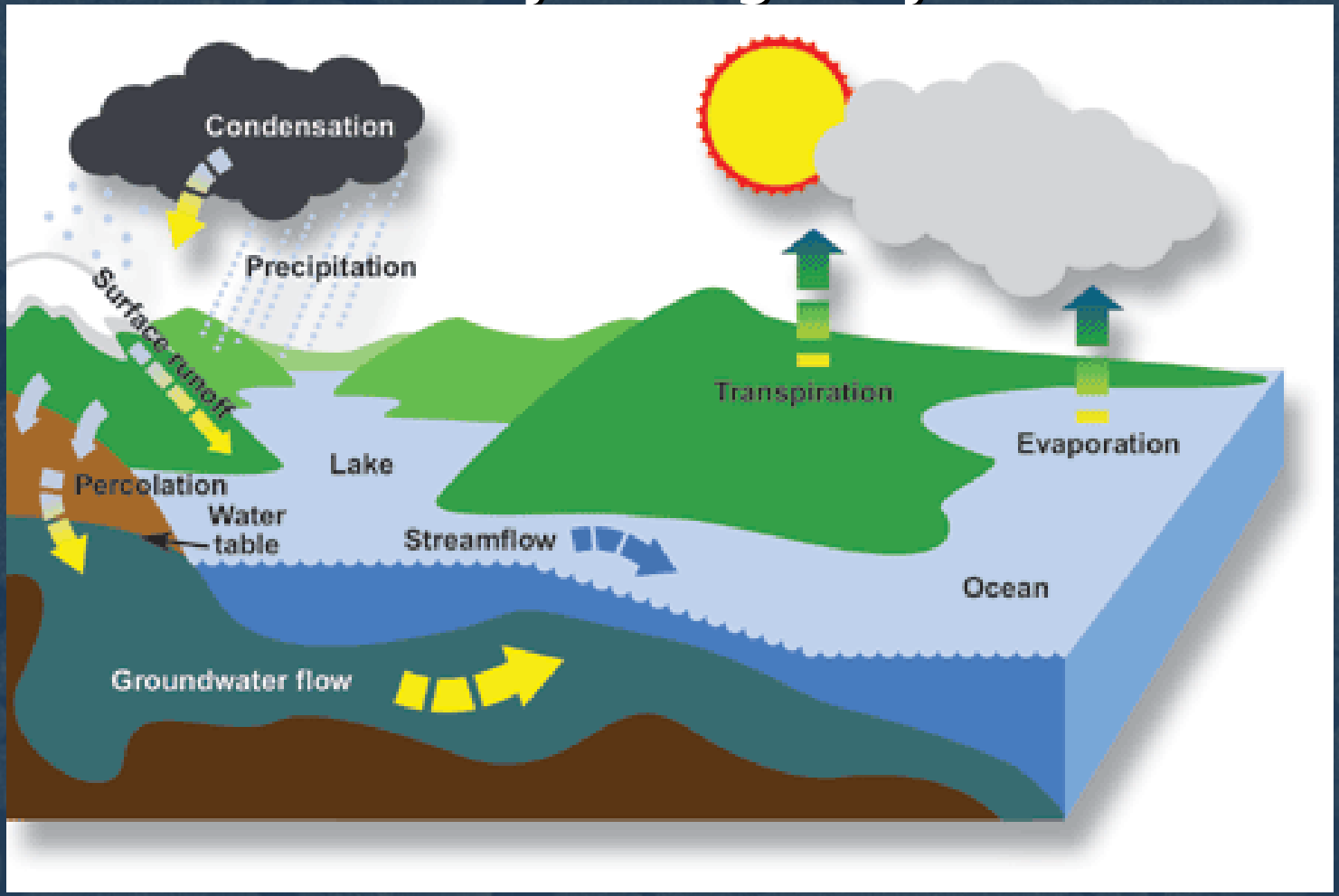
?How much water is there in the world

Scientists estimate that the quantity of water was over one billion cubic kilometers . And it covers nearly three quarters of the earth's surface in oceans as well as rivers, lakes, snow and glaciers. There is water in the atmosphere and water underground. Water evaporates and returns to the land surface in what is known as the Hydrologic Cycle.



URL of this page: http://www.ec.gc.ca/water/en/nature/prop/e_cycle.htm

The Hydrologic Cycle



URL of this page: http://www.ec.gc.ca/water/en/nature/prop/e_cycle.htm

The Golden Rule

Access to water supply and Sanitation is a fundamental need and a human right. It is vital for dignity and health of all people.

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- In September 2000, 189 UN Member States adopted the Millennium Development Goals (MDGs), Achieving these targets will directly affect the lives and future prospects of billions of people around the globe.

United Nations Children's Fund & World Health Organization

Millennium Development Goals ((MDG))

Goal 6: Combat HIV/AIDS, Malaria and other Diseases.

Goal 8: Develop a Global Partnership for Development.

Goal 7: Ensure Environmental Sustainability.

Adequate treatment and disposal of wastewater contributes to better ecosystem conservation and less pressure on scarce freshwater resources. Careful use of water resources prevents contamination of groundwater and helps minimize the cost of water treatment.

- by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation .

General Introduction

- People served with some form of improved water supply rose from 79% (4.1billion) in 1990 to 825 (4.9billion) in 2000.

- At the same time, the proportion of the world's population with access to excretal disposal facilities increase from55% (2.9billion) to 60% (3.6 billion people served).

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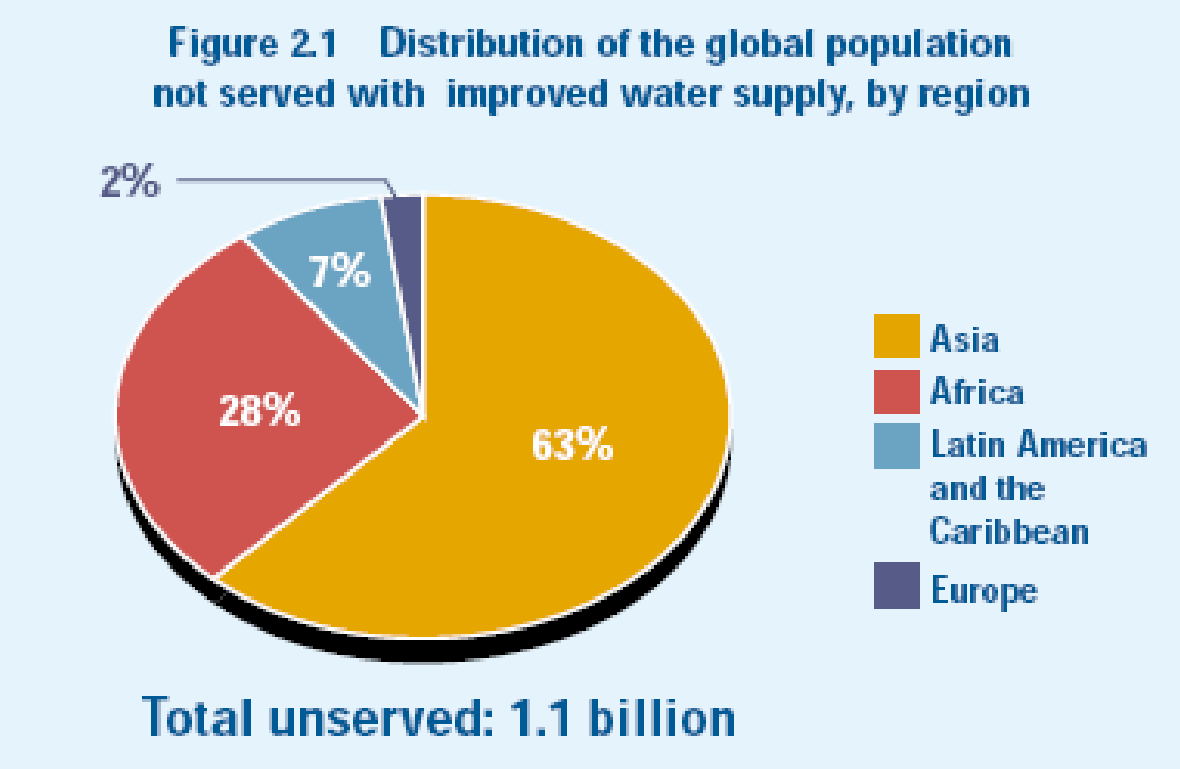
- At the beginning of 2000, $\frac{1}{6}$ (1.1 billion people) was without access to improved water supply.



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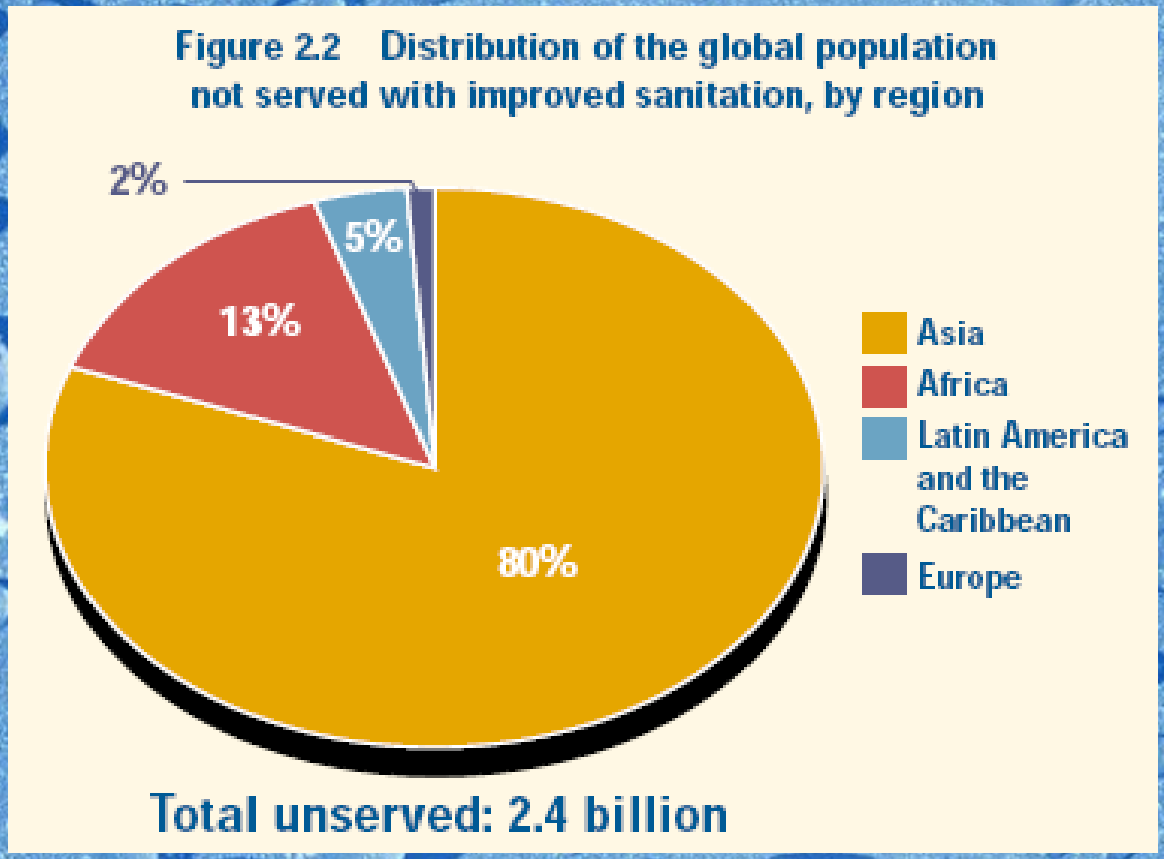
- And $\frac{2}{5}$ (2.4 billion people) lacked access to improved sanitation.



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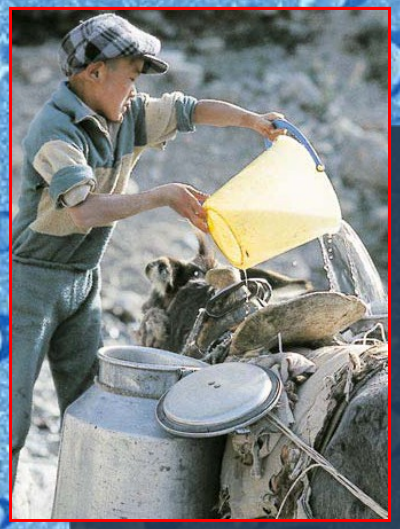

The majority live in Asia and Africa :

* Fewer than half of all Asians have access to improved Sanitation.

* 2 out of 5 Africans lack improved water supply.

Moreover, Rural services still lag far behind Urban services. 80% of those lacking adequate sanitation (2 billion people) live in Rural areas (1.3 in China and India).

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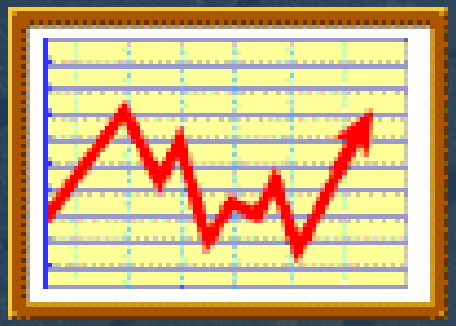
TABLE 6.1 AFRICA: WATER SUPPLY AND SANITATION COVERAGE BY COUNTRY, AREA OR TERRITORY, 1990 AND 2000

	Year	Total population[1] (thousands)	Urban population (thousands)	Rural population (thousands)	% urban water supply coverage	% rural water supply coverage	% total water supply coverage	% urban sanitation coverage	% rural sanitation coverage	% total sanitation coverage
Libyan Arab Jamahiriya	1990	4 416	3 614	802	72	68	71	97	96	97
	2000	5 604	4 911	693	72	68	72	97	96	97

1990 to 2000 :



- 816 million additional people gaining access to water supply .

- 747 million additional people gaining access to sanitation facilities.

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The Water supply and Sanitation sector will face challenges over the coming decades. As the No. of populations in Africa, Asia, Latin America and The Caribbean are expected to increase dramatically :

* The African urban population is expected to more than double over the next 25 years.

* The Asian will almost double.

* Latin Americans and the Caribbeans is expected to Increase by almost 50% over the same period.

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So, to achieve the 2015 target in these areas, an additional 2.2 billion people will need access to Sanitation and 1.5 billion will need access to Water supply by that date.

This means providing Water supply services to 280,000 people and Sanitation facilities to 384,000 people every day for the next 15 years.

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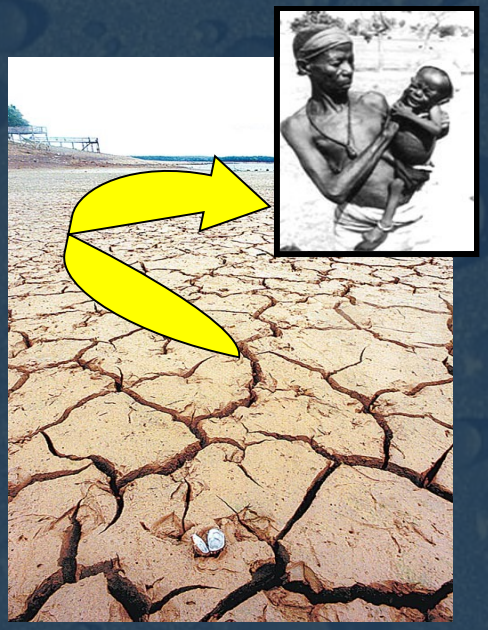
Health Hazards of Poor Water Supply and Sanitation

The WHO has estimated that up to 80% of all sickness and disease in the world is caused by inadequate sanitation, polluted water, or unavailability of water.

