# Chapter 1

How do you define life, or what is living?
It must:
- Regulate its internal environment
- Take in and use energy
- Respond to its environment
- Develop and maintain its complex organization
- Give rise to new cells (reproduce)

Robert Hooke did what?
Introduced the term cell
Observed that cork was composed of "little boxes"

Anton Van Leeuwenhoek was the first to do what?
Observe actual microorganisms using a simple microscope

List the types of microorganisms and their cell walls (if present).
- Bacteria → peptidoglycan cell wall
- Archaea → pseudomurein cell wall
- Protozoa
- Algae → cellulose cell wall
- Fungi → chitin cell wall
- Multicellular animal parasites
- Viruses

What are the three domains?
Bacteria
Archaea
Eukarya

Define the following types of study:

- Bacteriology → study of bacteria
- Mycology → study of fungi
- Virology → study of viruses
- Parasitology → study of parasitic protozoa and worms
- Genomics → study of organisms' genes (to classify bacteria, fungi, & protozoa)

Most microbes are pathogenic

a. True
b. False

All cells have a cell membrane.

Bacteria have cilia.

a. True
b. False

Bacteria reproduce by binary fission.

How do fungi obtain the organic chemicals used for energy?
Absorption

How do protozoa obtain organic chemicals?
Absorption or ingestion

Algae ingests organic chemicals for energy.

a. True
b. False

Viruses are living organisms (yes/no).

What are helminths?
Parasitic flatworms and roundworms

Which is a correctly typed scientific name? (circle all that apply)

a. Baker's yeast
b. Saccharomyces cerevisiae
c. *Saccharomyces cerevisiae*
d. *S. cerevisiae*

Explain the theory of spontaneous generation and its opposing theory.

- Spontaneous generation → theory that living organisms come from nonliving matter (the "vital force" in the air forms life)
- Biogenesis → theory that living organisms come from preexisting life

What did Louis Pasteur do?

- Offered proof of biogenesis
- Disproved spontaneous generation theory and the "vital force" in the air

## Chapter 3

6 μm is 0.006 mm.

1 mL is 1 CC.

How many lenses does a simple microscope have?
One

What type of microscope is used in the lab?
Compound brightfield microscope

How do you find the total magnification of the microscope?
Objective lens × ocular lens

Define the following:

- Resolution → the ability of the lenses to distinguish two points a specified distance apart
- Refractive index → a measure of the light-bending ability of a medium

Why is immersion oil added onto the slide?
To keep light from bending

What objects are visible under:

- Brightfield illumination → dark objects, visible against bright background
- Darkfield illumination → light objects, visible against dark background

Fluorescence microscopy uses UV light.

Electron microscopy uses light to view objects.

a. True
b. False

What is the purpose of fixed mounts?
To kill and fix the specimen to the slide

In positive staining, what type of dye is used? In negative staining?

- Positive staining → basic dyes
- Negative staining → acidic dyes

What is used in a gram stain? Star the critical step.

1. Primary stain → crystal violet (purple color)
2. Mordant → iodine
3. Decolorizing agent → alcohol-acetone
4. Counterstain → safranin (gram$^-$ have red color)

What is used in an acid fast stain? Star the critical step.

1. Primary stain → carbolfuchsin (red color)
2. Decolorizing agent → acid-alcohol
3. Counterstain → methylene blue (non-acid-fast have blue color)

Gram-negative bacteria are (easier/harder) to kill than gram-positive bacteria.

List all the types of differential stains.

- Gram stain
- Acid-fast stain
- Endospore stain

What are other ways to identify bacterial species?

- Macroscopic and microscopic appearance
- Biochemical tests
- Genetic characteristics
- Immunological testing

# Chapter 4

*Part 1 (prokaryotes)*

Identify the differences between prokaryotic and eukaryotic cells.

Prokaryotes:

- Have one circular chromosome
- Doesn't have histones (proteins that DNA wraps around to condense)
- Doesn't have organelles
- Doesn't have nucleus
- No mitotic spindles form during binary replication

Eukaryotes:

- Has multiple linear chromosomes
- Has histones
- Has organelles
- Has nucleus
- Has mitotic spindles

What shapes and arrangements can bacteria have?
Shapes → bacillus, coccus, vibrio, spirillum, spirochete
Arrangements → mono, diplo, tetrad, sarcinae, staphylo, strepto

What is the glycocalyx and its different forms?
Sticky layer outside the cell wall that allows cells to attach to surfaces
Two forma → capsule & slime layer

form slimy layers on surfaces (such as teeth).
Biofilms

What type of bacteria has an outer membrane?
Gram negative

How do bacteria move?
Run and tumble

What did Rebecca Lancefield do?
Proposed the use of immunology to identify some bacteria according to serotypes based on certain components in the bacterial cell wall

What is the function of fimbriae?
Allow attachment to other bacteria & surfaces

There are two types of pili, identify each type.

