# TYPES AND CHARACTERISTICS OF WASTEWATER

# Classifications of Waste Water

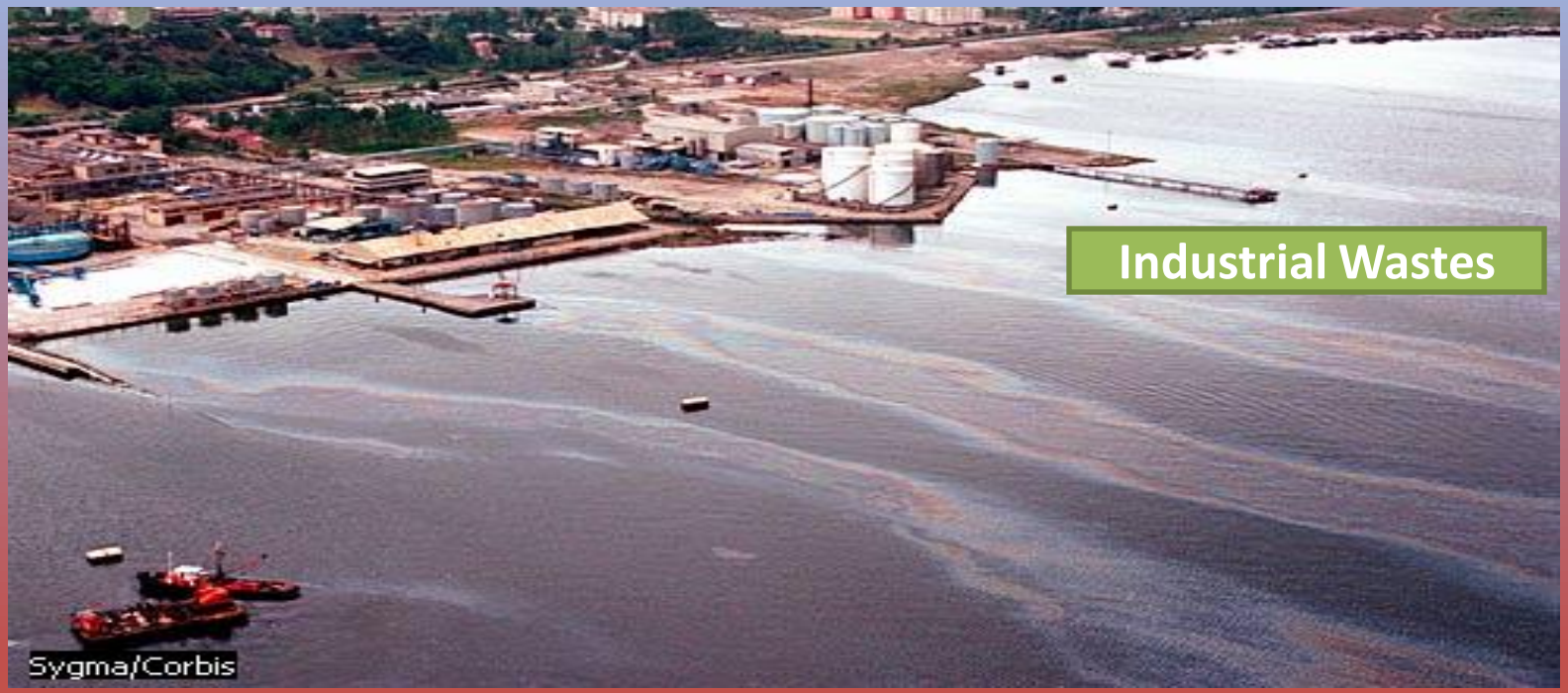
Domestic waste waters

These waters are produced by the mere acts of living such as using the bathroom, doing laundry, or washing the dishes.

# Classifications of Waste Water

## Process waste waters

These waters are produced by some industrial processes and include the undesired liquid product of any unit operation. The major concern with these wastes is the reactions that may occur with the environment being either direct or indirect. Some may rob oxygen from the environment, while others may be toxic


**Industrial Water Pollution**

Industrial pollutants that run into streams, rivers, or lakes can have serious effects on wildlife, plants, and humans. In the United States there are strict rules for the amount and composition of substances that factories can release into bodies of water. These rules are not always enforced, and much industrial water pollution comes from accidental chemical or oil spills.