Cholera

Trachoma



Drought

Diseases that may be associated with contaminated drinking water

	Organism	Disease Caused
1	**Bacteria**	
	Escherichia coli ((some types	Gastroenteritis
	.Leptospira spp	Leptospirosis
	Salmonella typhi	Typhoid fever
	.Salmonella spp	Salmonellosis
	.Shigella spp	(Shigellosis (bacillary dysentery
	Vibrio cholerae	Cholera
2	**Protozoa**	
	Balantidium coli	Balantidiasis
	Cryptosporidium parvum	Cryptosporidiosis
	Entamoeba histolytica	(Amebiasis (amoebic dysentery
	Giardia lamblia	Giardiasis

3	**Helminths**	
	Ascaris lumbricoides	Ascariasis
	T. solium	Taeniasis
	Trichuris trichiura	Trichuriasis
4	**Viruses**	
	,.Enteroviruses (72 types) e.g	Gastroenteritis, hear
	polio echo and coxsackie) (viruses	anomalies, meningitis
	Hepatitis A virus	Infectious hepatitis
	Norwalk agent	Gastroenteritis
	Rotavirus	Gastroenteritis

* Approximately 4 billion cases of Diarrhea each year, mostly among children under the age of Five.

This is equivalent to :

- one child dying every 15 seconds

- 20 jumbo jets crashed every day.

These deaths represent approximately 15% of all child deaths under the age of five in developing countries.

Water, sanitation, and hygiene interventions reduce diarrhoeal disease on average by between one-quarter and one-third

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* Intestinal worms infect about 10% of the population of the developing world, Intestinal parasitic infections can lead to malnutrition, anemia and retarded growth, depending upon the severity of the infection.

These can be controlled through better sanitation, hygiene and water supply

*** It is estimated that 6 million people are blind from trachoma and the population at risk from this disease is approximately 500 million.**

Providing adequate quantities of water reduced the median infection rate by 25%.

* 200 million people in the world are infected with schistosomiasis

a median 77% reduction from well-designed water and sanitation interventions.

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Potable Water

((Should be suitable for human consumption and for all usual domestic purposes including personal hygiene, Washing, Showering and Food preparation)) .

: Good quality water is

Odorless, Colorless, .Tasteless

Free from faecal pollution and chemicals in harmful amounts.

General Introduction on Microbiology

Definition – study of living organisms simple in structure and small in size
Include: bacteria, algae, fungi, protozoa, viruses

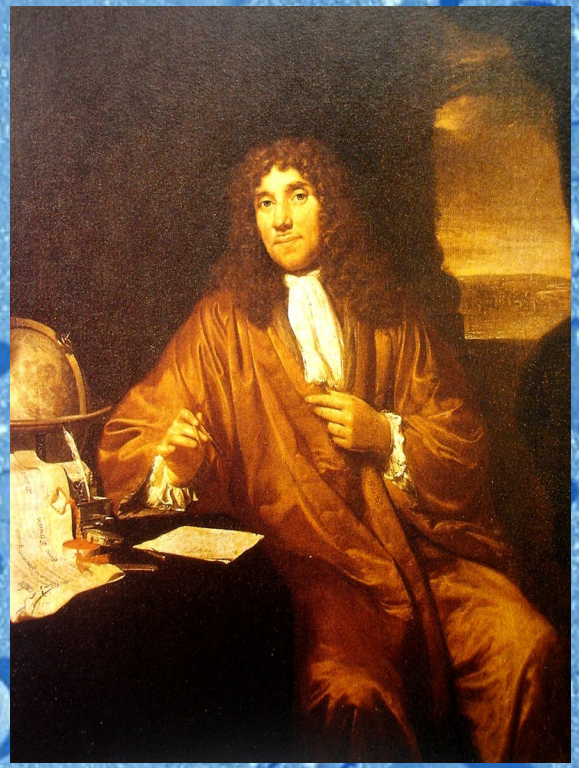
What are microbes?

Microbe is a term for tiny creatures that individually are too small to be seen with the unaided eye. Microbes include bacteria, fungi, parasites , algae and viruses.

Anthonie van Leewenhoek (1632 – (1723

Anthonie van Leewenhoek (1632 – 1723) simple microscope (200 x magnification), „Father of Microbiology“

- Descriptions of simple microorganisms („animalcula“) – bacteria, protozoa, yeasts, erythrocytes, sperms.



Robert Koch (1843-(1910

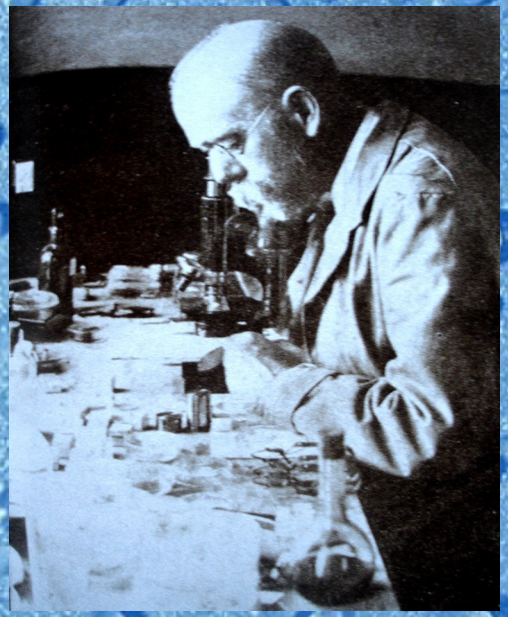
1876 – Koch´s postulates identifying the causativity of bacteria and disease:

1. bacteria must be present in all cases of illness

2. must be isolated in a pure culture

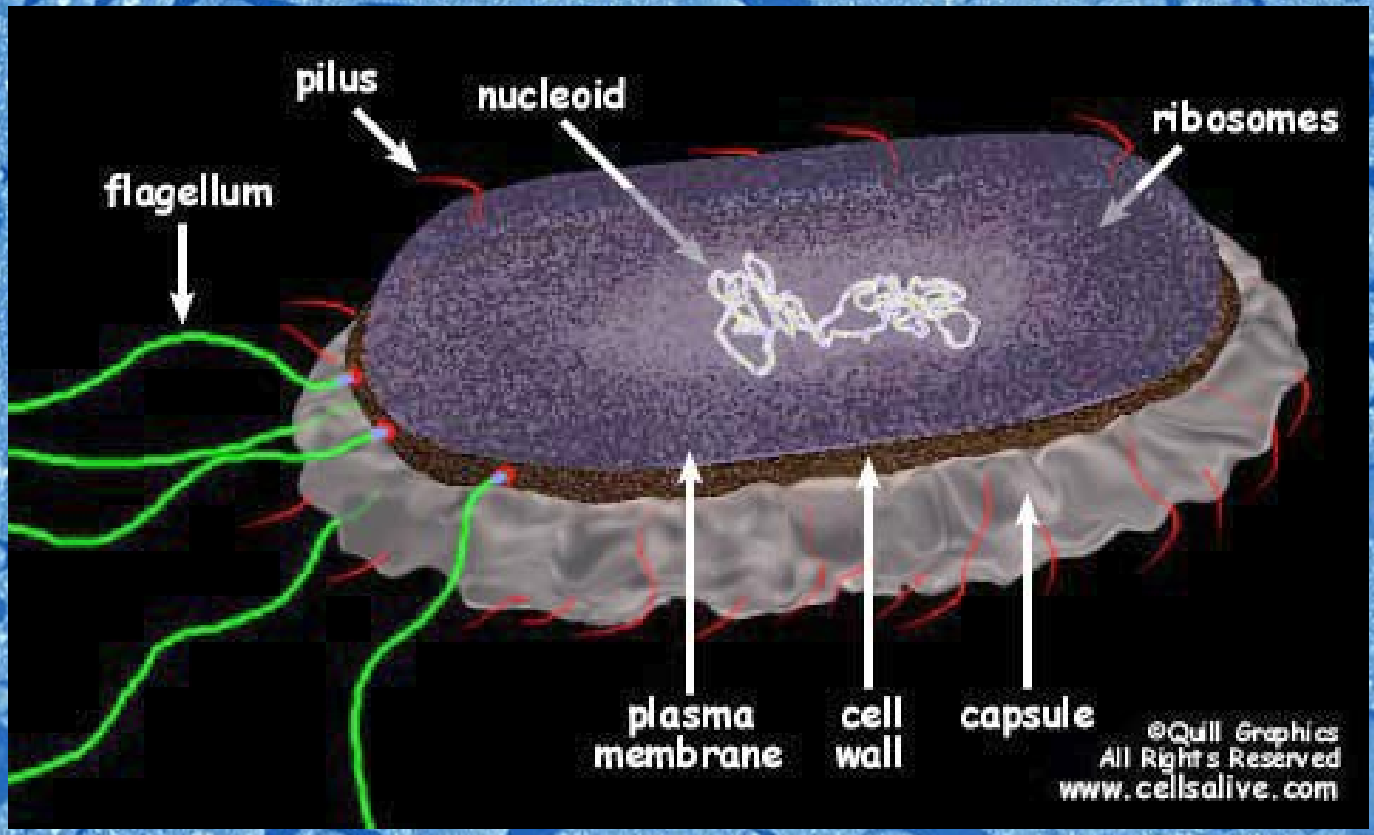
3. Application of the pure culture to the experimental animal must induce the illness with characteristic symptoms

