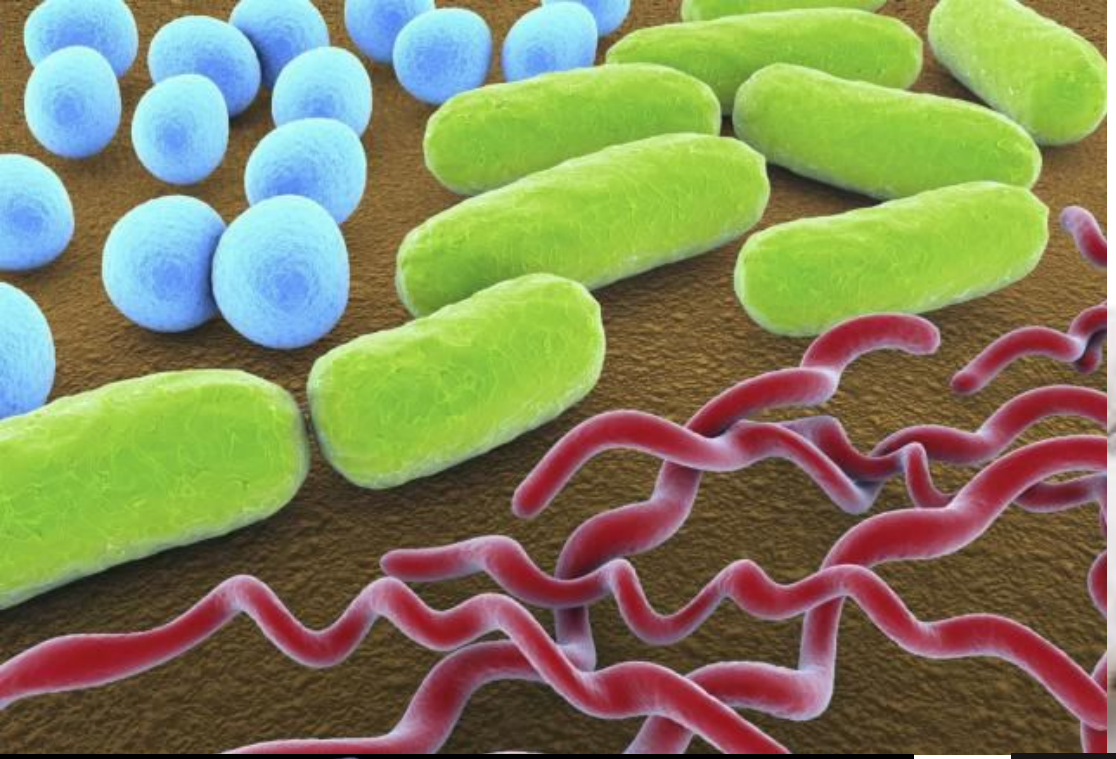
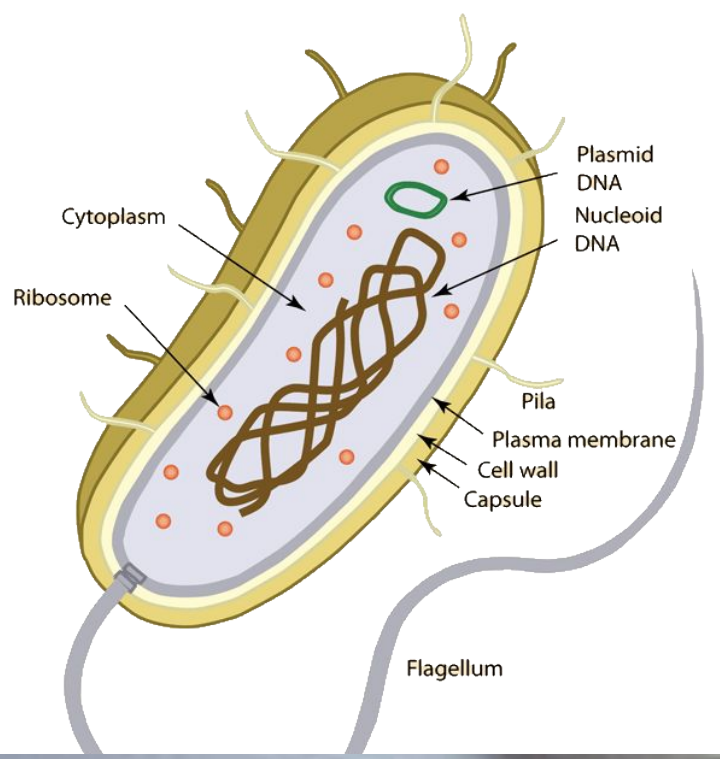
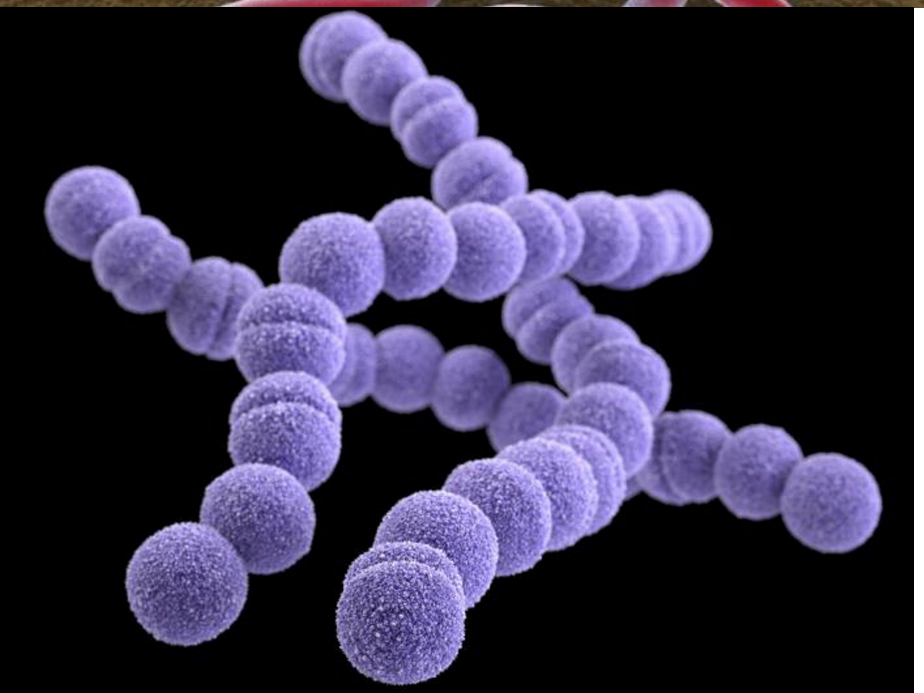



