

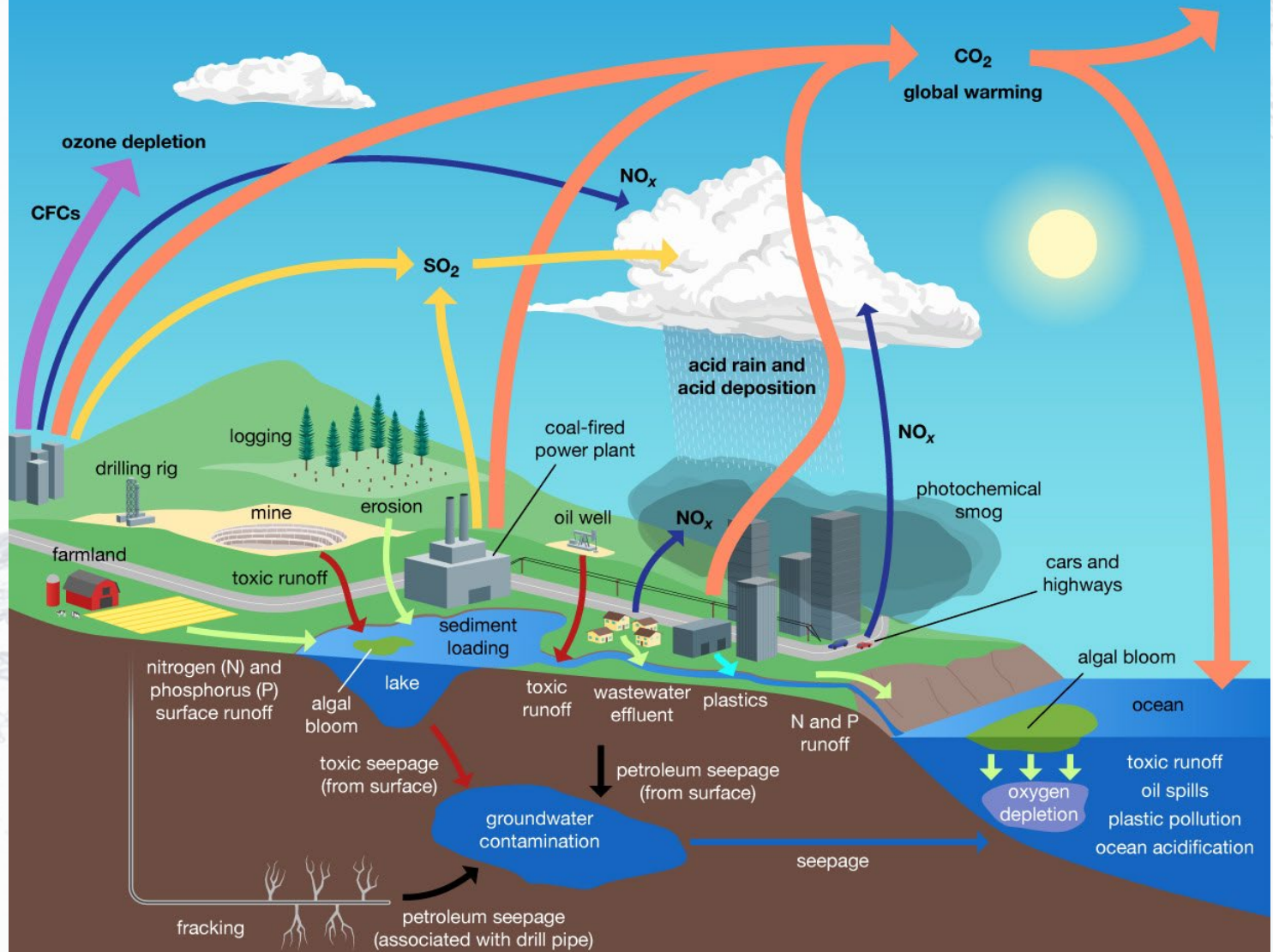
A dynamic splash of water with many bubbles, captured in a high-speed photograph, serves as the background for the slide. The water is white and frothy, contrasting with the light blue background.

# 18CEO405T WATER POLLUTION AND ITS MANAGEMENT

Dr. Karuppasamy Sudalaimuthu

# POLLUTION

## AIR, LAND, AND WATER POLLUTION





# WATER POLLUTION



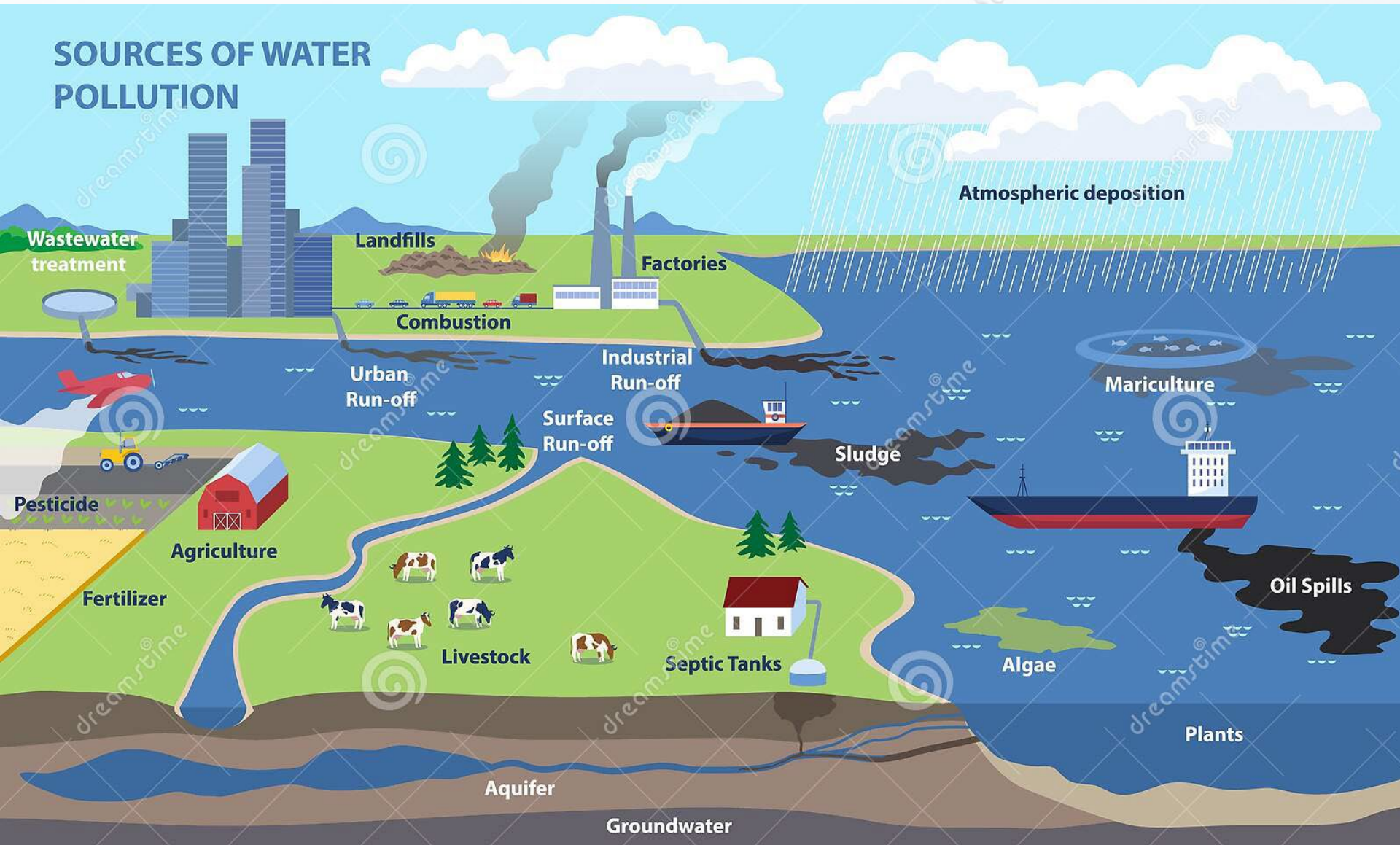
# S1-SLO 1- Introduction to Water pollution

## Introduction : Water Pollution

- Water that has constituents of human and/or animal metabolic wastes.
- Water that has the residuals from cooking, cleaning and/or bathing as a domestic
- Water that has the residuals from manufacturing, processing, cleaning as a industrial.



# SOURCES OF WATER POLLUTION



# OTHER TYPES OF POLLUTION

## PLASTIC

Addition of plastic waste to the landscape and waterways

### CAUSE

Manufactured plastics that are not properly disposed of

### ISSUES

- Plastic does not break down easily
- Additives in plastic may become endocrine disruptors
- Plastic waste flows downstream into rivers and oceans
- Sea life can ingest, choke upon, or become trapped in plastic waste
- Plastic is a source of polychlorinated biphenyls (PCBs), which are suspected carcinogens

## NOISE

Unwanted or excessive sound that affects health and environmental quality

### CAUSE

Machines and engines associated with industry, as well as airports and other transportation systems

### ISSUES

- Physical damage to hearing organs in humans and other animals
- Noise produces increased stress levels
- Noise disrupts ecosystems by driving certain species away
- Noise alters the habits of wildlife
- Noise occurs on land (industry and transportation) and at sea (sonar, boat engine noise)

## LIGHT

Unwanted or excessive light

### CAUSE

Streetlights and illuminated buildings, towers, and other structures

### ISSUES

- Light pollution changes nighttime visibility of natural features
- Light pollution disorients migratory animals
- Light pollution fosters bird collisions with lighted towers and buildings

## THERMAL

Addition of heat to a cool environment

### CAUSE

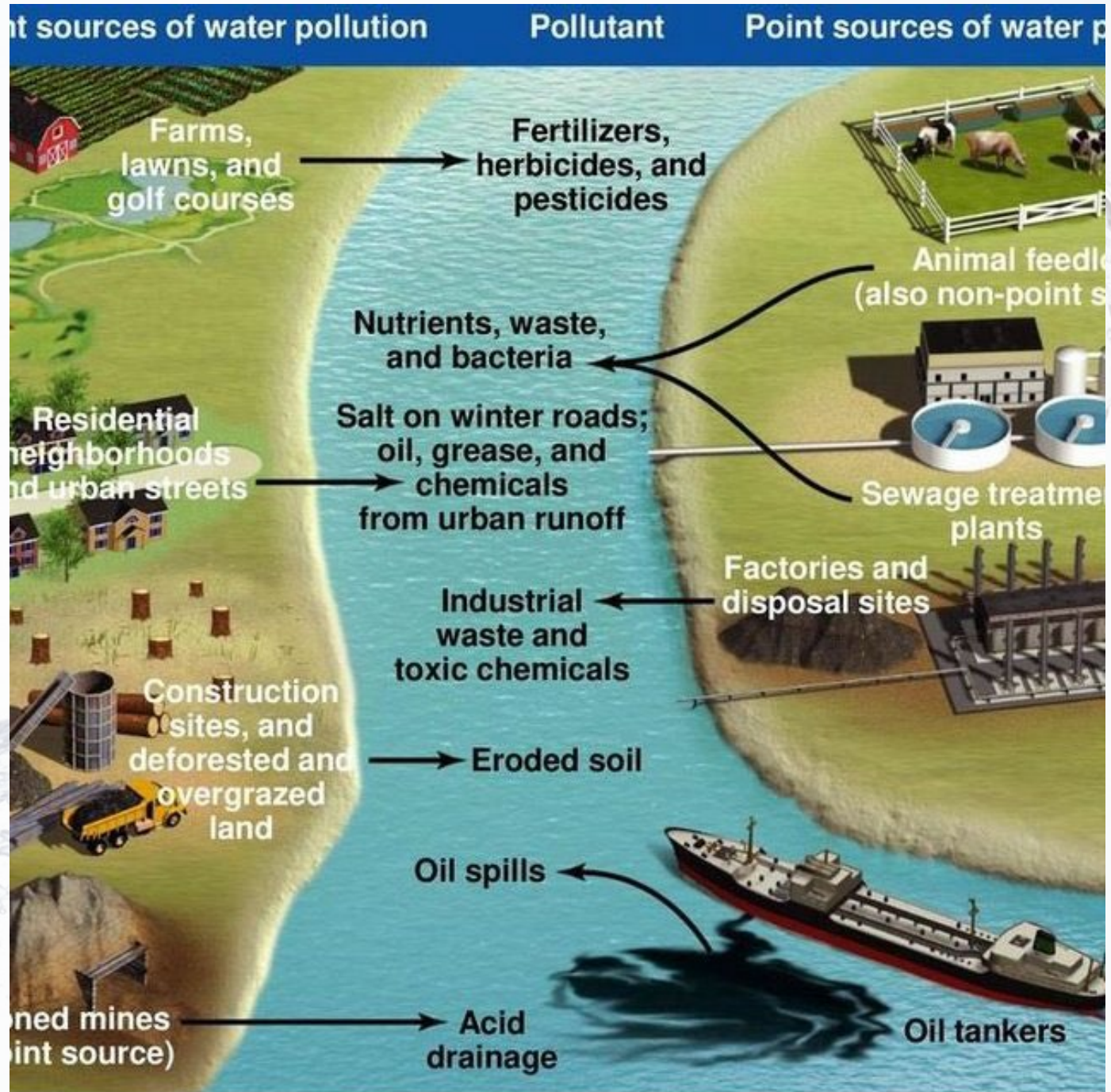
Water or air used as cooling fluids in power plants and manufacturing becomes heated

### ISSUES

- Heated cooling water from power plants may be 15 °C (27 °F) hotter than lake or stream water
- Heated water increases metabolic rates in fishes
- Adding heated water to a water body reduces the amount of dissolved oxygen that the water may hold







# What is called Waste water?

- Water that has been used in the home, in a business, or as part of an industrial process.

*(Source: Oxford Dictionary)*

- Water that has been used in washing, flushing, manufacturing etc.

*(Source: <http://www.dictionary.com>)*



# Wastewater: A burden or A resource ?

- Burden: As it Contains pollution
- Resource: Generally,  $> 99\%$  fraction is water

## What is Wastewater Treatment ?

- Processing of wastewater for removal of contaminants

# Why learn wastewater management ?

- To transform the “burden” into “resource”

## This Requires:

- Engineering/Technological approaches
- Social acceptability
- Financial / economic viability
- Environmental sustainability



# S1-SLO2- Sources and Types of water pollution

*Wastewater is liquid waste, often produced as the byproduct of many uses of water.*

- Household uses
- Industrial uses
- Commercial uses
- Agricultural uses
- Livestock uses