4. The same bacteria from infected and ill animal can be again isolated



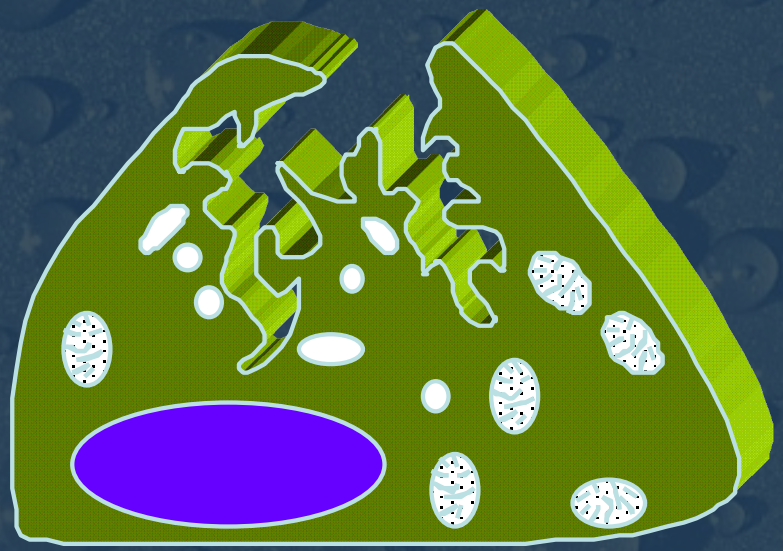
Classification

Structure of Bacterial cell



Size matters

Animal cell

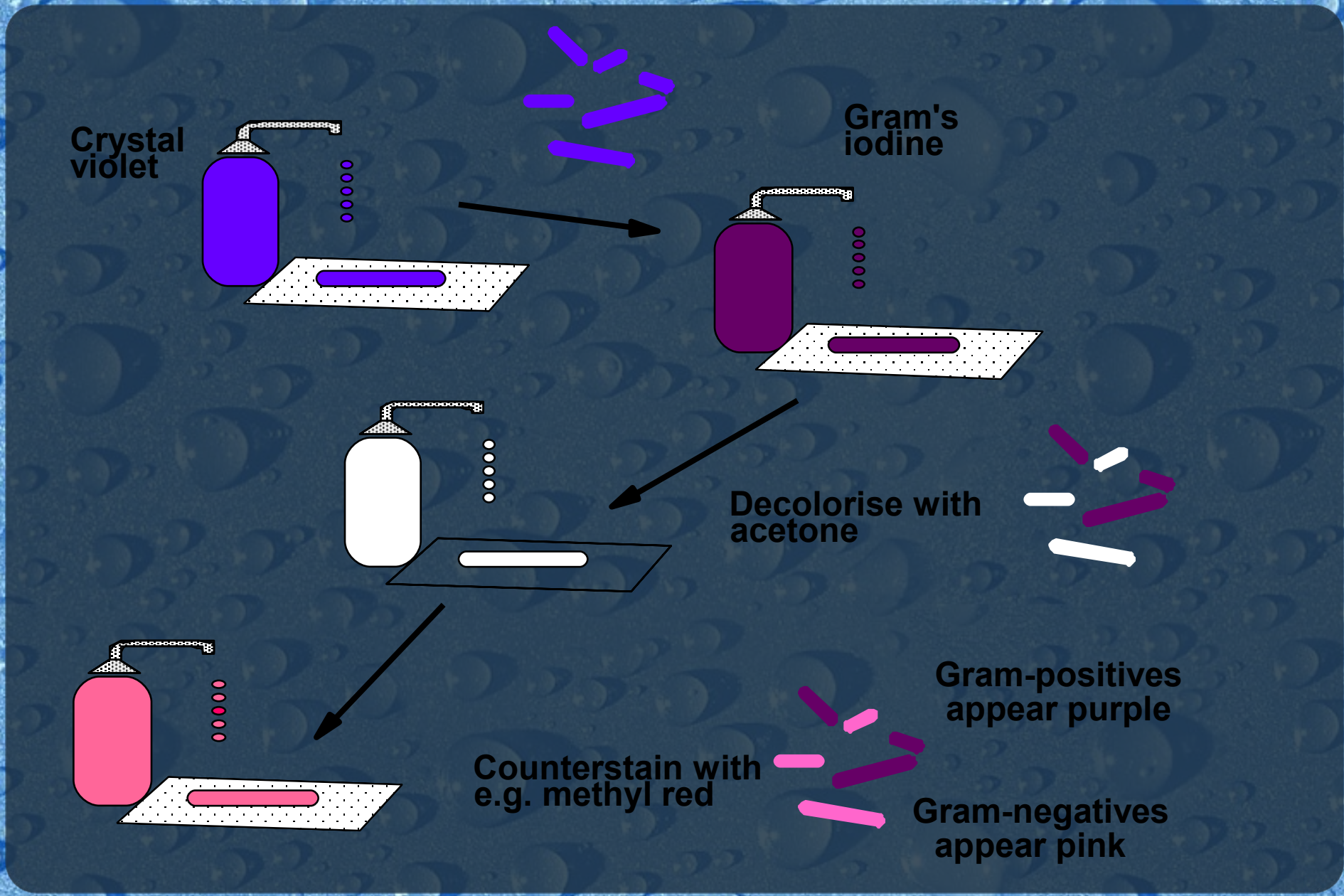


10 microns

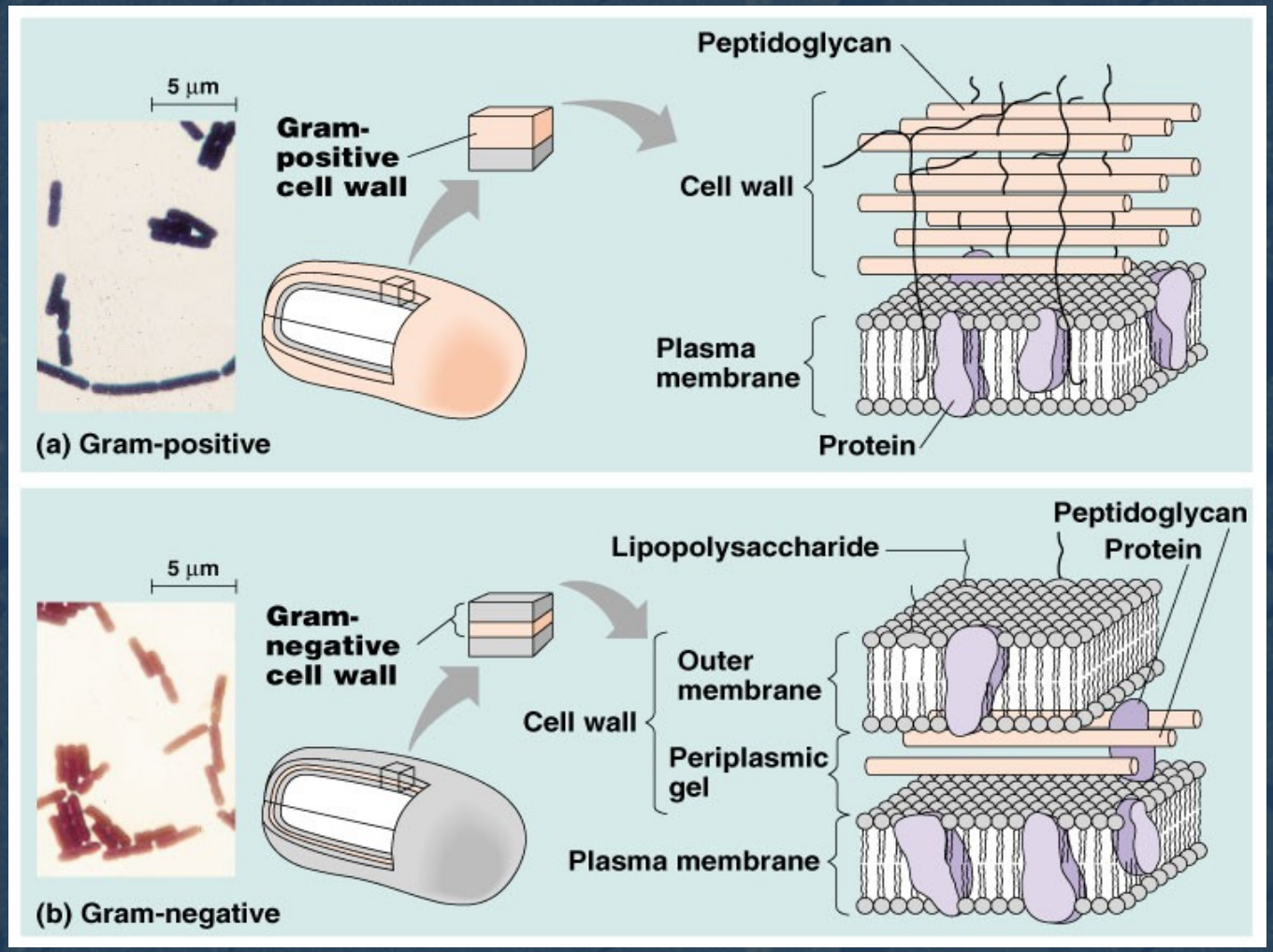
Bacterial cells

1 micron

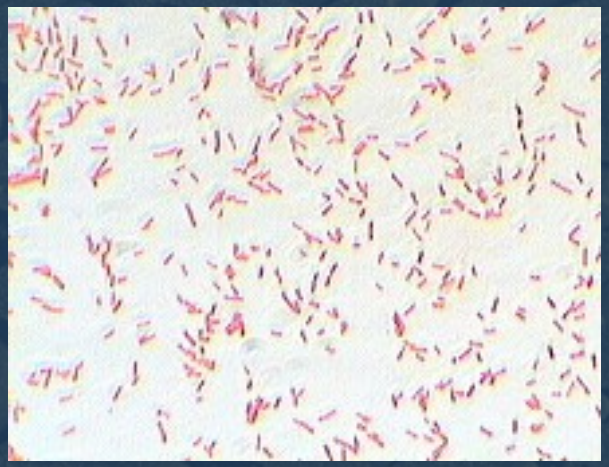
The Gram Stain

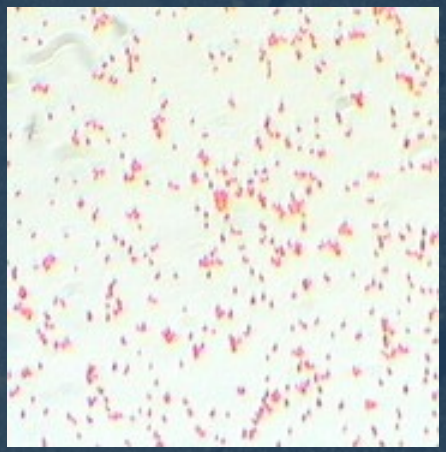


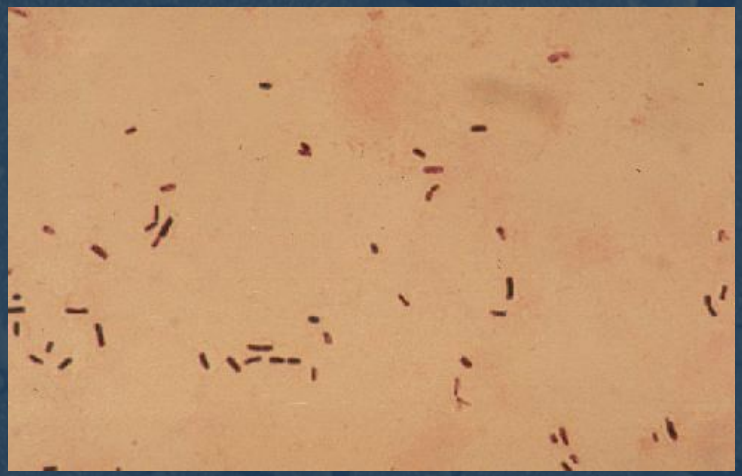
Cell Wall Structure

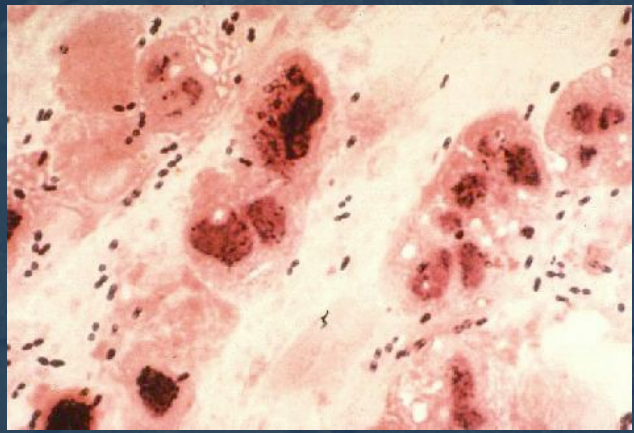


Gram Staining Reaction



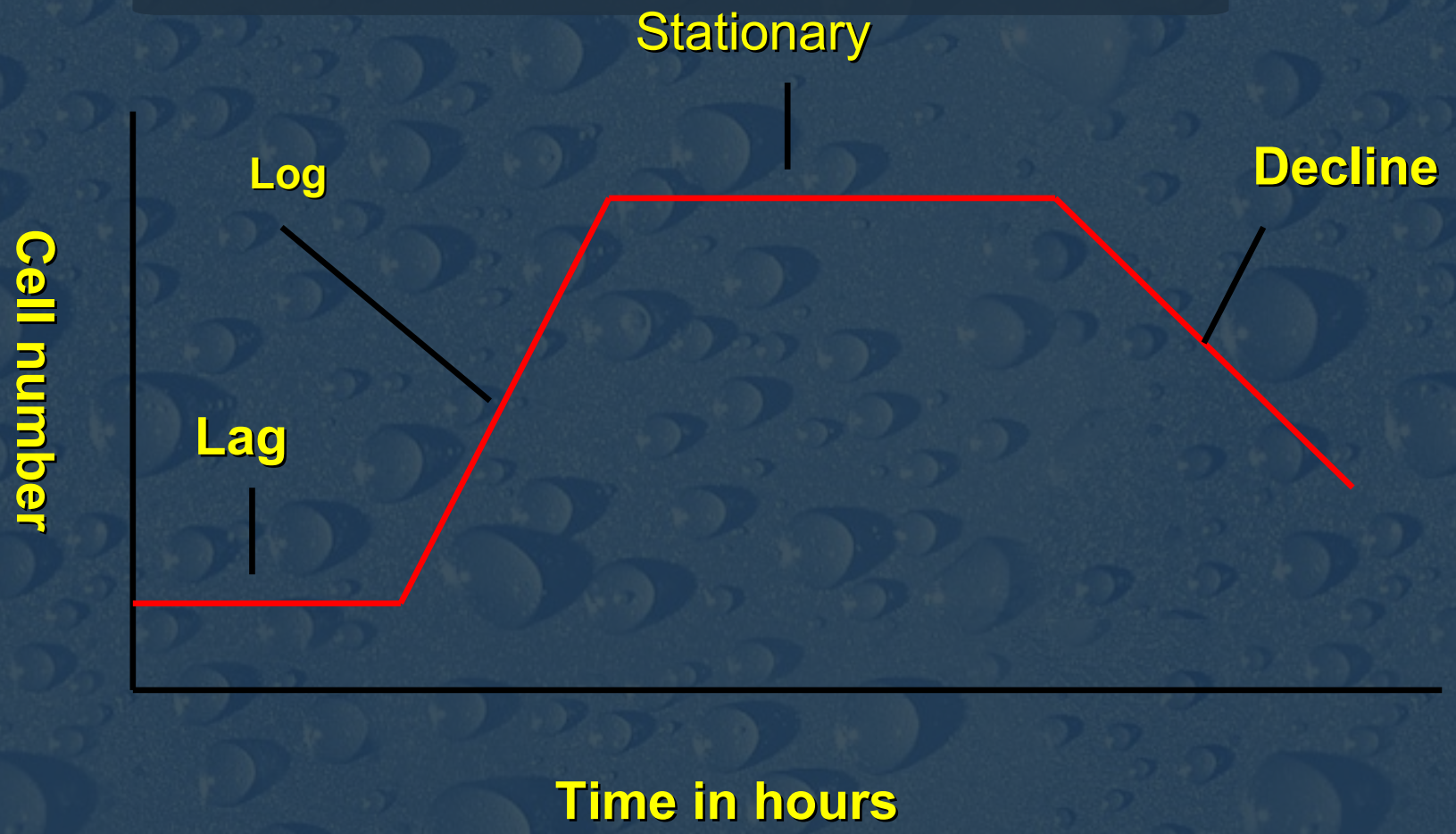






Bacterial Growth Curve

A growth curve (divided into 4 stages) :



:Lag phase -1

. Period from inoculation to beginning multiplication

. No or little cell division occurs

. Bacteria adapt to the new environment

. Clinically corresponds to incubation period of disease

:Logarithmic (Exponential) phase -2

. Rapid cell division (most active phase).

.Number of bacteria increase steadily.

. Clinically corresponds to clinical signs & symptoms of disease.

. This phase continues until:

. Exhaustion of nutrients and/or accumulation of toxic waste products.

Stationary -3 phase

. Number of dying cells equals newly formed cells.

. Number of living bacteria remains constant.

. Total number of bacteria (living + dead) increases.

. Slow growth due to Nutrient depletion , waste product accumulation or pH change.

. Clinically corresponds to recovery stage of disease.

Decline -4 phase

. Number of living bacteria decreases steadily.

. Death rate exceeds multiplication rate.

. Exhaustion of nutrients and accumulation toxic products.

Clinical Significance of Growth curve

Correlation of 4 stages of growth curve to stages of disease

Phases of growth curve ***In vitro***	**Stages of disease** ***In vivo***
lag phase	Incubation period of disease
Logarithmic & Stationary phase	Clinical signs & symptoms
Decline phase	Recovery & convalescence

Bacterial Reproduction

* Bacterial cell division is a asexual
* Start by duplication of chromosome
* Each copy attach to cytoplasmic membrane at mesozome
* Cytoplasmic Membrane forms a transverse membrane growing inwards
* A new transverse cell wall grows inwards
* A complete transverse septum separate two daughter cells

Growth Requirement Of Bacteria

* **Growth of bacteria depends on:**
  - adequate supply of food
* **Food is essential for :**
  - Build up of protoplasm
  - Production of energy
* **Metabolic activities are brought about:**
  - Various enzymes
* **Enzyme activity is conditioned by:**
  - Moisture, Temperature, pH

Bacterial Nutrition -1

2- Heterotrophic bacteria:

- Most bacteria of medical importance.
- Require complex preformed organic substance.
- Obtained food from plant or animal source.
- Live in or on animal body (parasitic bacteria).
- Many grow on simple media.
- Some require complex organic material (Blood, serum).

Gaseous Requirements -2

Oxygen requirements: 4 groups -1

b- Facultative anaerobes:
c- Obligate Anaerobes:
d- Microaerophilic bacteria:
a- Obligatory aerobes:

- Bacteria that grow in presence or absence of O_2
- Use O_2 to generate energy by aerobic respiration if present
- Use anaerobic respiration in absence of O_2

Grow only in complete absence of O_2
Organisms grow best in presence of minimal
Only grow in presence of free oxygen
In presence of O_2, toxic molecules are produced (H_2O_2)
Energy system depends on O_2 as H_2 acceptor
Anaerobic bacteria lack enzymes that breakdown toxic molec.

