

# High School: Foundations of Biology

Adopted 2018

## High School - Foundations of Biology

### 1. History of Biology and Impacts on Society **FB.1**

- 1A. Students will relate the importance of significant historical biological experiments and their impact of these on research, development, and society. **FB.1A**
  1. Identify and communicate the contributions of famous scientists and their experiments that formed fundamental scientific principles (e.g., Robert Hooke, Schleiden/ Schwann/Virchow, Griffith, Avery/MacLeod/McCarty, Hershey/Chase, Rosalind Franklin, Gregor Mendel, Watson/Crick, Pasteur, and Charles Darwin). **FB.1A.1**
  2. Trace and model the historical development of scientific ideas and theories (e.g., creation of the microscope, discovery of cells/cell theory, discovery of DNA/RNA, double helical shape of DNA, evolution/natural selection, endosymbiosis) through the development of a timeline. **FB.1A.2**
  3. Research, analyze, explain, and communicate how scientific enterprise relates to society and classic inventions (e.g., microscope, blood typing, gel electrophoresis equipment, DNA sequencing technology). **FB.1A.3**
  5. Enrichment: Research, analyze, explain, and communicate the influence of society, including cultural components, on the direction and progress of science and technology (e.g., medical treatments, emerging viruses, antibiotic resistance, vaccinations and re-emergent diseases, alternative energy development, and/or biomimicry). **FB.1A.5**

---

## 2. The Chemistry of Life FB.2

2A. Students will demonstrate an understanding of the structure and interactions of matter and how the organization of matter supports living organisms. FB.2A

1. Develop and use simple atomic models to describe the components of elements (e.g., relative position, charges of protons, neutrons, and electrons). FB.2A.1
2. Obtain and use information about elements (e.g., chemical symbol, atomic number, atomic mass, and group or family) to describe the organization of the periodic table. FB.2A.2
3. Relate chemical reactivity to an element's position on the periodic table. Use this information to determine what type of bond will form between elements (ionic, covalent, hydrogen). FB.2A.3
4. Analyze and interpret data to classify common solutions as acids, bases, or neutral. Communicate the importance of pH in living systems. FB.2A.4
5. Investigate how the properties of water (e.g., cohesion, adhesion, heat capacity, solvent properties) contribute to the maintenance of living cells and organisms. FB.2A.5
6. Explain the role of the major biomolecules (carbohydrates, proteins -including enzymes, lipids, and nucleic acids) to the survival of living organisms. FB.2A.6
7. Enrichment: Explore the structure of biomolecules using molecular models. Relate the structure of biomolecules to their function in living things (discuss types bonding, importance of the strength and weakness of the bond in function, energy in bonds, enzyme function). FB.2A.7

---

### 3. Organization and Energy in Living Systems **FB.3**

- 3A. Students will demonstrate an understanding of how the structure of living organisms supports the essential functions of life. **FB.3A**
1. Compare and contrast prokaryotic/eukaryotic and plant/animal/bacteria cells. **FB.3A.1**
  2. Use models to investigate and explain structures within living cells that support life (e.g., cytoplasm, cell membrane, cell wall, nucleus, mitochondria, chloroplasts, lysosomes, Golgi, vacuoles, ER, ribosomes, chromosomes, centrioles, cytoskeleton, nucleolus, nuclear membrane). **FB.3A.2**
  3. Compare and contrast active and passive cellular transport. Analyze the movement of water across a cell membrane in hypotonic, isotonic, and hypertonic solutions. **FB.3A.3**
  5. Analyze the relationship between photosynthesis and cellular respiration and explain that relationship in terms of the need for all living things to acquire energy from their environment. **FB.3A.5**
  6. Use models to explain how ADP and ATP cycle to store and release chemical energy using inorganic phosphate. **FB.3A.6**
  7. Compare and contrast the processes and results of mitosis and meiosis. **FB.3A.7**
  8. Enrichment: Research and orally communicate the possible outcomes of a failure of mitosis (cancer) or meiosis (nondisjunction). **FB.3A.8**

---

### 4. Molecular Basis of Heredity **FB.4**

- 4A. Students will demonstrate an understanding of how genetic information is transferred from parent to offspring. **FB.4A**
1. Compare and contrast the basic structure and function of nucleic acids (e.g., DNA, RNA). **FB.4A.1**
  2. Obtain and communicate information illustrating the relationships among DNA, genes, chromosomes, and proteins to the basis of life. **FB.4A.2**
  3. Use models (e.g., Punnett squares) and mathematical reasoning to describe and predict patterns of inheritance of single genetic traits from parents to offspring (e.g., dominant, and recessive traits, incomplete dominance, codominance, multiple alleles, sex- linkage). **FB.4A.3**
  4. Obtain and communicate information to describe how mutations may affect genetic expression and provide examples. **FB.4A.4**
  5. Research and report genetic technologies that may improve the quality of life (e.g., genetic engineering, cloning, gene splicing, DNA testing). **FB.4A.5**
  6. Enrichment: Debate the pros and cons of using biotechnology to manipulate genetic information for human purpose (society). **FB.4A.6**

---

## 5. Biological Evolution FB.5

- 5A. Students will demonstrate an understanding of Earth's fossil record and its indication of the diversity of life over time. FB.5A
1. Investigate through research the contributions of scientists to the theory of evolution and evolutionary processes (e.g., Needham, Spallanzani, Redi, Pasteur, Lyell, Lamarck, Malthus, Wallace, Darwin). FB.5A.1
  2. Analyze and interpret data to support claims that different types of fossils provide evidence of the diversity of life that has existed on Earth and of the relationships between past and existing life on Earth. FB.5A.2
  3. Obtain and communicate information to explain how DNA evidence and fossil records support Darwin's theory of evolution. FB.5A.3
  4. Investigate how biological adaptations and genetic variations of traits in a population enhance the probability of survival in an environment (natural selection). FB.5A.4
  5. Enrichment: Create and analyze models that illustrate the relatedness between all living things (cladograms/phylogenetic trees). FB.5A.5

---

## 6. Ecological Principles FB.6

- 6A. Students will understand the interdependence of living organisms and their environment. FB.6A
1. Compare and contrast biotic and abiotic factors. FB.6A.1
  2. Use models to analyze the cycling of matter in an ecosystem (e.g., water, carbon dioxide/oxygen, nitrogen). FB.6A.2
  3. Obtain, evaluate, and communicate information to explain relationships that exist between abiotic and biotic components of an ecosystem. Explain how changes in biotic and abiotic components affect the balance of an ecosystem over time. FB.6A.3
  4. Develop and use models to discuss the climate, flora, and fauna of the terrestrial and aquatic biomes of the world. FB.6A.4
  5. Use models to analyze the flow of energy through food chains, webs, and pyramids. FB.6A.5
  6. Engage in scientific argument from evidence to distinguish organisms that exist in symbiotic (mutualism, parasitism, commensalism) or co-evolutionary (predator-prey, cooperation, competition, and mimicry) relationships within ecosystems. FB.6A.6
  7. Enrichment: Design solutions to reduce the impact of human activity on the ecosystem. FB.6A.7