Biology

This post was written with ChatGPT.

Below is a concise, 100-point summary of key topics, principles, and terms typically covered in a high school (or introductory) biology course. Each point aims to highlight an essential concept relevant to foundational biology studies.

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1. Biology: The scientific study of living organisms and their interactions with the environment.
2. Cell Theory:
    1) All living things are composed of cells,
    2) Cells are the basic units of life,
    3) New cells arise from existing cells.
3. Prokaryotes vs. Eukaryotes:
    - Prokaryotes lack a membrane-bound nucleus (e.g., bacteria).
    - Eukaryotes have a nucleus and membrane-bound organelles (e.g., plant and animal cells).
4. Cell Membrane: A phospholipid bilayer that regulates what enters and leaves the cell.
5. Cytoplasm: The jelly-like substance within a cell, containing organelles and cytosol.
6. Nucleus: The control center of a eukaryotic cell, containing the cell' s genetic material (DNA).
7. Mitochondria: Organelles responsible for cellular respiration and energy (ATP) production.
8. Chloroplasts: Organelles in plant cells that carry out photosynthesis.
9. Ribosomes: Sites of protein synthesis; can be free in the cytoplasm or attached to the rough endoplasmic reticulum (ER).
10. Endoplasmic Reticulum (ER): A network of membranes; rough ER synthesizes proteins, smooth ER synthesizes lipids.
11. Golgi Apparatus: Modifies, sorts, and packages proteins and lipids for transport or secretion.
12. Lysosomes: Contain enzymes that break down waste materials and cellular debris.
13. Vacuoles: Storage organelles in cells; in plants they are large and central, storing water and nutrients.

14. Cell Wall: A rigid layer outside the cell membrane in plants, fungi, and some bacteria; provides support and protection.
15. Diffusion: The movement of molecules from high to low concentration (passive transport).
16. Osmosis: The diffusion of water across a selectively permeable membrane.
17. Active Transport: Movement of substances against their concentration gradient, requiring energy (ATP).
18. Photosynthesis: Conversion of light energy, CO , and H O into glucose and O (occurs in chloroplasts).
19. Cellular Respiration: The breakdown of glucose to produce ATP; includes glycolysis, Krebs cycle, and oxidative phosphorylation.
20. Aerobic vs. Anaerobic Respiration:

- Aerobic uses oxygen, producing more ATP.

- Anaerobic occurs without oxygen (fermentation), producing less ATP.

21. ATP (Adenosine Triphosphate): The main energy currency of cells.
22. Enzymes: Biological catalysts that speed up chemical reactions without being consumed.
23. Activation Energy: The energy needed to start a chemical reaction; lowered by enzymes.
24. Lock-and-Key Model: Describes how enzymes (locks) bind specific substrates (keys).
25. Carbohydrates: Sugars and starches; primary energy source, composed of carbon, hydrogen, and oxygen (e.g., glucose).
26. Lipids: Fats, oils, and waxes; used for long-term energy storage, insulation, and cell membranes.
27. Proteins: Polymers of amino acids; serve as enzymes, structural components, transport molecules, and more.
28. Nucleic Acids: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid); store and transmit genetic information.
29. DNA Structure: A double helix made up of nucleotide subunits (adenine, thymine, cytosine, guanine).
30. RNA: Single-stranded nucleic acid involved in protein synthesis (mRNA, tRNA, rRNA).
31. Replication: The process by which DNA makes a copy of itself before cell division.
32. Transcription: DNA is used to synthesize messenger RNA (mRNA).

33. Translation: mRNA is decoded by ribosomes to assemble amino acids into a polypeptide (protein).
34. Genes: Segments of DNA coding for specific proteins or traits.
35. Chromosomes: DNA molecules wrapped around proteins; carry genetic information.
36. Chromosome Number:

- Haploid (n) cells have one set of chromosomes (e.g., gametes).
- Diploid (2n) cells have pairs of chromosomes (e.g., somatic cells).

37. Cell Cycle: The series of events in cell growth and division; includes interphase and mitosis.
38. Interphase: G (growth), S (DNA replication), and G (preparation for division).
39. Mitosis: Division of the nucleus into two identical daughter nuclei (prophase, metaphase, anaphase, telophase).
40. Cytokinesis: Division of the cell' s cytoplasm, resulting in two separate cells.
41. Meiosis: Special cell division producing gametes (sperm, eggs); halves the chromosome number.
42. Genetics: The study of heredity and variation.
43. Mendel' s Laws:

- Law of Segregation: Alleles separate during gamete formation.
- Law of Independent Assortment: Genes for different traits sort independently.

44. Alleles: Different versions of a gene.
45. Dominant vs. Recessive: Dominant alleles mask recessive alleles in heterozygous conditions.
46. Genotype: The genetic makeup (e.g., AA, Aa, aa).
47. Phenotype: The observable characteristics (e.g., flower color).
48. Homozygous vs. Heterozygous:

- Homozygous: two identical alleles (AA or aa).
- Heterozygous: two different alleles (Aa).

