

SCIE1106: Molecular Biology of the Cell

Theme 1: Lecture schedule and learning materials

Structure of Eukaryotic & Prokaryotic Cells 1

- **Apply criteria that describe living “things”.**
 - Can reproduce.
 - Can respond to stimuli.
 - Can grow and develop.
 - Can transform matter and energy.
 - Display homeostasis = maintain a relatively constant internal environment.
 - Are highly organised.
 - Show adaptations to their environment.
 - Are made up of cells.
- **Memorize that cells are the basic unit of life.**
 - Huge variety of sizes, forms and functions.
 - Membrane-enclosed units → separation of cellular contents from the environment.
 - Contain cytoplasm.
- **Give a brief overview of the basic chemistry shared by all cells.**
 - All store their genetic material as DNA.
 - Same basic genetic mechanisms.
 - Genetic material is replicated and passed on via cell division.
 - Information flow uses the same chemical machinery.
 - All contain the same 20 amino acids.
- **Explain why cells are so similar in chemistry and composition**
 - Same common ancestor (3.5 billion years ago)
 - Evolution resulted in divergence, modification, adaptation and specialization.
 - Family tree of life contains 3 major divisions: eubacteria, archaea, eukaryotes.
- **Memorize, identify and contrast characteristics of prokaryotic and eukaryotic cells.**
 - **Prokaryotes**
 - Lack a nucleus and intracellular organelles → only have a cell wall, cytoplasm, cytoskeleton, plasma membrane, ribosomes, and flagellum.
 - Circular DNA in nucleoid in cytosol.

- Most diverse group with many growth forms.
- Circular DNA in nucleoid in cytosol.
- Quick reproduction
- Use many energy sources
 - Organotrophic = organic molecules.
 - Lithotrophic = inorganic molecules
 - Phototrophic = light
- Eubacteria (*common environments*) and archaea bacteria (*hostile environments*).
- **Eukaryotes**
 - Have a nucleus and intracellular organelles → mitochondria, chloroplasts, endoplasmic reticulum, golgi apparatus, endomembrane system.
 - Animals, plants, and fungi.
- **Explain the roles of cellular structures found in prokaryotic and eukaryotic cells.**
 - **Cytoplasm and cytosol**
 - Cytoplasm = entire content within the cell membrane excluding the nucleus.
 - Cytosol = molecules crowded together forming water-based gel.
 - Eukaryotes → cytosol is the fluid part of the cytoplasm. Organelles are excluded.
 - Prokaryotes → cytoplasm = cytosol.
 - Many chemical reactions occur (*glycolysis, protein synthesis*).
 - **Ribosomes**
 - Protein syntheses.
 - Eukaryotes are larger (80S) than prokaryotes (70S).
 - Cytosolic = free or attached to endoplasmic reticulum (80S).
 - In mitochondria/chloroplasts = bacterial size (70S).
 - **Cytoskeleton**
 - Provide structure and organise internal space.
 - Made up of proteins forming filamentous structures.
 - **In eukaryotes:**
 - *Actin filaments (7nm)* = respond to stimuli; reorganize and change shape of cell; allows movement.
 - *Intermediate filaments (10nm)* = support nuclear envelope; attachment for chromosomes; distribute force to cytosol preventing tearing.

- *microtubules (25nm)* = organise cytoplasm; intracellular transport; maintain structure; form mitotic spindle, backbone of cilia and flagella.
- **Describe the composition and roles of cellular membranes.**
 - Cell signalling.
 - Transport of solutes via transport proteins.
 - Movement and cell growth.
 - *Double membranes* = nucleus, mitochondria, chloroplasts.
 - **Selectively permeable:**
 - Small nonpolar molecules can cross freely.
 - Only some small uncharged polar molecules can cross freely.
 - Large uncharged polar molecules can hardly cross.
 - Charged molecules and ions cannot cross except through transport proteins.
 - *Integral proteins* = embedded in the bilayer.
 - *Peripheral proteins* = attached to the bilayer.
 - *Glycolipids* = carbohydrates attached to lipids.
 - *Glycoproteins* = carbohydrates attached to proteins.
 - Cell signalling.
 - Protection from chemical and mechanical damage.
 - Cell adhesion.

Structure of Eukaryotic & Prokaryotic Cells 2

- **Remember single membrane organelles and their functions.**
 - **Endoplasmic reticulum**
 - Flattened sacs and cisterna; in cytosol; connected to nuclear membrane.
 - Synthesize membrane lipids and export of molecules.
 - *Rough ER* → ribosomes → proteins synthesized + carbohydrate addition to proteins.
 - *Smooth ER* → no ribosomes → lipid synthesis.
 - **Golgi apparatus**
 - Stacks of cisternae.
 - *Cis face* = vesicles arrive from ER.
 - *Trans face* = vesicles pinch off and move towards plasma membrane.
 - Routing of proteins to intracellular locations.