

AP Biology Notes: The Cell Cycle and Homeostasis

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Three Things to Know about The Cell Cycle:

1. Interphase consists of three stages: G₁ (first gap phase), S (synthesis, in which DNA replication occurs), and G₂ (second gap phase). Interphase is followed in somatic cells by mitosis.
2. Mitosis is the process in which a cell produces two identical daughter cells. Its stages include prophase, metaphase, anaphase, and telophase. Cytokinesis occurs immediately following mitosis and refers to the splitting of the cell into two new cells.
3. Meiosis refers to the process by which sexually reproducing organisms produce sex cells (gametes) with half the chromosomes (haploid) of the rest of the organism's cells (which are diploid). It consists of two rounds of division, meiosis I and meiosis II, and it results in the creation of four gametes. In sexual reproduction, the male and female gametes join to create a new organism with the normal diploid number of chromosomes.

Five Things to Know about Homeostasis:

1. Homeostasis is the process by which a stable internal environment is maintained within an organism. Our primary homeostatic organs are the kidneys, liver, large intestine, and skin.
2. There are three laws of thermodynamics. Together they discuss the conservation of energy, entropy, and absolute zero.
3. Bioenergetics, or biological thermodynamics, studies how chemical energy is broken down and converted to usable energy within the biological system. This can be at the ecosystem, organismal, or cellular level.
4. Chemiosmosis produces energy from the movement of H⁺ ions across a membrane down a concentration gradient in both photosynthesis and respiration. Catabolism is the breaking down of complex substances into simple substances, making energy available in the process.
5. Thermoregulation refers to the physiological processes that come together to maintain a stable body temperature in warm-blooded animals.

The Cell Cycle: Interphase

- **Somatic cell:** Any cell that is not a reproductive cell
- **Interphase:** The cellular phase between meiotic or mitotic divisions
- **Chromatid:** One of the two strands that constitute a chromosome; chromatids are held together by the centromere

The Cell Cycle: Mitosis

- **Mitosis:** A type of nuclear division that is characterized by complex chromosomal movement and the exact duplication of chromosomes; occurs in somatic cells
- **Prophase:** A mitotic or meiotic stage in which the chromosomes become visible and during which the spindle fibers form; synapsis takes place during the first meiotic prophase
- **Metaphase:** A stage of mitosis; chromosomes line up at the equator of the cell
- **Anaphase:** The stage in mitosis that is characterized by the migration of chromatids to opposite ends of the cell; the stage in meiosis during which homologous pairs migrate (anaphase I); and the stage in meiosis during which chromatids migrate to different ends of the cell (anaphase II)
- **Telophase:** A mitotic stage in which nuclei reform and the nuclear membrane reappears
- **Cytokinesis:** A process by which the cytoplasm and the organelles of the cell divide; the final stage of mitosis
- **Chromatin:** A nuclear protein of chromosomes that stains readily
- **Spindle:** A structure that arises during mitosis and helps separate the chromosomes; composed of tubulin

The Cell Cycle: Meiosis

- **Meiosis:** A process of cell division whereby each daughter cell receives only one set of chromosomes; the formation of gametes
- **Gamete:** A sex or reproductive cell that must fuse with another of the opposite type to form a zygote, which subsequently develops into a new organism
- **Haploid:** Describes cells (gametes) that have half the chromosome number (N) typical of the species
- **Diploid:** Describes cells that have a double set of chromosomes in homologous pairs (2N)

- **Nucleolus:** A dark-staining small body within the nucleus; composed of RNA
- **Nuclear membrane:** A membrane that envelopes the nucleus and separates it from the cytoplasm; present in eukaryotes
- **Synapsis:** The pairing of homologous chromosomes during meiosis
- **Tetrad:** A pair of chromosome pairs present during the first metaphase of meiosis
- **Crossing over:** The exchange of parts of homologous chromosomes during meiosis
- **Chi-square analysis:** Test to see if a theory is backed up by experimental results
- **Degree of freedom (d.f.):** Independent statistical category; the number of categories of observation minus one

Homeostasis: Coupled Reactions and Chemiosmosis

- **Coupled reaction:** Chemical reaction in which energy is transferred from one side of the reaction to the other through a common intermediate
- **Chemiosmosis:** The coupling of enzyme-catalyzed reactions
- **ATPase:** Adenosine triphosphatase; enzyme that catalyzes the hydrolysis of ATP to ADP, thereby releasing energy
- **Intermembrane space:** Space between the outer and inner membranes of a mitochondrion
- **Electron transport chain:** A complex carrier mechanism located on the inside of the inner mitochondrial membrane of the cell; releases energy and is used to form ATP
- **Thylakoid space:** An inner compartment formed from the connected spaces between flattened sacs called thylakoids in chloroplasts
- **Photophosphorylation:** The synthesis of ATP using radiant energy absorbed during photosynthesis
- **Catabolism:** Metabolic breakdown of complex molecules into simple ones, releasing energy
- **Anaerobic catabolism:** Metabolic breakdown of complex molecules into simple ones without the use of oxygen; results in the release of energy
- **Aerobic catabolism:** aerobic catabolism Metabolic breakdown of complex molecules into simple ones through the use of oxygen; results in the release of energy

Homeostasis: Feedback Mechanisms

- **Feedback mechanism:** The process by which a certain function is regulated by the amount of the substance it produces

Homeostasis: Thermoregulation

- **Thermoregulation:** The ways in which organisms regulate their internal heat
- **Adrenaline (epinephrine):** An “emergency” hormone stimulated by anger or fear; increases blood pressure and heart rate to supply the emergency needs of the muscles