# Wastewater Sources

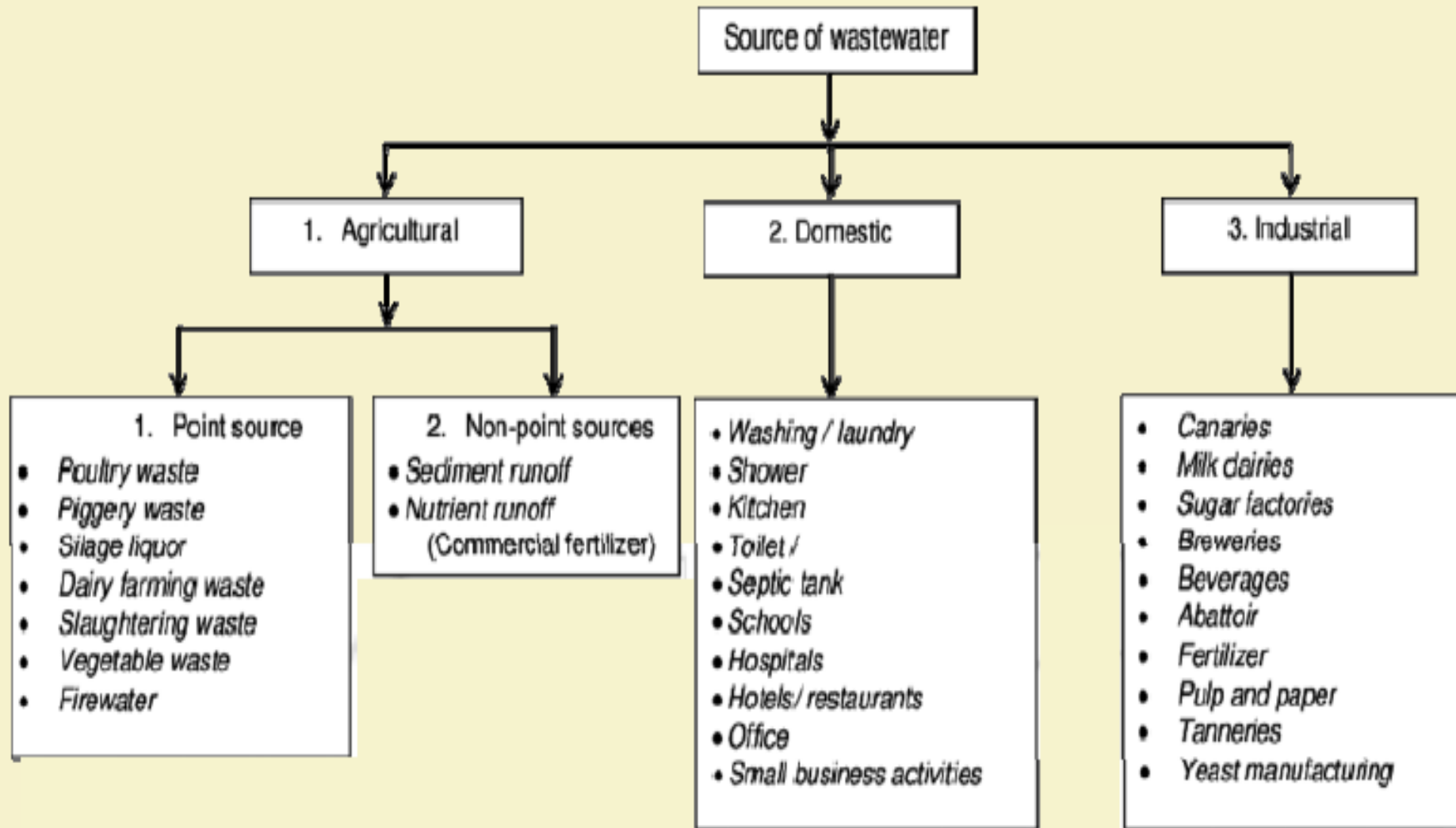


Image Source: *Irrigation and Drainage - Sustainable Strategies and Systems*, Publisher: INTECH, Editors: M S Javaid, pp.55-75



# Wastewater Sources: Industrial



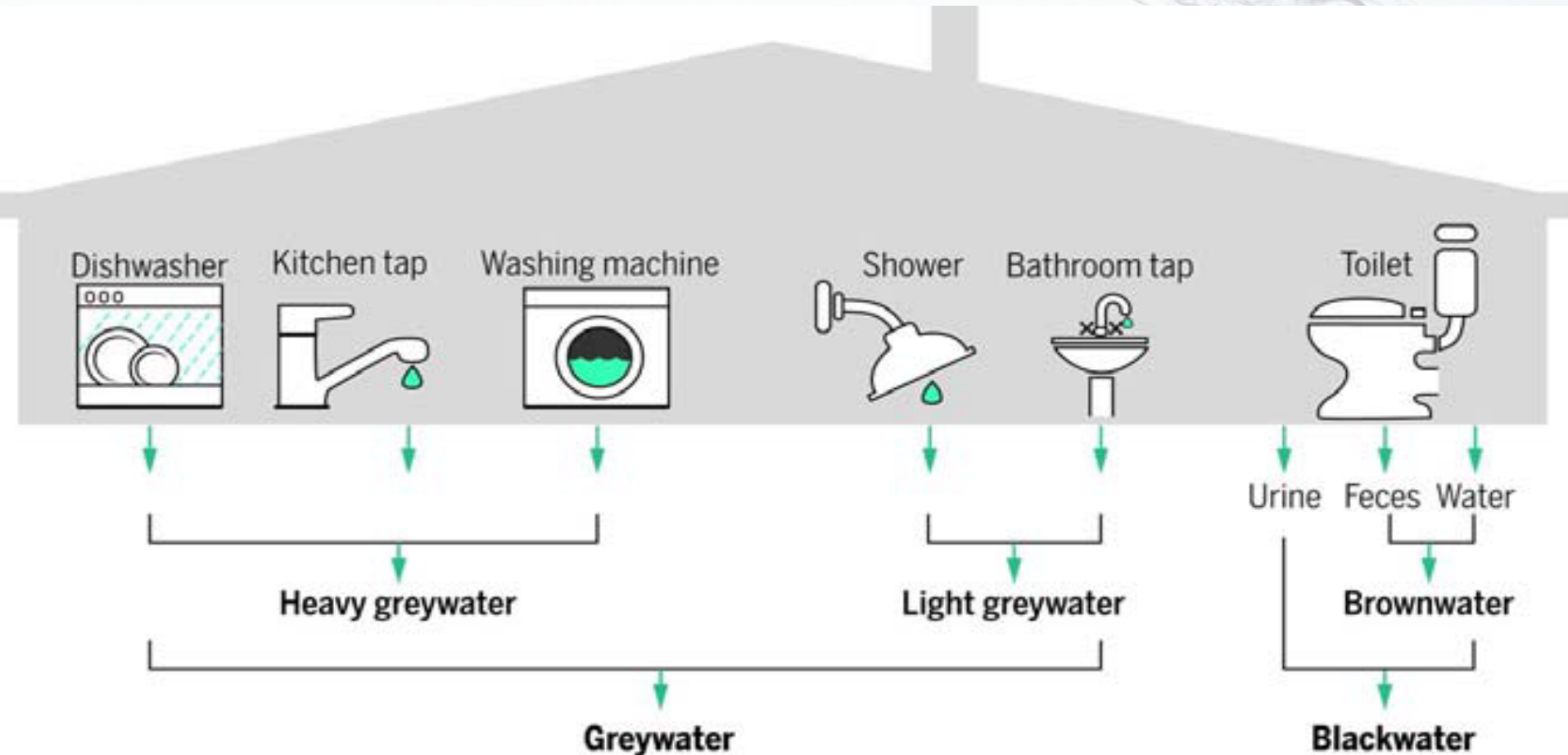
Image Source: <https://www.iswa.uni-stuttgart.de/Isww/arbeitsbereich/iwt/index.en.html>

# Types of Waste water

- Domestic Wastewater  
(Municipal wastewater or sewage)
- Industrial Wastewaters  
(Industrial effluents)
- Agricultural wastewater  
(Agricultural runoff)
- Storm water Runoff



# Types & Generation of Domestic Waste water



**Image Source: Larsen et al, (2016), Emerging solutions to the water challenges of an urbanizing world, Science , 352 (6288), pp. 928-933**

# S2-SLO1- Point source and non point source pollution

## Classification of water pollution

Water pollution is any chemical, biological, or physical change in water quality that has a harmful effect on living organisms or makes water unsuitable for desired uses.

- **Point source:** specific location (drain pipes, ditches, sewer lines).
- **Nonpoint source:** cannot be traced to a single site of discharge (atmospheric deposition, agricultural / industrial / residential runoff)



# Classification of water pollution



**Nonpoint source : Surface run off**

**Image Source:**

<http://www.deeproot.com/blog/blog-entries/whats-the-pointof-non-point>

07/30/2020



**Point source: Industrial effluent disposal**

**Image Source:**

<http://www.indiacelebrating.com/environmentalissues/sources-and-causes-of-water-pollution/>

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# Classification of water pollution- Cntd.,

## Differences between point and Non-point Sources of Pollution

### Point Sources (PS)

**Discharge usually controlled by permits**

**Relatively easy to control because we know the type of contaminants, and location of discharge**

**Easy to monitor above & below discharge, and dilution rates can be calculated**

**Industry can be fined if they do not comply with permit regulations**

### Non-Point Sources (NPS)

**Many small diffuse sources from many different locations**

**Individual contributions are small but cumulative effects can be significant**

**Difficult to monitor, requires many stations**

**Difficult to develop permit systems and difficult to enforce regulations**

**Difficult to determine despersion rates**

**Source:**

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<http://ubclfs-wmc.landfood.ubc.ca/webapp/IWM/course/land-use-water-4/introduction-5/>

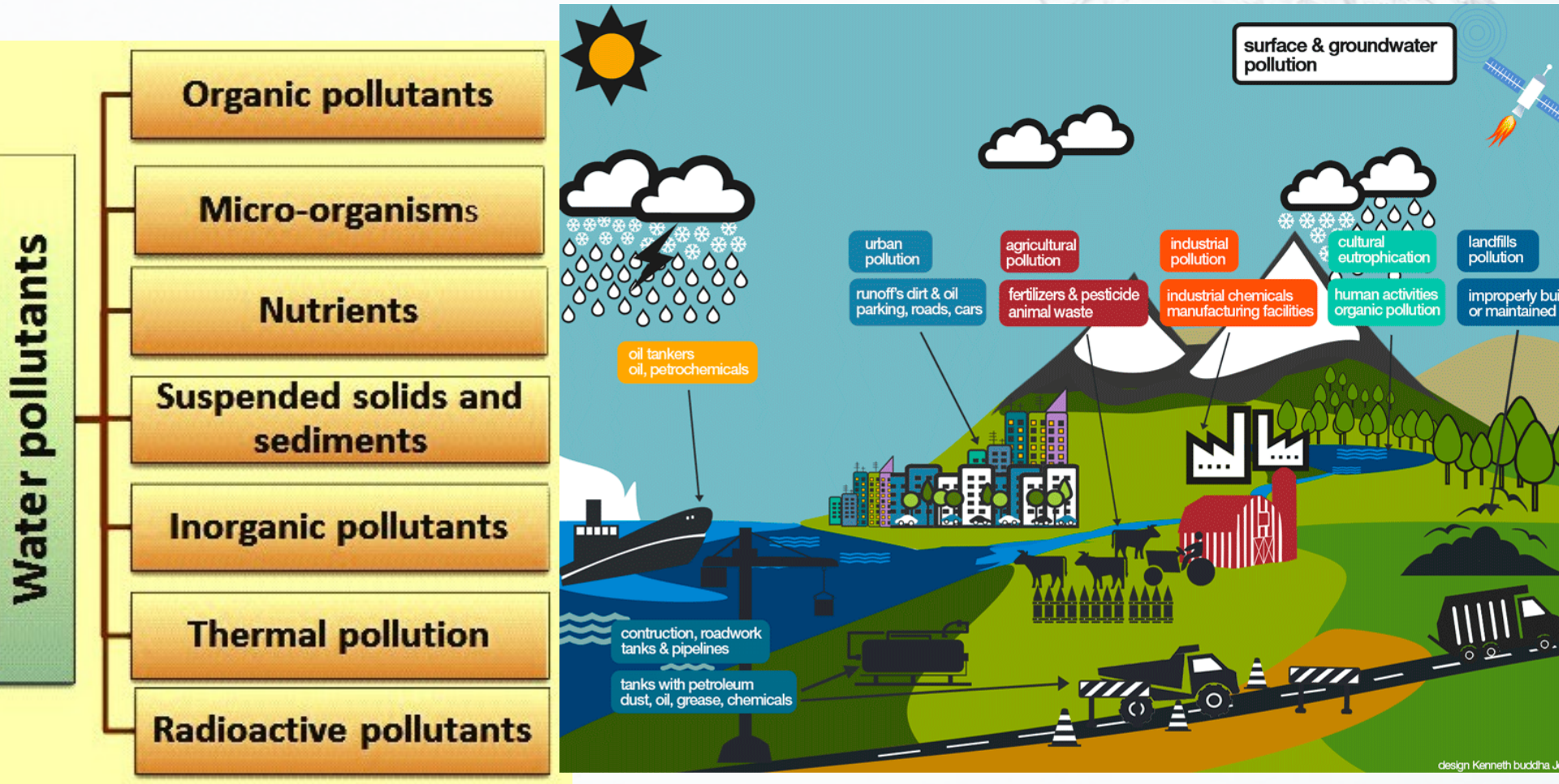
# WATER POLLUTANT AND CAUSES

Type of Water Pollution	Cause of Pollution	Symptoms of Pollution	Effect of Pollution	Source of Pollution
Biodegradable waste	Humans and animals	Decreasing numbers of fish and other aquatic life, increasing number of bacteria	Increased number of bacteria, decreased oxygen levels, death of aquatic life	Run-off, improperly treated effluent,
Nutrients	Nitrates and phosphates	Green, cloudy, slimy, stinky water	Algae blooms, eutrophication of water source	Over use of fertilizers, run-off from fields, improper disposal of containers, wastewater treatment
Heat	Increased water temperature	Warmer water, less oxygen, fewer aquatic organisms	Decrease in oxygen levels, death of fish and plants	Industrial run-off, wastewater treatment
Sedimentation	Suspended particles settling out of water	Cloudy water, increased amount of bottom	Warms up water, decreases depth of water source, deposits toxins	Construction sites, farming and livestock operations, logging, flooding, city run-off, dams
Chemicals	Toxic and hazardous chemicals	Water colour changes, develops an odour, aquatic life die out	Kills aquatic life, can enter human food chain, leads to birth defects, infertility, cancer and other diseases in humans and animals	Human-made, improper disposal, run-off, dams, landfill leachate, industrial discharge, acid rain
Radioactive pollutants	Radioactive isotopes	Increased rates of birth defects and cancer in human and animal populations.	Kills aquatic species and leads to cancer and death in humans and other animals	Waste water discharges from factories, hospitals and uranium mines
Medical	Medicines, antibiotics	Infertility in aquatic organisms, and other unknown symptoms	Unknown	Humans dumping medicines into water systems, wastewater treatment
Microbiological	Bacteria, viruses, protozoa	People and animals become ill with gastrointestinal disorders	Undrinkable water	Improper treatment of water/effluent, can occur naturally



# S2-SLO2- Types of pollutant

## Types Of Water Pollutants



# S2-SLO2- Types of pollutant

**Organic Pollutants :** It can be further divided into following categories:

- ➡ **Oxygen Demanding wastes:** The wastewaters such as, domestic and municipal sewage, wastewater from food processing industries, canning industries, slaughter houses, paper and pulp mills, tanneries, breweries, distilleries, etc. have considerable concentration of biodegradable organic compounds either in suspended, colloidal or dissolved form.
- ➡ These wastes undergo degradation and decomposition by bacterial activity.

**Inorganic pollutants:** Acids, Toxic metals and etc

**Organic pollutants :** Pesticides, Oil and etc





# S2-SLO2- Types of pollutant

- ➡ **Synthetic Organic Compounds :**
- ➡ Synthetic organic compounds are also likely to **enter the ecosystem through various manmade** activities such as production of these compounds, spillage during transportation, and their uses in different applications.
- ➡ These include **synthetic pesticides**, synthetic detergents, food additives, pharmaceuticals, insecticides, paints, synthetic fibers, plastics, solvents and **volatile organic compounds (VOCs)**.



# S2-SLO2- Types of pollutant

## ► Synthetic Organic Compounds :

► Most of these compounds are toxic and bio-refractory organics i.e., they are resistant to microbial degradation. Polychlorinated biphenyls (PCBs) are used in the industries since 1930s which are complex mixtures of chlorobiphenyls

► Inorganic pollutants- includes a variety of toxic heavy metals such as cadmium (Cd), chromium (Cr), arsenic (As), lead (Pb), mercury (Hg), etc. Copper greater than 0.1 mg/L is toxic to microbes.

# S2-SLO2- Types of pollutant

## ►Pathogens:

► The pathogenic microorganisms enter in to water body through sewage discharge as a major source or through the wastewater from industries like **slaughterhouses**.

► Viruses and bacteria can cause water borne diseases, such as cholera, typhoid, dysentery, polio and infectious hepatitis in human.

## ►Nutrients:

► The agriculture run-off, wastewater from fertilizer industry and sewage contains substantial concentration of nutrients like nitrogen and phosphorous.