Carbon dioxide (CO -2_2:) requirement

- Bacteria require CO_2 minute quantities as in air

- Some require higher CO_2 concentration (carboxyphilic)

e.g. Pathogenic *Neisseria* (5 % CO_2)

Brucella abortus (20 % CO_2)

3- Physical Requirements Of Bacteria

:(Hydrogen ion concentration (pH -2

- Pathogenic bacteria grow at a narrow range of pH (7.2 - 7.6)
- Few species require an alkaline pH (*Vibrio cholerae*, pH 8)
- Some prefer an acid pH (*Lactobacilli*, pH 4)

	Temperature range	Optimum temperature
Mesophilic bacteria	C° 42 – 18	C° 37
Psychrophilic bacteria	C° 30 – 5	C° 20 -15
Thermophilic bacteria	C° 80 – 25	C° 60 -50

Microbiology Techniques

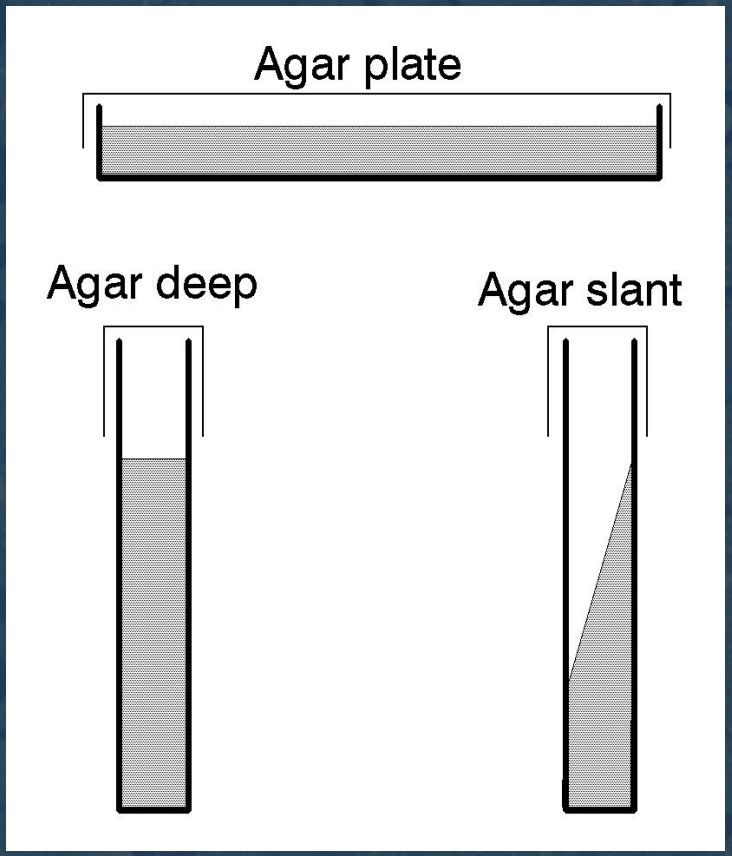
Media Types:

1- Solid Medium

- Agar Plate
- Agar Deep
- Agar Slant

2- Semi-Solid Medium

3- Liquid Medium



How to hold an Inoculating Loop

Inoculating Loop

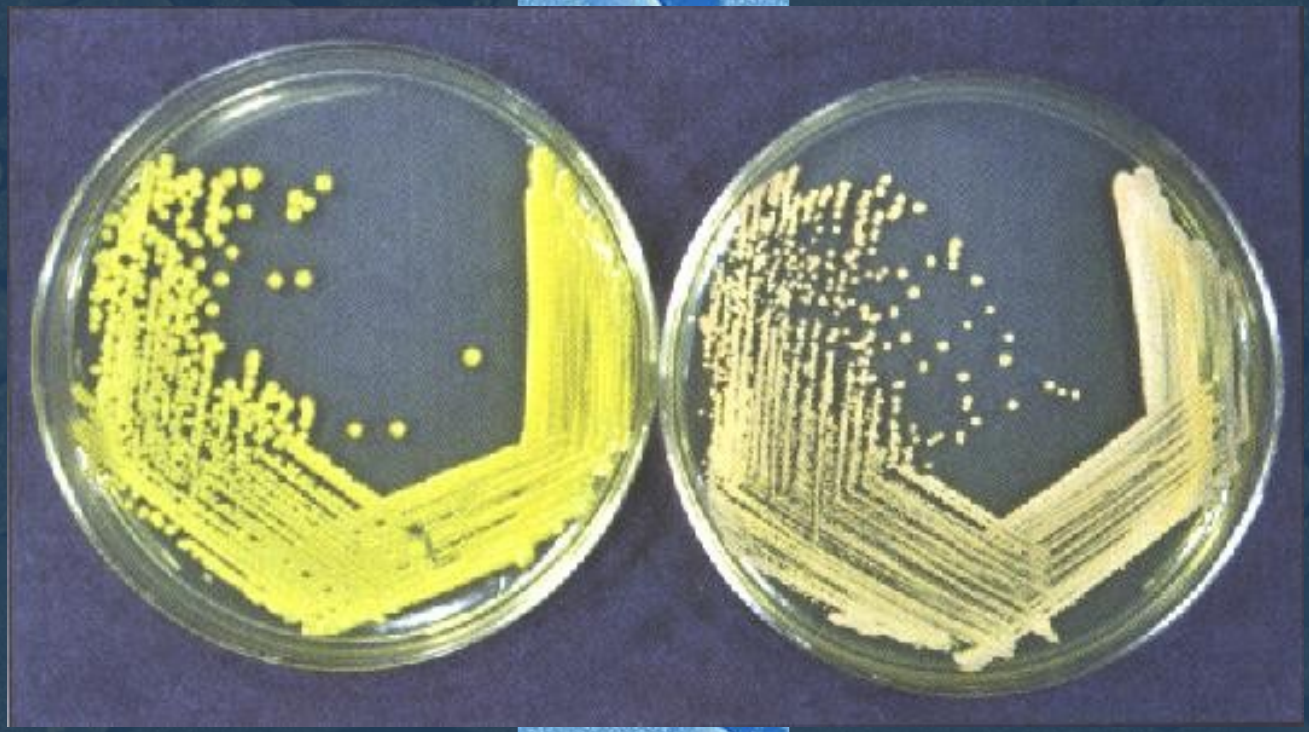
- The inoculating loop should be held comfortably, much as you would hold a pencil.

Flaming the Loop

Flaming the Loop

- Flaming the loop helps to prevent contamination of the bacteria.
- When flaming the loop, make sure that all of the wire has been heated to redness.

Streak Plate



Transfer to tubes

Remove the Caps

- While the wire is cooling, remove the first cap by grasping it with the little finger.

Indicator concept and criteria

- Should be absent in unpolluted water and present when the source of pathogenic microorganisms of concern is present.
- Should be easy to isolate, identify and enumerate. Over time.
- Should not multiply in the environment.
- Should not be a pathogenic microorganism (to minimise the health risk to analysts).
- Should be present in greater numbers than the pathogenic microorganisms.
- The test should be inexpensive thereby permitting numerous samples to be taken.
- Should respond to natural environmental conditions and water treatment processes in a manner similar to the pathogens of concern.

he coliform group :

Total coliforms: Coliform organisms, better referred to as total coliforms to avoid confusion with others in the group, are not an index of faecal pollution or of health risk, but can provide basic information on source water quality. Total coliforms have long been utilised as a microbial measure of drinking water quality, largely because they are easy to detect and enumerate in water.

Capable of fermenting lactose at 35-37ºC with the production of acid, gas within 24-48 hours.

Escherichia, Citrobacter, Enterobacter, and Klebsiella.

ermotolerant ('faecal') coliforms:

defined as the group of total coliforms that are able to ferment lactose at 44-45°C. They comprise the genus *Escherichia* and, to a lesser extent, species of *Klebsiella*,

Enterobacter, and *Citrobacter*.

only *E. coli* is considered to be specifically of faecal origin, being always present in the faeces of humans, other mammals, and birds in large numbers

Escherichia coli:

- *E. coli* is detectable by simple, inexpensive cultural methods that require basic routine bacteriology laboratory facilities, but require well-trained and competent laboratory workers. It can pose a health risk for laboratory workers as some strains of this organism are pathogenic.

- Characterised by possession of the enzymes β-galactosidase and β -glucuronidase. It grows at 44-45ºC on complex media, ferments lactose and mannitol with the production of acid and gas, and produces indole from tryptophan.

- Widely preferred as an index of faecal contamination.

nterococci and faecal *streptococci* :

- All possess the Lancefield group D antigen.

- Enterococci are detectable by simple, inexpensive cultural methods and can generally be regarded as specific indices of human faecal pollution for most practical purposes.

- Most of the *Enterococcus* species are of faecal origin and require well-trained and competent laboratory workers. They could pose a health risk for laboratory workers as some strains of these bacteria are pathogenic.

- Faecal *streptococci* are more resistant to stress and laboratory facilities, but require chlorination than *E. coli* and the other coliform bacteria.

Sulphite-reducing clostridia and *Clostridium perfringens*

- Obligately anaerobic, spore-forming organisms,

- *Clostridium perfringens*, is normally present in faeces

- They are not normally a health risk for laboratory workers but they are pathogenic and if carelessly handled can give rise to food poisoning and wound infections.

- Clostridia are not, however, recommended for the routine monitoring of distribution systems because of their length of survival they may be detected long after (and far from) the pollution event, leading to possible false alarms

Pseudomonas aeruginosa and *Aeromonas* spp.

- environmentally widespread, with some being opportunistic pathogens.

- ***Ps. aeruginosa*** is commonly found in faeces, soil, water, and sewage but cannot be used as an index of faecal contamination.

- ***Aeromonas*** shows no particular association with faecal pollution.

- Neither *Pseudomonas* nor *Aeromonas* are indices of faecal pollution

Bacteriophages :

- Divided into two groups, both of which occur in sewage and faecally polluted water.

1- Somatic coliphages :

- frequently detected in human and animal faeces.

2- F- Specific RNA bacteriophages :

- Although they are only present in the faeces of a small proportion of people, they are commonly found in high numbers in sewage.

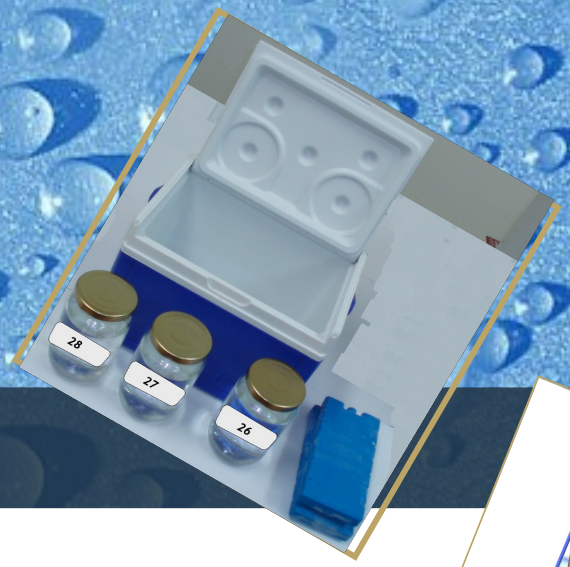
Protozoan parasites :

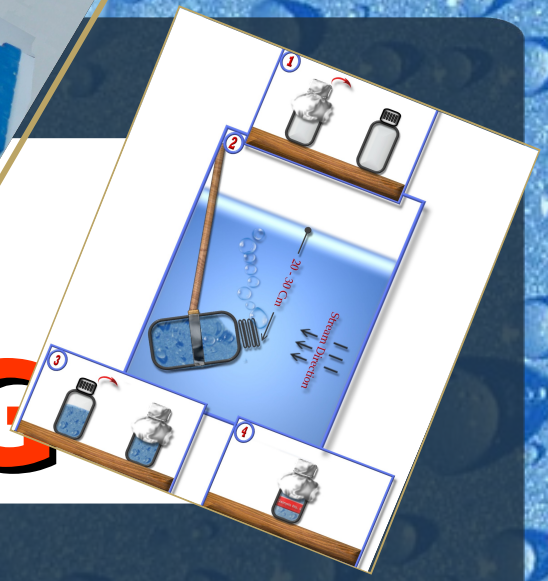
- ***Cryptosporidium*** oocysts and ***Giardia*** cysts are associated with human and animal faecal sources.

- The failure to detect cysts or oocysts does not constitute an indication of the absence of faecal pollution.

- They can survive for very long periods in the environment and are quite resistant to treatment.

SAMPLING





Garbage In
Garbage Out

Sampling locations should be chosen to provide a means of characterizing water quality in all parts of the system.

Sampling Bottle

- Capacity of at least 200 ml.

- Sterile bottles containing **sodium thiosulphate**.

- When collecting the sample, exercise extreme care to avoid contaminating it with bacteria from the environment.

- Stopper the bottle, label it with full details, and deliver it to the laboratory as quickly as possible.

Storage of samples for microbiological analysis :

Although recommendations vary, the time between sample collection and analysis should, in general,

not exceed 6 hours, and 24 hours is considered the absolute .maximum

It is assumed that the samples are immediately placed in a lightproof insulated box containing melting ice or ice-packs with water to ensure rapid cooling.

If ice is not available, the transportation time must not exceed 2 hours. It is imperative that samples are kept in the dark and that cooling is rapid. If these conditions are not met, the samples should be discarded.

Lightproof insulated box containing ice-packs

Information that should be supplied with the samples

Code No .....

Date of collection .....

Time of collection .....

Collected by .....

Reason of examination .....

Is there any infected cases .....

Free residual chlorine .....

Kind of treatment .....

.....

Source of sample with exact place ...

Date of Collection	/ /2005		Code Number: ( )			
Time of Collection						
Collected By:						
Reason of Examination	Routine Sample		Otherwise			
Source of Sample	Well		House Tap		other	
	Drilled by Hand	Drilled by Driller	Cistern	Direct From the Main		
Depth of the Well			Date of Drilling			
Treatment	Chlorination		Untreated		Other	
Possible Source of Pollution	Yes	No				
	Approximate Distance					