Plasmid DNA
Nucleoid DNA
Cytoplasm
Ribosome
Pila
Plasma membrane
Cell wall
Capsule
Flagellum



The main types of nutrition in microorganisms

Learning Objective

- Identify the main types of nutrition in microorganisms

Success criteria

1.Analyse information about microbes and name them.

2.Name and identify correctly at least four types of nutrition.

Terminology

- bacteria, yeast, fungus, dose, continuous growth curve, a lag phase, an exponential / lag phase, stationary phase, a dead phase, monitors, viable cell microorganism, optical density, seeding
- Growth factor, Trace elements, Macronutritions, Nitrogen, carbohydrates, Hydrogen, Phosphorus, oxygen, Sulfur, Potassium, Calcium, glucose, carbon dioxide, water, pH, temperature, mineral ions
- Nutrient supply, agar medium/growth medium, aeration
- Aseptic techniques, sterile, streak pattern

Classification of Nutrition in Microoganisms

Carbon sources – Autotrophs – CO_2 sole or principal source

Heterotrophs – reduced, preformed organic molecules

Energy sources

Phototrophs – light

Chemotrophs – oxidation of chemical compounds (organic/inorganic)

Electrons/Hydrogen sources

Lithotrophs – use reduced inorganic compounds as electron donors

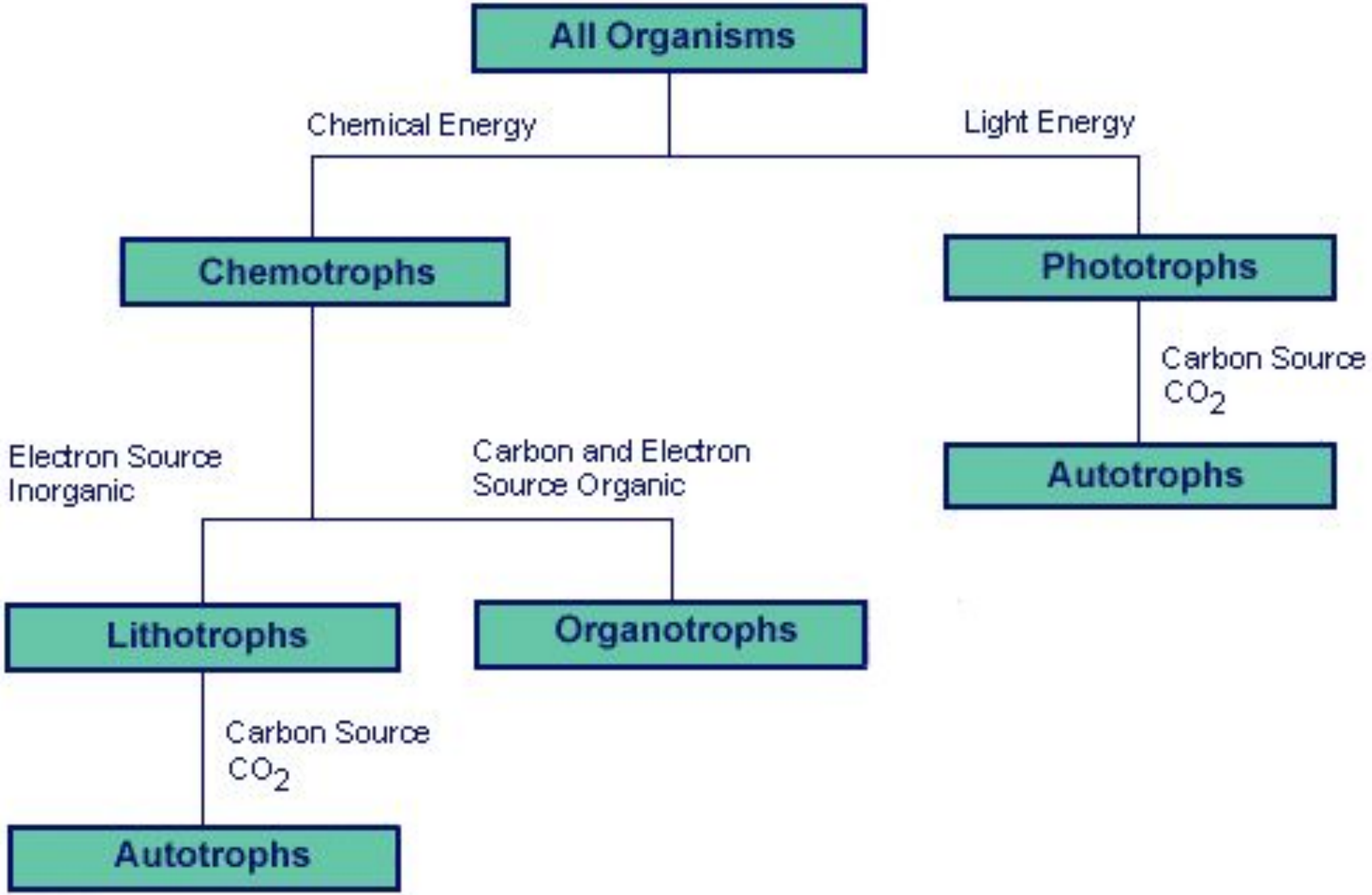
Organotrophs – organic compounds/moleculs

“mixotrophs: they can alter their metabolic patterns in response to the particular environment.