## Cooling waste waters

These are produced as a result of heat exchanger where heat is removed from the product. Waters can be used once or recycled.. This type of waste must also be monitored and often treated, and is also a major factor in thermal pollution of water sources.


**Thermal Pollution from Power Plants and Factories**

Power plants and industrial factories are among the major contributors to the problem of thermal pollution. These facilities draw water from nearby lakes and streams, which they use to cool their machinery and steam-driven equipment. The heated water warms local bodies of water by as much as 10° C (18° F), making the water uninhabitable for fish and other organisms.

# CHARATERISTICS of Wastewater

## PHYSICAL CHARACTERISTICS

- **Temperature**
  - Wide variation in the wastewater temperature indicates heated or cooled discharges.
  - decreased temperatures after a snowmelt or rainfall may indicate serious infiltration.
  - Changes in wastewater temperatures affect the settling rates, dissolved oxygen levels, and biological action.
  - The temperature of wastewater becomes extremely important in certain wastewater unit operations such as sedimentation tanks and recirculating filters.

# Color

The color of wastewater containing dissolved oxygen (DO) is normally gray. Black-colored wastewater usually accompanied by foul odors, containing little or no DO, is said to be *septic.*

**Significance of Color in Wastewater**

| Unit Process | Color | Problem Indicated |
|---|---|---|
| Influent of plant | Gray | None |
| | Red | Blood or other industrial wastes or TNT complex |
| | Green, Yellow, Other | Industrial wastes not pretreated (paints, etc.) |
| | Red or other soil color | Surface runoff into influent, also industrial flows |
| | Black | Septic conditions or industrial flows |

*domestic **wastes***

*oil **wastes***

Though the colors are beautiful, it is full of chemical wastes.

*White color of the chemical wastes*

No one is sure exactly how the ocean will disperse pollutants, such as dioxin, from the mill

Processing timber into pulp at the mill will result in tons of effluent a day being discharged

# Odor

Domestic sewage should have a musty odor. Bubbling gas and/or foul odor may indicate industrial wastes, anaerobic (septic) conditions, and operational problems.

**Odors in Wastewater Treatment Plant**

| Odor | Location | Problem | Possible Solutions |
|---|---|---|---|
| Earthy, Musty | Primary and Secondary Units | No problem (Normal) | None required |
| Hydrogen sulfide ($H_2S$), "Like rotten eggs" | Influent | Septic | Aerate, chlorinate, oxonizate |
| " | Primary Clarifier | Septic Sludge | Remove sludge |
| " | Activated Sludge Aeration Tanks Trickling Filters | Septic Conditions (Anaerobic) | More air or less BOD, recirculation rate, HTH, flood |
| " | Secondary Clarifier | " | Remove sludge and/or grease |
| " | Chlorine Contact Tank | " | Remove sludge |
| " | General Plant | " | Good housekeeping |
| Chlorinelike | Chlorine Contact Tank | Improper chlorine dosage | Adjust chlorine dosage controls |
| Industrial Odors | General Plant | Inadequate pretreatment | Enforce sewer use regulation |


*Effects of bioremediation in color and odor*

# Solids

Wastewater is normally 99.9 % water and 0.1 % solids. If a wastewater sample is evaporated, the solids remaining are *total solids.*

Types Solids:

1. Dissolved solids is an expression for the combined content of all inorganic and organic substances contained in a liquid which are present in a molecular, ionized or micro-granular suspended form.

Dissolved solids pass through a fine mesh filter. Normal wastewater processes using settling or flotation are designed to remove solids but cannot remove dissolved solids. -

**Taste/Health:** High TDS results in undesirable taste which could be salty, bitter, or metallic. It could also indicate the presence of toxic minerals. The EPA's recommended maximum of TDS in water is 500mg/L (500ppm).

**Filter performance** : Test your water to make sure the filter system has a high rejection rate and know when to change your filter (or membrane) cartridges.

