Indiana's Academic Standards 2010 Biology	Indiana's Academic Standards 2016 Biology
B.1.1 Describe the structure of the major categories of organic compounds that make up living organisms in terms of their building blocks and the small number of chemical elements (i.e., carbon, hydrogen, nitrogen, oxygen, phosphorous and sulfur) from which they are composed.	**B.1.1** Compare and contrast the shape and function of the essential biological macromolecules (i.e. carbohydrates, lipids, proteins, and nucleic acids), as well as, how chemical elements (i.e. carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur) can combine to form these biomolecules.
B.1.2 Understand that the shape of a molecule determines its role in the many different types of cellular processes (e.g., metabolism, homeostasis, growth and development, and heredity) and understand that the majority of these processes involve proteins that act as enzymes.	**B.1.2** Analyze how the shape of a molecule determines its role in the many different types of cellular processes (e.g., metabolism, homeostasis, growth and development, and heredity) and understand that the majority of these processes involve proteins that act as enzymes.
B.1.3 Explain and give examples of how the function and differentiation of cells is influenced by their external environment (e.g., temperature, acidity and the concentration of certain molecules) and changes in these conditions may affect how a cell functions.	
B.2.1 Describe features common to all cells that are essential for growth and survival. Explain their functions.	
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.	**B.1.3** Develop and use models that illustrate how a cell membrane regulates the uptake of materials essential for growth and survival while removing or preventing harmful waste materials from accumulating through the processes of active and passive transport.
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. Explain that 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.	

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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.	**B.1.4** Develop and use models to illustrate how specialized structures within cells (i.e. nuclei, ribosomes, Golgi, endoplasmic reticulum) interact to produce, modify, and transport proteins.
B.2.5 Explain that cells use proteins to form structures (e.g., cilia, flagella), which allow them to carry out specific functions (e.g., movement, adhesion and absorption).	
B.2.6 Investigate a variety of different cell types and relate the proportion of different organelles within these cells to their functions.	
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.	**B.2.1** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
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.	**B.2.2** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
B.3.3 Recognize and describe that metabolism consists of all of the biochemical reactions that occur inside cells, which include the production, modification, transport, and exchange of materials that are required for the maintenance of life.	
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.	**B.2.3** Use mathematical and/or computational representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
B.3.5 Describe how energy from the sun flows through an ecosystem by way of food chains and food webs and how only a small portion of that energy is used by individual organisms while the majority is lost as heat.	**B.2.4** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the bioshpere, atmosphere, hydrosphere, and geosphere.

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B.4.1 Explain that the amount of life environments 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.	**B.3.1** Use mathematical and/or computational representation to explain why the carrying capacity ecosystems 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.
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.	**B.3.2** Design, evaluate, and refine a model which shows how human activities and natural phenomena can change the flow of matter and energy in an ecosystem and how those changes impact the environment and biodiversity of populations in ecosystems of different scales, as well as, how these human impacts can be reduced.
B.4.3 Describe the consequences of introducing non-native species into an ecosystem and identify the impact it may have on that ecosystem.	**B.3.3** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, and identify the impact of changing conditions or introducing non-native species into that ecosystem.
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.	
B.5.1 Describe the relationship between chromosomes and DNA along with their basic structure and function.	**B.4.1** Develop and revise a model that clarifies the relationship between DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
B.5.2 Describe how hereditary information passed from parents to offspring is encoded in the regions of DNA molecules called genes.	
B.5.3 Describe the process by which DNA directs the production of protein within a cell.	**B.4.2** Construct an explanation for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

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B.5.4 Explain how the unique shape and activity of each protein is determined by the sequence of its amino acids.	**B.4.3** Construct a model to explain that the unique shape and function of each protein is determined by the sequence of its amino acids, and thus is determined by the sequence of the DNA that codes for this protein.
B.5.5 Understand that proteins are responsible for the observable traits of an organism and for most of the functions within an organism.	
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.	
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.	**B.4.4** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
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.	
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.	
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 (i.e., gametes).	**B.4.5** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and (3) mutations caused by environmental factors.
B.6.5 Explain how in sexual reproduction that crossing over, independent assortment and random fertilization result in offspring that are genetically different from the parents.	

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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.	
B.7.2 Describe dominant, recessive, codominant, sex-linked, incompletely dominant, multiply allelic and polygenic traits and illustrate their inheritance patterns over multiple generations.	
B.7.3 Determine the likelihood of the appearance of a specific trait in an offspring given the genetic make-up of the parents.	**B.4.6** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
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.	
B.7.5 Explain and demonstrate how inserting, substituting or deleting segments of a DNA molecule can alter a gene, how that gene is then passed to every cell that develops from it and how the results may be beneficial, harmful or have little or no effect on the organism.	
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.	**B.5.2** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence including both anatomical and molecular evidence.
B.8.2 Explain how organisms are classified and named based on their evolutionary relationships into taxonomic categories.	**B.5.1** Evaluate anatomical and molecular evidence to provide an explanation of how organisms are classified and named based on their evolutionary relationships into taxonomic categories.
B.8.3 Use anatomical and molecular evidence to establish evolutionary relationships among organisms.	

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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.	**B.5.4** Evaluate evidence to explain the role of natural selection as an evolutionary mechanism that leads to the adaptation of species, and to support claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and/or (3) the extinction of other species.
B.8.5 Describe how organisms with beneficial traits are more likely to survive, reproduce, and pass on their genetic information due to genetic variations, environmental forces and reproductive pressures.	**B.5.3** Apply concepts of statistics and probability to support a claim that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
B.8.6 Explain how genetic variation within a population (i.e., a species) can be attributed to mutations as well as random assortments of existing genes.	**B.5.5** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
B.8.7 Describe the modern scientific theory of the origins and history of life on earth and evaluate the evidence that supports it.	**B.5.6** Analyze and interpret data for patterns in the fossil record and molecular data that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
	B.1.5 Develop and use a model to illustrate the hierarchical organization of interacting systems (cell, tissue, organ, organ system) that provide specific functions within multicellular organisms.