Indiana Academic Standards for Biology
Standards Resource Guide Document

This Teacher Resource Guide has been developed to provide supporting materials to help educators successfully implement the Indiana Academic Standards fo Biology 1. These resources are provided to help you in your work to ensure all students meet the rigorous learning expectations set by the Academic Standards. of these resources is optional – teachers should decide which resource will work best in their school for their students.
This resource document is a living document and will be frequently updated.
Please send any suggested links and report broken links to:

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The resources, clarifying statements, and vocabulary in this document are for illustrative purposes only, to promote a base of clarity and common understanding Each item illustrates a standard but please note that the resources, clarifying statements, and vocabulary are not intended to limit interpretation or classroom applications of the standards.

Standard 1: Cellular Structure and Function			
Indiana Academic Standard	**Clarifying Statement**	**Highlighted Vocabulary Words from the Standard Defined**	**Crosscutting Concept**
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.		Macromolecules – large molecule (nucleic acids, proteins, carbohydrates, and lipids) Carbohydrates – organic compound composed of carbon, hydrogen, and oxygen Lipids – fatty or waxy organic compound that is readily soluble in nonpolar solvents, used for energy storage, structural components of cell membranes and cell signaling Proteins – polymer of amino acids joined by peptide bonds, contains nitrogen Nucleic acids – group of complex compounds consisting of linear chains of monomeric nucleotides whereby each monomeric unit consists of phosphoric acid, sugar, and nitrogenous base Elements – smallest unit of matter that maintains its unique properties Biomolecules – any molecule present in living organisms	Structure and Function

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.		Molecule – group of atoms bonded together representing the smallest fundamental unit of a chemical compound that can take part in a chemical reaction Metabolism – chemical processes that occur within a living organism in order to maintain life Homeostasis – tendency toward a relatively stable equilibrium between interdependent elements as maintained by physiological processes Growth – development from a lower or simpler to a higher or more complex form Development – process of growth and differentiation of an organism. Heredity – genetic transmission of characteristics from parent to offspring Proteins – large molecules composed of one or more chains of amino acids in a specific order determined by the base sequence of nucleotides in the DNA coding for the protein Enzymes – protein molecule that helps other organic molecules enter into chemical reactions with one another but is itself unaffected by these reactions, catalyst for organic biochemical reactions	Structure and Function

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.		Models – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Cell membrane – semipermeable membrane surrounding the cytoplasm of a cell Active transport – movement of molecules across a cell membrane from a region of their lower concentration to a region of their higher concentration in the direction against some gradient or other obstructing factor Passive transport – movement of biochemical and other atomic or molecular substances across cell membranes without need of energy input Selective permeability - allows the cell to control what enters and leaves cell through lipid bilayer fluid mosaic membrane	Structure and Function

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.		Models – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Nuclei – membrane enclosed organelle found in eukaryotic cells Ribosomes – cell organelle that consist of RNA and proteins, attach one amino acid at a time to build long chains, proteins Golgi – cell organelle responsible for the transport and modification of proteins Endoplasmic reticulum – network of tubular membranes within the cytoplasm of the cell that is involved with the transport of materials Mitochondria - double membrane bound structure that converts energy into an useable form.	Structure and Function

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.	Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system	Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Cell – smallest structural and functional unit of an organism Tissue – distinct type of specialized cell and their products Organ – part of an organism that is typically self-contained and has a specific vital function Organ system – group of organs that work together to perform one or more functions Multicellular organisms – organism composed of many cells (often times multiple specialized cells to perform specific tasks for the survival of the organism)	Structure and Function System and System Models

Standard 2: Matter Cycles and Energy Transfer			
Indiana Academic Standard	**Clarifying Statement**	**Highlighted Vocabulary Words from the Standard Defined**	**Crosscutting Concept**
B.2.1 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.	Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Photosynthesis – synthesis of complex organic material using carbon dioxide, water, inorganic salts, and light energy captured by light-absorbing pigments Chemical energy – energy stored in the bonds of chemical compounds that is released during a chemical reaction	Systems and System Models Structure and Function
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.	Emphasis on the conceptual understanding of the inputs and outputs of the process of cellular respiration.	Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Cellular respiration – a series of metabolic processes that take place within a cell in which biochemical energy is harvested from organic substance (glucose) and stored as energy carriers (ATP) for use in energy requiring activities of the cell Energy – ability to do work	Systems and System Models Structure and Function