1. Involved in motility
2. Facilitates conjugation (sex pilus)

The cell wall prevents osmotic lysis.

What makes up the carbohydrate backbone of the cell wall in both gram-positive and gram-negative cells?
NAG & NAM

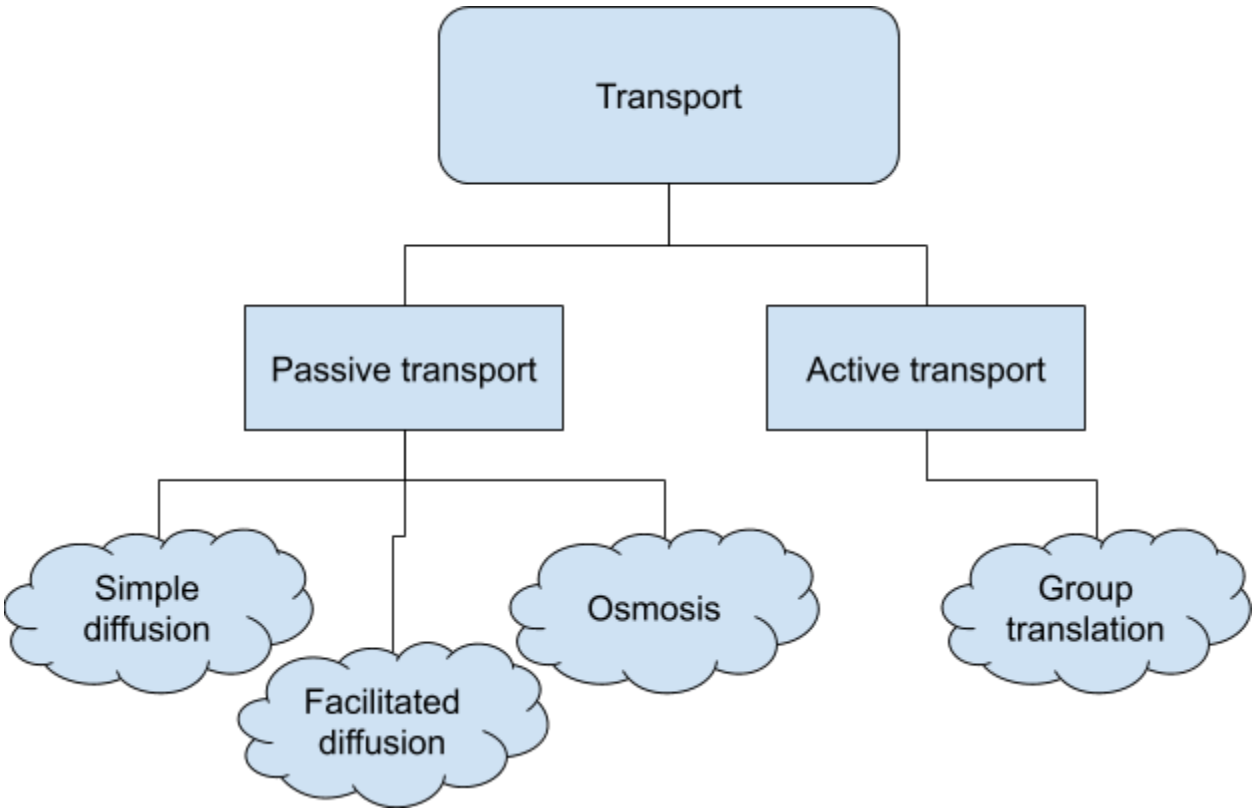
Gram-positive cells have a (thick/thin) peptidoglycan layer.