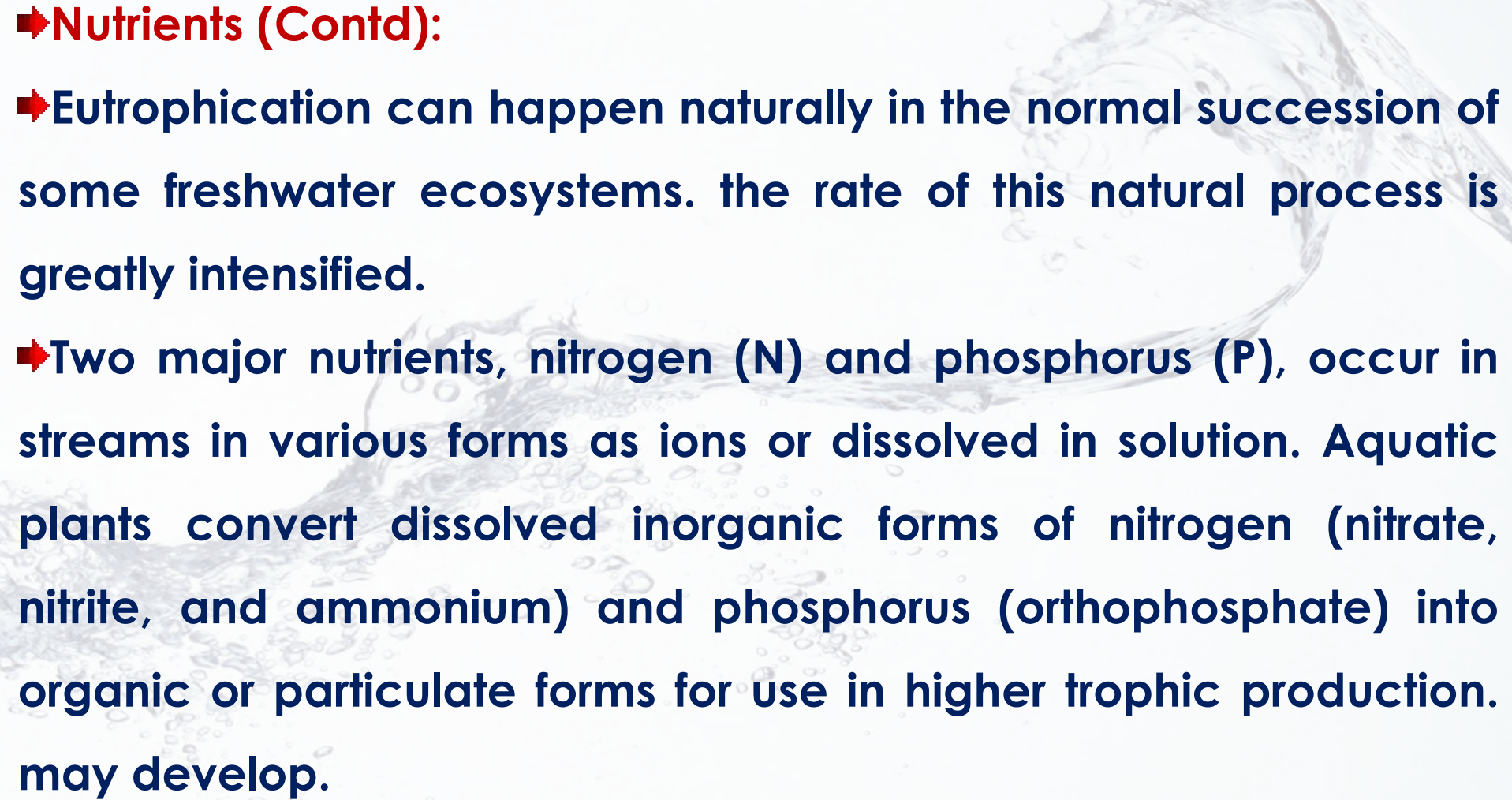
# S2-SLO2- Types of pollutant

## ➡Nutrients:

- ➡In long run, water body reduces DO, leads to eutrophication and ends up as a dead pool of water. People swimming in eutrophic waters containing blue-green algae can have skin and eye irritation, gastroenteritis and vomiting.
- ➡High nitrogen levels in the water supply, causes a potential risk, especially to infants under six months Eg., Blue baby disease.
- ➡In freshwater systems, eutrophication is a process whereby water bodies receive excess inorganic nutrients, especially N and P, which stimulate excessive growth of plants and algae.



# S2-SLO2- Types of pollutant

- 
- A background image showing a dynamic splash of water with bubbles and droplets, creating a sense of movement and freshness.
- ➡ **Nutrients (Contd):**
  - ➡ Eutrophication can happen naturally in the normal succession of some freshwater ecosystems. the rate of this natural process is greatly intensified.
  - ➡ Two major nutrients, nitrogen (N) and phosphorus (P), occur in streams in various forms as ions or dissolved in solution. Aquatic plants convert dissolved inorganic forms of nitrogen (nitrate, nitrite, and ammonium) and phosphorus (orthophosphate) into organic or particulate forms for use in higher trophic production. may develop.

# S2-SLO2- Types of pollutant

## ➡ **Suspended solids and sediments:**

➡ These comprise of silt, sand and minerals eroded from land. These appear in the water through the surface runoff during rainy season and through municipal sewers.

➡ This can lead to the siltation, reduces storage capacities of reservoirs. Presence of suspended solids can block the sunlight penetration in the water, which is required for the photosynthesis by bottom vegetation.

# S2-SLO2- Types of pollutant

- ▶ **Suspended solids and sediments: Cntd.,**
- ▶ **Deposition of the solids in the quiescent stretches of the stream or ocean bottom can impair the normal aquatic life and affect the diversity of the aquatic ecosystem.**
- ▶ **If the deposited solids are organic in nature, they will undergo decomposition leading to development of anaerobic conditions. Finer suspended solids such as silt and coal dust may injure the gills of fishes and cause asphyxiation.**



# S2-SLO2- Types of pollutant

## ➡ Thermal pollution:

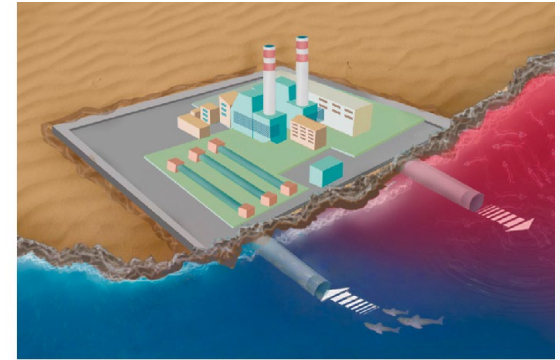
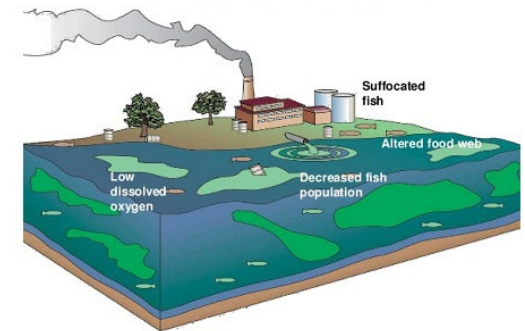
➡ Considerable thermal pollution results due to discharge of hot water from thermal power plants, nuclear power plants, and industries where water is used as coolant.

➡ As a result of hot water discharge, the temperature of water body increases. Rise in temperature reduces the DO content of the water, affecting adversely the aquatic life.

➡ This alters the spectrum of organisms, which can adopt to live at that temperature and DO level.



Impact of Thermal Pollution on Environment



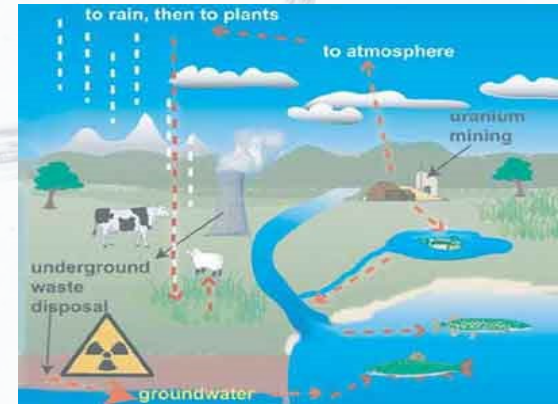
# S2-SLO2- Types of pollutant

## Radioactive pollutants:

➡ Radioactive materials originate from the following:

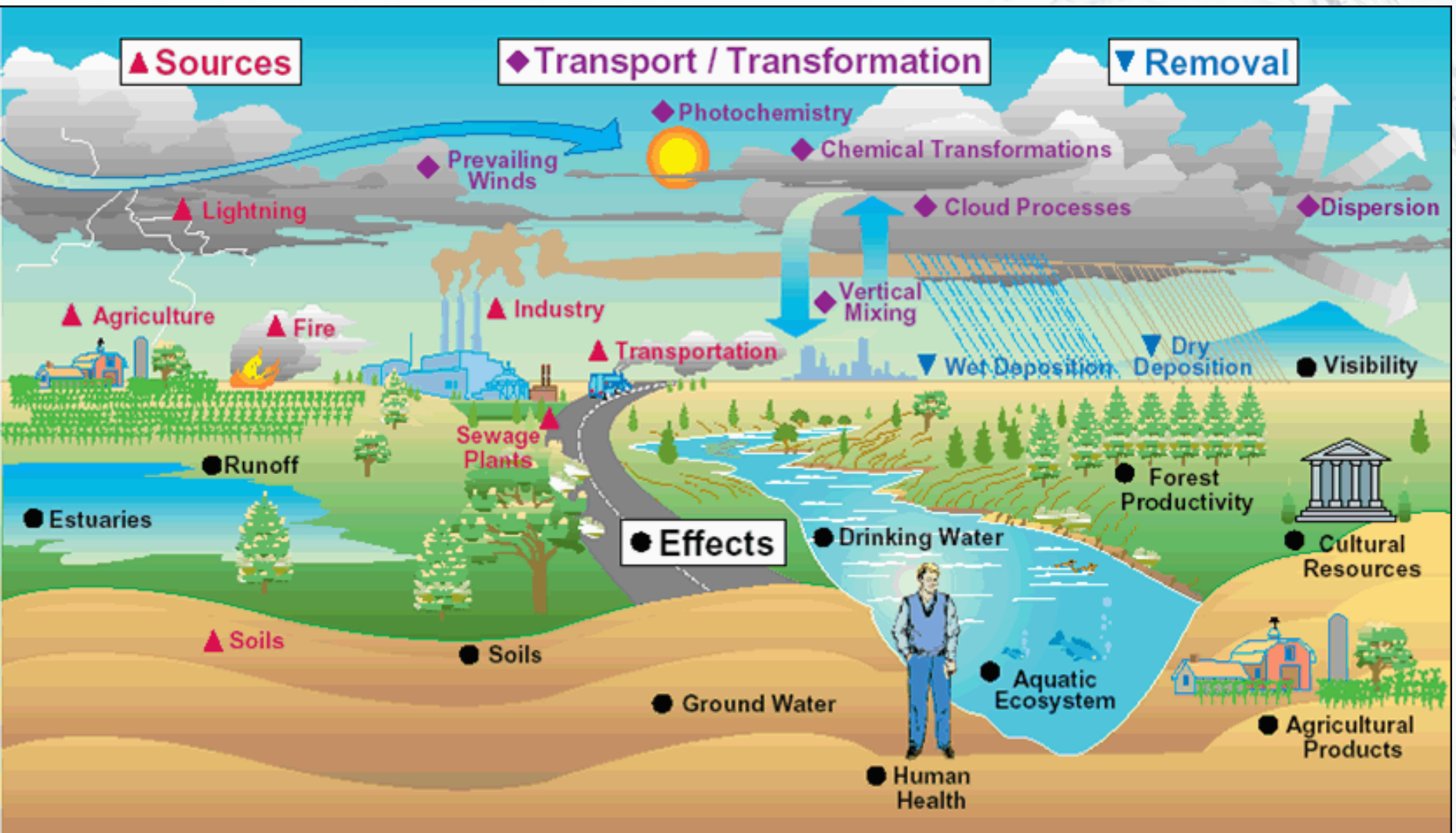
➡ Mining and processing of ores. Use in research, agriculture, medical and industrial activities, such as I131, P32, Co60, Ca45, S35, C14, etc.

➡ Radioactive discharge from nuclear power plants and nuclear reactors, e.g., Sr90, Cesium Cs137, Plutonium Pu248, Uranium-238, Uranium-235. Uses and testing of nuclear weapons. These isotopes are toxic to the life forms; they accumulate in the bones, teeth and can cause serious disorders.





# S3-SLO1- Adverse effects of pollutants



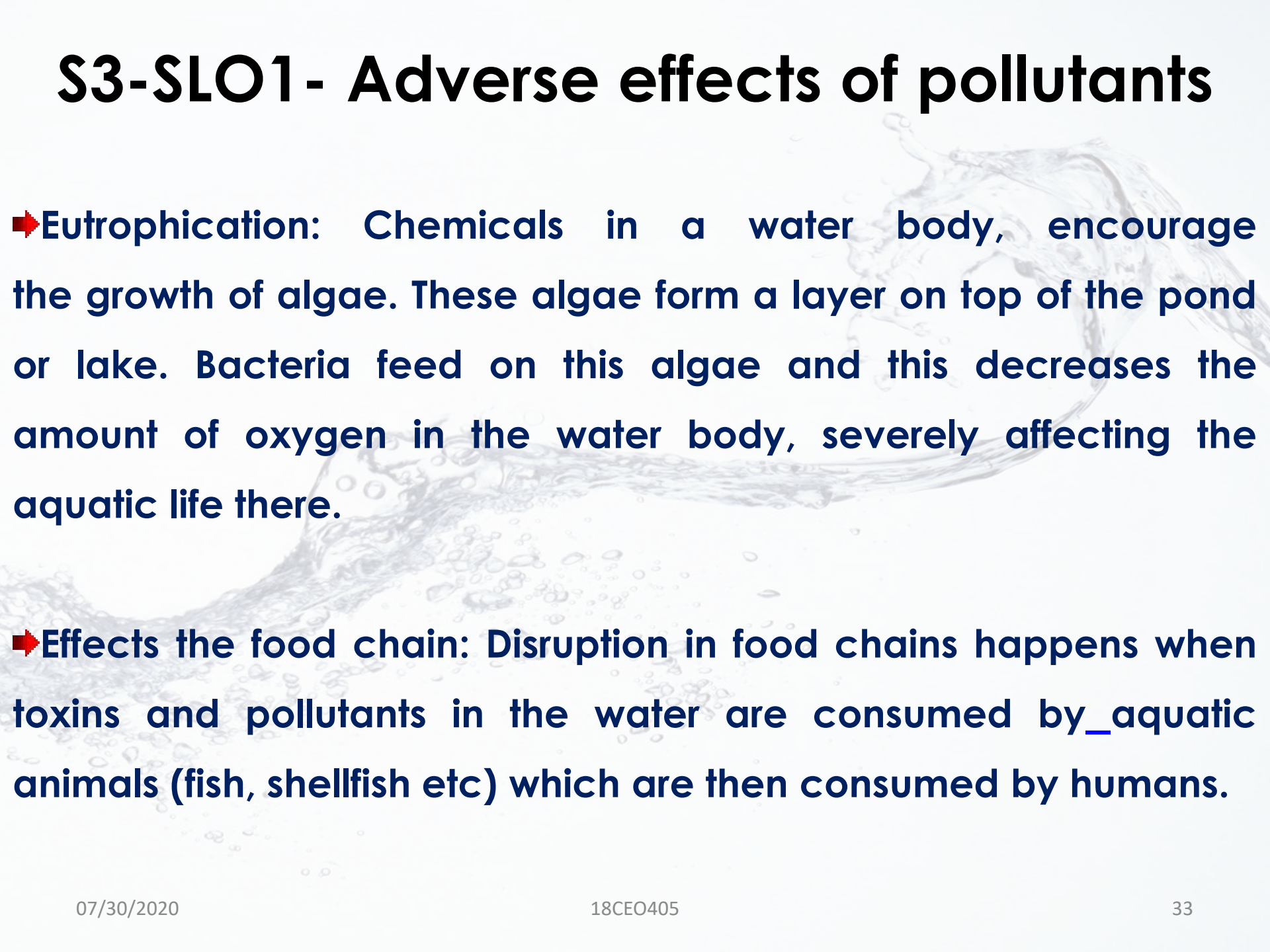


# S3-SLO1- Adverse effects of pollutants

➡ **Diseases:** In humans, drinking or consuming polluted water in any way has many disastrous effects on our health. It causes typhoid, cholera etc.,

➡ **Destruction of Ecosystems:** These are extremely dynamic and respond to even small changes in the environment. Water pollution can cause an entire ecosystem to collapse if left unchecked.

# S3-SLO1- Adverse effects of pollutants

A background image showing a dynamic splash of water with many bubbles, creating a sense of movement and freshness.

➡ **Eutrophication:** Chemicals in a water body, encourage the growth of algae. These algae form a layer on top of the pond or lake. Bacteria feed on this algae and this decreases the amount of oxygen in the water body, severely affecting the aquatic life there.