49. Punnett Square: A tool to predict offspring genotype and phenotype ratios.

50. Codominance: Both alleles are fully expressed in heterozygotes (e.g., AB blood type).
51. Incomplete Dominance: Heterozygote has an intermediate phenotype (e.g., pink flowers from red and white parents).
52. Sex-Linked Traits: Traits carried on sex chromosomes (often the X chromosome).
53. Pedigree: A diagram tracing the inheritance of a trait through generations.
54. Mutation: A change in the DNA sequence; can be harmful, beneficial, or neutral.
55. Evolution: Change in allele frequencies within a population over time.
56. Natural Selection: Mechanism of evolution; individuals with advantageous traits are more likely to survive and reproduce.
57. Darwin's Observations: Variation among individuals, overproduction of offspring, competition, differential survival.
58. Adaptation: Heritable trait increasing an organism's fitness (survival and reproduction).
59. Speciation: The formation of new species due to reproductive isolation and genetic divergence.
60. Fossils: Remains or traces of ancient organisms; evidence for evolution.
61. Homologous Structures: Similar anatomical features in different species, indicating common ancestry.
62. Analogous Structures: Similar function but different evolutionary origins (e.g., butterfly wing vs. bird wing).
63. Vestigial Structures: Reduced or unused features that hint at an organism's evolutionary past (e.g., human appendix).
64. Classification (Taxonomy): Organizing living things into groups (domain, kingdom, phylum, etc.).
65. Domains: Bacteria, Archaea, Eukarya—broadest categories of life.
66. Kingdoms: Commonly include Animalia, Plantae, Fungi, Protista, and sometimes Monera (or split into Bacteria, Archaea).
67. Viruses: Non-cellular entities that replicate inside host cells; not classified as living organisms by most biologists.
68. Bacteria: Single-celled prokaryotes; can be beneficial (gut flora) or pathogenic (disease-causing).
69. Protists: Mostly single-celled eukaryotes (amoeba, algae, etc.).
70. Fungi: Absorptive heterotrophs with chitin cell walls (mushrooms, molds, yeast).
71. Plants: Multicellular, photosynthetic autotrophs with cell walls made of cellulose.

72. Animals: Multicellular heterotrophs lacking cell walls.
73. Photosynthetic Pigments: Chlorophyll (green), carotenoids (orange/yellow), etc.
74. Plant Tissues: Dermal (protection), vascular (xylem/phloem for transport), ground (storage and support).
75. Xylem: Conducts water and minerals from roots to leaves.
76. Phloem: Transports sugars and other organic nutrients.
77. Transpiration: Loss of water vapor from plant leaves through stomata.
78. Stomata and Guard Cells: Regulate gas exchange and water loss in leaves.
79. Animal Tissues: Epithelial (covering), connective (support), muscle (movement), nervous (signal transmission).
80. Homeostasis: Maintenance of a stable internal environment (e.g., body temperature, pH, glucose).
81. Nervous System: Brain, spinal cord, nerves; coordinates body responses.
82. Endocrine System: Glands secreting hormones regulating growth, metabolism, reproduction.
83. Respiratory System: In many animals, lungs (or gills) exchange O and CO with the environment.
84. Circulatory System: Heart, blood vessels, and blood; transports nutrients, gases, wastes.
85. Immune System: Defends against pathogens; includes white blood cells, antibodies.
86. Digestive System: Breaks down food into nutrients; involves mouth, stomach, intestines.
87. Excretory System: Removes waste and regulates water balance (e.g., kidneys in vertebrates).
88. Reproductive System: Produces offspring; sexual or asexual reproduction.
89. Growth and Development: Involves cell division and differentiation; regulated by genes and hormones.
90. Behavior: Animal responses to environmental stimuli, can be innate or learned.
91. Ecology: Study of interactions among organisms and their environment.
92. Population: Members of the same species living in a given area.
93. Community: All the different species populations in a particular area.
94. Ecosystem: A community plus its physical environment (biotic + abiotic factors).
95. Food Chain: Linear sequence of who eats whom (producer $\rightarrow$ primary consumer $\rightarrow$ secondary consumer $\cdots$).
96. Food Web: More complex representation of feeding relationships in an ecosystem.

97. Energy Pyramid: Illustrates energy transfer between trophic levels; most energy is lost as heat.
98. Biogeochemical Cycles: Cycles of matter, such as carbon, nitrogen, water cycles.
99. Biodiversity: The variety of life in an area; crucial for ecosystem resilience.
100. Conservation Biology: The study and protection of biodiversity, addressing habitat loss, climate change, etc.

These 100 points outline fundamental concepts in biology, from cellular and molecular levels to ecological and evolutionary processes, providing a broad base for further study in life sciences.