

Wastewater Characteristics

**Men work on earth at many things;
Some till the soil, a few are kings;
But the noblest job beneath the sun
Is making Running Water run.**

John L Ford

WASTEWATER CHARACTERISTICS

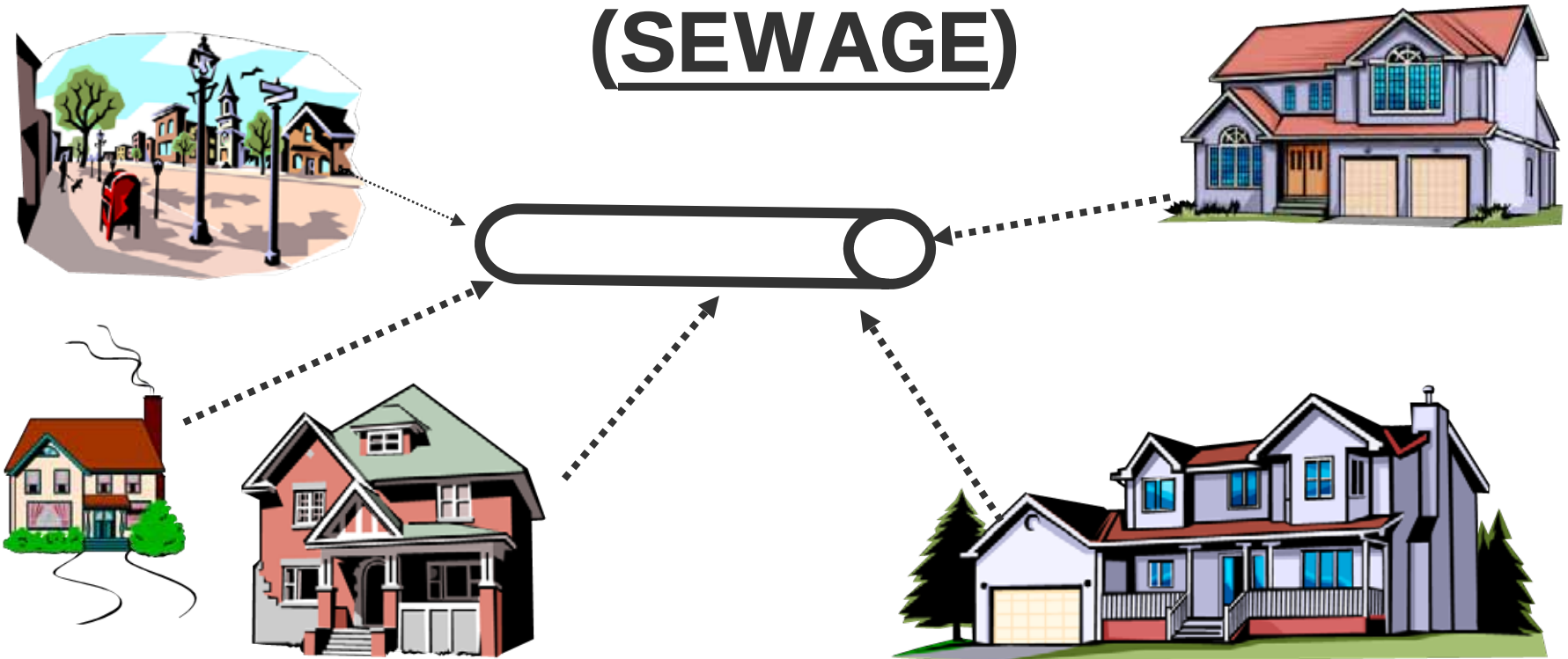


WHAT IS WASTEWATER?

