

## North Carolina Essential Standards Biology

The North Carolina Science Essential Standards maintain the respect for local control of each Local Education Authority (LEA) to design the specific curricular and instructional strategies that best deliver the content to their students. Nonetheless, engaging students in inquiry-based instruction is a critical way of developing conceptual understanding of the science content that is vital for success in the twenty-first century. The process of scientific inquiry, experimentation and technological design should not be taught nor tested in isolation of the core concepts drawn from physical science, earth science and life science. A seamless integration of science content, scientific inquiry, experimentation and technological design will reinforce in students the notion that “what” is known is inextricably tied to “how” it is known. A well-planned science curriculum provides opportunities for inquiry, experimentation and technological design. Teachers, when teaching science, should provide opportunities for students to engage in “hands-on/minds-on” activities that are exemplars of scientific inquiry, experimentation and technological design.

### Science as Inquiry

Traditional laboratory experiences provide opportunities to demonstrate how science is constant, historic, probabilistic, and replicable. Although there are no fixed steps that all scientists follow, scientific investigations usually involve collections of relevant evidence, the use of logical reasoning, the application of imagination to devise hypotheses, and explanations to make sense of collected evidence. Student engagement in scientific investigation provides background for understanding the nature of scientific inquiry. In addition, the science process skills necessary for inquiry are acquired through active experience. The process skills support development of reasoning and problem-solving ability and are the core of scientific methodologies.

## Structure and Functions of Living Organisms

|         | Essential Standard   | Clarifying Objectives |   |
|---------|--|-----------------------|---|
| Bio.1.1 | <b>Understand the relationship between the structures and functions of cells and their organelles.</b> | Bio.1.1.1             | Summarize the structure and function of organelles in eukaryotic cells (including: the nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes) and ways that these organelles interact with each other to perform the function of the cell. |
|         |  | Bio.1.1.2             | Compare prokaryotic and eukaryotic cells in terms of their general structures (plasma membrane and genetic material) and degree of complexity.  |
|         |  | Bio.1.1.3             | Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms.  |
| Bio.1.2 | <b>Analyze the cell as a living system.</b>  | Bio.1.2.1             | Explain how homeostasis is maintained in the cell and within an organism in various environments (including: temperature and pH).   |

|  | Essential Standard | Clarifying Objectives |   |
|--|--------------------|-----------------------|---|
|  |                    | Bio.1.2.2             | Analyze how cells grow and reproduce in terms of interphase, mitosis and cytokinesis.                                 |
|  |                    | Bio.1.2.3             | Explain how specific cell adaptations help cells survive in particular environments (focus on unicellular organisms). |

## Ecosystems

|                | Essential Standard   | Clarifying Objectives |  |
|----------------|--|-----------------------|--|
| <b>Bio.2.1</b> | <b>Analyze the interdependence of living organisms within their environments.</b>                      | Bio.2.1.1             | Analyze the flow of energy and cycling of matter (water, carbon, nitrogen and oxygen) through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem.                 |
|                |  | Bio.2.1.2             | Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations.   |
|                |  | Bio.2.1.3             | Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.                                  |
|                |  | Bio.2.1.4             | Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate (emphasizing availability of food, availability of shelter, number of predators and disease). |
| <b>Bio.2.2</b> | <b>Understand the impact of human activities on the environment (one generation affects the next).</b> | Bio.2.2.1             | Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.                      |
|                |  | Bio.2.2.2             | Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.  |

## Evolution & Genetics

|                | Essential Standard   | Clarifying Objectives |  |
|----------------|--|-----------------------|--|
| <b>Bio.3.1</b> | <b>Explain how traits are determined by the structure and function of DNA.</b> | Bio.3.1.1             | Explain the double-stranded, complementary nature of DNA as related to its function in the cell. |
|                |  | Bio.3.1.2             | Explain how DNA and RNA code for proteins and determine traits.                                  |

| Essential Standard |  | Clarifying Objectives |   |
|--------------------|--|-----------------------|---|
|                    |  | Bio.3.1.3             | Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype. |
| <b>Bio.3.2</b>     | <b>Understand how the environment, and/or the interaction of alleles, influences the expression of genetic traits.</b> | Bio.3.2.1             | Explain the role of meiosis in sexual reproduction and genetic variation.   |
|                    |  | Bio.3.2.2             | Predict offspring ratios based on a variety of inheritance patterns (including: dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits).                        |
|                    |  | Bio.3.2.3             | Explain how the environment can influence the expression of genetic traits.   |
| <b>Bio.3.3</b>     | <b>Understand the application of DNA technology.</b>   | Bio.3.3.1             | Interpret how DNA is used for comparison and identification of organisms.   |
|                    |  | Bio.3.3.2             | Summarize how transgenic organisms are engineered to benefit society.   |
|                    |  | Bio.3.3.3             | Evaluate some of the ethical issues surrounding the use of DNA technology (including: cloning, genetically modified organisms, stem cell research, and Human Genome Project).                   |
| <b>Bio.3.4</b>     | <b>Explain the theory of evolution by natural selection as a mechanism for how species change over time.</b>           | Bio.3.4.1             | Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.   |
|                    |  | Bio.3.4.2             | Explain how natural selection influences the changes in species over time.  |
|                    |  | Bio.3.4.3             | Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection.  |
| <b>Bio 3.5</b>     | <b>Analyze how classification systems are developed based upon speciation.</b>   | Bio.3.5.1             | Explain the historical development and changing nature of classification systems.   |
|                    |  | Bio.3.5.2             | Analyze the classification of organisms according to their evolutionary relationships (including: dichotomous keys and phylogenetic trees).   |

## Molecular Biology

| Essential Standard |  | Clarifying Objectives |   |
|--------------------|--|-----------------------|---|
| <b>Bio.4.1</b>     | <b>Understand how biological molecules are essential to the survival of living organisms</b> | Bio.4.1.1             | Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms. |
|                    |  | Bio.4.1.2             | Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms.                                  |
|                    |  | Bio.4.1.3             | Explain how enzymes act as catalysts for biological reactions.  |

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|----------------|--|-----------------------|---|
| <b>Bio 4.2</b> | <b>Analyze the relationships between biochemical processes and energy use in the cell.</b> | Bio.4.2.1             | Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems. |
|                |  | Bio.4.2.2             | Explain ways that organisms use released energy for maintaining homeostasis (active transport).   |