➡ **Effects the food chain:** Disruption in food chains happens when toxins and pollutants in the water are consumed by aquatic animals (fish, shellfish etc) which are then consumed by humans.

# S3-SLO1- Adverse effects of pollutants

Sr. No.	Pollutants	Impact
1.	Organic pollutants i)Oxygen Demanding wastes: ii)Synthetic organic pollutants iii) oil	Depletion of the DO will be a serious problem adversely affecting aquatic life, if the DO falls below 4.0 mg/L. Most of these compounds are toxic and biorefractory organics. It also make water unfit for different uses. This pollutant is also responsible for endangering water birds and coastal plants due to coating of oils and adversely affecting the normal activities which cause reduction of light transmission and photosynthesis.
2.	Pathogens	Number of diseases transmitted by pathogens available in wastewater
3.	Nutrients	When these are disposed in aquatic environment, it can lead to growth of undesirable aquatic life. When it discharged on land it causes groundwater pollution.
4.	Thermal pollutants	When organic matter is also present, the bacterial action increases due to rise in temperature; hence, resulting in rapid decrease of DO. It also results in thermal stratification which alters spectrum of organisms.
5.	Radioactive pollutants	These isotopes are toxic to the life forms; they accumulate in the bones, teeth and can cause serious disorders
6.	Suspended solids and sediments	Presence of suspended solids can block the sunlight penetration in the water, which is required for the photosynthesis by bottom vegetation. Finer suspended solids such as silt and coal dust may injure the gills of fishes and cause asphyxiation.
7.	Inorganic pollutants	These pollutants include mineral acids, inorganic salts, trace elements, metals, metals compounds, complexes of metals with organic compounds, cyanides, sulphates, etc. They have adverse effect on aquatic flora and fauna and may constitute a public health problem.

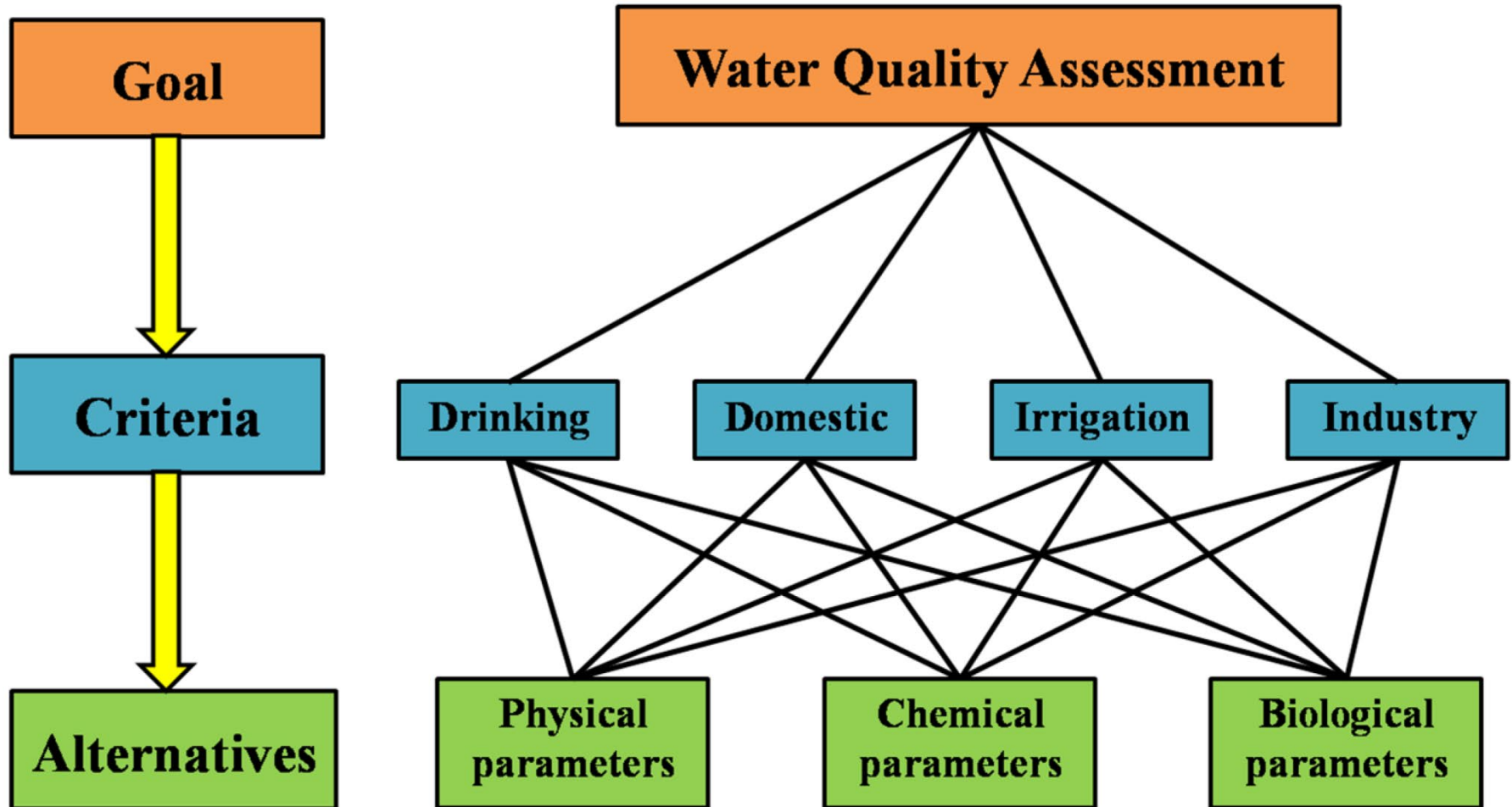


# S3-SLO2- Principles of pollution assessment

➡ Pollution assessment is the systematic identification and evaluation of the potential impacts(effects) of proposed projects, plans, programs or legislative actions relative to the physical- chemical, biological, cultural and socioeconomic components of the total environment. It is classify into the following categories

- ➡ Physical Assessment
- ➡ Chemical Assessment &
- ➡ Biological Assessment

# S3-SLO2- Principles of pollution assessment



# S3-SLO2- Principles of pollution assessment

## Water Quality Parameters

### Physical

- (i) Suspended solids
- (ii) Turbidity
- (iii) Color
- (iv) Taste and odor
- (v) Temperature

### Chemical

- (i) pH
- (ii) Total Dissolved Solids
- (iii) Alkalinity
- (iv) Hardness
- (v) Fluoride
- (vi) Chlorides
- (vii) Sulphates
- (viii) Metals:
  - Toxic metals
  - Non-toxic metals
- (ix) Organics
  - Biodegradable
  - Non-Biodegradable
- (x) Nutrients
  - Nitrogen
  - Phosphorous

### Microbiological

- (i) Pathogens indicators

MPN :  
Most probable number

BOD

COD

### Radiological

- 1) Alpha particles
- 2) Beta particles
- 3) Photon emitters
- 4) Radium - 226 & 228
- 5) Uranium



# S4-SLO1- Terms and Definitions in wastewater

- ➡ **Wastewater:** The term wastewater includes both organic and inorganic constituents, in soluble or suspended form, and mineral content of liquid waste carried through liquid media.
- ➡ Generally the **organic portion of the wastewater** undergoes **biological decompositions** and the mineral matter may combine with water to form dissolved solids.
- ➡ **Stormwater:** It indicates the rain water of the locality.
- ➡ **Night Soil:** It is a term used to indicate the human and animal excreta.

# S4-SLO1- Terms and Definitions in wastewater

► **Industrial wastewater:** It is the wastewater generated from the industrial and commercial areas. This wastewater contains objectionable organic and inorganic compounds that may not be amenable to conventional treatment processes.

► **Sullage:** This refers to the wastewater generated from bathrooms, kitchens, washing place and wash basins, etc. Composition of this waste does not involve higher concentration of organic matter and it is less polluted water as compared to sewage.

# S4-SLO1- Terms and Definitions in wastewater

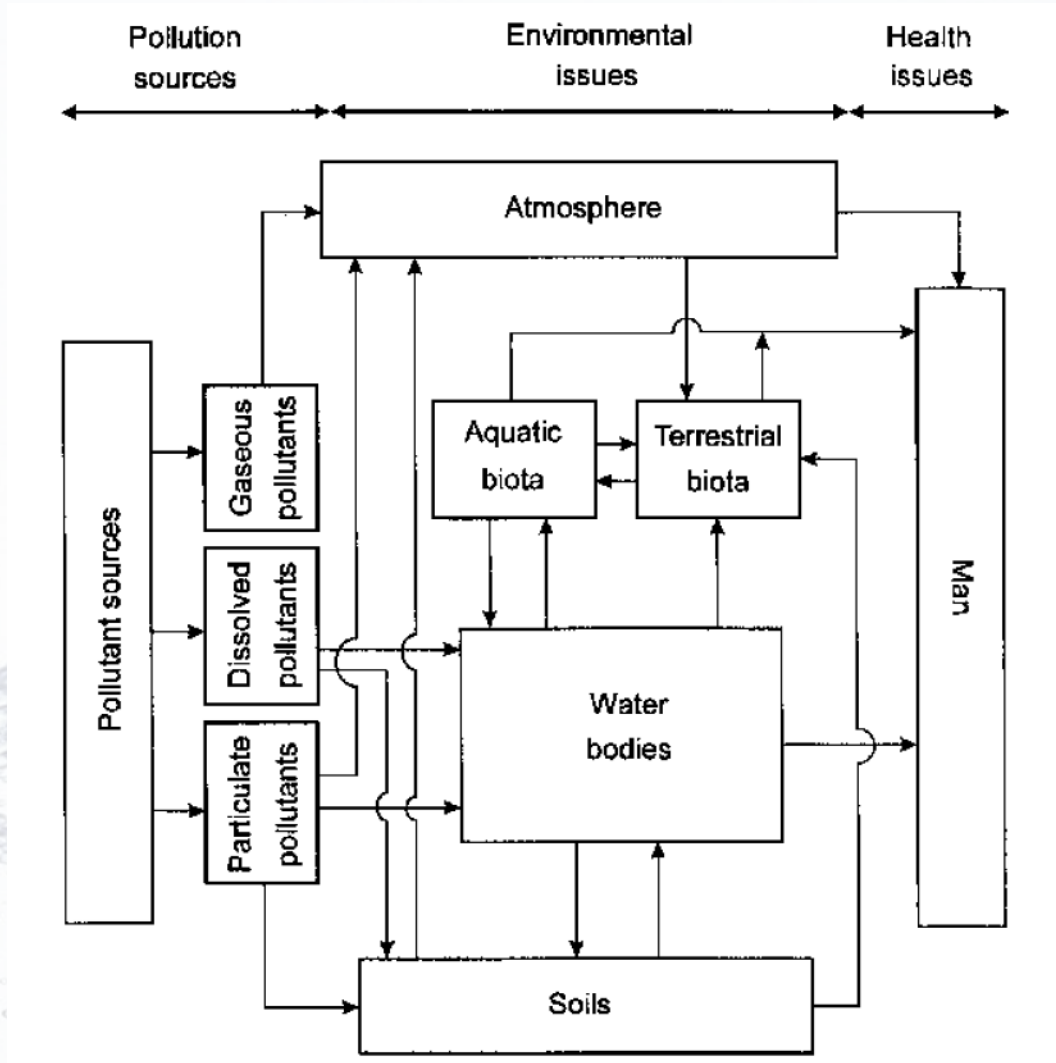
**Sewage:** It indicates the liquid waste originating from the domestic uses of water. It includes sullage, discharge from toilets, urinals, wastewater generated from commercial establishments, institutions, industrial establishments and also the groundwater and storm water that may enter into the sewers. Its decomposition produces large quantities of malodorous gases, and it contains numerous pathogenic or disease producing bacteria, along with high concentration of organic matter and suspended solids.



# S4-SLO1- Terms and Definitions in wastewater

- **Sanitary sewage:** Sewage originated from the residential buildings comes under this category. This is very foul in nature.
- It is the wastewater generated from the lavatory basins, urinals and water closets of residential buildings, office building, theatre and other institutions. It is also referred as domestic wastewater.
- **Sewer:** It is an underground conduit or drain through which sewage is carried to a point of discharge or disposal. There are three types of sewer systems that are commonly used for sewage collection. 1) Separate sewer 2) Combined sewer 3) Storm sewer.

# S4-SLO2- Transport of pollutants

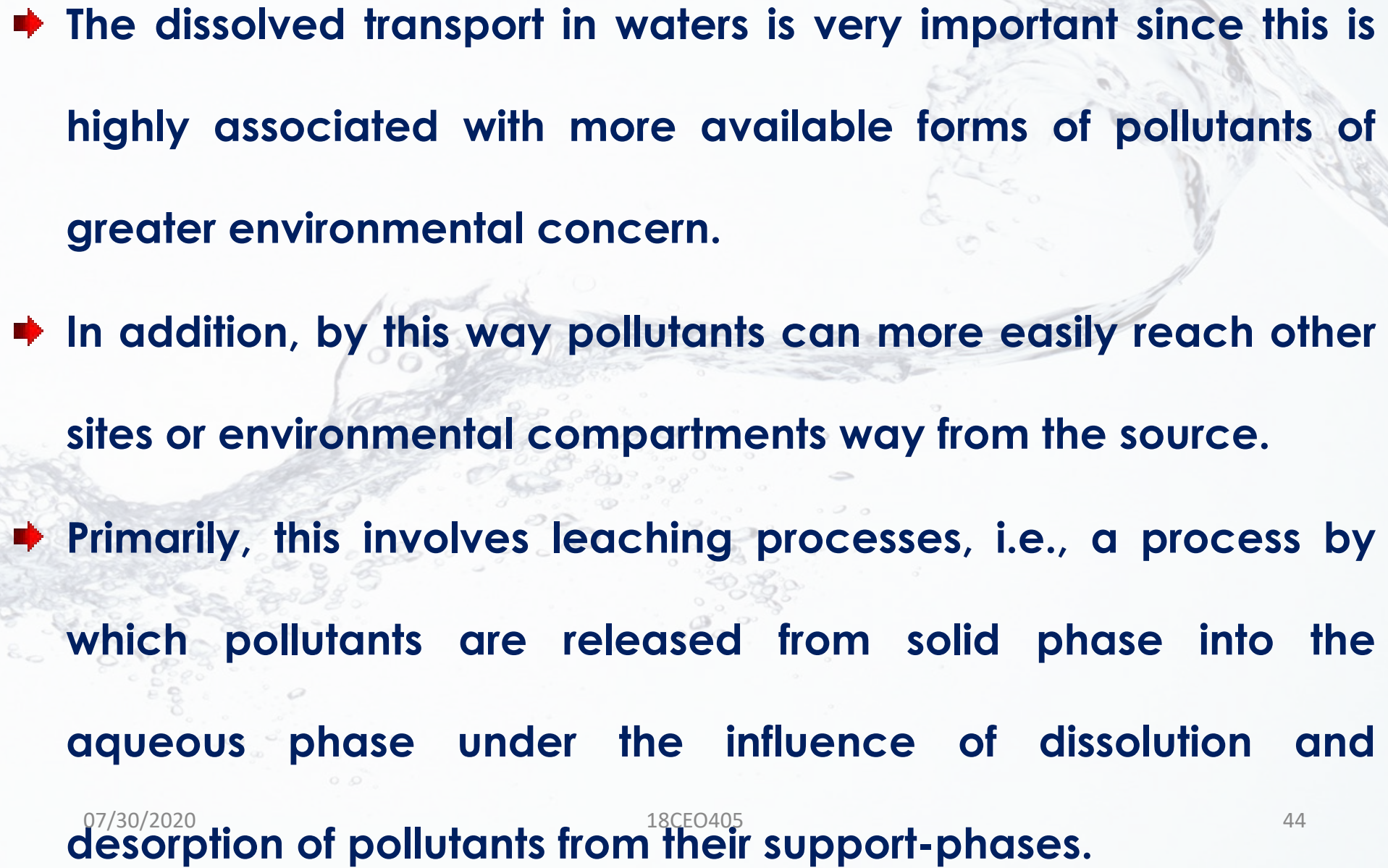


# S4-SLO2- Transport of pollutants





# S4-SLO2- Transport of pollutants

- 
- A background image showing a dynamic splash of water with bubbles and droplets, creating a sense of movement and fluidity.
- ➡ The dissolved transport in waters is very important since this is highly associated with more available forms of pollutants of greater environmental concern.
  - ➡ In addition, by this way pollutants can more easily reach other sites or environmental compartments way from the source.
  - ➡ Primarily, this involves leaching processes, i.e., a process by which pollutants are released from solid phase into the aqueous phase under the influence of dissolution and desorption of pollutants from their support-phases.