Total Count

Total Coliform

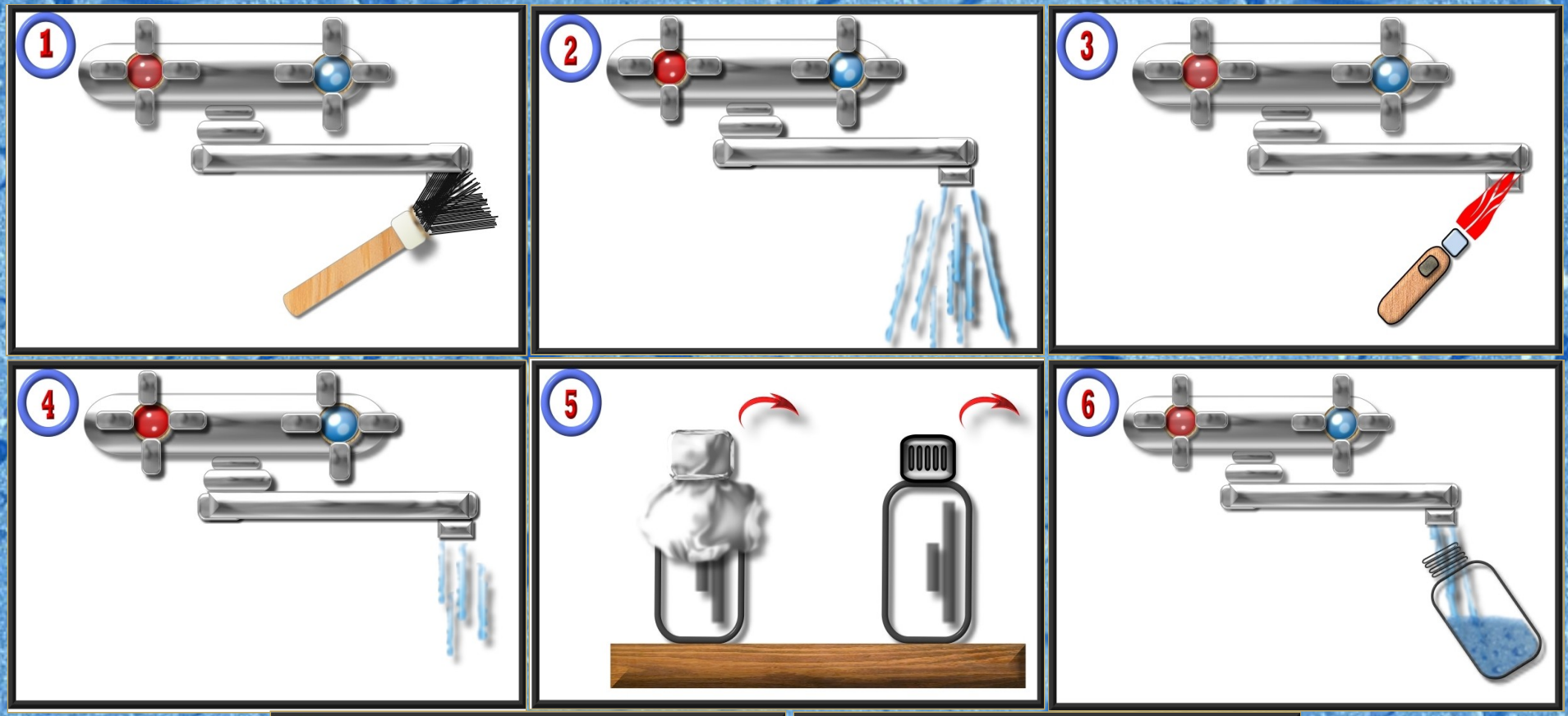
Thermotolerant Coliform

Frequency of Sampling

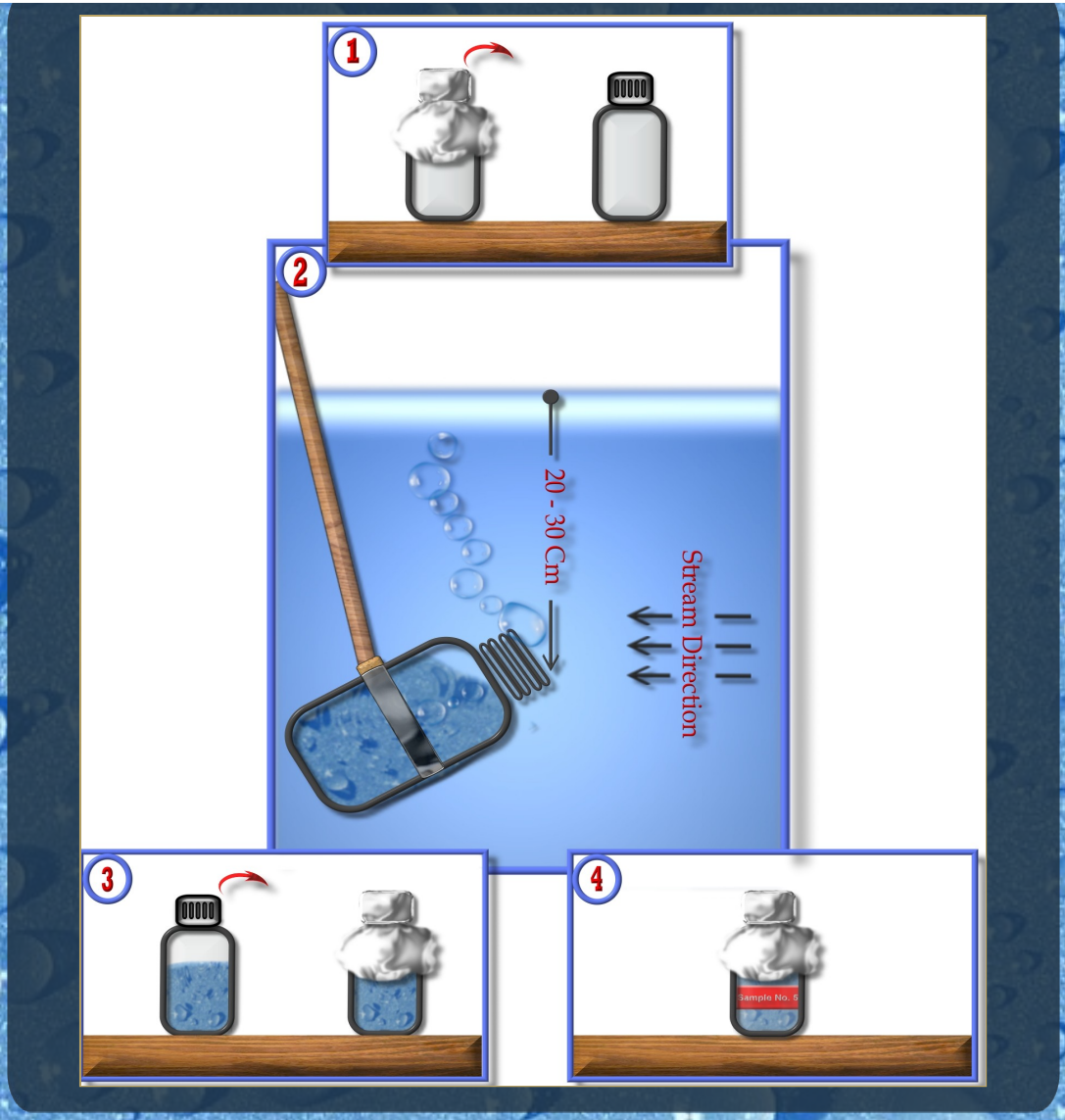
Population served	Samples to be taken monthly
Less than 5000	sample 1
000 5000-100	sample / 5000 population 1
More than 100 000	sample / 10 000 population, 1 .plus 10 additional samples

Sampling from Different Sources

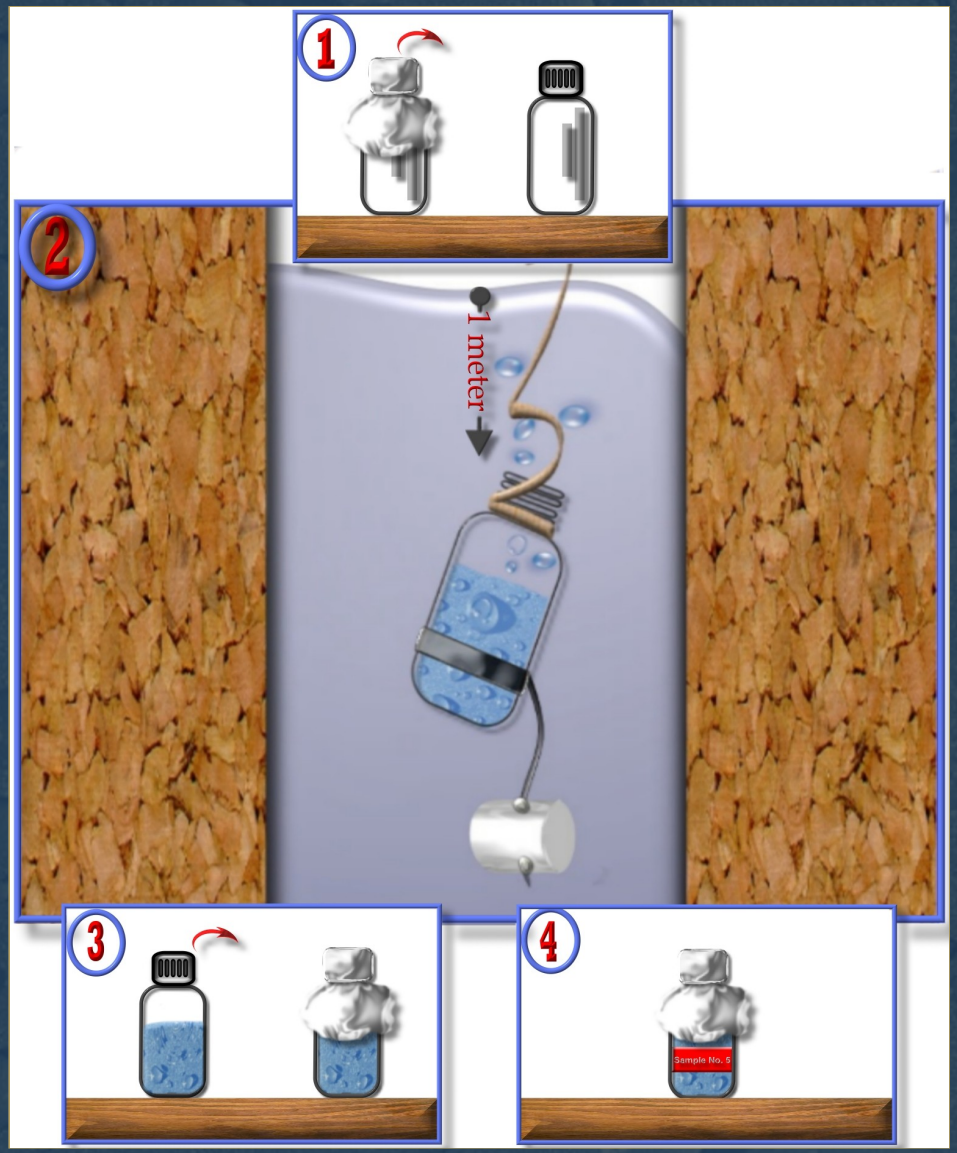
Sampling from Tap



Sampling from Stream or River



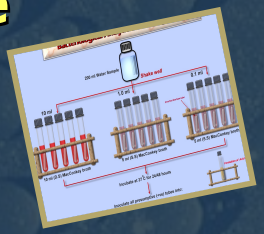
Sampling from Well



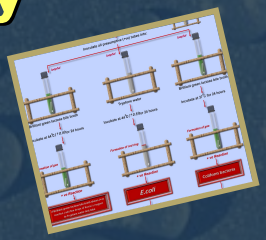
Detection and counting of Indicator Microorganisms