How does the gram stain work in differentiating between cell types? (focus on cell walls)
Gram positive cells → alcohol dehydrates peptidoglycan which makes it less permeable (holds onto crystal violet iodine)
Gram negative cells → alcohol dissolves outer membrane & leaves holes in peptidoglycan (crystals leave peptidoglycan)

How do lysozyme and penicillin damage the cell wall?
Lysozyme → digests disaccharide in peptidoglycan, causing lysis
Penicillin → inhibits peptide bridges in peptidoglycan

What part of the phospholipid is hydrophilic in the plasma membrane?
The polar head

Bacterial plasma membranes are:
a. Impermeable
b. Semipermeable
c. Permeable

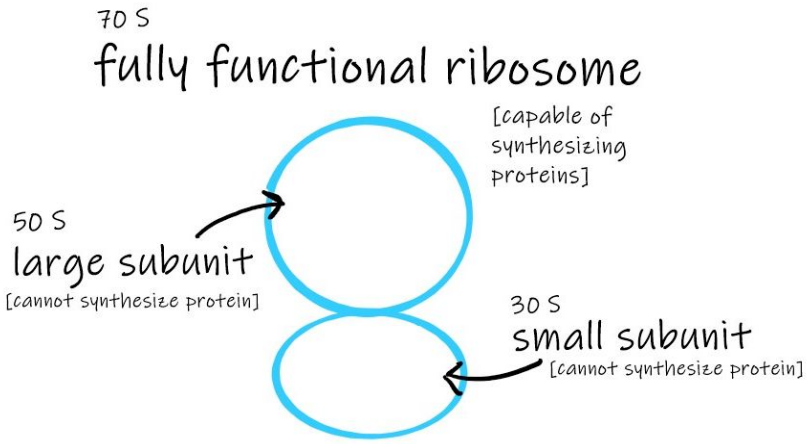


Explain the principles of osmosis.
Iso = equal concentrations on both sides
Hypo = concentration of solutes is lower outside the cell (swelling of cell occurs)
Hyper = concentration of solutes is higher outside the cell (shrinking of cell occurs)

The nucleoid is found in bacterial cells.

What is the plasmid?
A separate piece of DNA, circular and smaller than chromosome

Label the ribosome.




What are inclusions?
Reserve deposits (storage molecules)

*Part 2 (eukaryotes)*

Eukaryotes do not have cell walls.

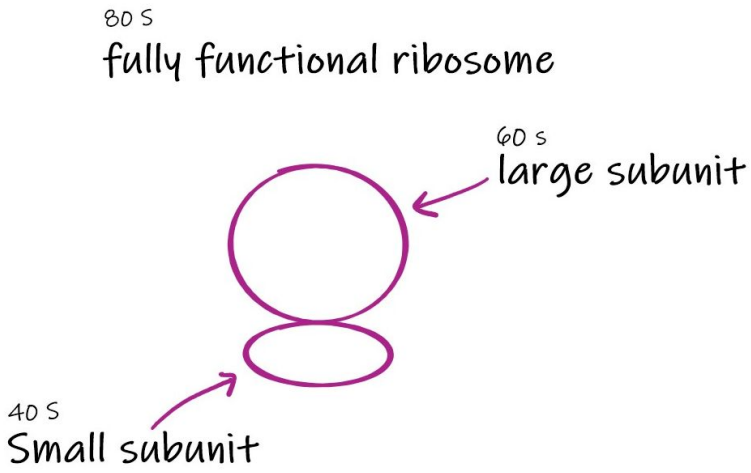
a. True
b. False

What does the plasma membrane contain?

- Peripheral proteins
- Integral proteins
- Transmembrane proteins
- Sterols
- Glycocalyx carbohydrates

What does the cytoplasm include?
Everything inside the plasma membrane, excluding the nucleus

Label the ribosome.




List the three types of endocytosis.
- Phagocytosis
- Pinocytosis
- Receptor-mediated

What is cytoplasmic streaming?
The movement of cytoplasm throughout cells (helps distribute nutrients)

Cytoskeleton provides support, shape, and transport of substances.

What is chromatin?
DNA wrapped around histones (proteins), appears a threadlike mass

Where is RNA synthesized?
The nucleolus

Where are proteins synthesized?
In the rough ER

What does the golgi complex do?
Modifies proteins & sends them to their final destinations

Define the following organelles:

- Lysosome → contains digestive enzymes
- Vacuole → brings food into cells, and stores food, water, and poisons
- Mitochondria → Cellular respiration

What are sacs of thylakoid called?
Grana

What organelles are part of the endosymbiotic theory?
Mitochondria & chloroplasts

# Chapter 5

*Part 1*

Differentiate between catabolism and anabolism.
Catabolism → breaks down larger molecules into smaller molecules (releases energy)
Anabolism → forms larger molecules from smaller molecules (consumes energy)

What type of reaction releases energy? What type consumes energy?
Exergonic reactions release energy
Endergonic reactions consume energy

Why is a hydrogen cation referred to as a "proton"?
Hydrogen atoms have 1 proton & 1 electron. When the atom loses the electron, it just has one proton and holds a +1 charge (protons have a positive charge). Therefore, $H^+$ is called a proton.