# S5-SLO1- Causes of Water pollution

- ➡ Urbanization
- ➡ Deforestation
- ➡ Destruction of Wetland
- ➡ Dumping of waste
- ➡ Mining's
- ➡ Global warming
- ➡ Acid rain
- ➡ Oil pollution

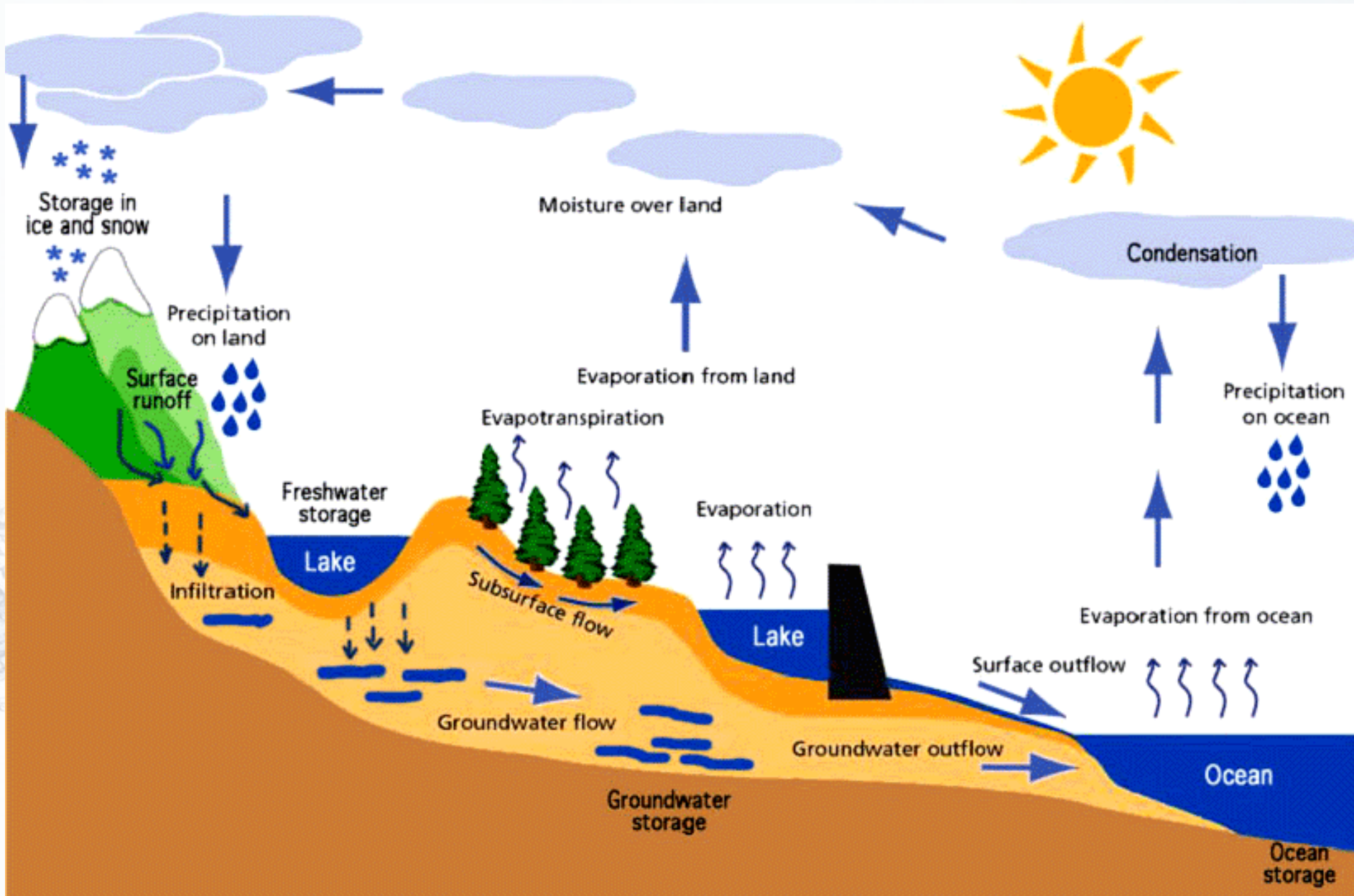


# S5-SLO2- Hydrology cycle





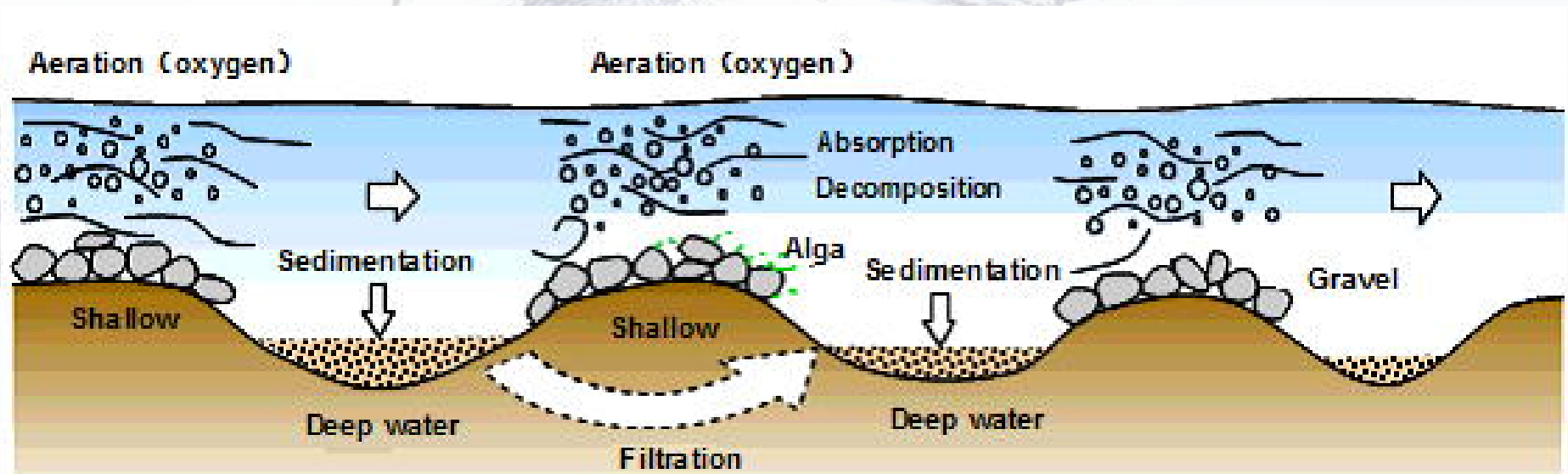
# S5-SLO2- Hydrology cycle



# S5-SLO2- Hydraulic flow of water pollution

Transport  
Sediment transport  
Advection  
Dispersion  
Filtration  
Hydrolysis  
Photodecomposition

Dilution  
Sedimentation  
Diffusion  
Leaching  
Adsorption  
Biodegradation

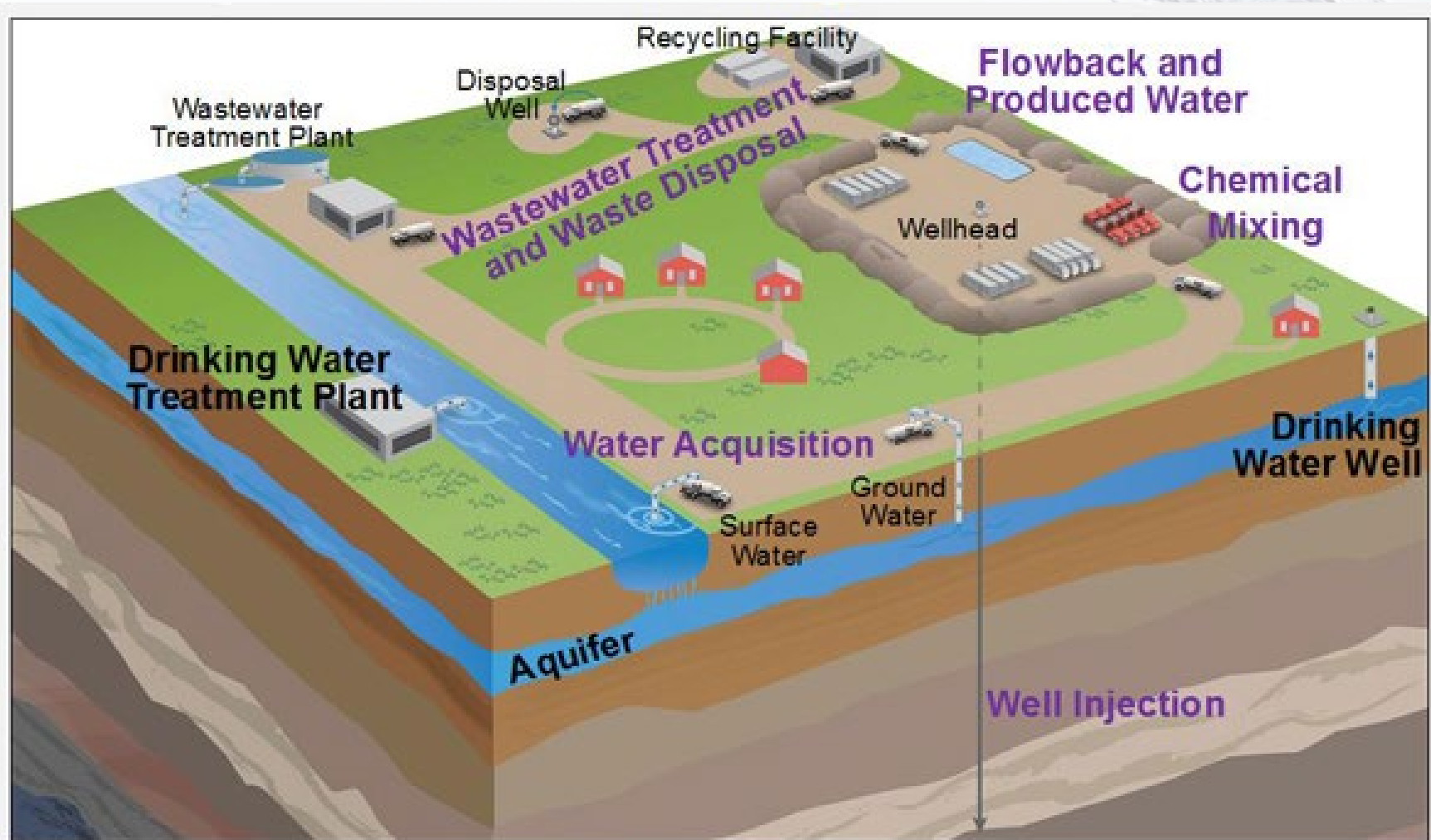


Source : <http://ngojwg.org/study3-2-e.html>

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# S5-SLO2- Hydraulic flow of water pollution



## WATER CYCLE STAGES

Water Acquisition ! Chemical Mixing ! Well Injection !  
Flowback and Produced Water ! Wastewater Treatment and Waste Disposal



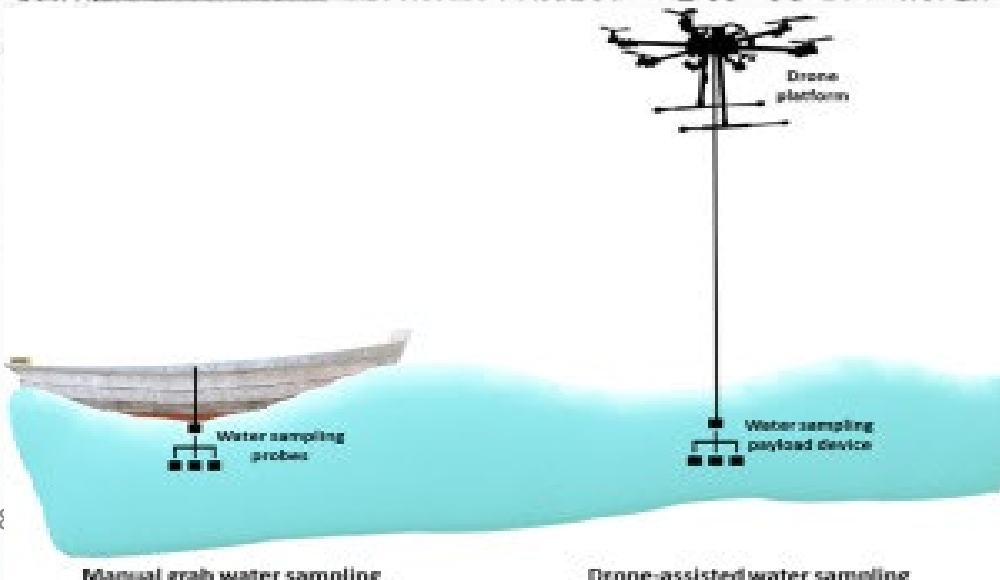
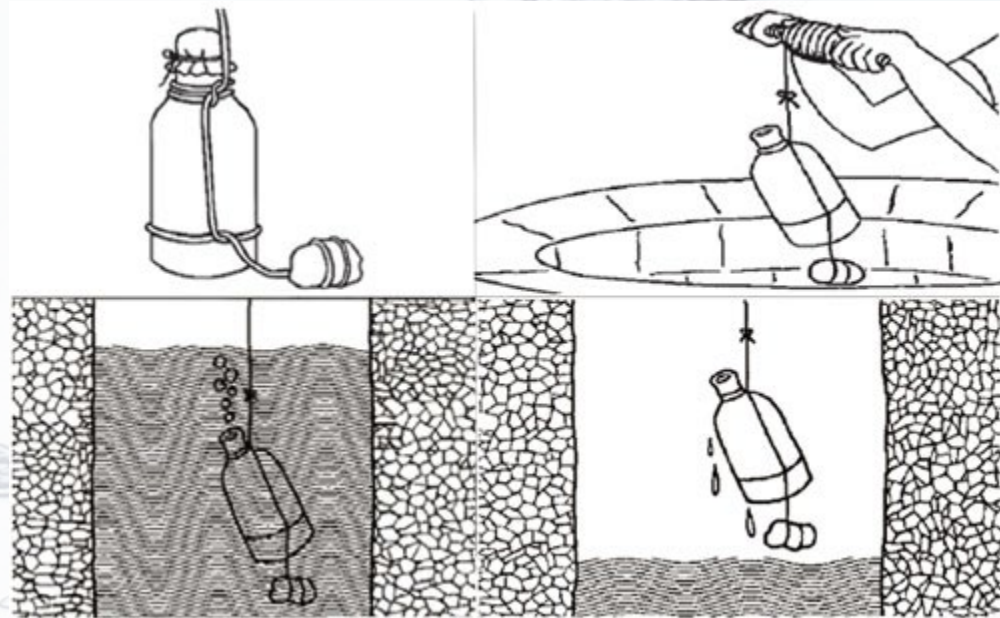
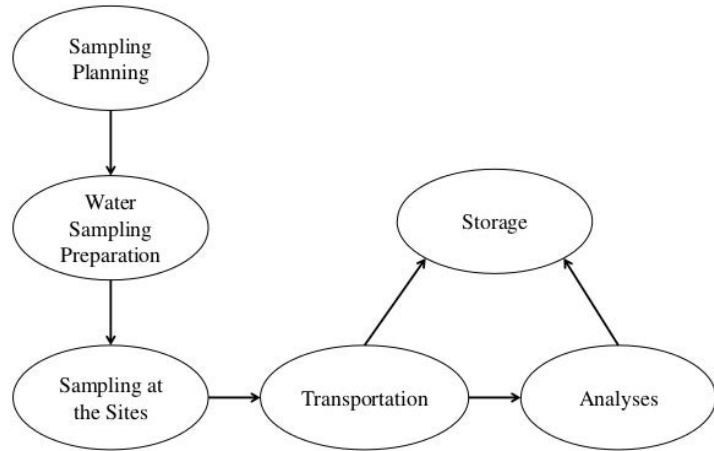
# S6-SLO1- Water sampling