All bacteria require two things for growth:

1) A source of energy

2) A source of matter for building additional cells: C, O, H, N, S, P, trace minerals.


All Organisms
Chemical Energy
Light Energy
Chemotrophs
Phototrophs
Carbon Source
CO_2
Electron Source
Inorganic
Carbon and Electron
Source Organic
Autotrophs
Lithotrophs
Organotrophs
Carbon Source
CO_2
Autotrophs

Nutrient Required for Growth

Carbon – heterotrophs: glucose, fatty acids, alcohols, hydrocarbons…

Nitrogen – organic: amino acids, peptides, proteins

inorganic: ammonium salts and nitrates

Water – chemical reactions

Growth factors, Vitamins, Mineral salts – positive ions: calcium, potassium, sodium, B vitamins, some in TRACE (small) amounts

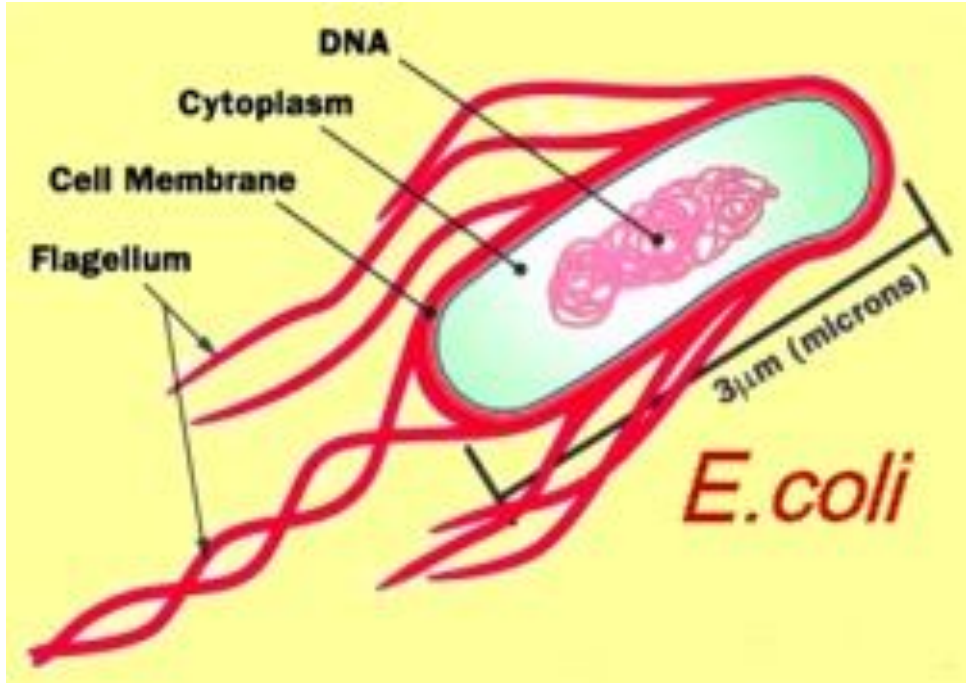
Energy – chemical or light

chemotrophs-chemical energy – glucose

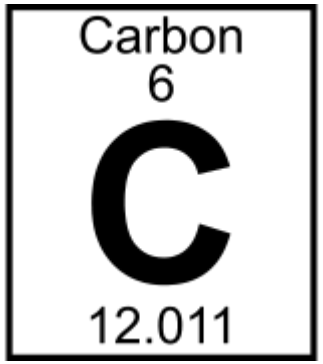
phototrophic – light energy: blue green algae bacteria

Elemental Assay of E. coli (dry weight)

- 50% carbon
- 20% oxygen
- 14% nitrogen
- 8% hydrogen
- 3% phosphorus
- 2% sulfur
- 2% potassium
- 0.05% calcium, magnesium, chlorine
- 0.2% iron
- 0.3% trace elements

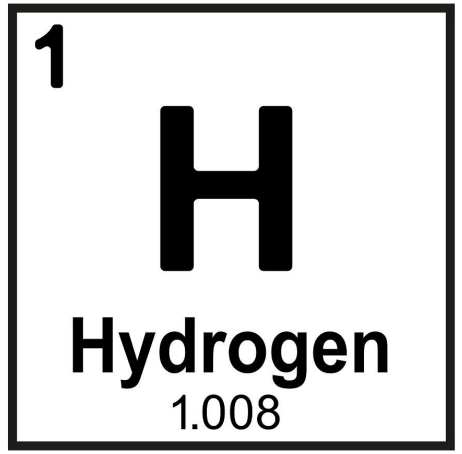


Carbon



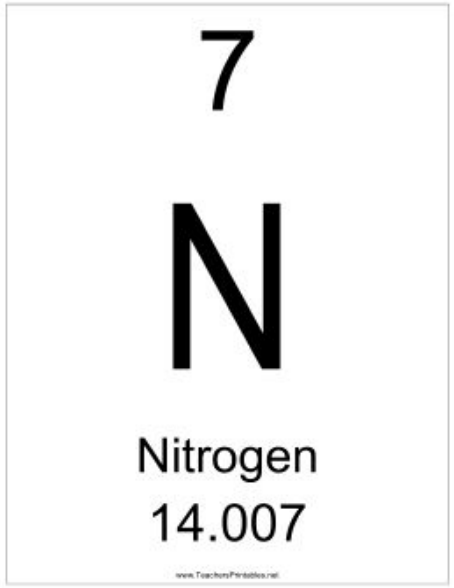
- **the backbone of functional biological molecules**: cells vary in their ability to synthesize all of their carbon compounds. Range of carbon compounds utilized: CO, CH4, to complex organic compounds.