1- Most Probable Number Technique

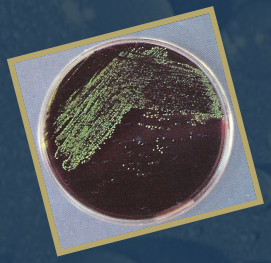
A- Presumptive Test



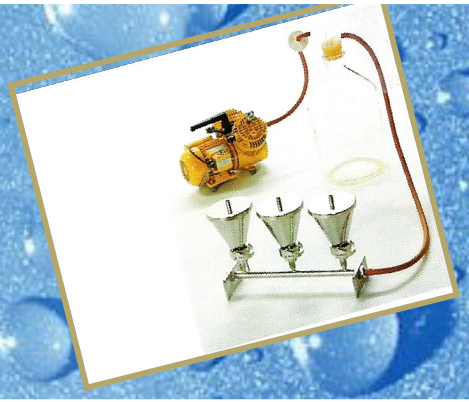
B- Confirmatory Test



C- Completed Test



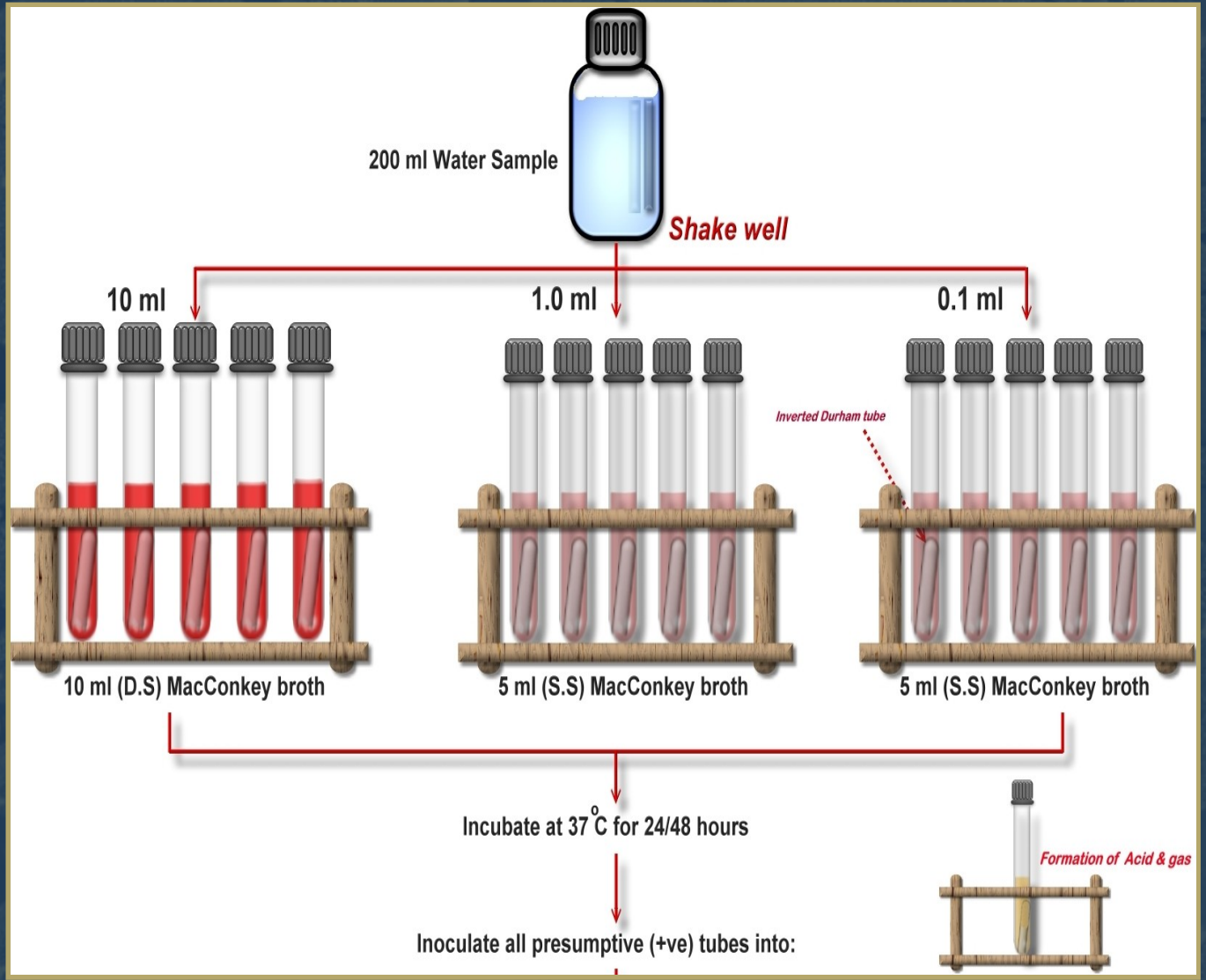
2- Membrane Filtration Technique



3- Presence-Absence Technique

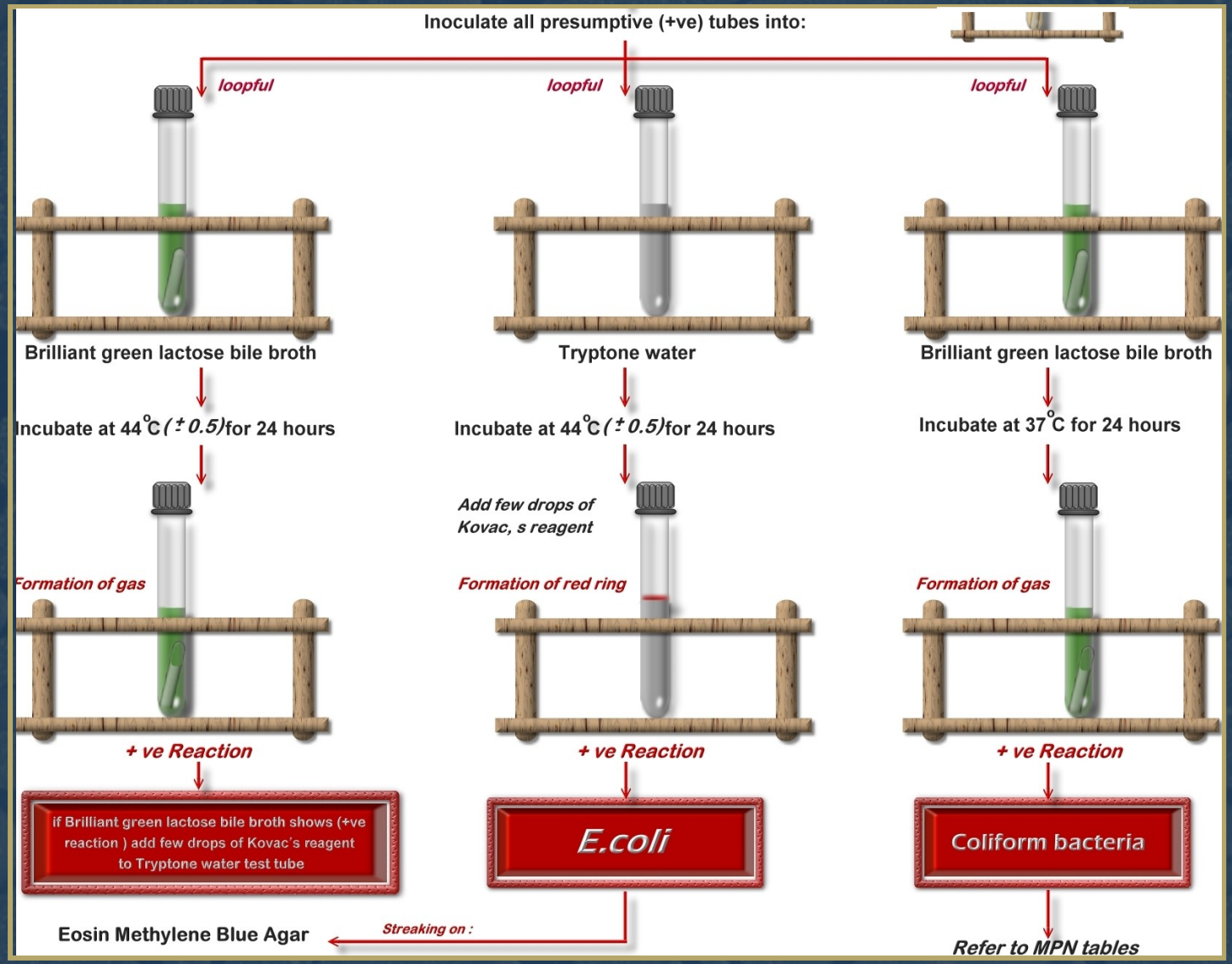
4-Heterotrophic Plate Count Test

A- Presumptive Test



BACK

B- Confirmatory Test



BACK

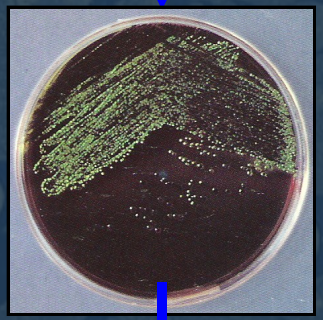
C- Completed Test

Inoculate a loopful of (+ve reaction) test tube of BGB

onto Eosin Methylene Blue Agar

37 °C / 18 – 24 hr.

Green Methallic Sheen Colonies



E.coli

3 sets of 5 tubes MPN table

Positive Tubes			MPN	Positive Tubes			MPN	Positive Tubes			MPN	Positive Tubes			MPN	Positive Tubes			MPN	Positive Tubes			MPN
10	1.0	0.1		10	1.0	0.1		10	1.0	0.1		10	1.0	0.1		10	1.0	0.1		10	1.0	0.1	
0	0	0	<1.8	1	0	0	2	2	0	0	4.5	3	0	0	7.8	4	0	0	13	5	0	0	23
0	0	1	1.8	1	0	1	4	2	0	1	6.8	3	0	1	11	4	0	1	17	5	0	1	31
0	0	2	3.6	1	0	2	6	2	0	2	9.1	3	0	2	13	4	0	2	21	5	0	2	43
0	0	3	5.4	1	0	3	8	2	0	3	12	3	0	3	16	4	0	3	25	5	0	3	58
0	0	4	7.2	1	0	4	10	2	0	4	14	3	0	4	20	4	0	4	30	5	0	4	76
0	0	5	9	1	0	5	12	2	0	5	16	3	0	5	23	4	0	5	36	5	0	5	95
0	1	0	1.8	1	1	0	4	2	1	0	6.8	3	1	0	11	4	1	0	17	5	1	0	33
0	1	1	3.6	1	1	1	6.1	2	1	1	9.2	3	1	1	14	4	1	1	21	5	1	1	46
0	1	2	5.5	1	1	2	8.1	2	1	2	12	3	1	2	17	4	1	2	26	5	1	2	64
0	1	3	7.3	1	1	3	10	2	1	3	14	3	1	3	20	4	1	3	31	5	1	3	84
0	1	4	9.1	1	1	4	12	2	1	4	17	3	1	4	23	4	1	4	36	5	1	4	110
0	1	5	11	1	1	5	14	2	1	5	19	3	1	5	27	4	1	5	42	5	1	5	130
0	2	0	3.7	1	2	0	6.1	2	2	0	9.3	3	2	0	14	4	2	0	22	5	2	0	49
0	2	1	5.5	1	2	1	8.2	2	2	1	12	3	2	1	17	4	2	1	26	5	2	1	70
0	2	2	7.4	1	2	2	10	2	2	2	14	3	2	2	20	4	2	2	32	5	2	2	95
0	2	3	9.2	1	2	3	12	2	2	3	17	3	2	3	24	4	2	3	38	5	2	3	120
0	2	4	11	1	2	4	15	2	2	4	19	3	2	4	27	4	2	4	44	5	2	4	150
0	2	5	13	1	2	5	17	2	2	5	22	3	2	5	31	4	2	5	50	5	2	5	180
0	3	0	5.6	1	3	0	8.3	2	3	0	12	3	3	0	17	4	3	0	27	5	3	0	79
0	3	1	7.4	1	3	1	10	2	3	1	14	3	3	1	21	4	3	1	33	5	3	1	110
0	3	2	9.3	1	3	2	13	2	3	2	17	3	3	2	24	4	3	2	39	5	3	2	140
0	3	3	11	1	3	3	15	2	3	3	20	3	3	3	28	4	3	3	45	5	3	3	180
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0	4	0	7.5	1	4	0	11	2	4	0	15	3	4	0	21	4	4	0	34	5	4	0	130
0	4	1	9.4	1	4	1	13	2	4	1	17	3	4	1	24	4	4	1	40	5	4	1	170
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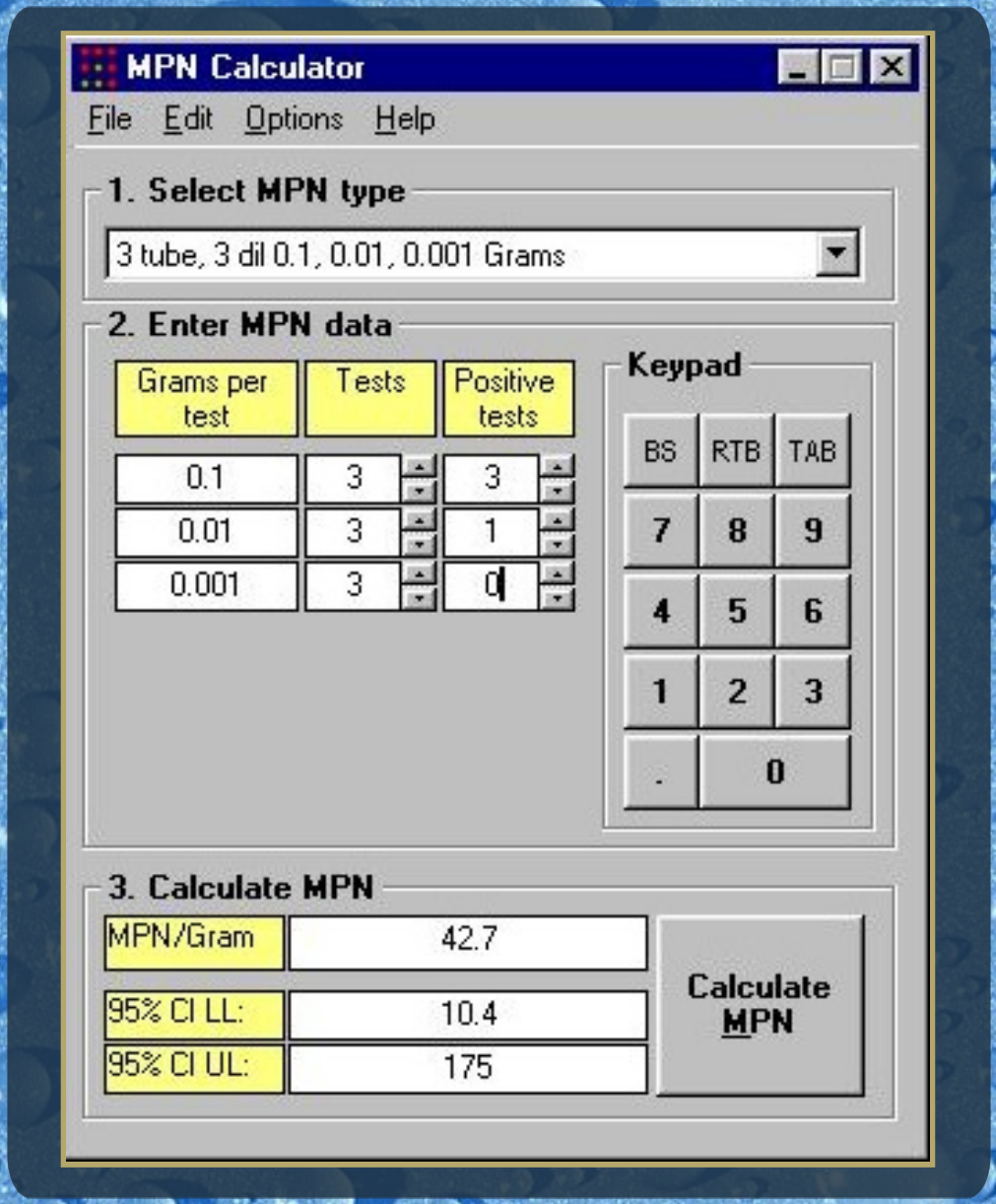
0	5	0	9.4	1	5	0	13	2	5	0	17	3	5	0	25	4	5	0	41	5	5	0	240
0	5	1	11	1	5	1	15	2	5	1	20	3	5	1	29	4	5	1	48	5	5	1	350
0	5	2	13	1	5	2	17	2	5	2	17	3	5	2	32	4	5	2	56	5	5	2	540
0	5	3	15	1	5	3	19	2	5	3	26	3	5	3	37	4	5	3	64	5	5	3	920
0	5	4	17	1	5	4	22	2	5	4	29	3	5	4	41	4	5	4	72	5	5	4	1600
0	5	5	19	1	5	5	24	2	5	5	32	3	5	5	45	4	5	5	81	5	5	5	>1600

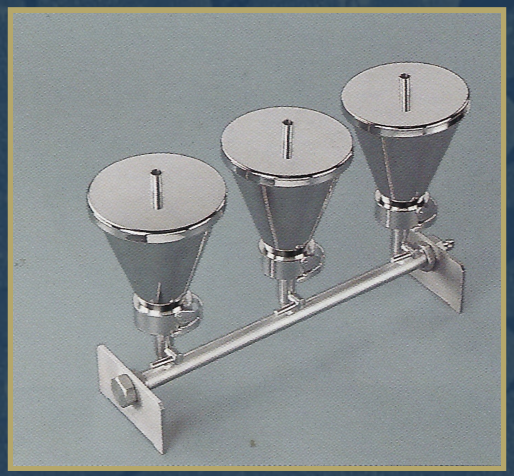
MPN Calculator Software

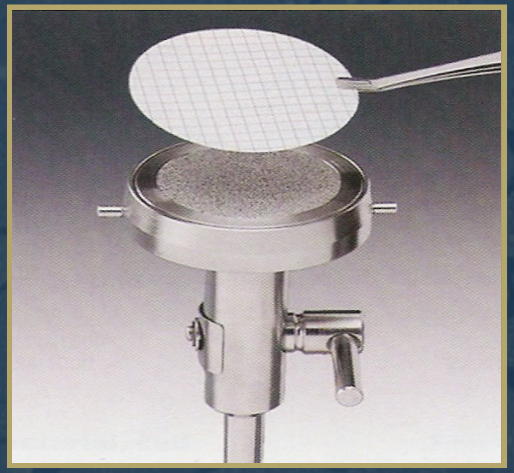


حجم العينة وعدد الأنابيب المستعملة وذلك حسب نوعية المياه

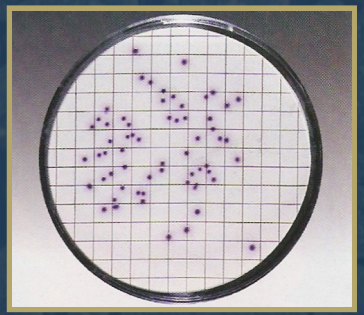
نوع العينة	حجم العينة (مل)				
	50	10	1	0.1	0.01
مياه الشرب المعالجة	1	5			
مياه الشرب المعالجة جزئياً		5	5	5	
مياه الترفيه		5	5	5	
مصادر المياه المحمية		5	5	5	
المياه السطحية			5	5	5

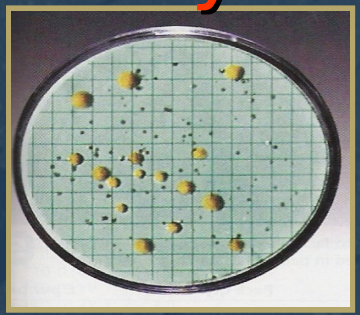
2- Membrane Filtration Method

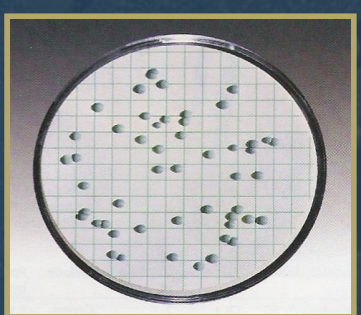




Recommended for Lab Analysis







حجم العينة حسب نوعية المياه

نوع العينة	حجم العينة (مل)					
	100	10	1	0.1	0.01	0.001
مياه الشرب المعالجة	X					
مياه الشرب المعالجة جزئياً	X	X				
مياه الترفيه			X	X		
مصادر المياه المحمية	X	X	X			
المياه السطحية			X	X	X	
مياه الصرف الصحي			X	X	X	
مياه الصرف الصحي المعالجة			X	X	X	X
البرك, الأنهار, مياه الفيضان				X	X	X

Small volumes should be added to the filtration apparatus together with a minimum of 9 ml of sterile diluent to ensure adequate dispersal across the surface of the filter membrane.

Advantages & Disadvantages

Most Prob. Number	.Membrane filt. Tech
Slower	Faster
More Labor	Less Labor
More Media Required	LessMedia Required
More Glassware Required	Less Glassware Required
(Less Precise(Statistics	More Precise
More Sensitive	Less Sensitive
Inexpensive	Expensive
Used in the Lab Only	May used in the field
Can be used for all Kinds of Water	Not Recommended for Turbid Water
Enhance Stressed Colonies to Grow	

Heterotrophic Plate Count

Only a small fraction (~0.01%) of waterborne M.Os are thought to belong to the group of culturable HB, and ~ 1% of the viable bacteria are Not culturable.

- A longer cultivation time (5-7 days at 27oC).

- There is no clear-cut evidence that HB as such pose a public health risk.

