

**Indiana High School Science  
Curriculum Standards, 2010**

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<b>Biology</b>		<b>Boardworks High School Biology Presentations</b>
<b>Standard 1: Cellular Chemistry</b>		
B.1.1 Describe the structure of the major categories of organic compounds which make up living organisms in terms of their building blocks and the small number of chemical elements (carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur) from which they are composed.		Lipids Monosaccharides Polysaccharides Nucleic Acids Proteins Water
B.1.2 Understand that the shape of a molecule determines its role in the many different types of cellular processes including metabolism, homeostasis, growth and development, and heredity, and understand that the majority of these processes involve proteins that act as enzymes.		Enzymes Proteins Enzyme Shapes
B.1.3 Explain and give examples of how the function and differentiation of cells is influenced by their external environment, including temperature, acidity and the concentration of certain molecules, and that changes in these conditions may affect how a cell functions.		Homeostasis Thermoregulation Glucoregulation Body Temperature Enzymes
<b>Standard 2: Cellular Structure</b>		
B.2.1 Describe features common to all cells that are essential for growth and survival, and explain their functions.		Organelles Eukaryotic Cells Prokaryotic Cells Cell Theory
B.2.2 Describe the structure of a cell membrane and explain how it regulates the transport of materials into and out of the cell and prevents harmful materials from entering the cell.		Organelles Osmosis The Fluid Mosaic Model Eukaryotic Cells Diffusion Active Transport Cell Theory
B.2.3 Explain that most cells contain mitochondria, the key sites of cellular respiration, where stored chemical energy is converted into useable energy for the cell and some cells, including many plant cells, contain chloroplasts, the key sites of photosynthesis, where the energy of light is captured for use in chemical work.		Photosynthesis 1 Photosynthesis 2 Organelles Aerobic Respiration

B.2.4 Explain that all cells contain ribosomes, the key sites for protein synthesis, where genetic material is decoded in order to form unique proteins.	Protein Synthesis Proteins Transcription and Translation
B.2.5 Explain that cells use proteins to form structures, including cilia, flagella, which allow them to carry out specific functions, including movement, adhesion, and absorption.	Proteins
B.2.6 Investigate a variety of different cell types and relate the proportion of different organelles within these cells to their functions.	Eukaryotic Cells Prokaryotic Cells Organelles Specialized Plant Cells
<b>Standard 3: Matter Cycles and Energy Transfer</b>	
B.3.1 Describe how some organisms capture the sun's energy through the process of photosynthesis by converting carbon dioxide and water into high energy compounds and releasing oxygen.	Photosynthesis 1 Photosynthesis 2
B.3.2 Describe how most organisms can combine and recombine the elements contained in sugar molecules into a variety of biologically essential compounds by utilizing the energy from cellular respiration.	Aerobic Respiration Photosynthesis 1 Photosynthesis 2
<i>B.3.3 Recognize and describe that metabolism consists of all of the biochemical reactions that occur inside cells, including the production, modification, transport, and exchange of materials that are required for the maintenance of life.</i>	–
B.3.4 Describe how matter cycles through an ecosystem by way of food chains and food webs and how organisms convert that matter into a variety of organic molecules to be used in part in their own cellular structures.	Food Chains Food Webs Energy Transfer in Food Chains Decomposers
B.3.5 Describe how energy from the sun flows through an ecosystem by way of food chains and food webs and only a small portion of that energy is used by individual organisms while the majority of energy is lost as heat.	Food Chains Food Webs Energy Transfer in Food Chains Energy Loss in Food Chains
<b>Standard 4: Interdependence</b>	
B.4.1 Explain that the amount of life an environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the remains of dead organisms.	Ecosystems Decomposers
B.4.2 Describe how human activities and natural phenomena can change the flow and of matter and energy in an ecosystem and how those changes impact other species.	Human Impact on the Environment Climate Change Loss of Diversity Ecosystems Describing Populations