Hydrogen



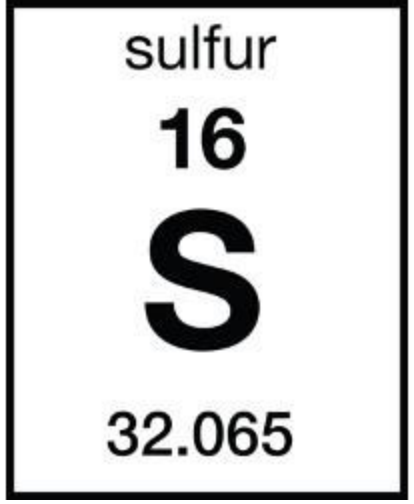
- **structural molecule, participant in process of energy generation.**
  Protons (H+) involved in ATP production, CO2 reduction, anaerobic and aerobic respiration.

Nitrogen



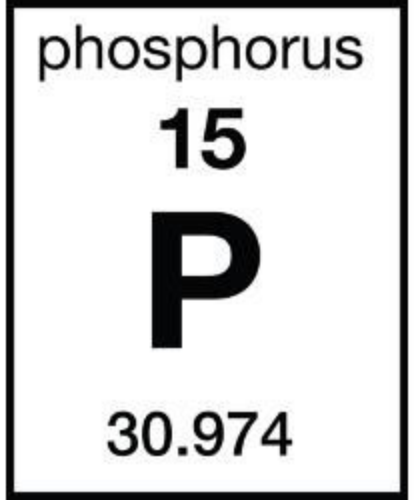
- **in amino acids, nucleic acids. membranes, cell walls, and most macromolecules.** Most free-living microbes assimilate ammonia from their environment or reduce nitrate. An array of microbial types can "fix" atmospheric nitrogen.

Sulfur



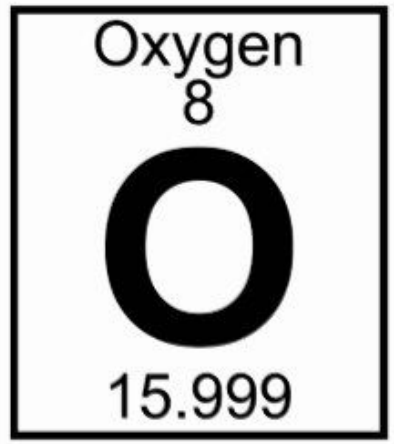
- **in certain amino acids, some B-vitamins (biotin and thiamine).** Reduced inorganic sulfur (e.g. H2S) used as energy source for *thiobacilli*. Sulfur serves as terminal electron acceptor in some Archaea.

Phosphorus



- **a constituent of high energy compounds (ATP), phospholipids in membranes, nucleic acids.**

Oxygen



- **equal amounts in aerobes and anaerobes,** but free oxygen toxic to anaerobes, so they obtain it in **a combined form from the substrate**.

Trace elements, though not required in large amounts, are essential for cellular growth:

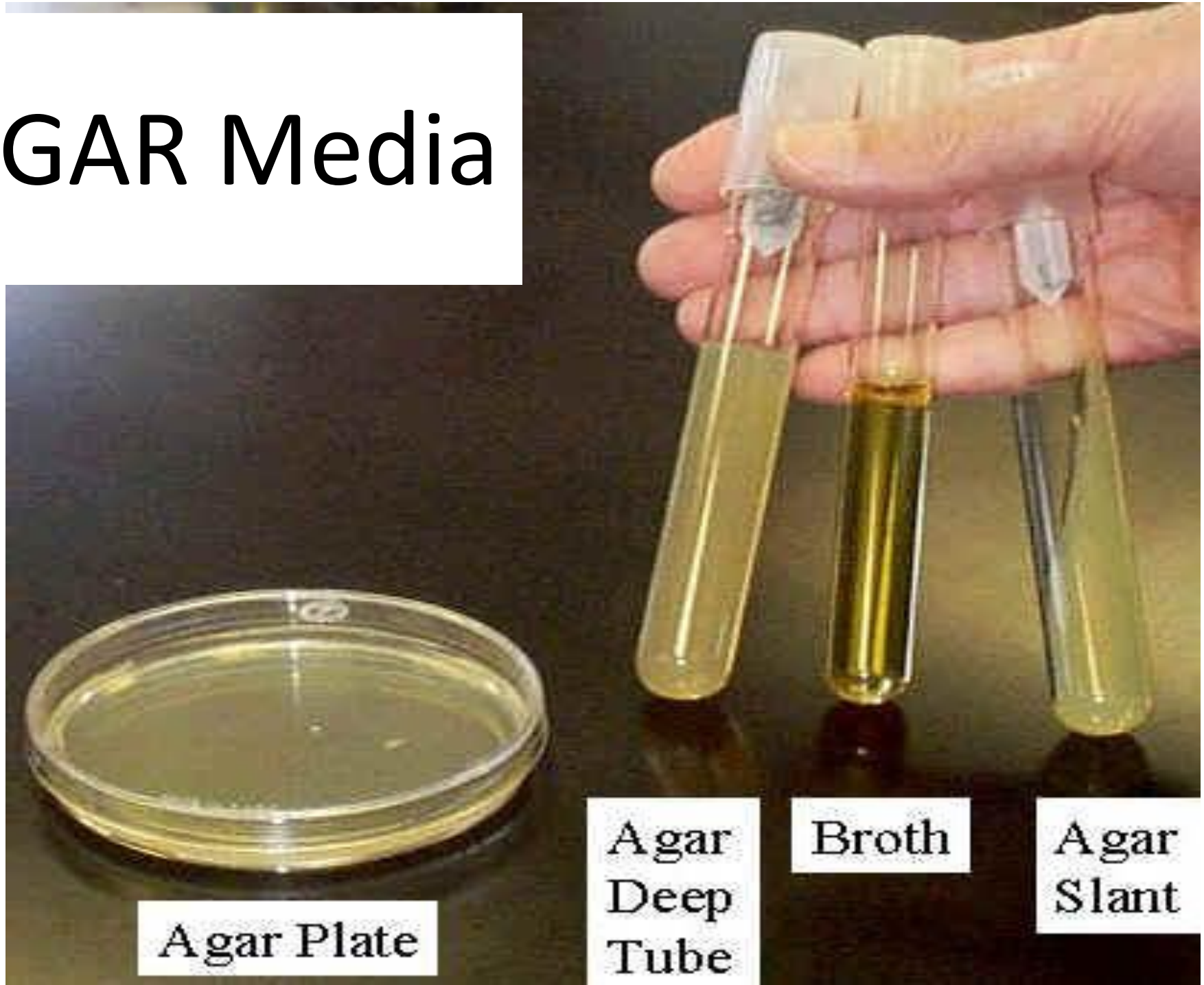
- K+ Principle cellular counterion
- Mg++ DNA polymerase
- Ca++ Intracellular signalling, wall structure
- Fe++ Cytochromes
- Mn++ PsII, photosynthesis
- Co++ Vitamin B12 constituent (methylations)
- Cu++ Superoxide dimutase
- Zn++ Some DNA binding proteins