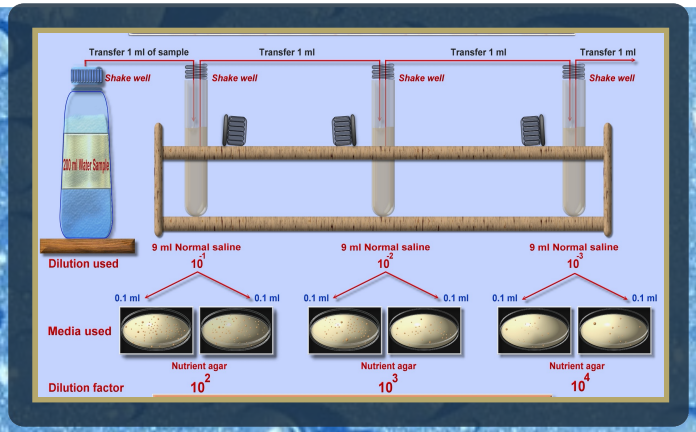
Use of HPC in Water Management

- To indicate the effectiveness of water treatment processes.

- As a measure of No. of growth organisms that may or may not have a significance.

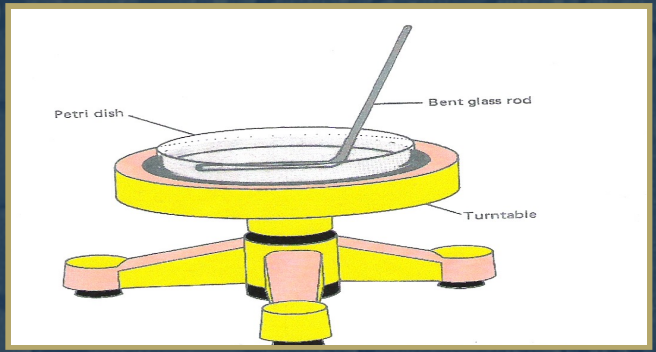
- As a measure of possible interference with coliform Measurements in Lactose-based culture method.

Serial Dilution Method

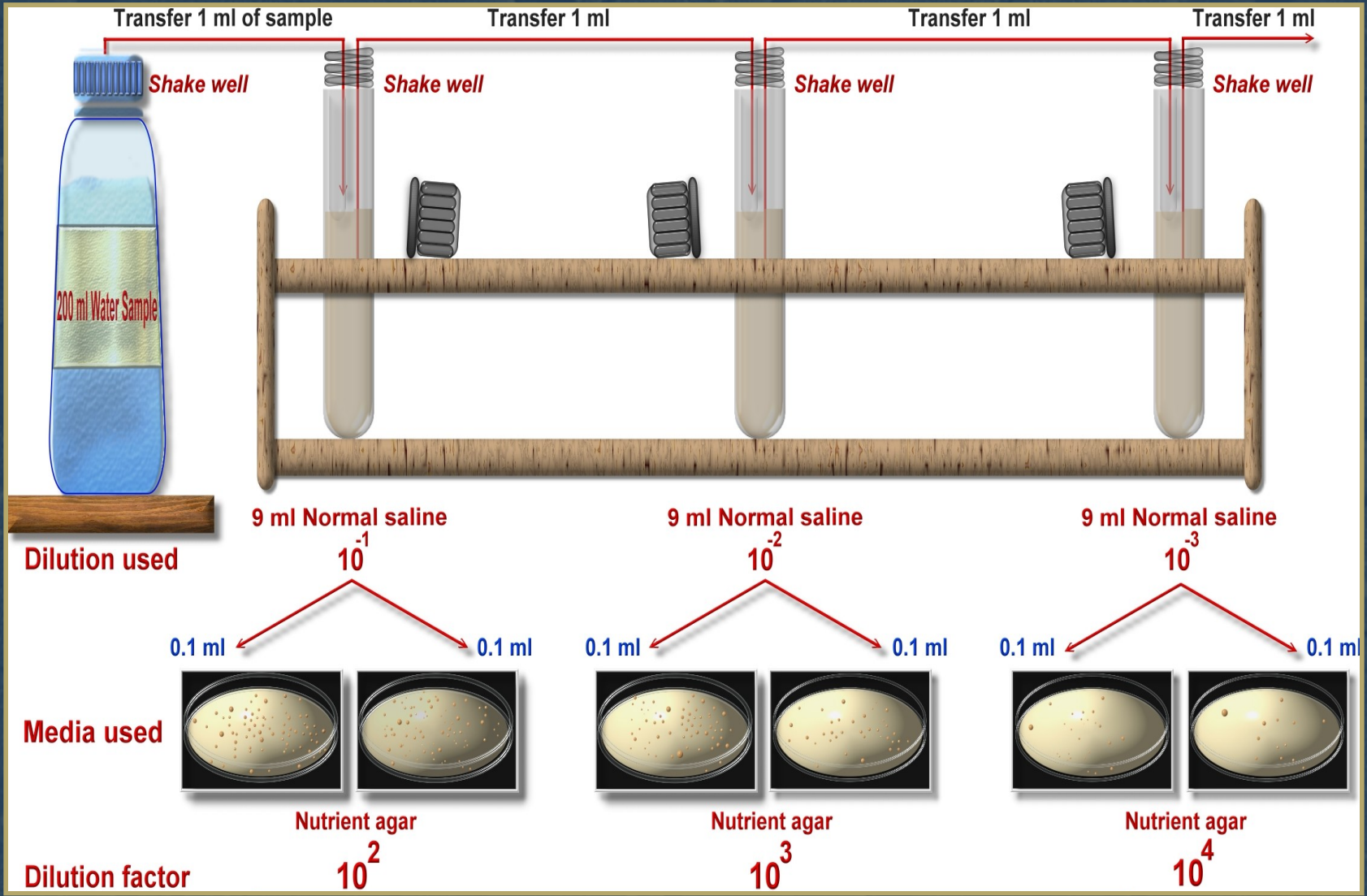


A- Pour Plate .Technique

B- Spread Plate .Technique

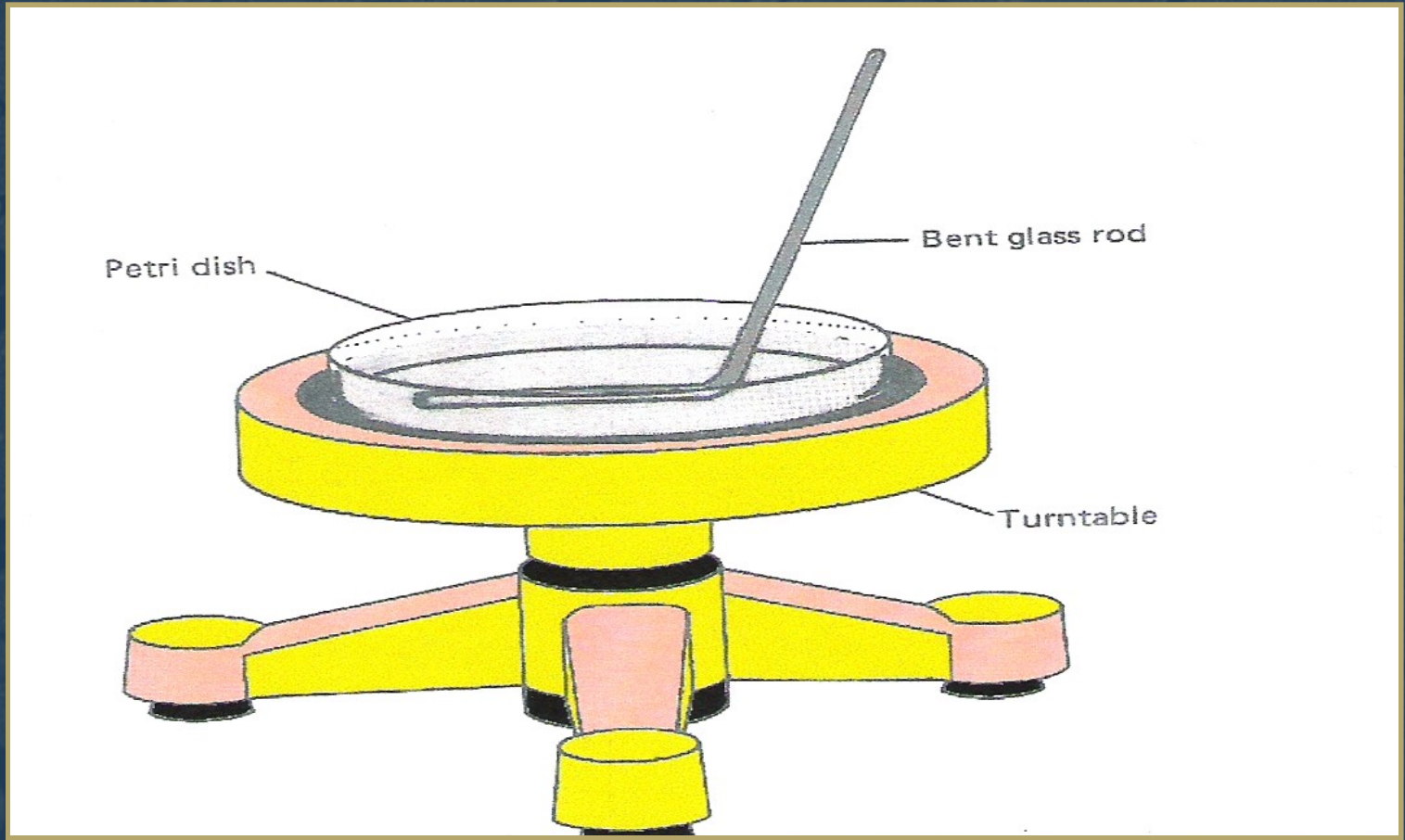


Serial Dilution Method



A- Pour Plate Technique

B- Spread Plate Technique



Quality Control Standard

A. For Water drawn from the distribution system.

B. For Water drawn from unpiped well.

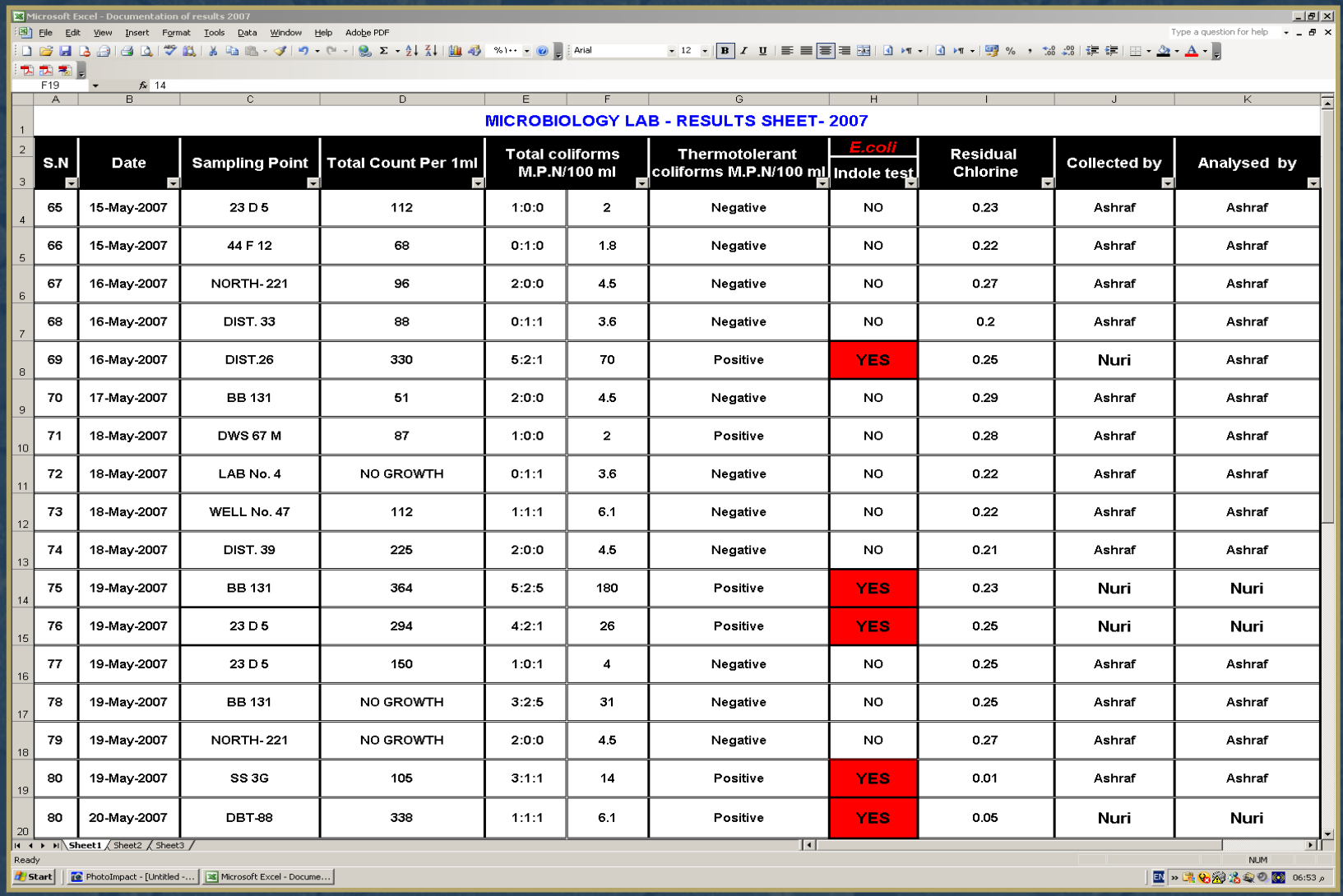
A. Water drawn from the distribution system:

Quality of supply	Results from routine samples coliform count/ 100ml	*E. coli* count/100ml	Tolerance
Excellent -1	0	0	In all samples
Satisfactory -2	0	3 - 1	Provided that coliform organisms do not occur in consecutive samples or in more than 5% of samples.
Intermediate -3	0	9 - 4	
Unsatisfactory -4	10 or more, *E. coli* or any coliform organisms present in consecutive samples. or presence of any coliform organisms in more than 5% of routine samples.		In any sample

B. Water drawn from unpiped well:

*Mean count 44^{0}C, 100 ml *E . coli* count	Category	Comments
0	A	.Excellent
10 – 1	B	Acceptable: But make regular sanitary checks on equipment
50 – 10	C	Unacceptable: Look for and correct structural faults and poor maintenance of pump and plinth. Then disinfect .equipment and source
More than 50	D	Grossly polluted: Look for alternative source, or carryout necessary repairs, .and disinfect well