**“THE USED WATER AND
SOLIDS MIXTURE FROM A
HOUSEHOLD,
COMMUNITY, OR
INDUSTRY”**

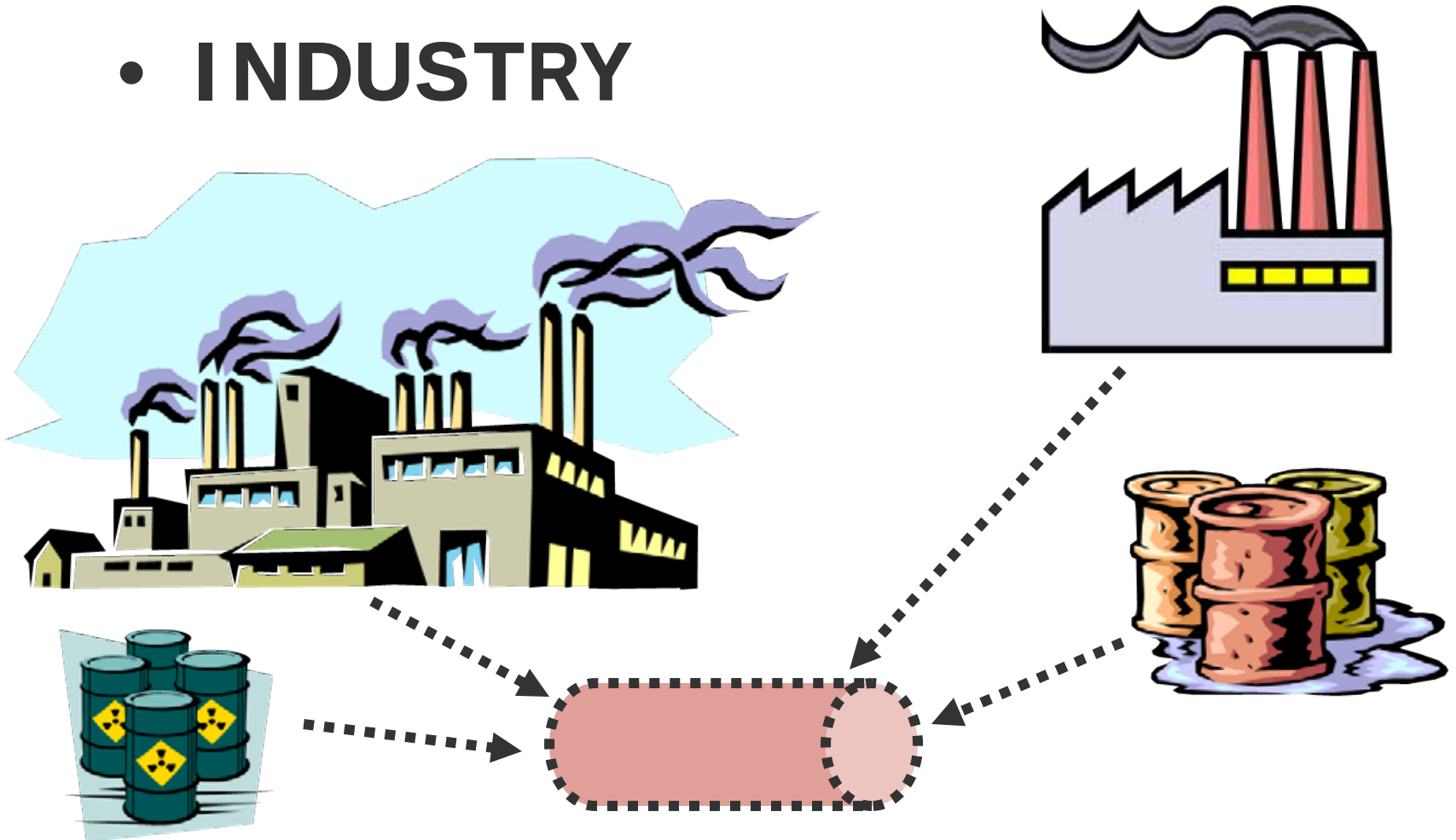
SOURCES OF WASTEWATER

- DOMESTIC WASTEWATER
(SEWAGE)



