

CHAPTER 1

Cell Theory

1) All organisms are composed of one or more cells.

2) The cell is the structural unit of life.

3) Cells arise only by division from a pre-existing cell.

* HeLa: first human cells for extended culturing (Immortalized).

* The molecular structure of genes allows for changes in genetic information (mutations) that lead to variation among individuals, which forms the basis of biological evolution.

* In division; each daughter cell receives a complete and equal share of genetic information.

* Cell's metabolism (The sum total of the chemical reactions in a cell).

* Cells are very active, they can:-

1) transport materials.

2) assemble and disassemble structures.

3) move itself from one site to another.

Activities are based on dynamic, mechanical changes within cells.

* Motor proteins are used for mechanical activities.

* chemotaxis (A single-celled protist can move away from an object in its path or toward nutrients).

* Hormones, growth factors, extracellular materials, and substances on the surfaces of other cells can interact with receptors, thus stimulates the cell.

* Cells may respond to stimuli by altering their metabolism, moving from one place to another, or even committing suicide (apoptosis).

* Feedback circuits serve to return the cell to the appropriate state.

- Methanogens: convert CO_2 and H_2 into methane.

- Domain Bacteria includes the smallest known cells (mycoplasma) which lack a cell wall.

- Cyanobacteria gave rise to green plants and an oxygen-rich atmosphere, and some are capable of nitrogen fixation.

- The genes present in the microbes of a given habitat can be sequenced, generating a collective genome, or metagenome.

- microbiome (the collection of microbes living on us).

- Functions of proteins encoded by these microbial genomes include:-

1) the synthesis of vitamins.

2) the breakdown of complex plant sugars.

3) prevention of growth of pathogenic organisms.

prokaryotic

eukaryotic

* common features *

- Surrounded by a rigid cell wall (in plant cells).
- Plasma membrane of similar construction.
- Genetic information are identical.
- Similar mechanisms for transcription and translation (similar ribosomes).
- Shared metabolic pathways (glycolysis and TCA cycle).
- similar apparatus for conservation of chemical energy as ATP (located in the plasma membrane of prokaryote and the mitochondrial membrane of eukaryote)
- similar mechanism for photosynthesis/synthesizing and inserting membrane proteins.
- similar proteasomes (protein digesting structures).
- cytoskeletal filaments built of proteins similar to actin and tubulin.

- relatively simple.
 - mostly nonsexual organisms.
 - divided by simple fission
 - have flagella
- but they differ in
- have a nucleoid region
 - have a single, circular DNA.

- The mitotic spindle allows each daughter cell to receive an equivalent array of genetic material. →
- have no processes comparable to meiosis, gamete formation, or true fertilization.
- are more adept at picking up and incorporating foreign DNA, which has had considerable impact on microbial evolution.

- * Archaea that live in inhospitable environments "extremophiles".
- * Halophiles: Live in salty environments
- * Acidophiles: thrive at a pH as low as 0.
- * Thermophiles: Live at very high temperatures.
- * Hyperthermophiles: Live in the hydrothermal vents of the ocean floor up to a temperature of 121°C.

- more complex
- have membrane-bounded organelles and complex cytoskeletal proteins.
- divided by mitosis
- use both cytoplasmic movement, and cilia and flagella.
- both form and mechanism
- have membrane-bound nucleus.
- have many chromosomes (DNA + Protein)
- Division of cells into nucleus and cytoplasm separated by nuclear envelope.
- complex chromosomes.
- membranous cytoplasmic organelles (endoplasmic reticulum, Golgi complex, lysosomes, endosomes, peroxisomes and glyoxisomes).
- specialized cytoplasmic organelles for aerobic respiration (mitochondria) and photosynthesis (chloroplasts).
- complex cytoskeletal system (intermediate and actin filaments, microtubules.)
- phagocytosis (Ability to ingest material).
- cellulose-containing cell walls.
- diploidy.
- presence of three different RNA synthesizing enzyme (RNA polymerase)
- sexual reproduction requiring meiosis and fertilization.

The most complex eukaryotic cells: protist because it is unicellular.

Example: Vorticella (have a contractile ribbon and a large macronucleus).

* Model organisms *

- bacterium: *Escherichia coli*
- yeast: *Saccharomyces*
- mustard plant: *Arabidopsis*
- mouse: *Mus musculus*
- fruit fly: *Drosophila*
- nematode: *Caenorhabditis elegans*.

* The cell size is limited by the -

- 1) Volume of cytoplasm that can be supported by the genes in nucleus.
- 2) // // // // // // // // exchange of nutrients.
- 3) distance over which substances can efficiently travel through the cytoplasm via diffusion.

* Synthetic Biology is a field oriented to create a living cell in the laboratory and develop novel life forms.