## ➡Sampling:

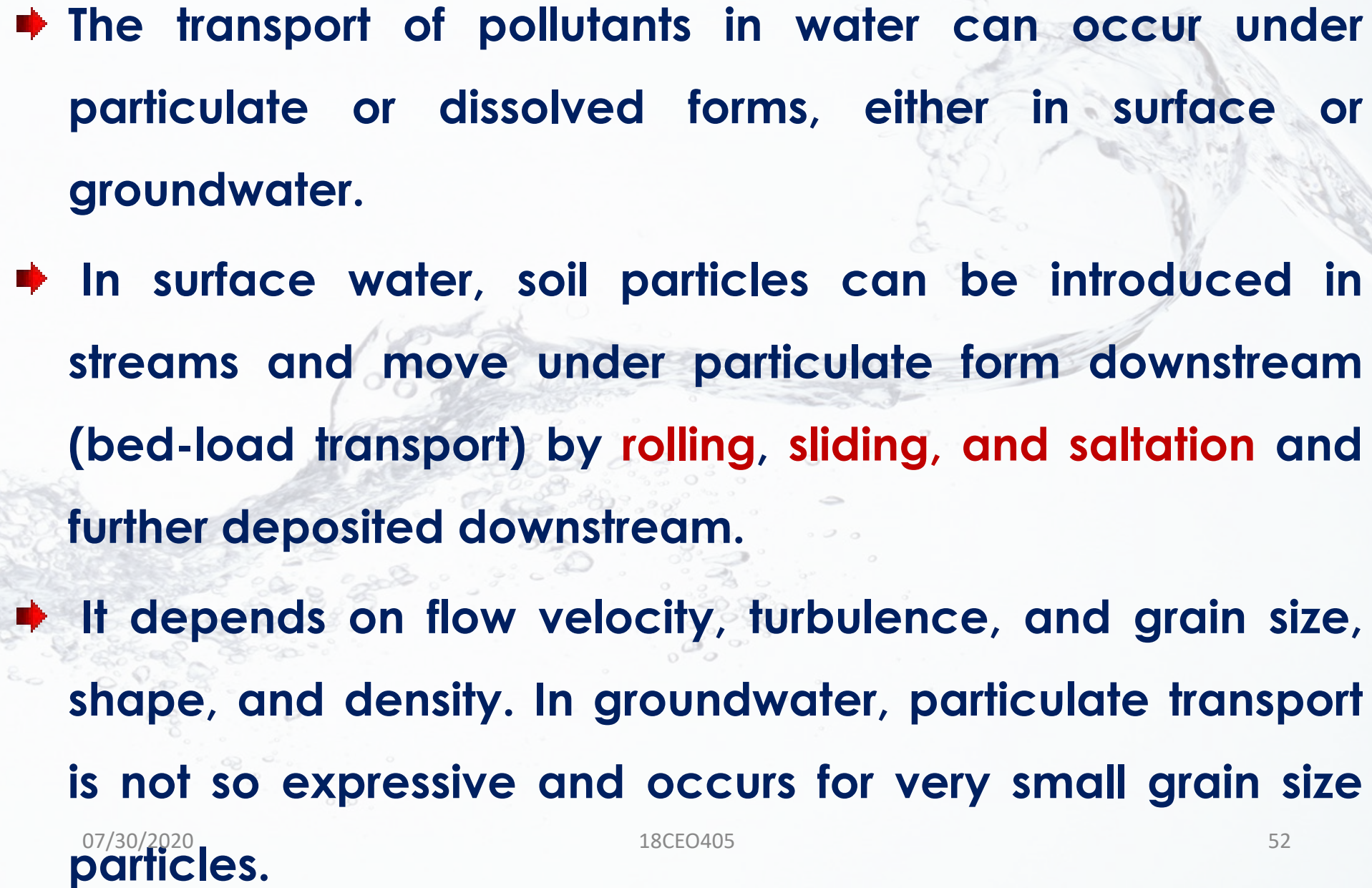
- ➡The process of collecting a representative portion of water, as from the natural environment or from an industrial site, for the purpose of analyzing it for constituents.
- ➡The process of taking a portion of water for analysis or other testing
- ➡E.g drinking water to check that it complies or river water to check for pollutants, or bathing water to check that it is safe.

# S6-SLO1- Sampling procedure

Sampling Flow Chart



# S4-SLO2- Transport of pollutants

- 
- A background image showing a dynamic splash of water with bubbles and droplets, creating a sense of movement and fluidity.
- ➡ The transport of pollutants in water can occur under particulate or dissolved forms, either in surface or groundwater.
  - ➡ In surface water, soil particles can be introduced in streams and move under particulate form downstream (bed-load transport) by **rolling, sliding, and saltation** and further deposited downstream.
  - ➡ It depends on flow velocity, turbulence, and grain size, shape, and density. In groundwater, particulate transport is not so expressive and occurs for very small grain size particles.



# S6-SLO1- Sampling procedure

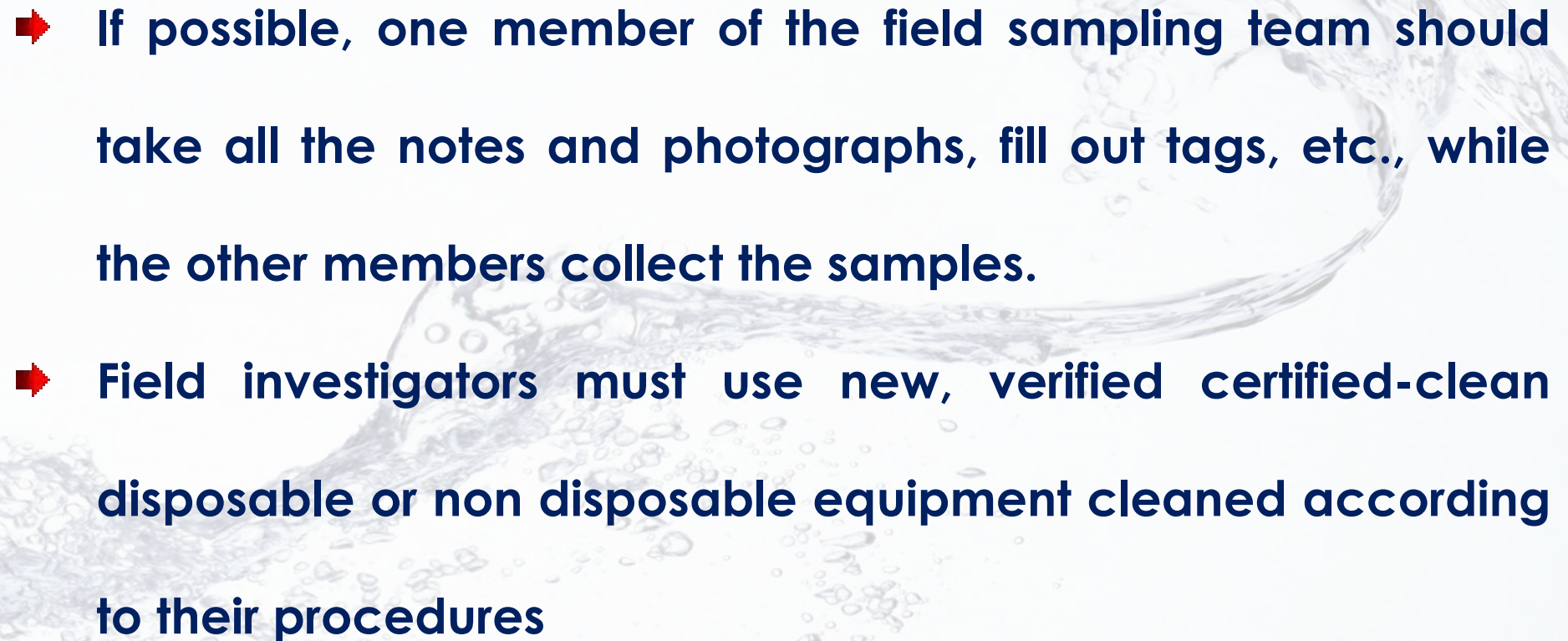
## ➡ Sampling:

- ➡ Objective of sampling is to collect a portion of material small enough in volume to be transported comfortably and yet large enough for analytical purposes while still representing the material being sampled.
- ➡ A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.

# S6-SLO1- Sampling procedure

- ➡ Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately.
- ➡ Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area.
- ➡ Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background/control samples.

# S6-SLO1- Sampling procedure

- 
- A dynamic splash of water, likely from a faucet, creating a circular shape with many bubbles and droplets, set against a light blue background.
- ➡ If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
  - ➡ Field investigators must use new, verified certified-clean disposable or non disposable equipment cleaned according to their procedures



# S6-SLO2- Methods of Sampling and Storage

## ➡Types of Sampling:

- ➡ Dip or Grab sampling
- ➡ Composite sampling
- ➡ Integrated sampling

### Grab Sampling:

- Provides a snapshot of water quality at the time the sample was taken



### Continuous Sampling:

- Provides a clearer picture of water quality over time



Government of Newfoundland and Labrador

➡Dip or Grab sampling : Water samples are usually obtained by filling a container held beneath the surface of the water. A sample taken at a specific time and point which gives an indication of the water quality at that point in time.

➡A properly taken grab sample is a snap shot of the quality of the water at the exact time and place the sample was taken. Depending on the water body, grab samples may be taken by simply dipping a sample bottle in the water body, or they may require the use of specific sampling devices.

## Discrete Grab Samples

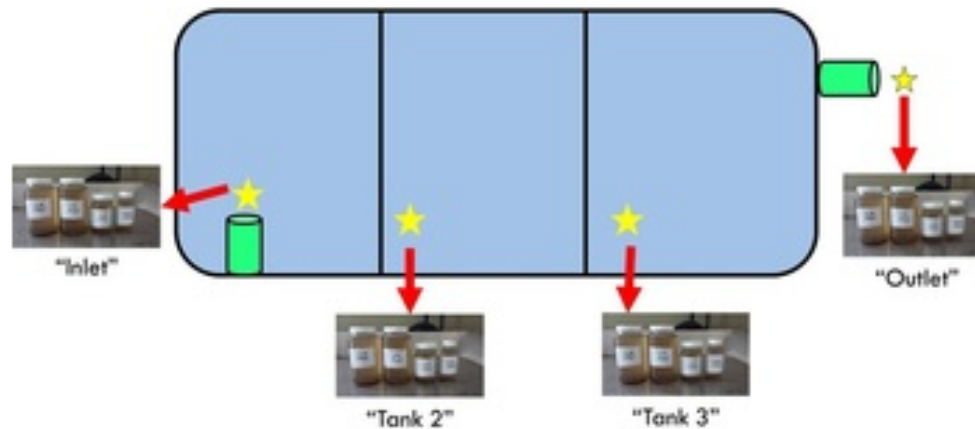


Figure 1: Discrete samples are taken from the inlet pipe, at the overflow points of two cells of a settling tank, and at the outlet pipe.

## Composite Samples – Same location, different times

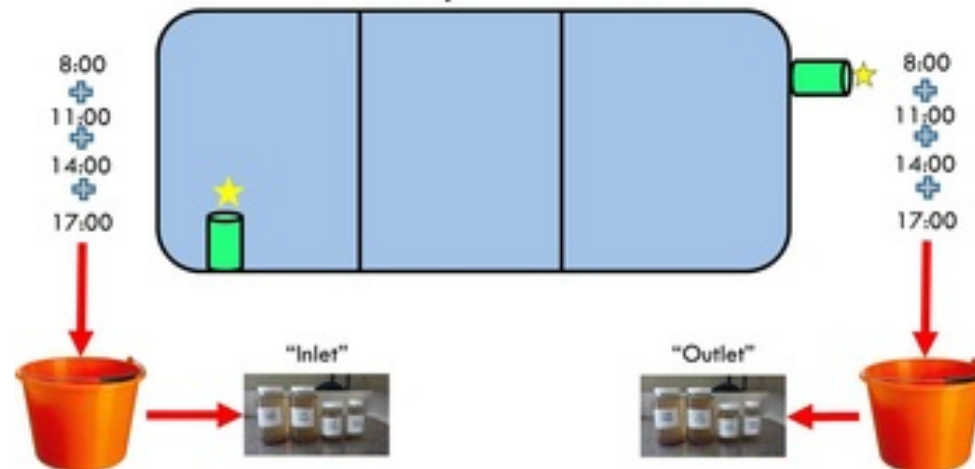


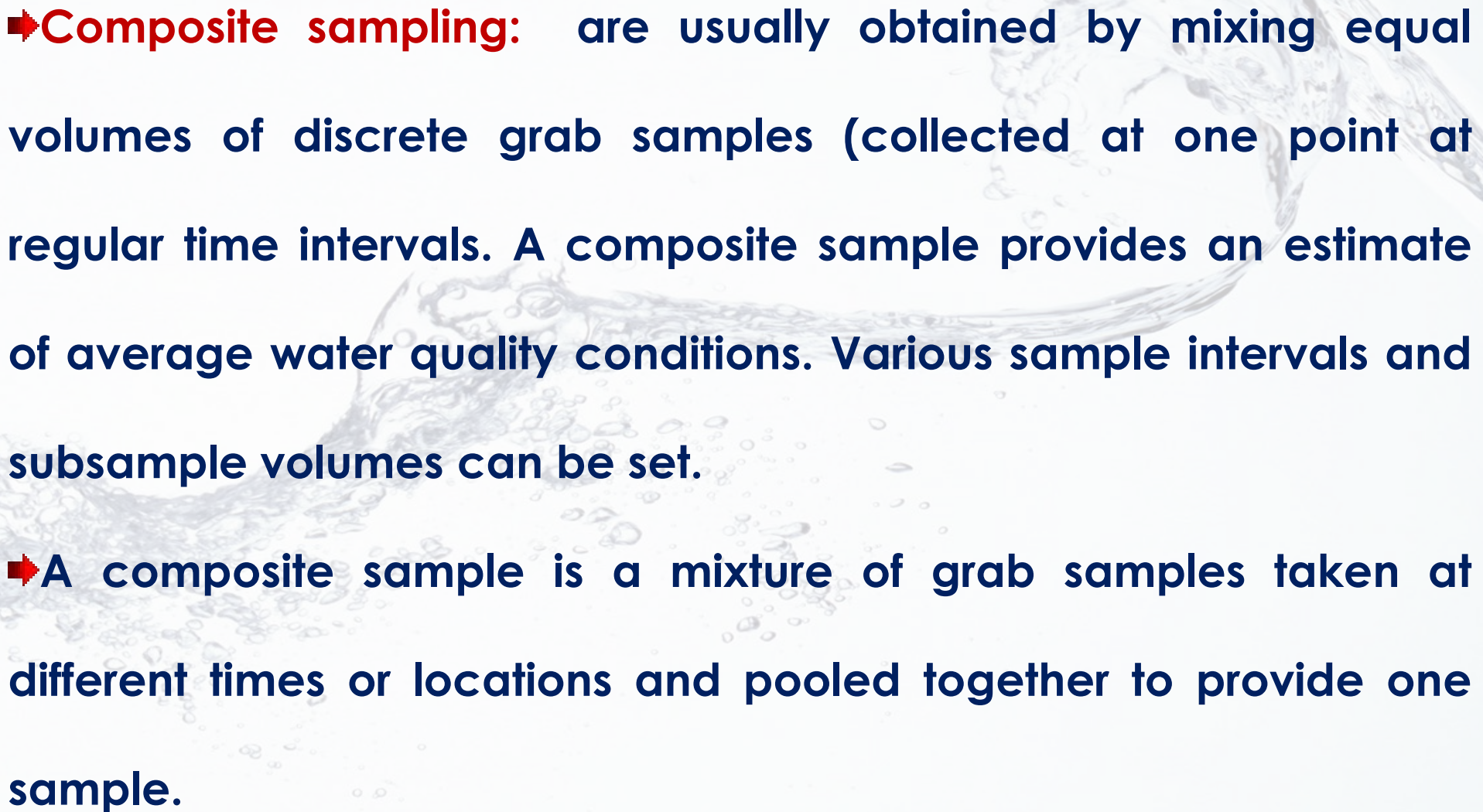
Figure 2: A composite sample is taken from the inlet and outlet pipe in a settling tank; samples are taken at several times and grouped together in one bottle submitted to the laboratory.