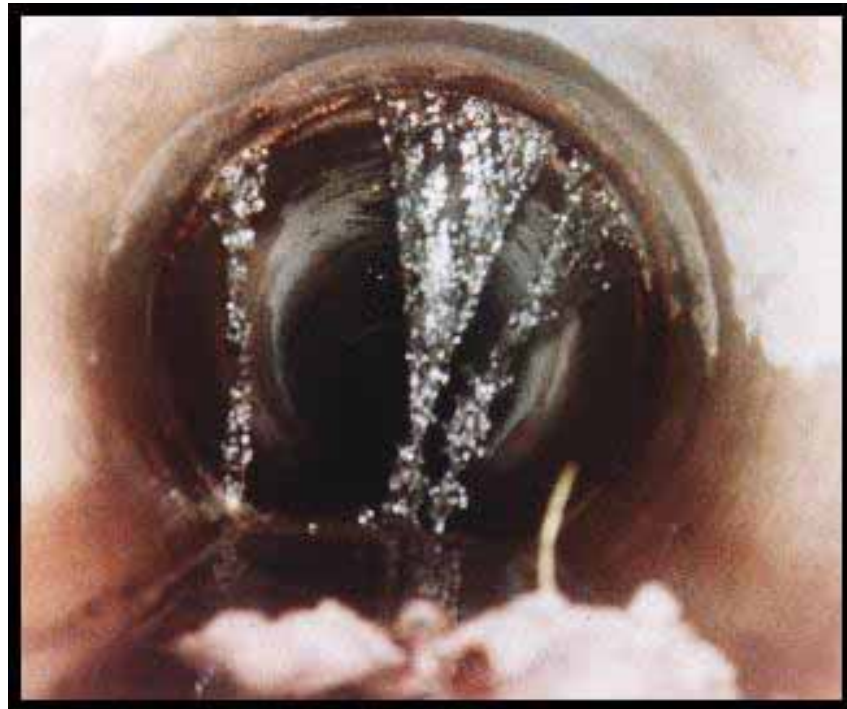
SOURCES OF WASTEWATER

- INDUSTRY



SOURCES OF WASTEWATER

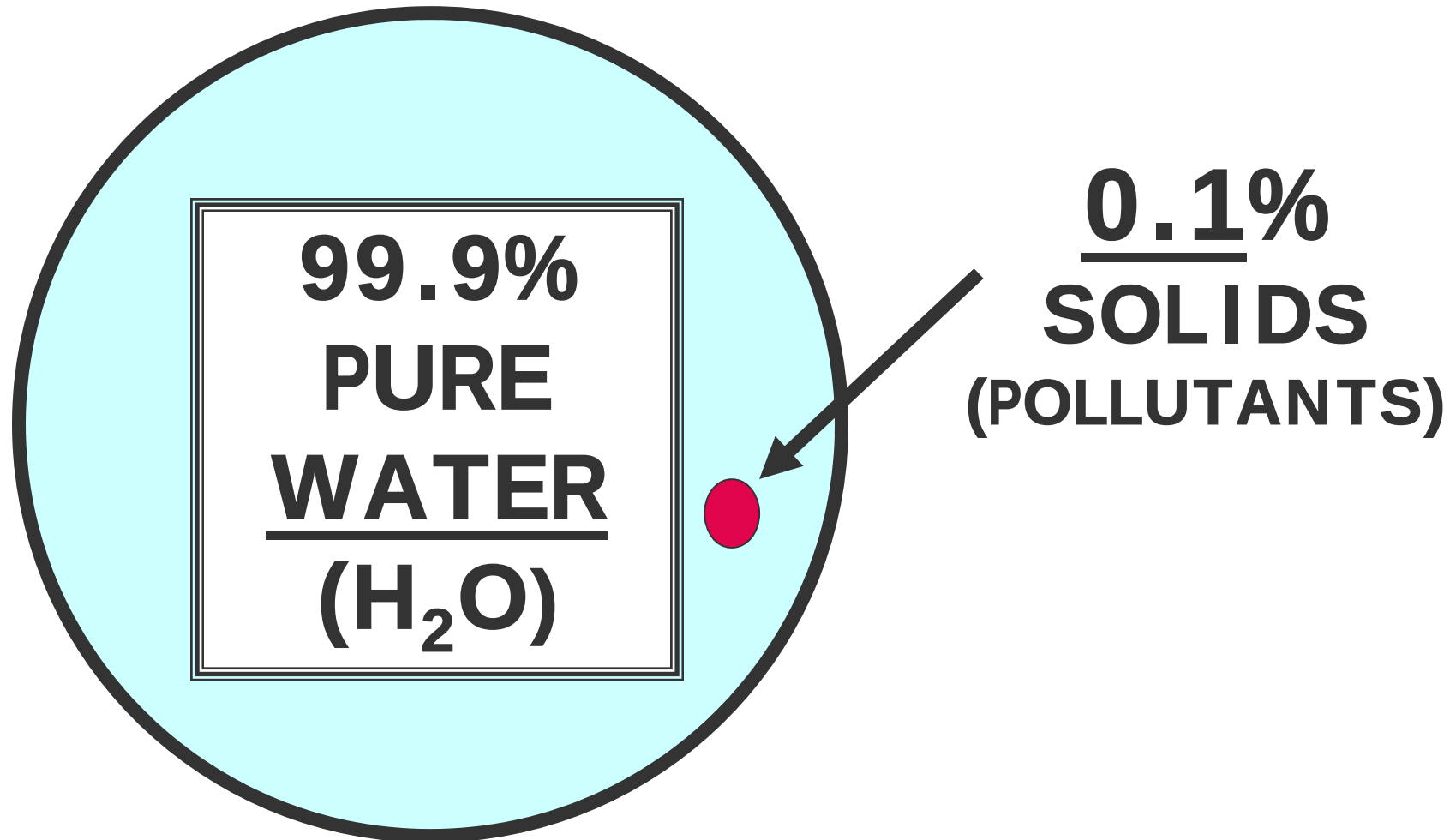
- STORM WATER RUNOFF & INFILTRATION



SOURCES OF WASTEWATER

- **DOMESTIC HOUSEHOLDS**
- **INDUSTRY**
- **STORM WATER RUNOFF &
INFILTRATION**

WHAT'S IN WASTEWATER?



**BEFORE WE CAN EXAMINE THE
CONTAMINANTS IN
WASTEWATER, WE MUST
UNDERSTAND THE TERM “UNITS”**

UNITS: ***“A SPECIFIED AMOUNT
FOR A GIVEN VOLUME,
LENGTH, OR TIME***

<u>TERM</u>	<u>UNITS</u>
MILEAGE	<u>MILES</u> PER GALLON
SALARY	<u>DOLLARS</u> PER HOUR
VELOCITY	<u>MILES</u> / HOUR

WHAT “UNITS” ARE USED IN WASTEWATER MEASUREMENTS?