B.4.3 Describe the consequences of introducing non-native species into an ecosystem and identify the impact it may have on that ecosystem.	Extinction Describing Populations
B.4.4 Describe how climate, the pattern of matter and energy flow, the birth and death of new organisms, and the interaction between those organisms contribute to the long term stability of an ecosystem.	Ecosystems Ecosystems and Succession Describing Populations Carbon Cycle Food Chains Food Webs Nitrogen Cycle Water Cycle Predator-Prey Relationships Host-Parasite Relationships
<b>Standard 5: Molecular Basis of Heredity</b>	
B.5.1 Describe the relationship between chromosomes and DNA along with their basic structure and function.	DNA
B.5.2 Describe how hereditary information passed from parents to offspring is encoded in regions of DNA molecules called genes.	DNA Genes and Alleles
B.5.3 Describe the process by which DNA directs the production of protein within a cell.	Controlling Protein Synthesis Protein Synthesis Transcription and Translation
B.5.4 Explain how the unique shape and activity of each protein is determined by the sequence of its amino acids.	Controlling Protein Synthesis Protein Synthesis Proteins
B.5.5 Understand that proteins are responsible for the observable traits of an organism and for most of the functions within an organism.	Proteins
B.5.6 Recognize that traits can be structural, physiological or behavioral and can include readily observable characteristics at the organismal level or less recognizable features at the molecular and cellular level.	Animal Adaptations Plant Adaptations Behavior Boy or Girl Cells to Organisms Classification DNA Environmental Variation Genes and Alleles Genetic Variation Understanding Genomes

<b>Standard 6: Cellular Reproduction</b>	
B.6.1 Describe the process of mitosis and explain that this process ordinarily results in daughter cells with a genetic make-up identical to the parent cells.	Mitosis The Stages of Mitosis
B.6.2 Understand that most cells of a multicellular organism contain the same genes, but develop from a single cell (e.g., a fertilized egg) in different ways due to differential gene expression.	Genetic Variation Cell Differentiation
B.6.3 Explain that in multicellular organisms the zygote produced during fertilization undergoes a series of cell divisions that lead to clusters of cells that go on to specialize and become the organism's tissues and organs.	Cell Differentiation Cells to Organisms
B.6.4 Describe and model the process of meiosis and explain the relationship between the genetic make-up of the parent cell and the daughter cells (gametes).	Meiosis The Stages of Meiosis
B.6.5 Explain how, in sexual reproduction, crossing over, independent assortment, and random fertilization, result in offspring that are genetically different from the parents.	Meiosis The Stages of Meiosis
<b>Standard 7: Genetics</b>	
B.7.1 Distinguish between dominant and recessive alleles and determine the phenotype that would result from the different possible combinations of alleles in an offspring.	Genes and Alleles Patterns of Inheritance Gregor Mendel
B.7.2 Describe dominant, recessive, codominant, sex-linked, incompletely dominant, multiply allelic, and polygenic traits and illustrate their inheritance patterns over multiple generations.	Genes and Alleles Patterns of Inheritance Incomplete Dominance and Codominance
B.7.3 Determine the likelihood of the appearance of a specific trait in an offspring given the genetic make-up of the parents.	Patterns of Inheritance
B.7.4 Explain the process by which a cell copies its DNA and identify factors that can damage DNA and cause changes in its nucleotide sequence.	DNA Replication 1 DNA Replication 2 Genetic Mutations
B.7.5 Explain and demonstrate how inserting, substituting or deleting segments of a DNA molecule can alter a gene, which is then passed to every cell that develops from it and that the results may be beneficial, harmful or have little or no effect on the organism.	Genetic Mutations
<b>Standard 8: Evolution</b>	
<i>B.8.1 Explain how anatomical and molecular similarities among organisms suggests that life on earth began as simple, one-celled organisms about 4 billion years ago and multicellular organisms evolved later.</i>	—
B.8.2 Explain how organisms are classified and named based on their evolutionary relationships into taxonomic categories.	Classification