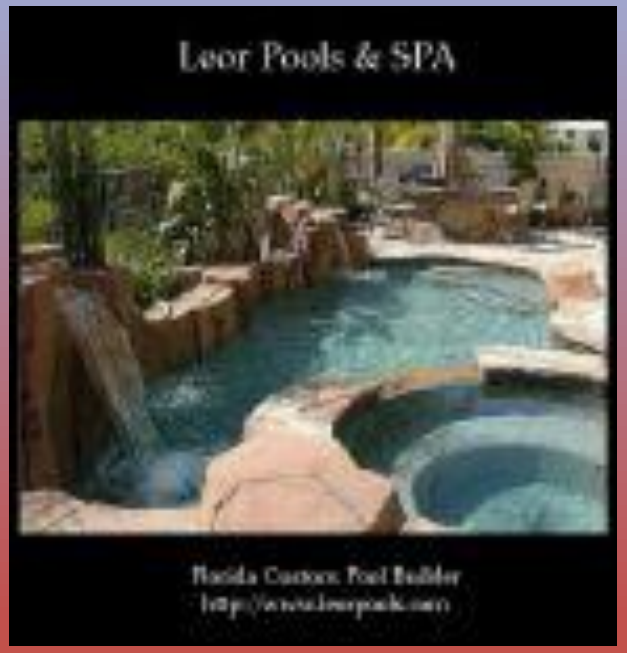
**Hardness:** High TDS indicates Hard water, which causes scale buildup in pipes and valves, inhibiting performance.

**Aquaculture:** A constant level of minerals is necessary for aquatic life. The water in an aquarium should have the same levels of TDS and pH as the fish and reef's original habitat.


*Nutrients for hydrophonics*

**Hydroponics:** TDS is the best measurement of the nutrient concentration in a hydroponics' solution.

**Pools and Spas:** TDS levels must be monitored to prevent maintenance problems.




**Commercial/Industrial/ Medical:** High TDS levels could impede the functions of certain applications

generators

Dialysis machine

2. Suspended - This parameter was at one time called non-filterable residue (**NFR**), a term that refers to the identical measurement: the dry-weight of particles trapped by a filter, typically of a specified pore size.

3. Settleable or **settleable**, **solids** will settle out of water over time, though this may be so slow that it is impractical to allow the particles to settle out in a water treatment plant. The particles are more than 1,000 Mu in size and can be seen with a microscope or, sometimes, with the naked eye. Ex. of sand and heavy silts.

4. Floatable Solids

Floatables discharged to receiving waters create a variety of problems. Visible, floating material degrades the aesthetics of waterways and their shorelines, which in turn can contribute to loss of use (e.g. beach closings) and can have an adverse economic impact on recreation and business in the area.

5. Colloidal Solids

**also known as nonsettleable solids, do not dissolve in water although they are electrically charged, the particles are so small that they will not settle out of the water even after several years and they cannot be removed by filtration alone, can be seen only with a high-powered microscope. Ex. bacteria, fine clays, and silts. Colloidal solids often cause colored water, such as the "tea color" of swamp water.**

**6. Organic Solids**

Volatile suspended solids reflects the weight of organic matter in the dried solids that burns off after combustion at 550 degrees C and indicates the organic solids content of the water sample.

**7. Inorganic solids**

Non-volatile suspended solids reflects the weight of solids remaining on the filter after combustion and indicates the inorganic solids (primarily sediment) content of the water sample.