- THE BRITISH (or ENGLISH) SYSTEM
(FEET, GALLONS, POUNDS)**

- THE SYSTEM INTERNATIONAL (SI) or
METRIC SYSTEM
(METERS, LITERS, GRAMS)**

UNITS

CHEMICAL “INGREDIENTS”:

WEIGHT *per* VOLUME

such as milligrams per liter
(abbreviated as mg/L)

EXAMPLE: The dissolved oxygen content of the wastewater was 5 mg/L (meaning there was five (5) milligrams of oxygen for each liter of wastewater)

UNITS

BIOLOGICAL “INGREDIENTS”:

NUMBER *per* VOLUME

**such as Colony Forming Units per
milliliter (abbreviated as cfu/mL)**

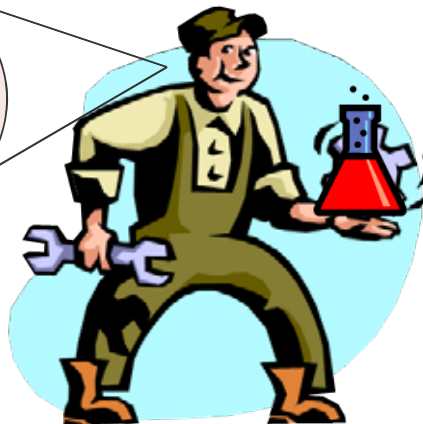
**EXAMPLE: The bacteria
concentration in the wastewater was
25 cfu/ 100 mL (meaning there were
twenty five (25) colonies of bacteria
in each 100 milliliters of wastewater)**

MILLIGRAMS PER LITER or PARTS PER MILLION ???

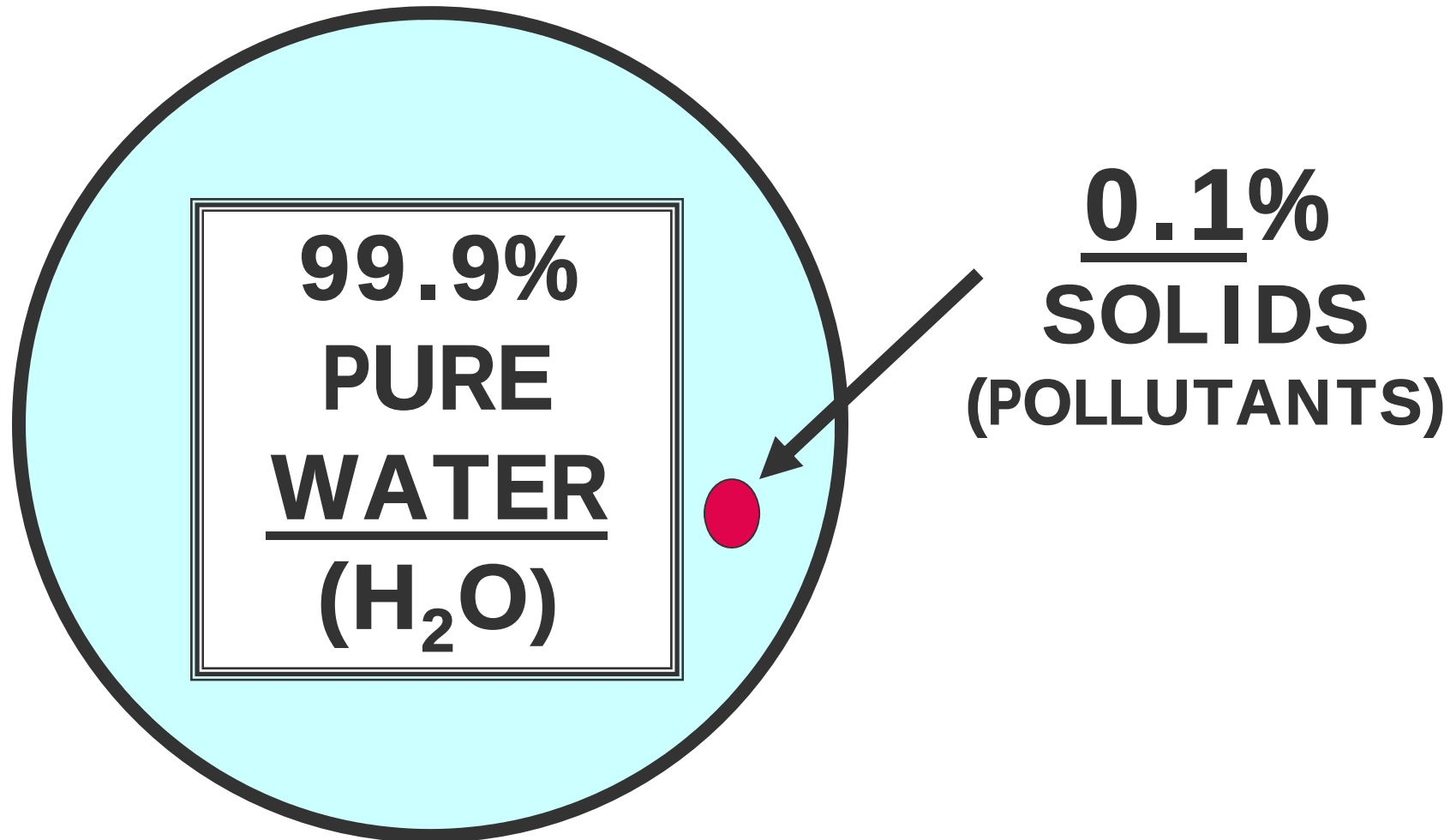
ONE LITER OF WATER WEIGHS 1000 GRAMS
(or ONE MILLION MILLIGRAMS).