Organic Growth Factors

- Organic Growth Factors are essential organic compounds that an organism is unable to synthesize. They must be obtained directly from the environment.

- Examples: **Vitamins, Amino acids, Purines, pyrimidines**

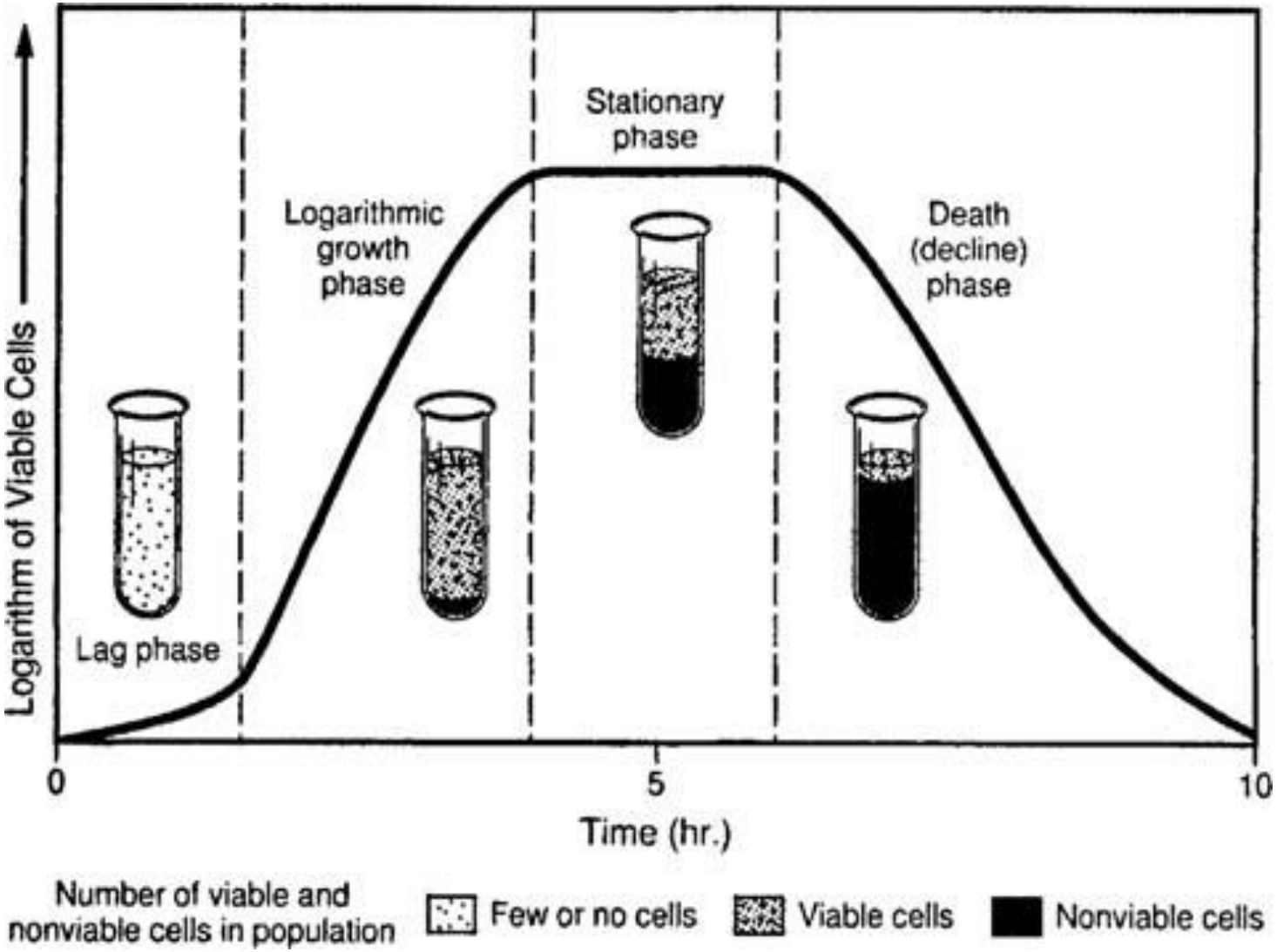
Types of AGAR Media



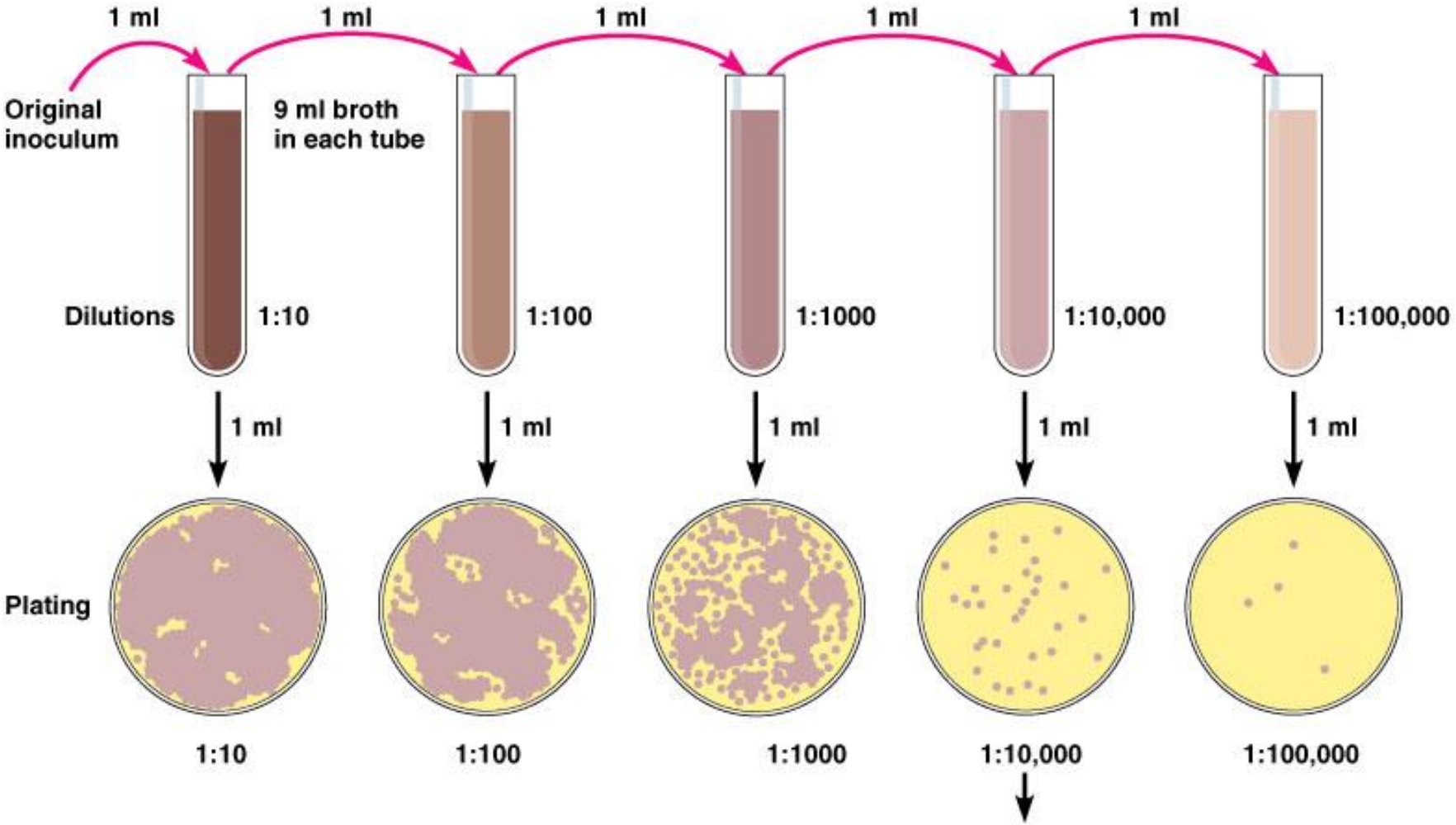
Liquid agar cultures of bacteria at the different stages of growth.

What the limiting factors a time = 4.5 – 5.5 hours?

What is happening to the culture at time =5.5-10 hours?



Serial Dilutions are used to reduce the number of bacterial colonies from liquid agar culture so they may be easily counted.