## CHEMICAL CHARACTERISTICS

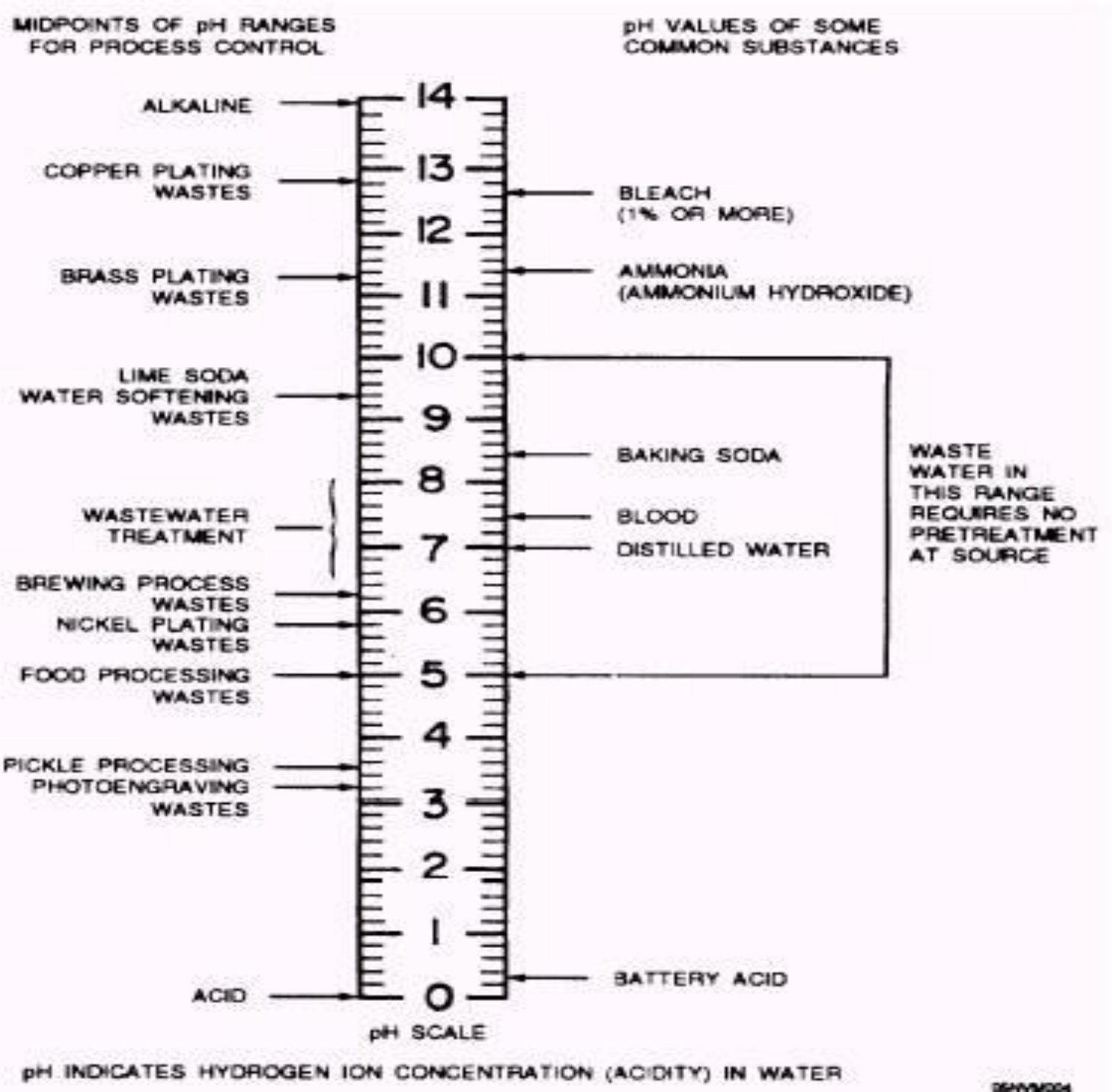
**pH** The term *pH* is used to describe the acid or base properties of water solutions.

A pH value less than 7 in the wastewater plant influent may indicate septic conditions of wastewater.

The pH values less than 5 and more than 10 usually indicate that industrial wastes exist and are not compatible with biological wastewater operations.

Pretreatment of these wastes at the source is usually required since extreme pH values may damage biological treatment units.

# Common Substances' pH Values



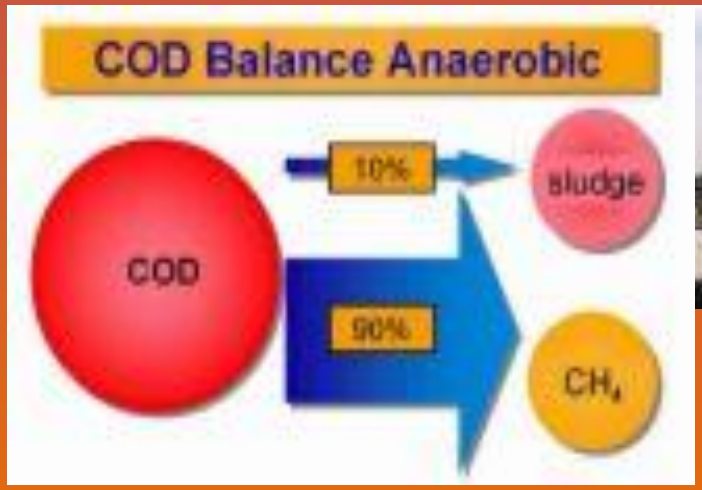
## Dissolved oxygen

Dissolved oxygen (DO) in wastewater has a great effect on the characteristics of the water.