THEREFORE, ONE MILLIGRAM OF A
CONTAMINANT, IN ONE LITER OF WATER
WOULD “ONE PART PER MILLION” (*ppm*).

“OH, it’s got
about 10 parts
of chlorine”



WHAT'S IN WASTEWATER?



$$0.1\% = ? \text{ ppm}$$

$$100\% = \underline{1,000,000} \text{ ppm}$$

$$10\% = \underline{100,000} \text{ ppm}$$

$$1\% = \underline{10,000} \text{ ppm}$$

$$0.1\% = 1,000 \text{ ppm or } \underline{1,000} \text{ mg/L}$$

**1000 mg/L of SOLIDS
MEANS:**

**AN AVERAGE DOMESTIC
WASTEWATER (SEWAGE)
CONTAINS:**

**ONE THOUSAND (1,000)
MILLIGRAMS OF SOLIDS
IN EACH LITER OF
WASTEWATER**

SOLIDS

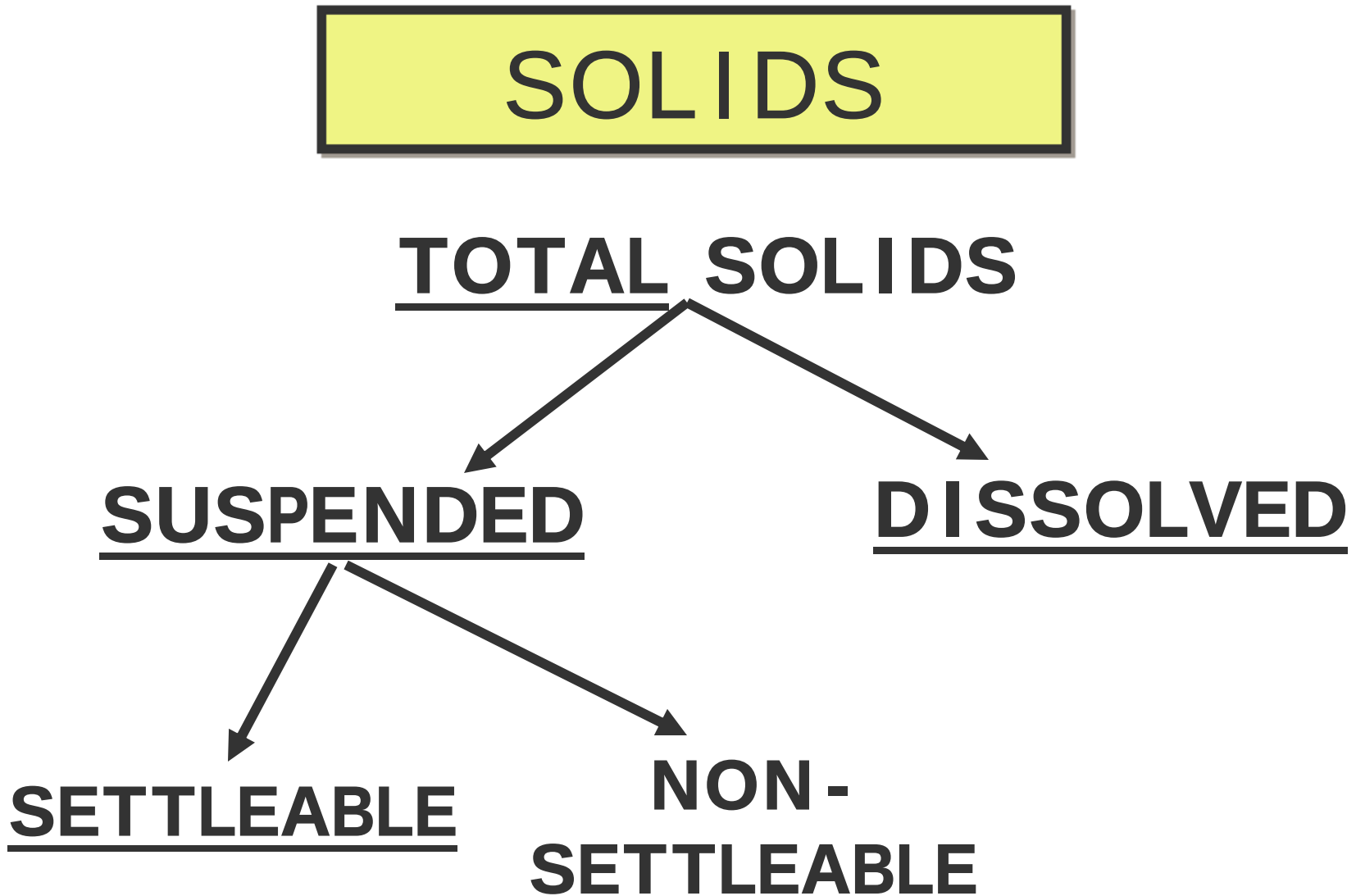
TOTAL SOLIDS

SUSPENDED

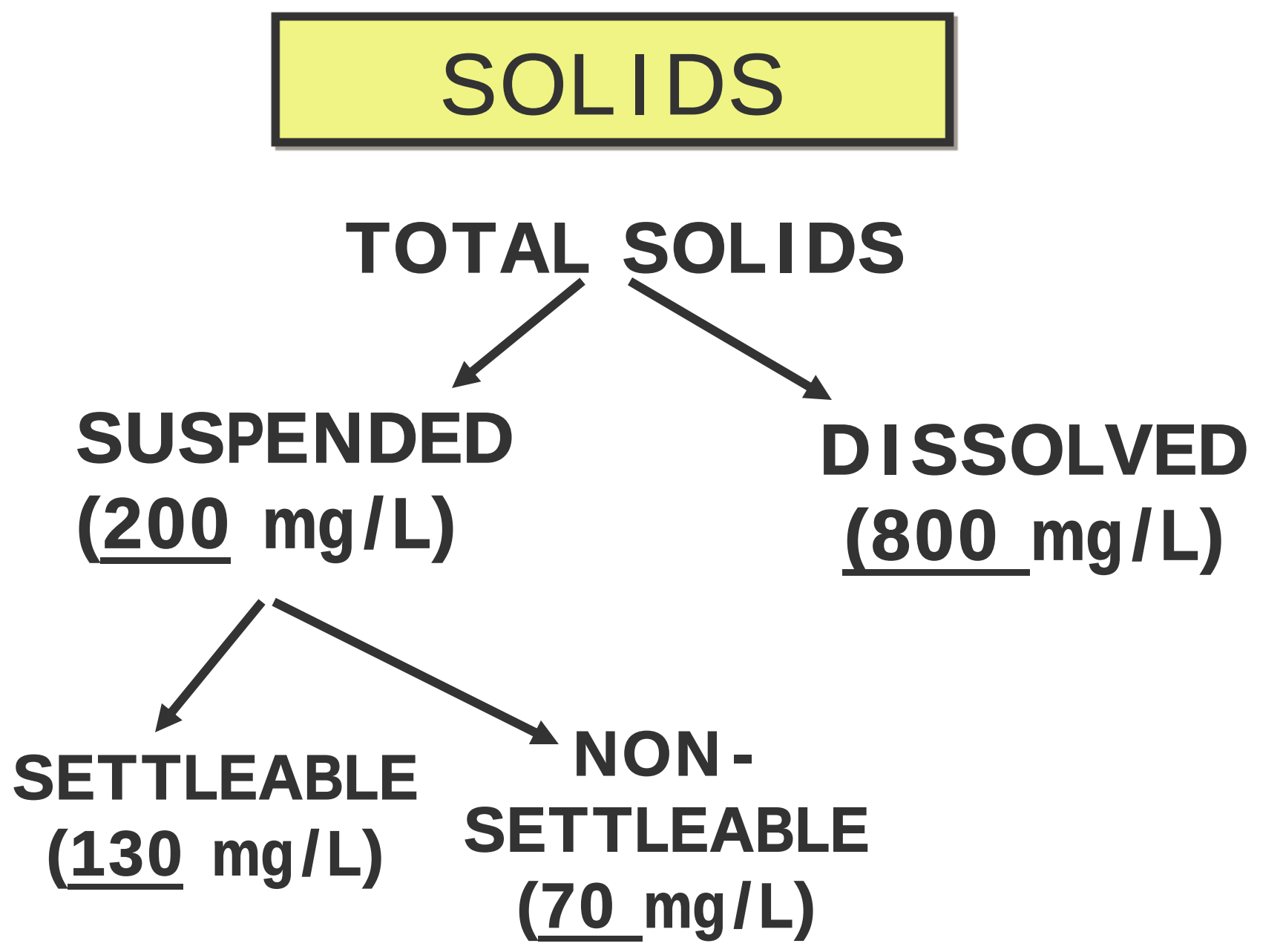
DISSOLVED

SETTLEABLE

NON -
SETTLEABLE



SOLIDS