B.8.3 Use anatomical and molecular evidence to establish evolutionary relationships between organisms.	Evolution The Process of Evolution Fossil Record
<i>B.8.4 Understand that molecular evidence supports the anatomical evidence for these evolutionary relationships and provides additional information about the order in which different lines of descent branched.</i>	–
B.8.5 Describe how due to genetic variations, environmental forces, and reproductive pressures, organisms with beneficial traits are more likely to survive, reproduce, and pass on their genetic information.	Genetic Variation Evolution The Process of Evolution Population Genetics
B.8.6 Explain how genetic variation within a population (a species) can be attributed to mutations as well as a random assortment of existing genes.	Genetic Variation Genetic Mutations What is a Species?
B.8.7 Describe the modern scientific theory of the origins and history of life on earth, and evaluate the evidence that supports it.	Evolution The Process of Evolution Fossil Record

### Curriculum Standards, 2006

<b>Molecules and Cells</b>	
B.1.1 Recognize that and explain how the many cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. Understand that different parts of the genetic instructions are used in different types of cells and are influenced by the cell's environment and past history.	Cell Differentiation Controlling Protein Synthesis Protein Synthesis Transcription and Translation
B.1.2 Explain that every cell is covered by a membrane that controls what can enter and leave the cell. Recognize that in all but quite primitive cells, a complex network of proteins provides organization and shape. In addition, understand that flagella and/or cilia may allow some Protista, some Monera, and some animal cells to move.	The Fluid Mosaic Model Eukaryotic Cells Prokaryotic Cells Organelles
B.1.3 Know and describe that within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback, and movement. In addition to these basic cellular functions common to all cells, understand that most cells in multicellular organisms perform some special functions that others do not.	Cell Differentiation Eukaryotic Cells Prokaryotic Cells Organelles

B.1.4 Understand and describe that the work of the cell is carried out by the many different types of molecules it assembles, such as proteins, lipids, carbohydrates, and nucleic acids.	Proteins Lipids Nucleic Acids Monosaccharides Polysaccharides
B.1.5 Demonstrate that most cells function best within a narrow range of temperature and acidity. Note that extreme changes may harm cells, modifying the structure of their protein molecules and therefore, some possible functions.	Homeostasis Enzymes
B.1.6 Show that a living cell is composed mainly of a small number of chemical elements – carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur. Recognize that carbon can join to other carbon atoms in chains and rings to form large and complex molecules.	Monosaccharides Polysaccharides
B.1.7 Explain that complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Note that cell behavior can also be affected by molecules from other parts of the organism, such as hormones.	Mitosis Meiosis Hormones
B.1.8 Understand and describe that all growth and development is a consequence of an increase in cell number, cell size, and/or cell products. Explain that cellular differentiation results from gene expression and/or environmental influence. Differentiate between mitosis and meiosis.	Cell Differentiation Mitosis Meiosis The Stages of Mitosis The Stages of Meiosis
<i>B.1.9 Recognize and describe that both living and nonliving things are composed of compounds, which are themselves made up of elements joined by energy-containing bonds, such as those in ATP.</i>	–
B.1.10 Recognize and explain that macromolecules such as lipids contain high energy bonds as well.	Lipids
<b>Developmental and Organismal Biology</b>	
B.1.11 Describe that through biogenesis all organisms begin their life cycles as a single cell and that in multicellular organisms, successive generations of embryonic cells form by cell division.	Cell Differentiation
B.1.12 Compare and contrast the form and function of prokaryotic and eukaryotic cells.	Prokaryotic Cells Eukaryotic Cells
<i>B.1.13 Explain that some structures in the modern eukaryotic cell developed from early prokaryotes, such as mitochondria, and in plants, chloroplasts.</i>	–
<i>B.1.14 Recognize and explain that communication and/or interaction are required between cells to coordinate their diverse activities.</i>	–
<i>B.1.15 Understand and explain that, in biological systems, structure and function must be considered together.</i>	–