Result Documentation & interpretation

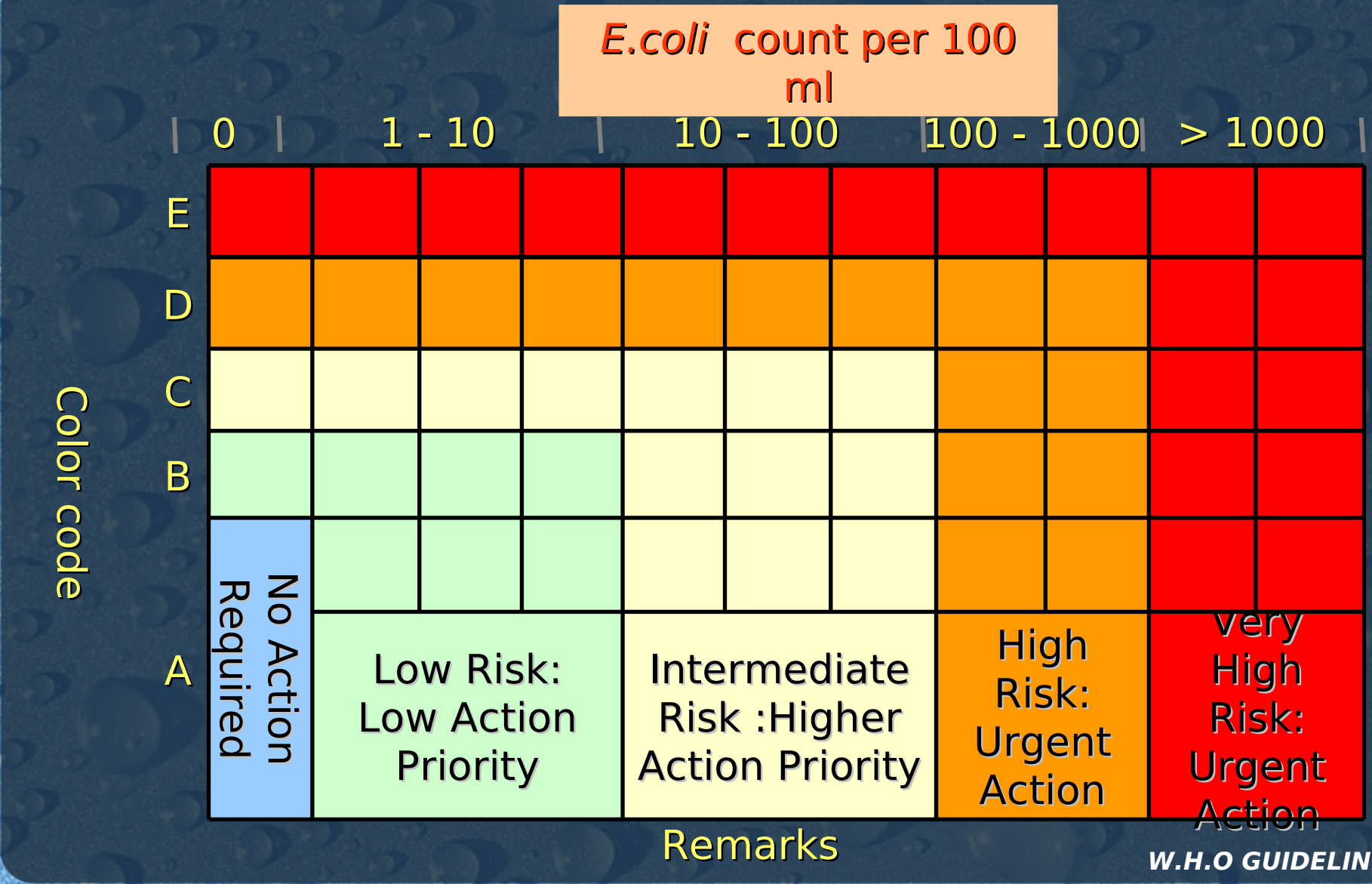


Microsoft Excel - Documentation of results 2007

MICROBIOLOGY LAB - RESULTS SHEET- 2007

S.N	Date	Sampling Point	Total Count Per 1ml	Total coliforms M.P.N/100 ml		Thermotolerant coliforms M.P.N/100 ml	E.coli Indole test	Residual Chlorine	Collected by	Analysed by
65	15-May-2007	23 D 5	112	1:0:0	2	Negative	NO	0.23	Ashraf	Ashraf
66	15-May-2007	44 F 12	68	0:1:0	1.8	Negative	NO	0.22	Ashraf	Ashraf
67	16-May-2007	NORTH- 221	96	2:0:0	4.5	Negative	NO	0.27	Ashraf	Ashraf
68	16-May-2007	DIST. 33	88	0:1:1	3.6	Negative	NO	0.2	Ashraf	Ashraf
69	16-May-2007	DIST.26	330	5:2:1	70	Positive	YES	0.25	Nuri	Ashraf
70	17-May-2007	BB 131	51	2:0:0	4.5	Negative	NO	0.29	Ashraf	Ashraf
71	18-May-2007	DWS 67 M	87	1:0:0	2	Positive	NO	0.28	Ashraf	Ashraf
72	18-May-2007	LAB No. 4	NO GROWTH	0:1:1	3.6	Negative	NO	0.22	Ashraf	Ashraf
73	18-May-2007	WELL No. 47	112	1:1:1	6.1	Negative	NO	0.22	Ashraf	Ashraf
74	18-May-2007	DIST. 39	225	2:0:0	4.5	Negative	NO	0.21	Ashraf	Ashraf
75	19-May-2007	BB 131	364	5:2:5	180	Positive	YES	0.23	Nuri	Nuri
76	19-May-2007	23 D 5	294	4:2:1	26	Positive	YES	0.25	Nuri	Nuri
77	19-May-2007	23 D 5	150	1:0:1	4	Negative	NO	0.25	Ashraf	Ashraf
78	19-May-2007	BB 131	NO GROWTH	3:2:5	31	Negative	NO	0.25	Ashraf	Ashraf
79	19-May-2007	NORTH- 221	NO GROWTH	2:0:0	4.5	Negative	NO	0.27	Ashraf	Ashraf
80	19-May-2007	SS 3G	105	3:1:1	14	Positive	YES	0.01	Ashraf	Ashraf
80	20-May-2007	DBT-88	338	1:1:1	6.1	Positive	YES	0.05	Nuri	Nuri

Example of classification and color-code scheme for *E. coli* in water supplies



W.H.O GUIDELINES

Drinking Water Treatment

- To provide drinking water to consumers that is free of waterborne pathogens.

- No single treatment process can be expected to remove all of the different types of pathogens that can be found in water.

Microbial treatment :

1- The physical removal of the pathogens.

2- The inactivation (death) of the pathogen.

- Coagulation and sedimentation

- Filtration

Chemical inactivation :

Chemicals used include chlorine, chloramine, chlorine dioxide and ozone.

Factors affecting chemical TTT :

Dose, Contact time, Temperature and sometimes pH.

Chlorination :

chlorine, chloramines, chlorine dioxide and Monochloramine .

- Nearly 100 years of drinking water chlorination has demonstrated its effectiveness in the inactivation of microbial pathogens

Ozonation :

- Ozone has been used for more than a century for water treatment, mostly in Europe.

- The exact mechanism of how ozone inactivates microbes is not well understood.

- *E. coli* is one of the most sensitive to ozone disinfection, while Gram-positive cocci (*Staphylococcus* and *Streptococcus*), *the* Gram-positive bacilli (*Bacillus*) and the mycobacteria are the most resistant.

- Ozone is effective against *Giardia* and to a lesser extent *Cryptosporidium*.

UV disinfection :

- UV action results from absorption by nucleic acids (DNA and RNA), leading to the dimerisation of pyrimidine bases.

- Usually a dose of 400 J/m2 (40 mW s/cm2) is accepted as being sufficient for efficient treatment.

Three types of light source are used for UV disinfection :

- Low-pressure mercury lamp.
- Medium-pressure mercury lamp.
- Pulsed lasers.

Solar water disinfection :

- In low-income countries the sunlight alone can be used to kill or inactivate many, if not all, of the pathogens found in relatively small amount of water at the point of use.

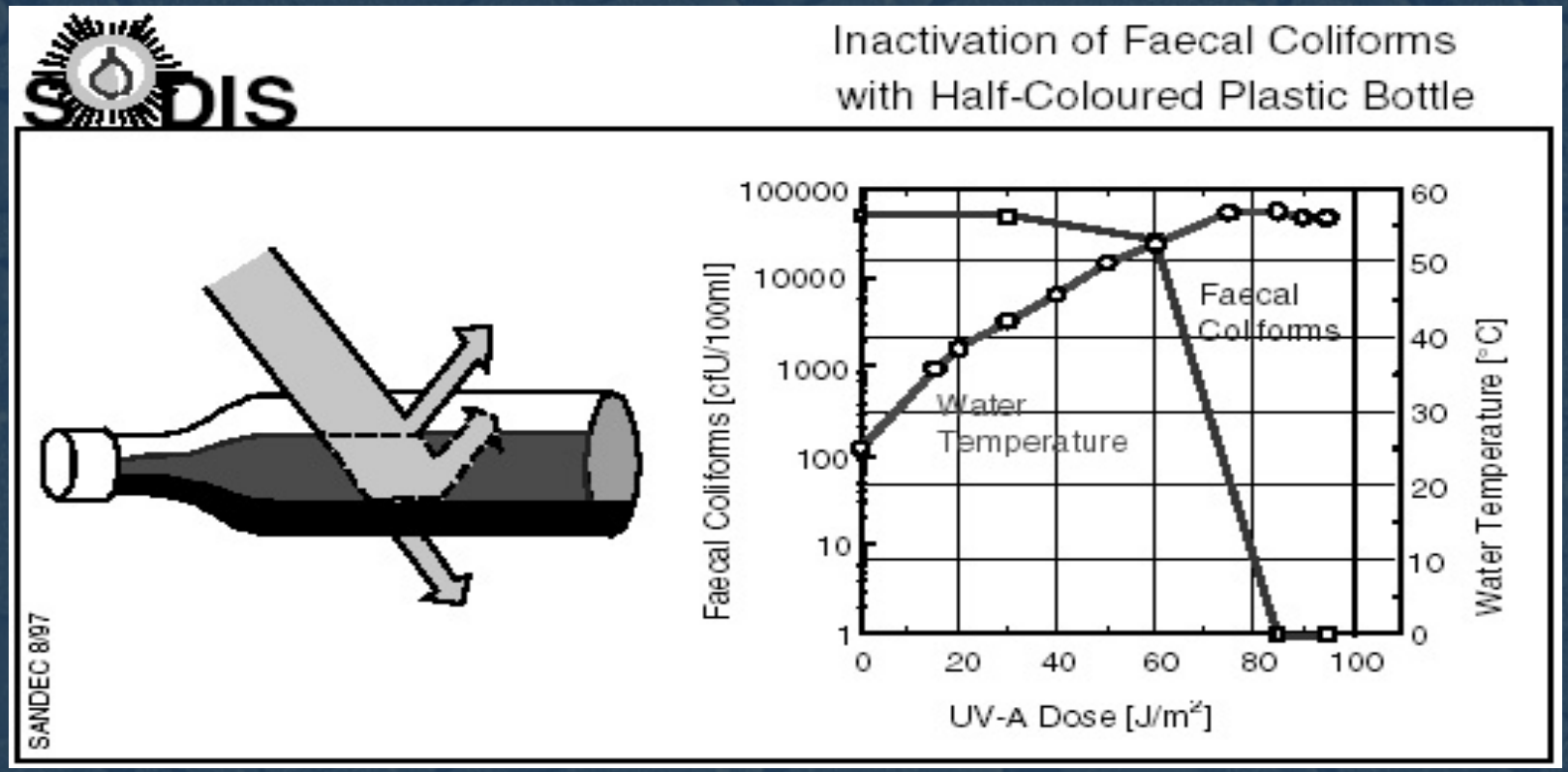
three ways in which solar radiation can be used to eliminate pathogens :

1- Heating.

2- Natural UV radiation.

3- Mixture of both thermal and UV effects.

Schematic representation of solar water disinfection and the influence of the water temperature on the UV-inactivation of bacterial cells



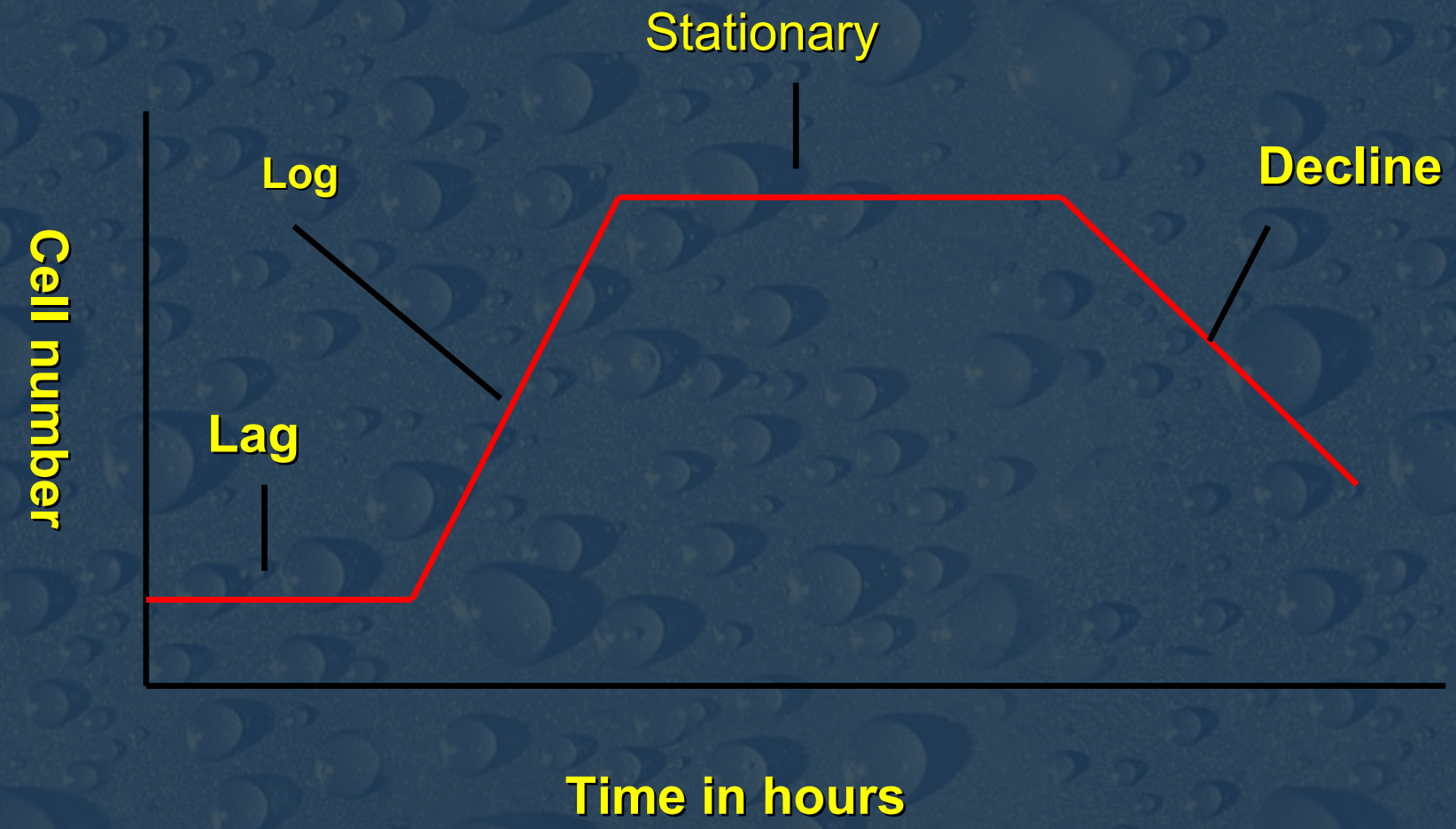
.....Thank you

Abdurra

Tomei

2008

com


Stationary
Log
Decline
Lag
Cell number
Time in hours