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graph TD; SOLIDS[SOLIDS] --> TOTAL[TOTAL SOLIDS]; TOTAL --> SUSPENDED[SUSPENDED<br/>(200 mg/L)]; TOTAL --> DISSOLVED[DISSOLVED<br/>(800 mg/L)]; SUSPENDED --> SETTLEABLE[SETTLEABLE<br/>(130 mg/L)]; SUSPENDED --> NONSETTLEABLE[NON-SETTLEABLE<br/>(70 mg/L)];
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A hierarchical flowchart showing the breakdown of solids. At the top is a yellow box labeled 'SOLIDS'. Below it, 'TOTAL SOLIDS' branches into 'SUSPENDED (200 mg/L)' and 'DISSOLVED (800 mg/L)'. 'SUSPENDED' further branches into 'SETTLEABLE (130 mg/L)' and 'NON-SETTLEABLE (70 mg/L)'. The numerical values are underlined.

TOTAL SOLIDS

SUSPENDED
(200 mg/L)

DISSOLVED
(800 mg/L)

SETTLEABLE
(130 mg/L)

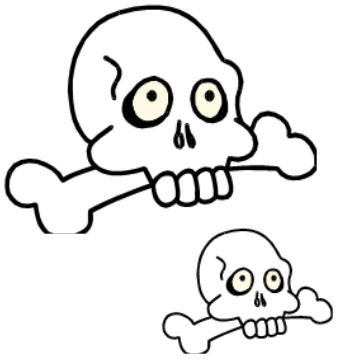
**NON-
SETTLEABLE**
(70 mg/L)

WHY TREAT WASTEWATER?