Explain the function of enzymes.
Enzymes are specific proteins that serve as catalysts.
Catalysts increase the rate of a chemical reaction by lowering the energy of activation (the amount of energy required to begin the reaction)

A substrate is a reactant molecule that participates in the reaction.

Dehydration/condensation reactions do what?
Form larger molecules from smaller ones (anabolic reaction, forms covalent bonds between molecules)
Releases $H_2O$

Hydrolysis reactions do what?
Breaks down larger molecules into smaller ones (catabolic reaction, breaks bonds)
Requires $H_2O$

Define denaturation.
The breaking of weak bonds in enzymes

Holoenzymes contain:
Apoenzyme + cofactor

What does catalase do?
Breaks down $H_2O_2$ (hydrogen peroxide)

List the substrate and action of the following enzymes.

- Lactase → Breaks lactose (substrate) down into glucose and galactose.
- Penicillinase → substrate is penicillin, hydrolyzes beta-lactam ring

constitutive enzymes are always present, while regulated enzymes are not constantly present.

Explain the difference between competitive and noncompetitive inhibition.
Competitive inhibition → a substance that resembles the normal substrate competes with the substrate for the active site
Noncompetitive inhibition → a substance that binds to a separate site (not the active site) that changes the shape of the enzyme & active site (regulates the enzyme)

Metabolic pathways can be shut down by negative feedback inhibition.

List the forms of energy.

- Thermal
- Radiant
- Electrical
- Mechanical
- Atomic
- Chemical

What type of energy is in ATP?
Chemical energy

Release of chemical energy occurs through the breakdown of nutrients.

Explain cellular respiration.
Cellular respiration refers to two processes that harvest the energy from digested food molecules
Processes → aerobic (requires oxygen) & anaerobic (doesn't require oxygen)

In aerobic respiration, one glucose molecule produces 38 ATP.

ADP is phosphorylated when converting to ATP.

What makes up the ATP molecule?
Nitrogenous base (adenine)
5-carbon sugar (ribose)
3 phosphate groups

Define the following.
- Reduction → gains an electron
- Oxidation → loses an electron
- Redox reaction → (reduction-oxidation reaction) consists of an electron donor & electron acceptor

Name the coenzymes that are electron carriers during cellular respiration.
NAD, FAD, & coenzyme-A

*Part 2*

List the steps of aerobic & anaerobic respiration.
Glycolysis, citric acid cycle, & electron transport chain (ETC)

Fermentation is a type of cellular respiration.
a. True
b. False

What undergoes aerobic respiration?
a. Eukaryotes
b. Prokaryotes
c. Neither
d. Both

What undergoes anaerobic respiration?

a. Eukaryotes
b. Prokaryotes
c. Neither
d. Both

What undergoes alcoholic fermentation?

a. Bacteria
b. Eukaryotes
c. Yeasts
d. B & C
e. A & C
f. They all do

What undergoes lactic acid fermentation?

a. Bacteria
b. Fungi
c. Animal muscle cells
d. Protists
e. A & B
f. B & D
g. A, C, & D
h. A, B, & C

Where does glycolysis and the citric acid cycle occur in prokaryotes?
The cytoplasm

In eukaryotes, glycolysis occurs in the cytoplasm and the citric acid cycle occurs in the mitochondria.

What are the products of glycolysis?
Two pyruvate molecules

What is the net gain of ATP from glycolysis?
2 ATP

What is the final electron acceptor of aerobic respiration?
Oxygen

The two-carbon compound is (oxidized/reduced) prior to the citric acid cycle.

What joins onto the two-carbon compound before entering the citric acid cycle?
Coenzyme-A

What is the yield from the citric acid cycle?
2 ATP, 6 NADH, 2 $FADH_2$

Explain chemiosmosis.
The electron transport carriers shuttle the electrons, actively pumping $H^+$ across the inner mitochondrial membrane (in eukaryotes) or cell membrane (in prokaryotes). This creates a concentration gradient of $H^+$, and the $H^+$ diffuses down the concentration gradient (back through the ATP synthase complex, which causes it to rotate and resulting in the production of ATP)

How is water produced in aerobic ETC?
Oxygen picks up 2 electrons from the ETC, then picks up 2 $H^+$ from the solution, forming a water molecule.

How is fermentation different from anaerobic respiration?
Fermentation doesn't include the citric acid cycle or ETC, has organic compound as the final electron acceptor (citric acid cycle has inorganic compounds)

Which is the chemical equation of photosynthesis?

a. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

b. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$