B.1.16 Explain how higher levels of organization result from specific complexing and interactions of smaller units and that their maintenance requires a constant input of energy as well as new material.	Cells to Organisms Cell Differentiation Aerobic Respiration Photosynthesis 1
B.1.17 Understand that and describe how the maintenance of a relatively stable internal environment is required for the continuation of life and explain how stability is challenged by changing physical, chemical, and environmental conditions, as well as the presence of disease agents.	Homeostasis Enzymes Thermoregulation Glucoregulation Body Temperature HIV and AIDS Infectious Disease
B.1.18 Explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short- and long-term equilibrium.	Behavior Reflexes Homeostasis Thermoregulation Glucoregulation
B.1.19 Recognize and describe that metabolism consists of the production, modification, transport, and exchange of materials that are required for the maintenance of life.	Aerobic Respiration Digestion Photosynthesis 1 Photosynthesis 2
B.1.20 Recognize that and describe how the human immune system is designed to protect against microscopic organisms and foreign substances that enter from outside the body and against some cancer cells that arise within.	Immune System Immune Responses Infectious Disease
<b>Genetics</b>	
B.1.21 Understand and explain that the information passed from parents to offspring is transmitted by means of genes which are coded in DNA molecules.	DNA Genes and Alleles Meiosis
B.1.22 Understand and explain the genetic basis for Mendel's laws of segregation and independent assortment.	Gregor Mendel Patterns of Inheritance The Stages of Meiosis
B.1.23 Understand that and describe how inserting, deleting, or substituting DNA segments can alter a gene. Recognize that an altered gene may be passed on to every cell that develops from it, and that the resulting features may help, harm, or have little or no effect on the offspring's success in its environment.	Genetic Mutations

B.1.24 Explain that gene mutations can be caused by such things as radiation and chemicals. Understand that when they occur in sex cells, the mutations can be passed on to offspring; if they occur in other cells, they can be passed on to descendant cells only.	Genetic Mutations
B.1.25 Explain that gene mutation in a cell can result in uncontrolled cell division, called cancer. Also know that exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.	Genetic Mutations
B.1.26 Demonstrate how the genetic information in DNA molecules provides instructions for assembling protein molecules and that this is virtually the same mechanism for all life forms.	DNA Nucleic Acids Controlling Protein Synthesis Protein Synthesis Proteins Transcription and Translation
B.1.27 Explain that the similarity of human DNA sequences and the resulting similarity in cell chemistry and anatomy identify human beings as a unique species, different from all others. Likewise, understand that every other species has its own characteristic DNA sequence.	–
B.1.28 Illustrate that the sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents. Recognize that genetic variation can occur from such processes as crossing over, jumping genes, and deletion and duplication of genes.	Meiosis The Stages of Meiosis Genetic Variation
B.1.29 Understand that and explain how the actions of genes, patterns of inheritance, and the reproduction of cells and organisms account for the continuity of life, and give examples of how inherited characteristics can be observed at molecular and whole-organism levels – in structure, chemistry, or behavior.	Patterns of Inheritance Meiosis Mitosis Population Genetics Animal Adaptations Plant Adaptations
<b>Evolution</b>	
B.1.30 Understand and explain that molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched off from one another.	–
B.1.31 Describe how natural selection provides the following mechanism for evolution: Some variation in heritable characteristics exists within every species, and some of these characteristics give individuals an advantage over others in surviving and reproducing. Understand that the advantaged offspring, in turn, are more likely than others to survive and reproduce. Also understand that the proportion of individuals in the population that have advantageous characteristics will increase.	The Process of Evolution