**UNTREATED
WASTEWATER
WILL CAUSE
OXYGEN
DEPLETION IN
THE RECEIVING
WATER**

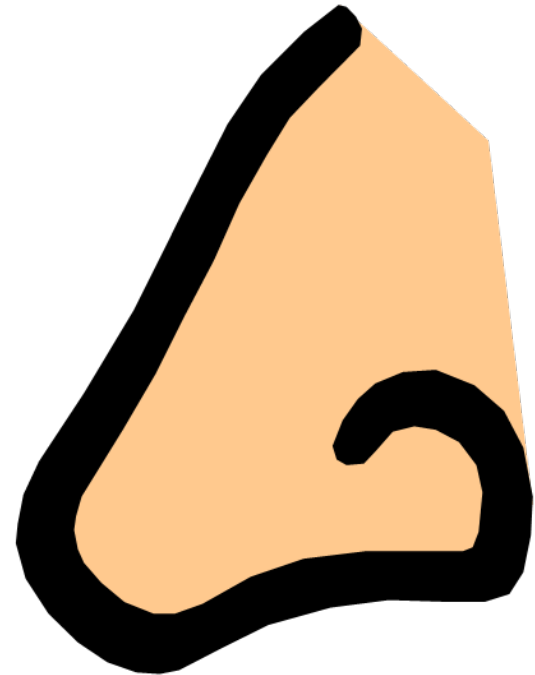
WHY TREAT WASTEWATER?



**WASTEWATER
CONTAINS
PATHOGENS AND
CHEMICALS**

WHY TREAT WASTEWATER?

**WASTEWATER
CAN BE
UNSIGHTLY AND
SMELLY!**



WHY TREAT WASTEWATER?



**BECAUSE OF THE
NUTRIENTS,
WASTEWATER
CONTRIBUTES TO
EUTROPHICATION**

Why Treat Wastewater?

- ⇒ Causes oxygen depletion in receiving stream
- ⇒ Contains pathogens and/or chemicals
- ⇒ Unsightly and smelly
- ⇒ Contributes to eutrophication

EUTROPHICATION

Pronounced: YOU –tro-fa-kay-shun

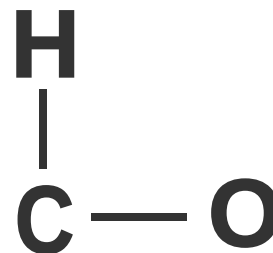
EU – from Greek meaning “large amount”

TROPHIC – from Greek meaning “nutrients”

Current meaning: “the results of having an overabundance of nutrients in the receiving water”

LET'S LOOK AT SOME GENERAL IMPURITIES

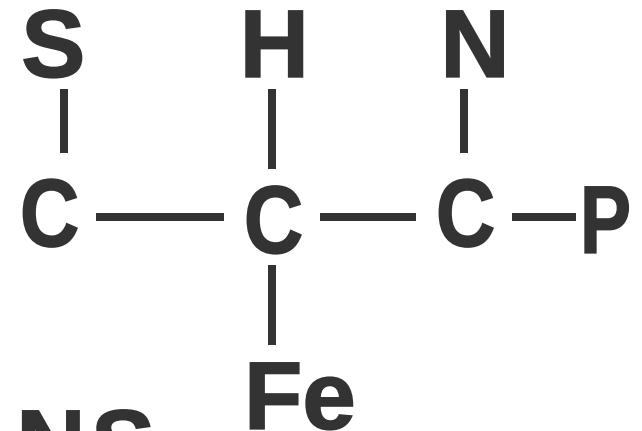
- ORGANICS



**ALWAYS CONTAINS
CARBON, and usually
HYDROGEN and OXYGEN**

LET'S LOOK AT SOME GENERAL IMPURITIES

- ORGANICS



SOMETIMES CONTAINS
SULFUR (S), NITROGEN
(N), IRON (Fe), &
PHOSPHORUS (P)

Organics (cont.)

- ⇒ Carbohydrates and alcohol
- ⇒ Lipids (fats and oils)
- ⇒ Proteins
- ⇒ Nucleic acids (DNA and RNA)
- ⇒ Pesticides

LET'S LOOK AT SOME GENERAL IMPURITIES

- ORGANICS
- INORGANICS

INORGANIC COMPONENTS

■ Minerals / Salts / Metals

–Calcium (Ca^{++}), Magnesium (Mg^{++}), Sodium (Na^+), Potassium (K^+), Chloride (Cl^-), Nitrate (NO_3^-)

Inorganic (cont.)

- ⇒ Carbonates (CO_3)
- ⇒ Phosphates (PO_4)
- ⇒ Hydrogen sulfide (H_2S)
- ⇒ Ammonia or Ammonium (NH_3 / NH_4^+)
- ⇒ Nitrites and/or nitrates (NO_2 / NO_3)

Inorganic (cont.)