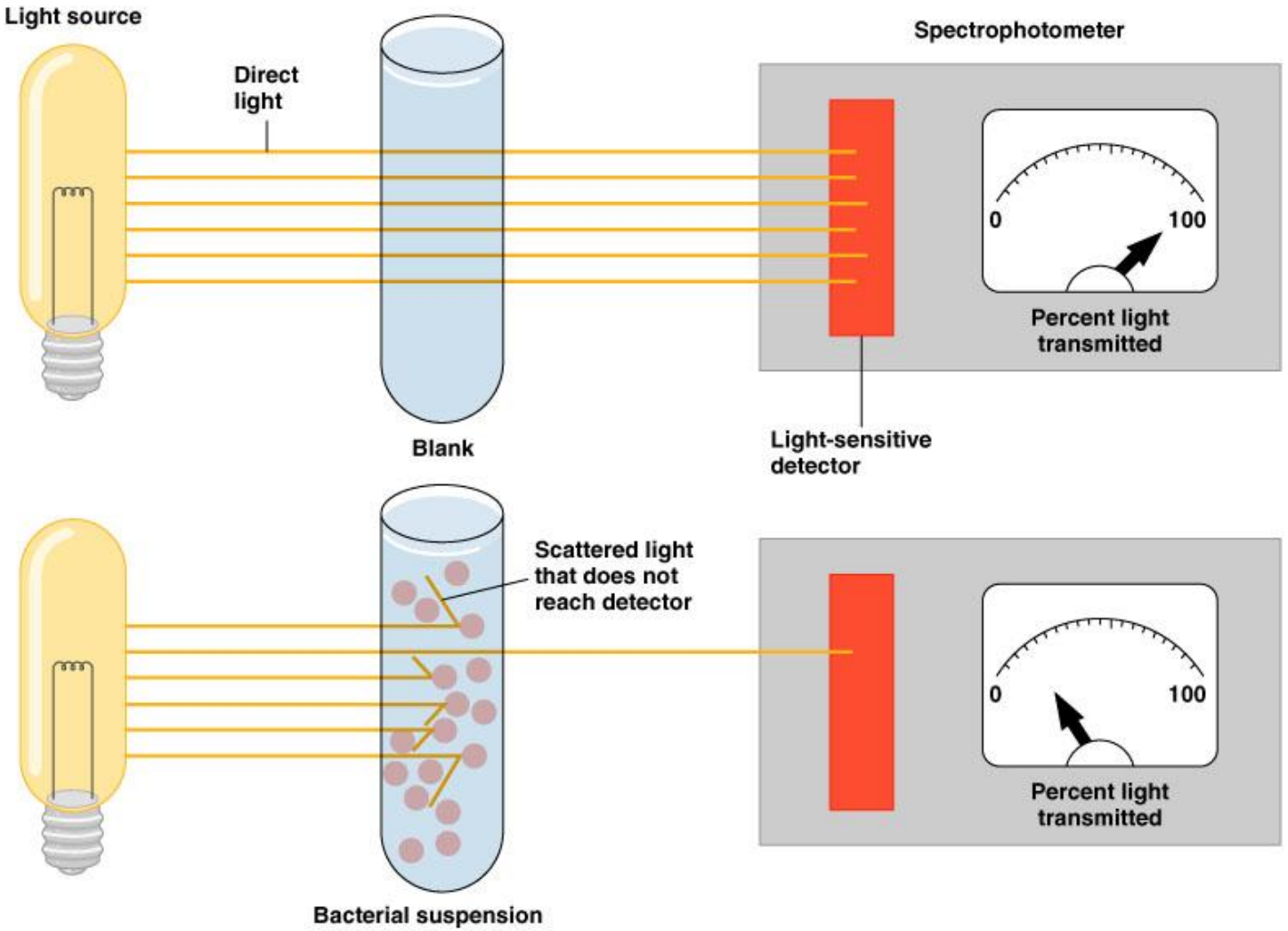
Calculation: Number of colonies on plate × reciprocal of dilution of sample = number of bacteria/ml
(For example, if 32 colonies are on a plate of $^{1}/_{10,000}$ dilution, then the count is 32 × 10,000 = 320,000/ml in sample.)