Wastewater that has DO is called *aerobic* or fresh. Aerobic raw sewage is usually gray in color and has a musty odor.

Aerobic sludge foam

Wastewater that has no DO is called *anaerobic* or septic. Anaerobic raw sewage is usually black and has an offensive hydrogen sulfide or rotten egg odor.




Anaerobic digester

Oxygen demand is the amount of oxygen used by bacteria and other wastewater organisms as they feed upon the organic solids in the wastewater.

Chemical tests such as the BOD (biochemical oxygen demand), the COD (chemical oxygen demand), the ODI (instantaneous oxygen demand or oxygen demand index), and the TOC (total organic carbon) measure the "strength" of sewage. It is important that organic wastes be removed to protect the receiving body of water into which the wastewater plant is discharging.

Sludge deposits, odors, and fish kills may occur
if removal is not adequate.

# Nutrients

**Nutrients are life-supporting nitrogen and phosphorus.**

They stimulate excessive growths of algae and other aquatic plant life. They are always present in domestic wastewaters and are not removed during conventional primary and secondary treatment.

Removal is accomplished by processes in addition to normal wastewater treatment or tertiary treatment, when specific reuse requirements require it.

## BIOLOGICAL CHARACTERISTICS

**Bacteria** pathogenic (disease-causing) organisms such as typhoid, dysentery, and other intestinal disorders may be present in wastewater.

Tests for total coliform and fecal coliform nonpathogenic bacteria are used to indicate the presence of pathogenic bacteria. Because it is easier to test for coliforms, fecal coliform testing has been accepted as the best indicator of fecal contamination.

Fecal coliform counts of 100 million per 100 milliliters may be found in raw domestic sewage. Detectable health effects have been found at levels of 2,300 to 2,400 total coliforms per 100 milliliters in recreational waters.

Disinfection, usually chlorination, is generally used to reduce these pathogens. Breakdown or malfunctions of chlorination equipment will probably result in excessive discharge of pathogenic organisms and can seriously affect public health.

Bacteria can also be classified according to their dissolved oxygen requirement. Aerobic bacteria are bacteria that require dissolved oxygen to live. Anaerobic bacteria cannot live if dissolved oxygen is present. *Facultative* bacteria can live with or without dissolved oxygen.

## Viruses

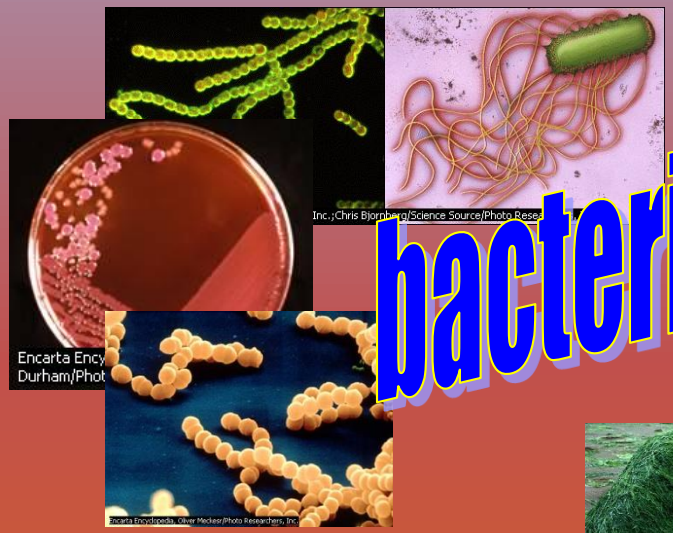
Wastewater often contains viruses that may produce diseases. Outbreaks of infectious hepatitis have been traced through water systems because of wastewater entering the supply. sedimentation, filtration, and disinfection, if used efficiently, usually provide acceptable virus removal.