# S6-SLO2- Methods of Sampling and Storage

- ➡ The discrete grab sample is one that is taken at a selected location, depth, and time and then analyzed for the constituents of interest.
- ➡ A Depth-Integrated Grab Sample is collected over a predetermined part or the entire depth of the water column, at a selected location and time, in a given body of water, and then analyzed for the constituents of interest.
- ➡ The primary advantage of grab samples is that sometimes very little equipment is required for sample collection and there is flexibility in sampling location selection. However, this method sacrifices data resolution because of the smaller number of samples that are usually collected



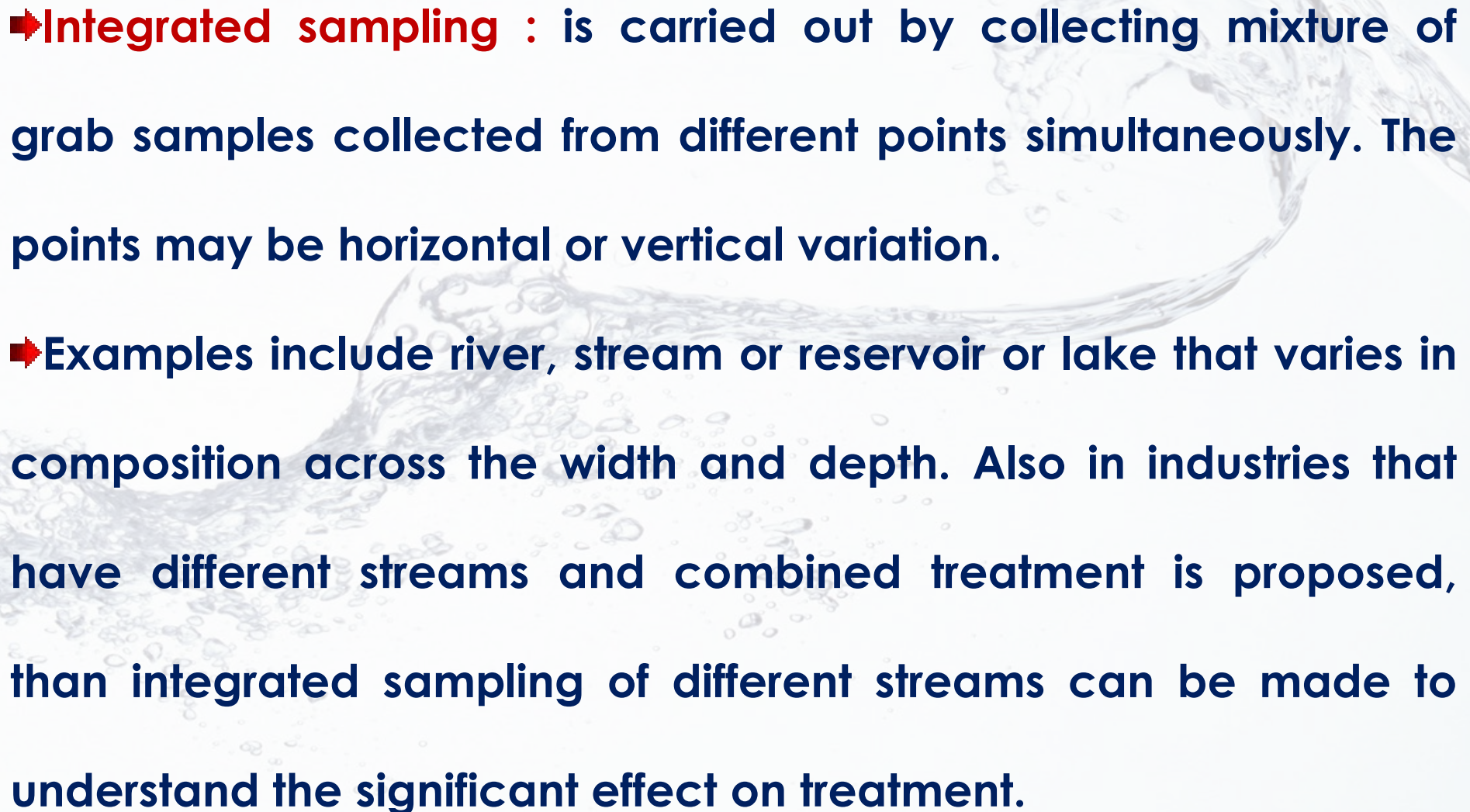
# S6-SLO2- Methods of Sampling and Storage

- 
- A background image of a water splash, showing droplets and bubbles in motion, creating a dynamic and fluid visual effect.
- ➡ **Composite sampling:** are usually obtained by mixing equal volumes of discrete grab samples (collected at one point at regular time intervals. A composite sample provides an estimate of average water quality conditions. Various sample intervals and subsample volumes can be set.
  - ➡ A composite sample is a mixture of grab samples taken at different times or locations and pooled together to provide one sample.

# S6-SLO2- Methods of Sampling and Storage

- ➡ The advantage of composite sampling is that it gives you an idea of the average condition of a water body over time, (samples taken at different times and mixed together) or space, (samples taken at different locations within the water body).
- ➡ This is particularly useful in water bodies that have a lot of **chemical variability** either over space or over short time periods. Composite samples are often used to reduce the cost of analyzing a large number of samples.
- ➡ This method also has its limitations. Individual sample information is lost and you lose the ability to mathematically assess the variability.

# S6-SLO2- Methods of Sampling and Storage

- 
- A background image showing a dynamic splash of water, with droplets and bubbles, creating a sense of movement and freshness. The water is white and frothy against a light blue background.
- ▶ **Integrated sampling** : is carried out by collecting mixture of grab samples collected from different points simultaneously. The points may be horizontal or vertical variation.
  - ▶ Examples include river, stream or reservoir or lake that varies in composition across the width and depth. Also in industries that have different streams and combined treatment is proposed, than integrated sampling of different streams can be made to understand the significant effect on treatment.



Parameter	Container	Preservative	Storage time
pH	Polyethylene	None	6 h
Spec. cond.			
Alkalinity			
Acidity			
TIC, TOC			
NH <sub>4</sub> <sup>+</sup>	Polyethylene	Cool, 4 °C	24 h except 7 days for major ions
NO <sub>3</sub> <sup>-</sup> , NO <sub>2</sub> <sup>-</sup>			
TKN <sup>a</sup>			
Major ions			
Phosphorus	Glass	Filter 0.45 μm	24 h on site
dissolved			
inorganic	Glass	cool, 4 °C	24 h
ortho			
total <sup>a</sup>	Polyethylene	2 ml conc. HNO <sub>3</sub> l <sup>-1</sup> sample	6 months
Heavy metals			

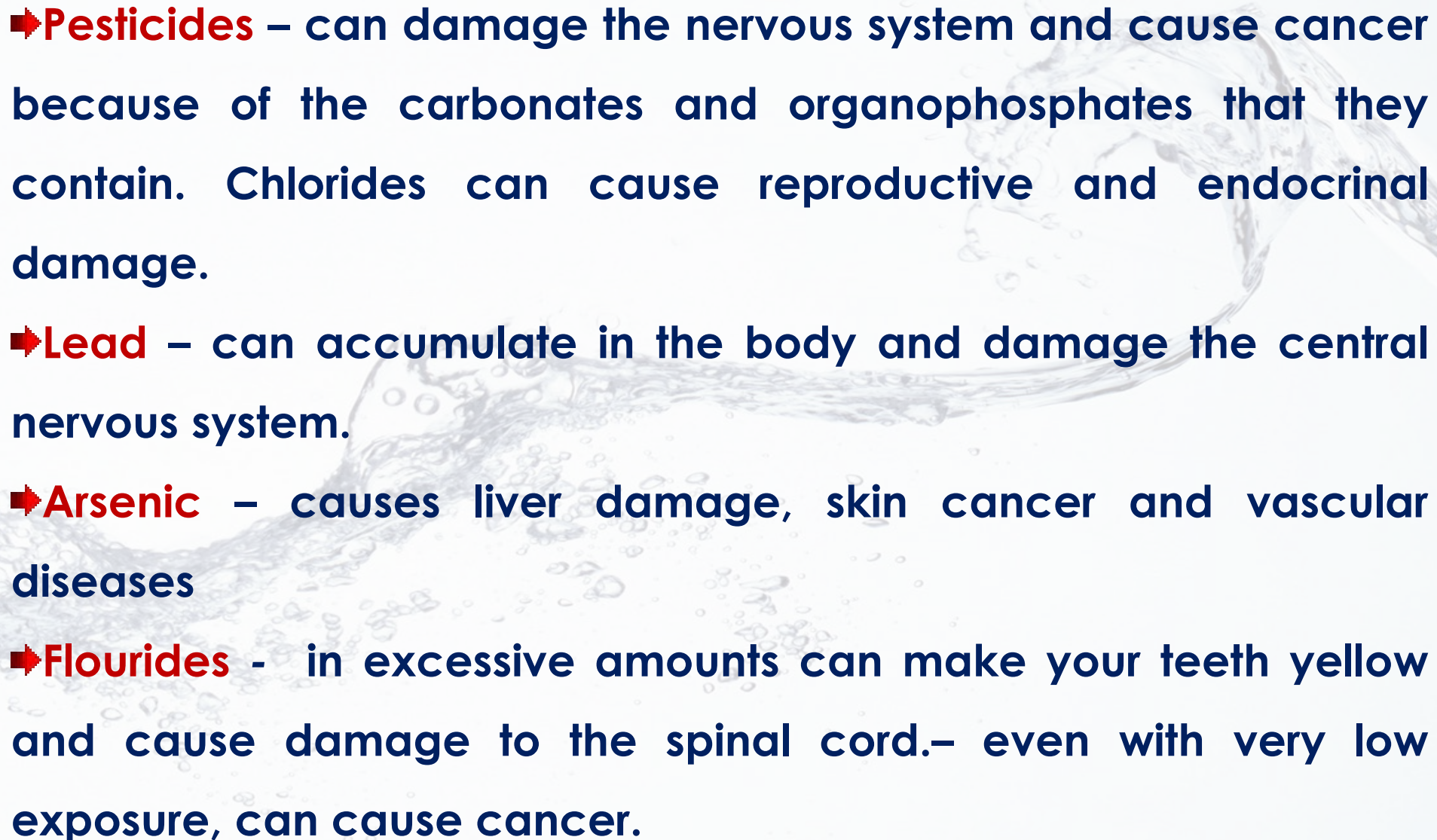
# S7-SLO1- Effects of water pollution

➡ Water-borne diseases account for the deaths of 3,575,000 people a year! That's equivalent to a jumbo jet crashing every hour, and the majority of these are children.

➡ Infectious diseases can be spread through contaminated water. Some of these water-borne diseases are *Typhoid, Cholera, Paratyphoid Fever, Dysentery, Jaundice, Amoebiasis and Malaria.*

➡ Chemicals in the water also have negative effects on our health.

# S7-SLO1- Effects of water pollution

- 
- A decorative background image showing a dynamic splash of water with bubbles and droplets, rendered in a light blue and white color scheme.
- ➡ **Pesticides** – can damage the nervous system and cause cancer because of the carbonates and organophosphates that they contain. Chlorides can cause reproductive and endocrinal damage.
  - ➡ **Lead** – can accumulate in the body and damage the central nervous system.
  - ➡ **Arsenic** – causes liver damage, skin cancer and vascular diseases
  - ➡ **Flourides** - in excessive amounts can make your teeth yellow and cause damage to the spinal cord.– even with very low exposure, can cause cancer.

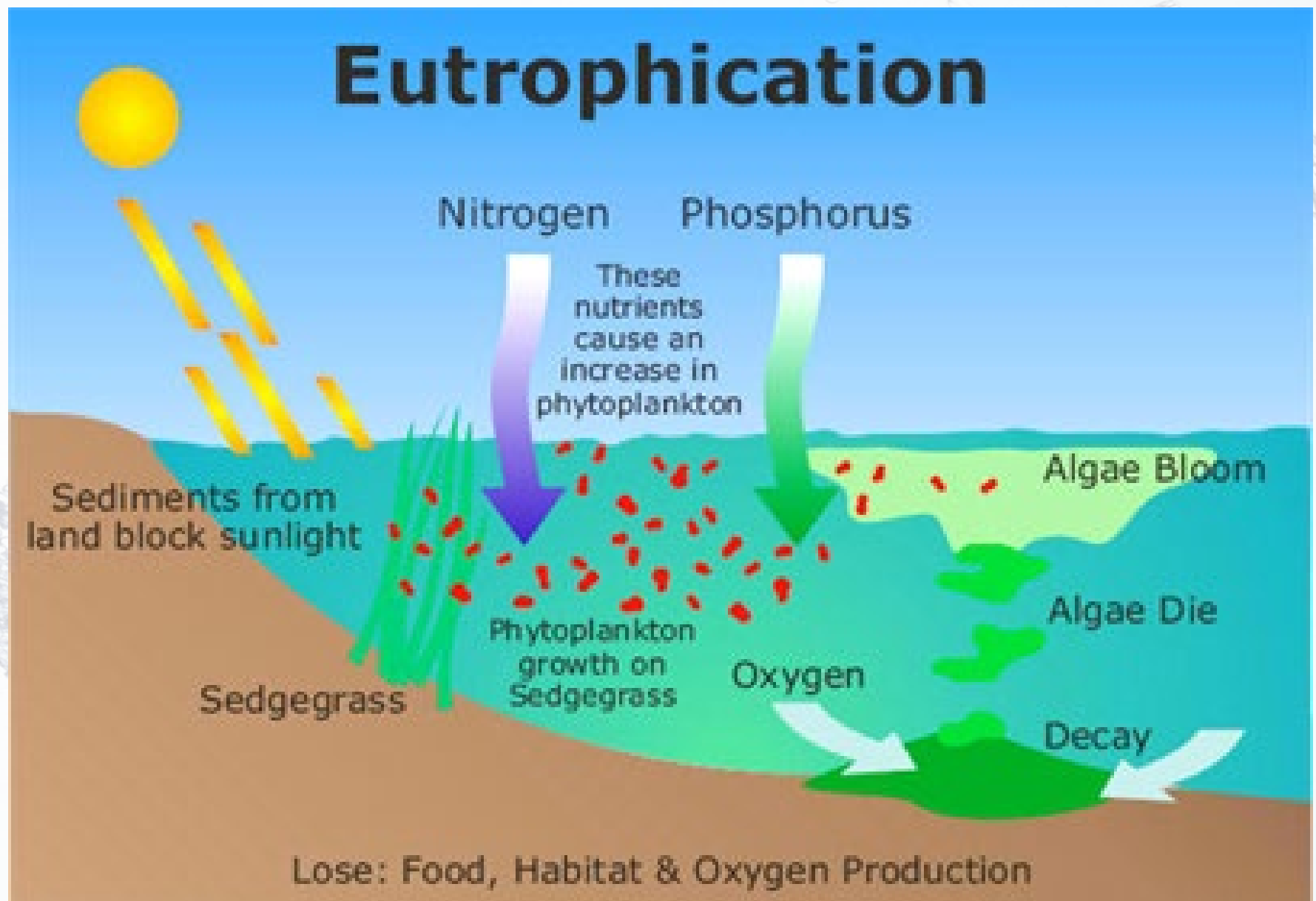


# S7-SLO2- Eutrophication

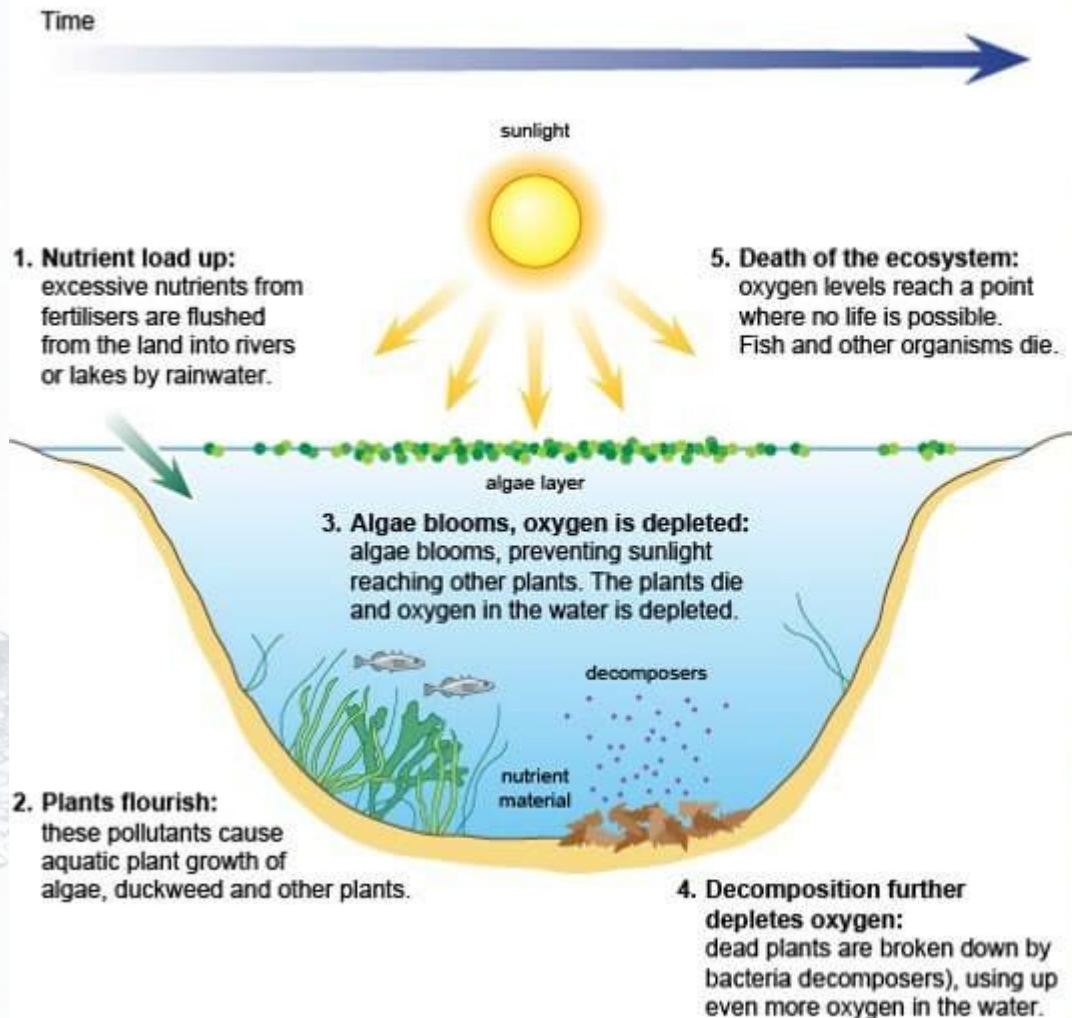
➡ Eutrophication can happen naturally in the normal succession of some freshwater ecosystems. However, when the nutrient enrichment is due to the activities of humans, sometimes referred to as “cultural eutrophication”, the rate of this natural process is greatly intensified.