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.		Ecosystem – system that includes all biotic factors and abiotic factors functioning together as a unit	Systems and System Models
B.2.4 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.		Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Biosphere – zone of air, land, and water where organisms exist Atmosphere – mixture of gases surrounding the earth Hydrosphere – all of the Earth's water, including surface water, groundwater, snowcover, ice, and water in the atmosphere as water vapor Geosphere – core, mantle, and crust of the earth, solid portion of the earth	Systems and System Models

Standard 3: Interdependence			
Indiana Academic Standard	**Clarifying Statement**	**Highlighted Vocabulary Words from the Standard Defined**	**Crosscutting Concept**
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.	Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical sets of data.	Carrying capacity – maximum population size of the species that the environment can sustain indefinitely given the food, habitat, water, and other necessities available in the environment Recycle – extracting and reusing useful substances from waste/other materials	Systems and System Models
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.	Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.	Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Biodiversity – variety of life on earth or in a given sample/ecosystem	Systems and System Models
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.	Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood, and extreme changes, such as volcanic eruption or sea level rise. Examples of non – native species and their impact are used to examine relationships.	Non – native species – plant or animal species introduced into an area where they do not occur naturally	Systems and System Models Stability and Change

Standard 4: Inheritance and Variation in Traits			
Indiana Academic Standard	**Clarifying Statement**	**Highlighted Vocabulary Words from the Standard Defined**	**Crosscutting Concept**
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.		Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis DNA – deoxyribonucleic acid is a type of macromolecule that has a twisted double helix and is composed of long strands of alternating sugars, phosphate groups, and nitrogenous bases Chromosomes – single molecule of DNA bonded to various proteins and carries the genes determining heredity	Systems and System Models Structure and Function
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.		Specialized cells – cells in multicellular organisms that are modified to carry out a particular function	Systems and System Models Structure and Function
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.		Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Amino acids – building blocks of biological proteins	Systems and System Models Structure and Function

B.4.4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.		Model – simplified representation of a relationship. Scientific models can be material, visual, mathematical, or computational and are often used in the construction of scientific theories. 1-, 2-, and 3-D graphics, physical 3-d, map overlays, animations, image manipulation and image analysis Mitosis – process where a single cell divides into two identical daughter cells	Systems and System Models
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.	Emphasis is on using data to support arguments for the way variation occurs.	Meiosis – form of cell division happening in sexually reproducing organisms by which two consecutive nuclear divisions occur without the chromosomal replication in between, resulting in the production of four haploid gametes Replication – process of making an identical copy of a section of double-stranded DNA using existing DNA as a template for the synthesis of new DNA strands Mutations – DNA gene is damaged or changed in such a way as to alter the genetic message carried by that gene	Systems and System Models Stability and Change
B.4.6 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population	Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. Is not intended to include Hardy-Weinberg calculations.	Expressed traits – characteristics or attributes that are exhibited by the organism	Systems and System Models Structure and Function

Standard 5: Evolution			
Indiana Academic Standard	**Clarifying Statement**	**Highlighted Vocabulary Words from the Standard Defined**	**Crosscutting Concept**
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.	Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.	Anatomical – shape, structure and relationship of parts of an organism Taxonomic categories – classification of organisms in an ordered system to indicate natural relationships	Systems and System Models
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.		Common ancestry – multiple species resulting from one specie variation over many generations Biological evolution – descent with modification	Systems and System Models
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.		Advantageous – helpful or favorable characteristic/trait that aids in survival	Systems and System Models

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.		Natural selection – any characteristic of an individual that allows it to survive and reproduce will cause that characteristic to become more frequent in a population Adaptation – trait with a current functional role in the life of an organism that is maintained and evolved by means of natural selection Species – group of closely related organisms that are very similar to each other and are capable of interbreeding and producing fertile offspring Extinction – end/termination of a species	Systems and System Models Structure and Function
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	Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.	Sexual reproduction – mode of reproduction where the fusion of a female gamete and male gamete forms a zygote that potentially develops into genetically distinct offspring	Systems and System Models Structure and Function

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.		Fossil record – fossilized artifacts and their placement within the earth's rock strata	Systems and System Models

Crosscutting Concepts

1. *Patterns.* Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
2. *Cause and effect: Mechanism and explanation*. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. *Scale, proportion, and quantity.* In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. *Systems and system models.* Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. *Energy and matter: Flows, cycles, and conservation.* Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. *Structure and function.* The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
7. *Stability and change.* For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.