Spectrophotomer or a colorimeter measures transmission of light

Used to measure ‘turbidity’
concentration of bacterial in solution

100 % Transmittance
0 % Absorbance

20 % Transmittance
80 % Absorbance

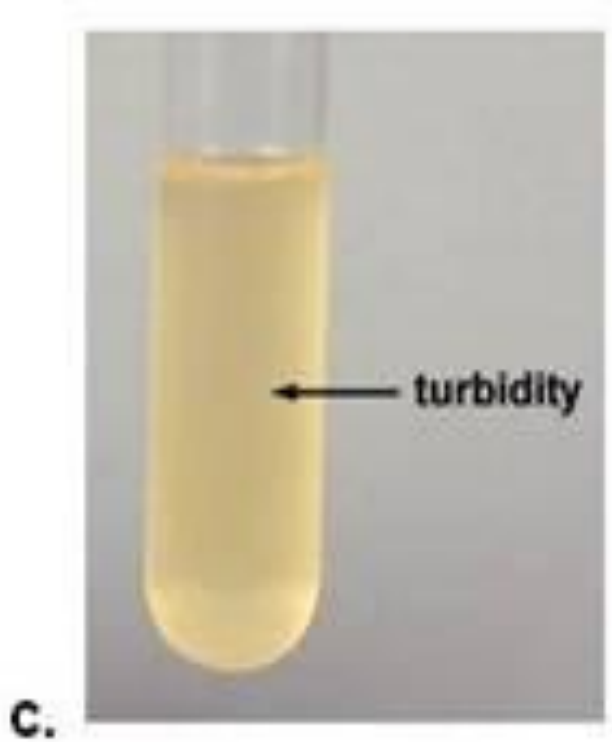


Turbidity – the cloudiness shows bacterial growth

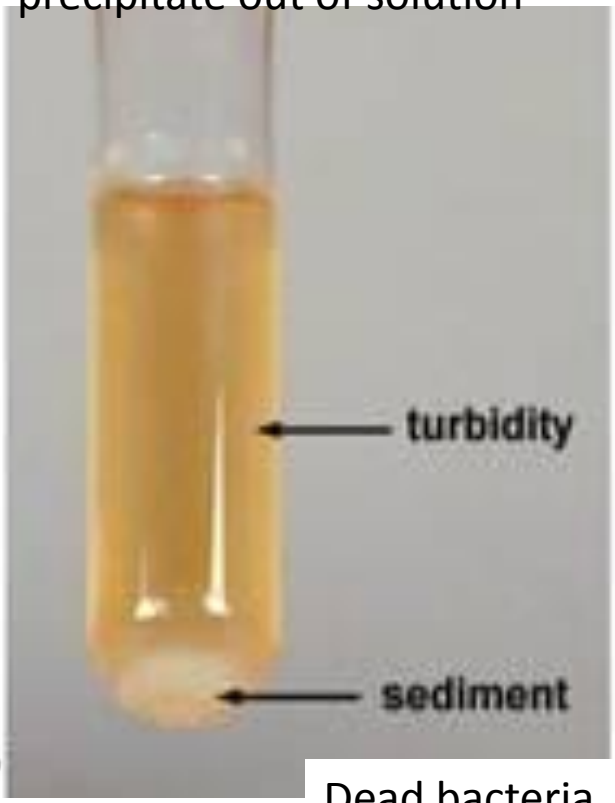
Sterile Broth

Slight turbidity
-some bacteria

Significant turbidity
-lots of bacteria

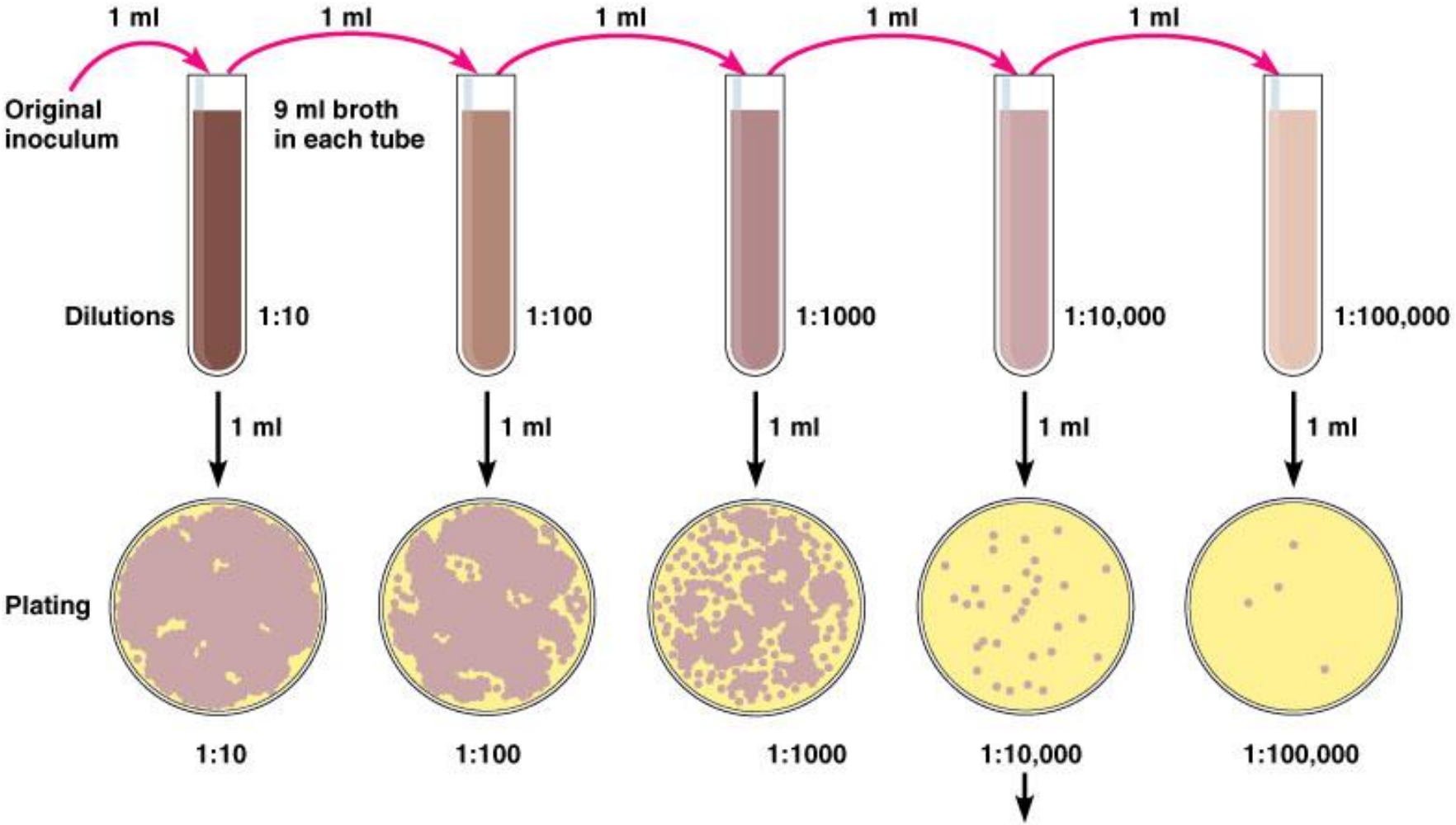


Turbidity and Sediment
-death phase – dead bacteria precipitate out of solution



Dead bacteria

Serial Dilutions are used to reduce the number of bacterial colonies from liquid agar culture so they may be easily counted.



Calculation: Number of colonies on plate × reciprocal of dilution of sample = number of bacteria/ml
(For example, if 32 colonies are on a plate of $^{1}/_{10,000}$ dilution, then the count is 32 × 10,000 = 320,000/ml in sample.)

Practical: **Plate it on different nutrient agar dishes**

1- Nutrient closed petri dish

2- No nutrient closed petri dish

3- Glucose closed petri dish

4 – No glucose closed petri dish

5 – Nutrient open petri dish

6 - No nutrient open petri dish

72 hours in incubator or 72 hours covered in warm part of room.

Success criteria

1.Analyse information about microbes and name them.

2.Name and identify correctly at least four types of nutrition.

http://oregonstate.edu/instruct/mb302/field/Lecture12.htm