## Parasites

There are also many species of parasites carried by wastewater. The life cycle of each is peculiar to the given parasite. Some are dangerous to man and livestock, particularly during certain stages of the life cycle. Amoebic dysentery is a common disease caused by amoebic parasites. Chlorination, chemical precipitation, sedimentation, or sand filtration is used to ensure protection against parasites.

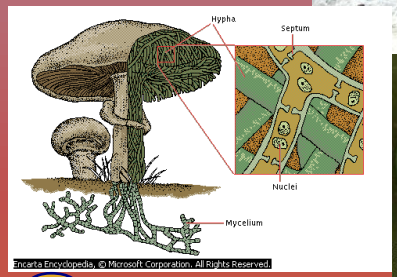
# MAJOR MICROBIAL GROUPS

## The world of microorganisms is made of:



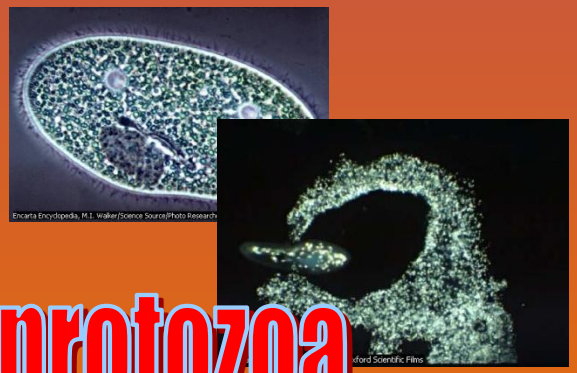

bacteria

fungi

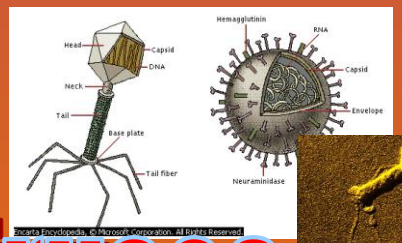




algae

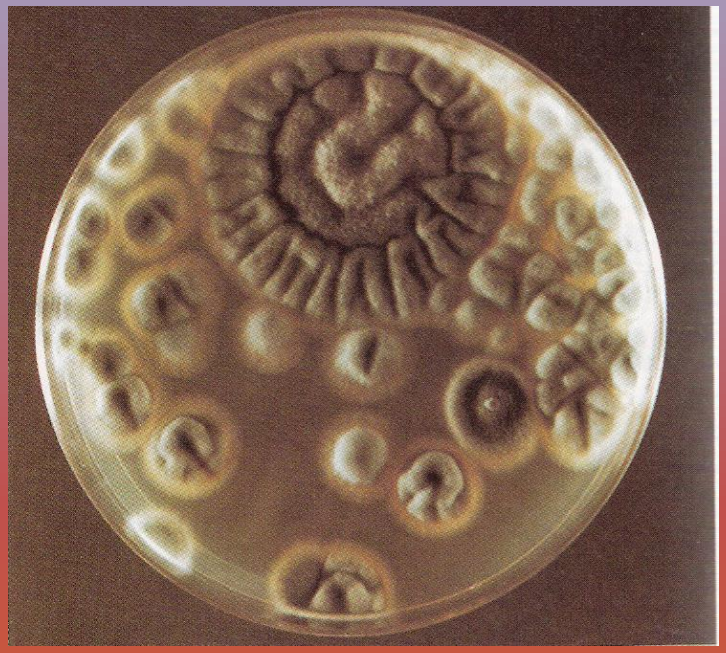



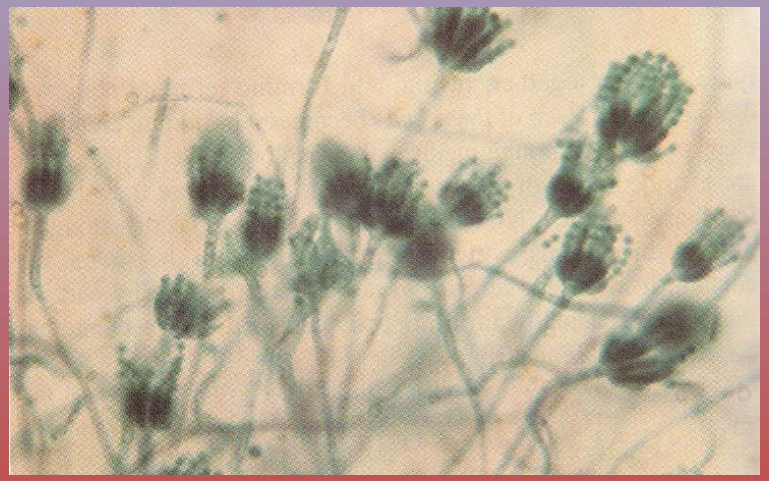

protozoa




viruses

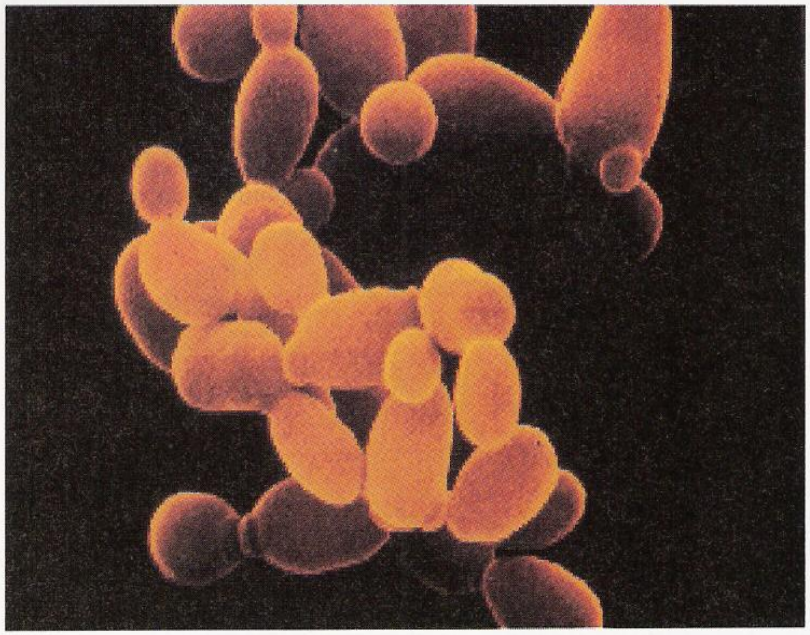
# Molds



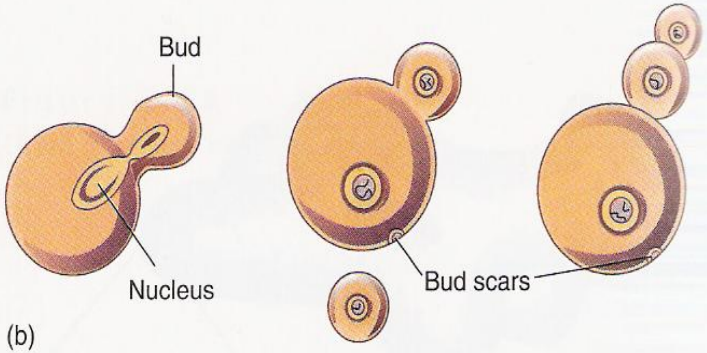


**Made up of a network of branched threadlike structures called hyphae which grows to form a tangled mass called mycellium.**

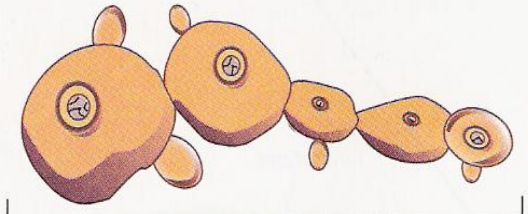
# Yeasts



(a)