➡ Two major nutrients, nitrogen (N) and phosphorus (P), occur in streams in various forms as ions or dissolved in solution. Aquatic plants convert dissolved inorganic forms of nitrogen (nitrate, nitrite, and ammonium) and phosphorus (orthophosphate) into organic or particulate forms for use in higher trophic production.

# S7-SLO2- Eutrophication

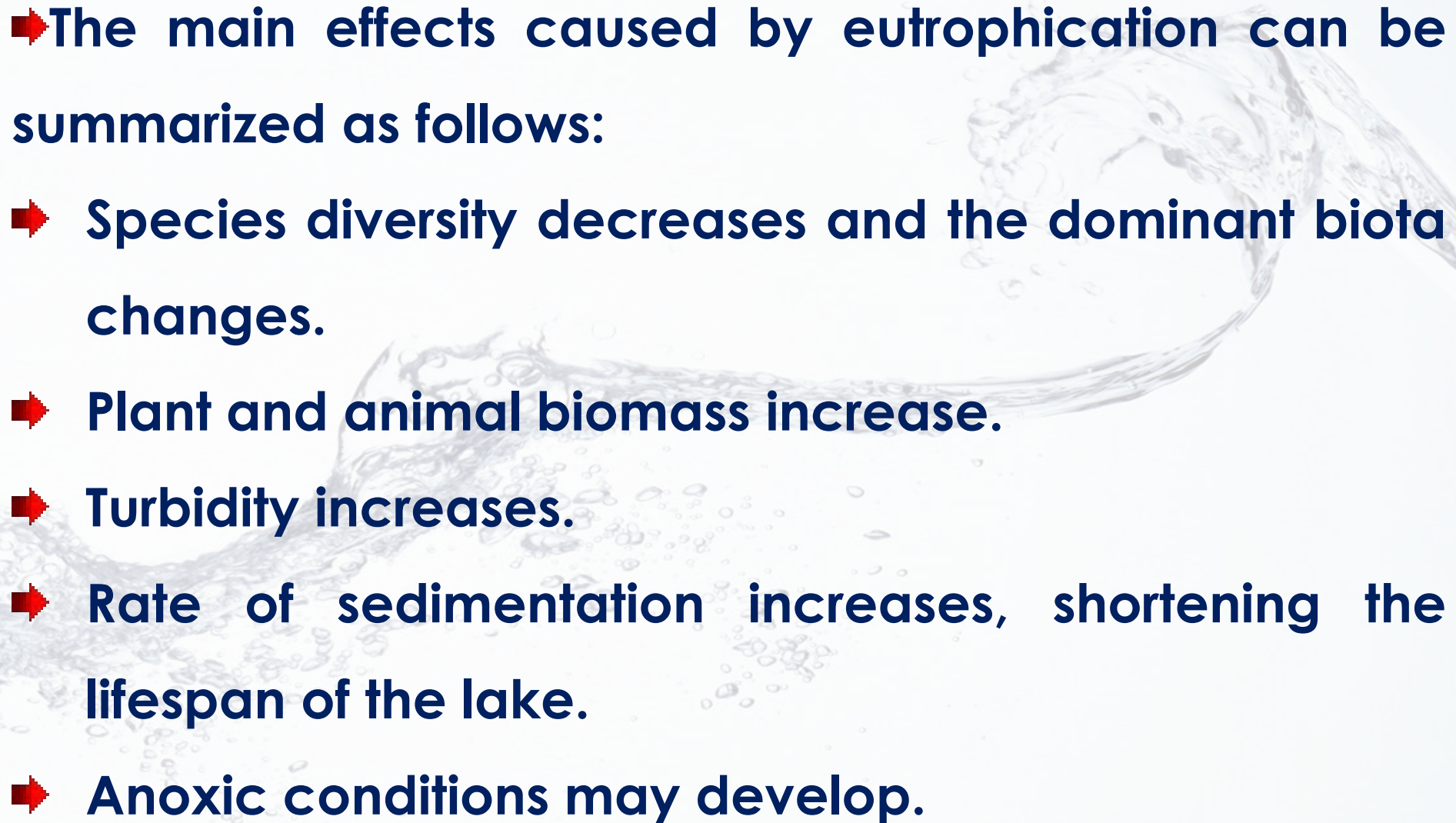


# S7-SLO2- Eutrophication

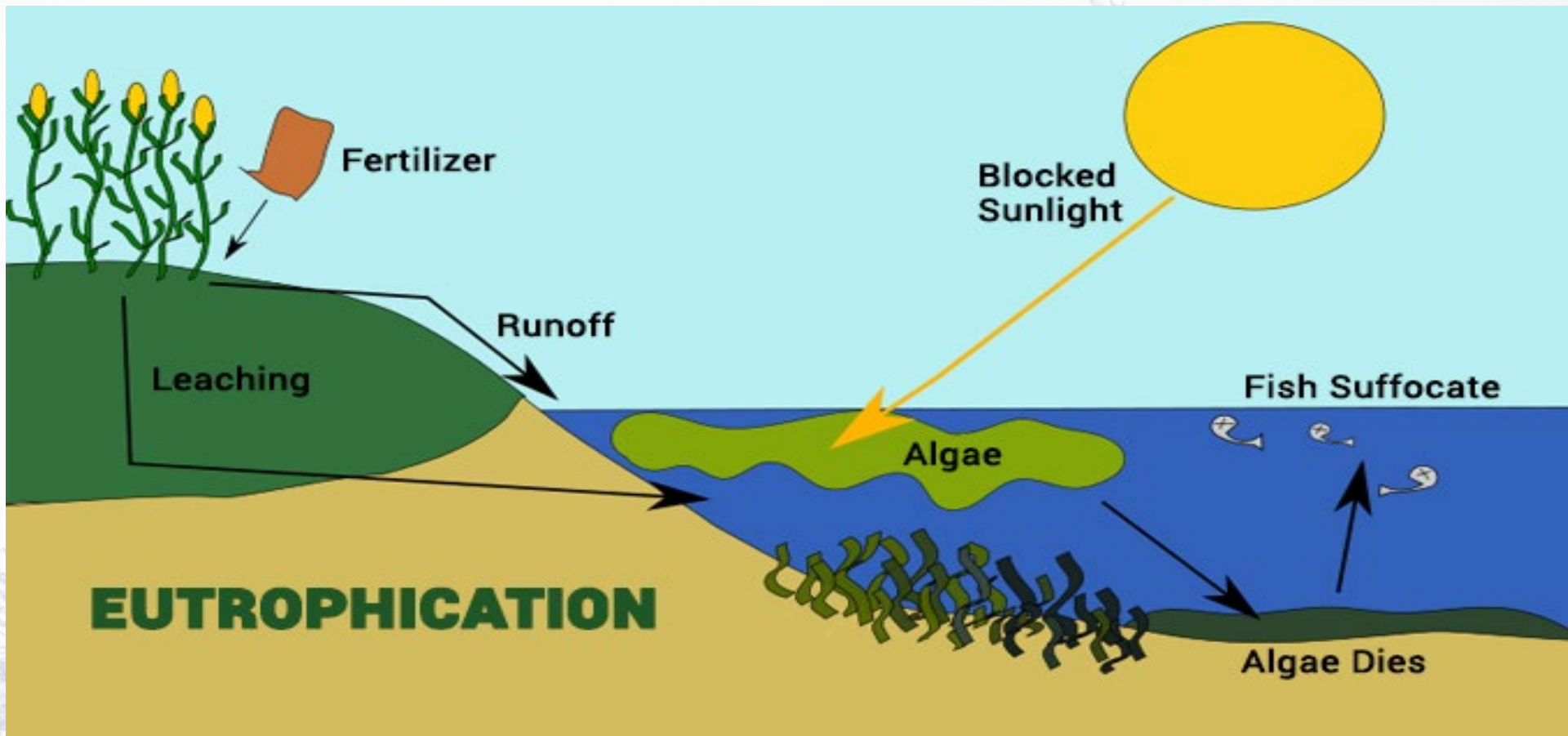




# S7-SLO2- Eutrophication

- 
- A decorative background image showing a dynamic splash of water with bubbles and droplets, rendered in a light blue and white color scheme.
- ➡ The main effects caused by eutrophication can be summarized as follows:
  - ➡ Species diversity decreases and the dominant biota changes.
  - ➡ Plant and animal biomass increase.
  - ➡ Turbidity increases.
  - ➡ Rate of sedimentation increases, shortening the lifespan of the lake.
  - ➡ Anoxic conditions may develop.

# S7-SLO2- Eutrophication



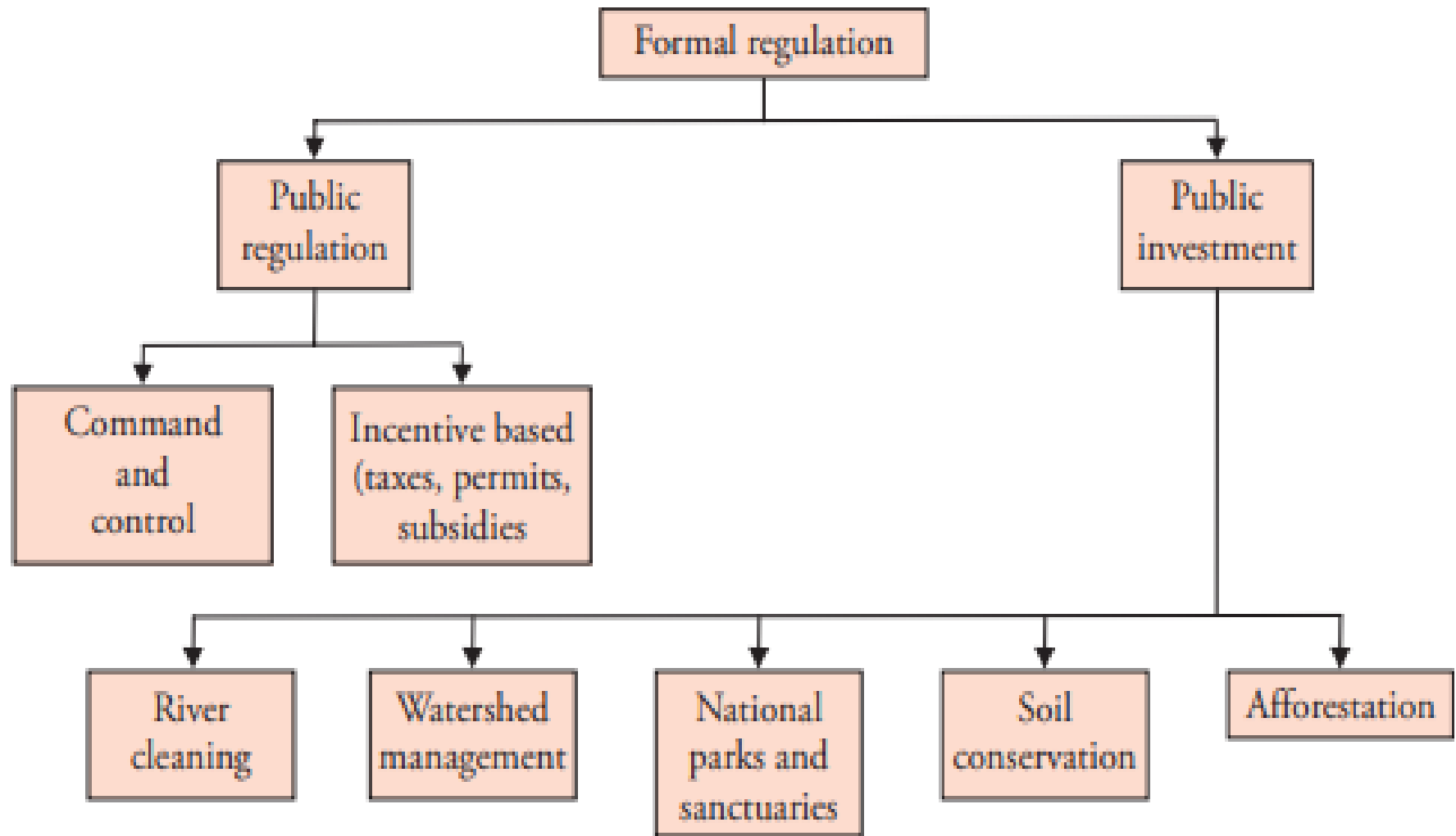
Source : <http://quizlet.com/291485834/eutrophication-diagram/>

# **S8-SLO1- Public awareness and participation in water pollution**

- 
- ➡ **Water conservation**
  - ➡ **Hygienic water use**
  - ➡ **Preservation of ecosystem**
  - ➡ **Public environmental awareness is one of the most important indicators for displaying national civilization.**
  - ➡ **It reflects many aspects of environmental status, such as peoples knowledge, personal consideration and behaviour, public capacity, and the local citizen's attitudes towards a sustainable society as a whole.**



# S8-SLO1- Public awareness and participation in water pollution



**Source :** <http://www.idfc.com/pdf/report/2011/Chp-19-Water-Pollution-in-India-An-Economic-Appraisal.pdf>

# S8-SLO2- Industries and their role in water pollution

- ➡ The wastewater from industries varies so greatly in both flow and pollution strength. So, it is impossible to assign fixed values to their constituents.
- ➡ In general, industrial wastewaters may contain suspended, colloidal and dissolved (mineral and organic) solids.
- ➡ In addition, they may be either excessively acid or alkaline and may contain high or low concentrations of colored matter. These wastes may contain inert, organic or toxic materials and possibly pathogenic bacteria

# S8-SLO2- Industries and their role in water pollution

## Types of Industrial Effluents

- 
- ➡ Tannery
  - ➡ Electric power plants
  - ➡ Iron and steel industry
  - ➡ Distillery
  - ➡ Pharmaceutical
  - ➡ Petroleum refining and petrochemicals.
  - ➡ Paper and pulp industries
  - ➡ Organic chemicals manufacturing.
  - Battery manufacturing.
  - Food industry.
  - Mines and quarries.
  - Nuclear industry
  - Dairy industry





Thank you