- ⇒ Dissolved
- ⇒ Suspended (particulate)
- ⇒ Fixed/inert

LET'S LOOK AT SOME GENERAL IMPURITIES

- ORGANICS
- INORGANICS
- GASSES

Gases

- ⇒ Ammonia (NH3)
- ⇒ Hydrogen Sulfide (H2S)
- ⇒ Methane (CH4)
- ⇒ Oxygen (O2)

LET'S LOOK AT SOME GENERAL IMPURITIES

- ORGANICS
- INORGANICS
- GASSES
- MICROORGANISMS

Microorganisms

⇒ Viruses

⇒ Bacteria

⇒ Protozoa

⇒ Metazoa

⇒ Pathogens

Viruses

- ⇒ Either DNA or RNA encapsulated in protein coat
- ⇒ Enterovirus: Polio
- ⇒ Adenovirus
- ⇒ Infectious Hepatitis

Bacteria

- ⇒ Used to stabilize wastewater
- ⇒ Procaryote (pronounced pro-CARRY-oat)
 - No true nucleus
 - Reproduces by fission

Bacteria - waterborne

- ⇒ Salmonella (salmonellosis)
- ⇒ Shigella (bacillary dysentery)
- ⇒ Bacillus typhosus (typhoid fever)
- ⇒ Vibrio cholera (cholera)
- ⇒ Salmonella paratyphi (paratyphoid)

Protozoa

➔ Eucaryote

(pronounced you-CARRY- oat)

- True membrane bound nucleus
- Divides by mitosis

➔ Single cells or a group of more or less identical cells

➔ Amoeba, flagellates, ciliates

Metazoa

- ⇒ Eucaryotes
- ⇒ Worms or worm-like animals
(frequently parasitic)
- ⇒ Nematodes, other helminths,
rotifers

BIOCHEMICAL OXYGEN DEMAND (BOD)

➡ **THE AMOUNT OF OXYGEN NEEDED TO
STABILIZE THE WASTEWATER**

**USED AS A MEASURE OF
THE ORGANIC STRENGTH
OF WASTES IN WATER**

MICROBIAL RESPIRATION

“AEROBIC ORGANISM”

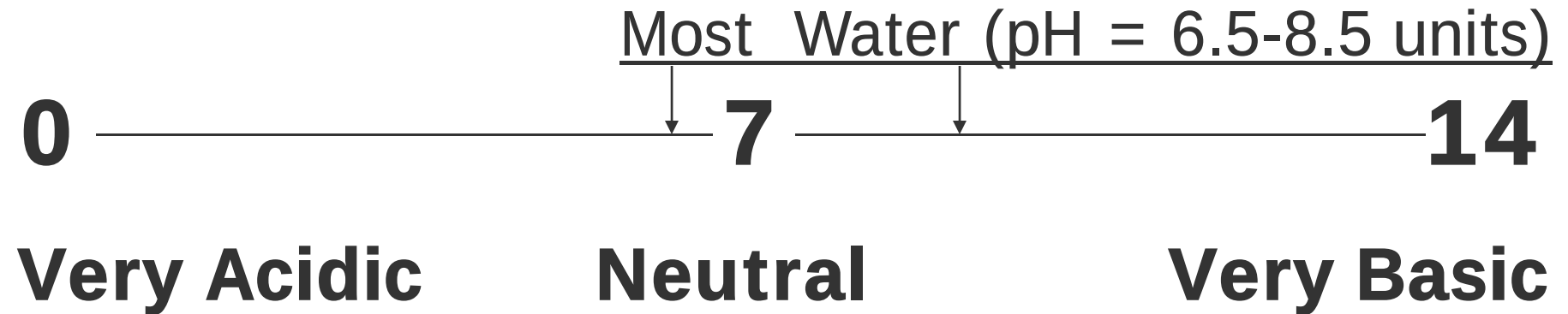
REQUIRES FREE AVAILABLE OXYGEN
(DISSOLVED O₂) TO LIVE AND
REPRODUCE

“ANAEROBIC ORGANISM” IS

ABLE TO LIVE AND REPRODUCE
WITHOUT DISSOLVED OXYGEN (breaks
down chemicals like SO₄ to get oxygen)

pH

**A MEASURE OF HOW
ACIDIC OR BASIC A
MATERIAL OR SOLUTION
IS.**



Fresh vs. Septic Sewage

➡ Fresh

- Grey
- Musty odor
- Floatable solids visible
- No apparent gas bubbles

➡ Septic

- Black
- Of fensive odor
- No floatable solids visible
- Apparent gas bubbles

Treatment Advantages of Fresh Wastewater

➡ Fresh

- Smells better
- Solids settle better in downstream treatment units
- Grease and oil separate better
- Reduces possibility of septic conditions in primary clarifier

Why Treat Wastewater?

- ⇒ Contains pathogens and/or chemicals
- ⇒ Unsightly and smelly
- ⇒ Contributes to eutrophication
- ⇒ Causes oxygen depletion in receiving stream

**AND... WE DO
IT FOR THE
\$\$\$\$\$\$\$!!**