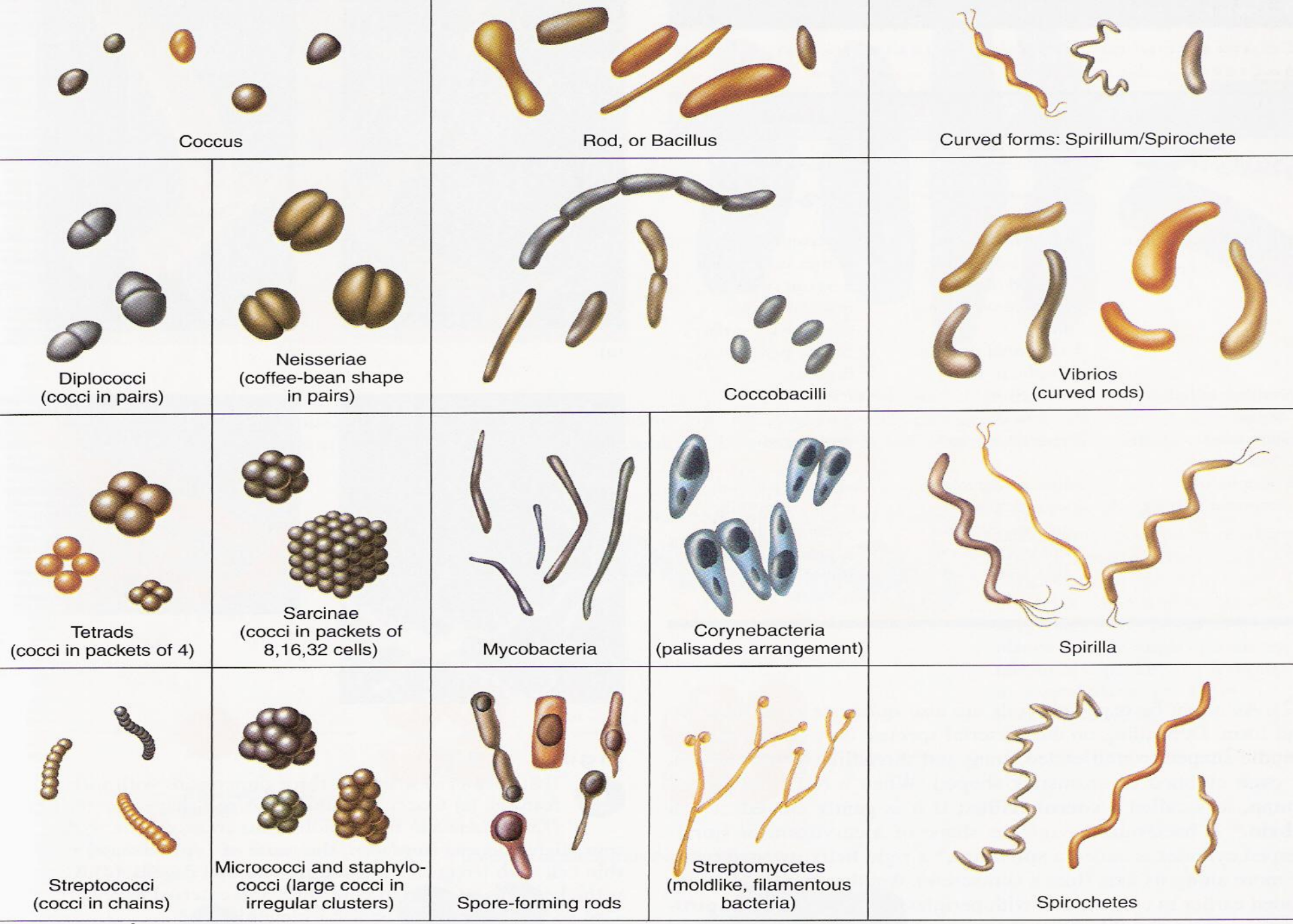



(b)



(c) Pseudohypha

They occur constantly as single budding cells and do not form the branching filaments which characterized the molds.


Coccus
Rod, or Bacillus
Curved forms: Spirillum/Spirochete
Diplococci (cocci in pairs)
Neisseriae (coffee-bean shape in pairs)
Coccobacilli
Vibrios (curved rods)
Tetrads (cocci in packets of 4)
Sarcinae (cocci in packets of 8,16,32 cells)
Mycobacteria
Corynebacteria (palisades arrangement)
Spirilla
Streptococci (cocci in chains)
Micrococci and staphylo-cocci (large cocci in irregular clusters)
Spore-forming rods
Streptomycetes (moldlike, filamentous bacteria)
Spirochetes

# Bacteria