B.1.32 Explain how natural selection leads to organisms that are well suited for survival in particular environments, and discuss how natural selection provides scientific explanation for the history of life on Earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.	Fossil Record Evolution The Process of Evolution
<i>B.1.33 Describe how life on Earth is thought to have begun as simple, one-celled organisms about 4 billion years ago. Note that during the first 2 billion years, only single-cell microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.</i>	–
<i>B.1.34 Explain that evolution builds on what already exists, so the more variety there is, the more there can be in the future. Recognize, however, that evolution does not necessitate long-term progress in some set direction.</i>	–
B.1.35 Explain that the degree of kinship between organisms or species can be estimated from the similarity of their DNA sequences, which often closely matches their classification based on anatomical similarities. Know that amino acid similarities also provide clues to this kinship.	Understanding Genomes
B.1.36 Trace the relationship between environmental changes and changes in the gene pool, such as genetic drift and isolation of sub-populations.	Population Genetics
<b>Ecology</b>	
B.1.37 Explain that the amount of life any environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organic materials. Recognize, therefore, that human activities and technology can change the flow and reduce the fertility of the land.	Loss of Diversity Human Impact on the Environment Describing Populations
<i>B.1.38 Understand and explain the significance of the introduction of species, such as zebra mussels, into American waterways, and describe the consequent harm to native species and the environment in general.</i>	–
B.1.39 Describe how ecosystems can be reasonably stable over hundreds or thousands of years. Understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages that eventually result in a system similar to the original one.	Ecosystems and Succession
B.1.40 Understand and explain that like many complex systems, ecosystems tend to have cyclic fluctuations around a state of rough equilibrium. However, also understand that ecosystems can always change with climate changes or when one or more new species appear as a result of migration or local evolution.	Ecosystems Extinction Climate Change

B.1.41 Recognize that and describe how human beings are part of Earth's ecosystems. Note that human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.	Human Impact on the Environment Air Pollution Water Pollution Climate Change Loss of Diversity Extinction
B.1.42 Realize and explain that at times, the environmental conditions are such that plants and marine organisms grow faster than decomposers can recycle them back to the environment. Understand that layers of energy-rich organic material thus laid down have been gradually turned into great coal beds and oil pools by the pressure of the overlying earth. Further understand that by burning these fossil fuels, people are passing most of the stored energy back into the environment as heat and releasing large amounts of carbon dioxide.	Fossil Fuels Human Impact on the Environment Climate Change Carbon Cycle
B.1.43 Understand that and describe how organisms are influenced by a particular combination of living and nonliving components of the environment.	Ecosystems Ecosystems and Succession
B.1.44 Describe the flow of matter, nutrients, and energy within ecosystems.	Recycling Nutrients Carbon Cycle Water Cycle Nitrogen Cycle
<i>B.1.45 Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of the way organisms develop within ecosystems.</i>	–
<i>B.1.46 Recognize and describe that a great diversity of species increases the chance that at least some living things will survive in the face of large changes in the environment.</i>	–
B.1.47 Explain, with examples, that ecology studies the varieties and interactions of living things across space while evolution studies the varieties and interactions of living things across time.	Describing Populations The Process of Evolution
<b>Historical Perspectives of Biology</b>	
B.2.1 Explain that prior to the studies of Charles Darwin, the most widespread belief was that all known species were created at the same time and remained unchanged throughout history. Note that some scientists at the time believed that features an individual acquired during a lifetime could be passed on to its offspring, and the species could thereby gradually change to fit an environment better.	Darwin
B.2.2 Explain that Darwin argued that only biologically inherited characteristics could be passed on to offspring. Note that some of these characteristics were advantageous in surviving and reproducing. Understand that the offspring would also inherit and pass on those advantages, and over generations the aggregation of these inherited advantages would lead to a new species.	Darwin Evolution The Process of Evolution

<p><i>B.2.3 Describe that the quick success of Darwin's book Origin of Species, published in 1859, came from the clear and understandable argument it made, including the comparison of natural selection to the selective breeding of animals in wide use at the time, and from the massive array of biological and fossil evidence it assembled to support the argument.</i></p>	–
<p>B.2.4 Explain that after the publication of Origin of Species, biological evolution was supported by the rediscovery of the genetics experiments of an Austrian monk, Gregor Mendel, by the identification of genes and how they are sorted in reproduction, and by the discovery that the genetic code found in DNA is the same for almost all organisms.</p>	Gregor Mendel Evolution