



*Pre-Lab, Skills, and Standards Alignments*

**BIOINFORMATICS: PHYLOGENETICS AND BARCODING**

In this computer lab, students will learn about different methods of building phylogenetic trees and practice building them using both morphological and genetic data. They will also use sample sequence data on the bioinformatics platform *DNA Subway* to identify and compare species using BLAST and DNA sequence alignments.

**Lab Length:** 2.5 hours

**Suggested Pre-Lab Teaching**

- DNA structure, function and replication
- Polymerase Chain Reaction (PCR)
- Taxonomy and classification
- Cladograms and phylogenetics

**Lab Skills**

- Perform a BLAST search.
- View, compare, and interpret DNA sequence alignments.
- Use computer software to build phylogenetic trees.

**Conceptual Knowledge/Skills** (Post Lab)

- Interpret sequence data to identify organisms.
- Use phylogenetic trees to show evolutionary relationships among organisms.
- Explain how DNA barcoding can be used in fields such as conservation genetics and forensics.

**New York State Science Learning Standards/NGSS**

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
<p><u>Engaging in Argument from Evidence</u> Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.</p> <p><u>Analyzing and Interpreting Data</u> Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.</p>	<p><u>LS1.A: Structure and Function</u> All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (secondary to HS-LS3-1)</p> <p><u>LS3.A: Inheritance of Traits</u> Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some</p>	<p><u>Patterns</u> Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</p> <p><u>Cause and Effect</u> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p> <p><u>Stability and Change</u> Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.</p>



	<p>segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)</p> <p><u>LS3.B: Variation of Traits</u> In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. (HS-LS3-2)</p> <p>•(NYSED) Environmental factors can cause mutations in genes. Only mutations in sex cells can be inherited. (HS-LS3-2)</p> <p><u>LS4.A: Evidence of Common Ancestry and Diversity</u> Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)</p>	<p><u>Nature of Science: Science is a Human Endeavor</u> Technological advances have influenced the progress of science and science has influenced advances in technology. Science and engineering are influenced by society and society is influenced by science and engineering.</p>
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AP Biology Lab Alignment	AP Biology Learning Objective	AP Biology Science Skill
Investigation - #3 BLAST Lab	<p><b>SYI-3.A:</b> Explain the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments.</p> <p><b>EVO-3.B:</b> Describe the types of evidence that can be used to infer an evolutionary relationship.</p> <p><b>EVO-3.C:</b> Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness.</p>	<b>2D:</b> Represent relationships within a biological model.



<b>NYS Living Environment</b> <i>Standard 1</i>	<b>NYS Living Environment</b> <i>Standard 4</i>
<b>Performance Indicators</b>  1.1 Elaborate on basic scientific and personal explanations of natural phenomena. 2.1 Devise ways of making observations to test proposed explanations. 3.2 Apply statistical analysis techniques when appropriate to test if chance alone explains the results.	<b>Performance Indicators</b>  2.1 Explain how the structure and replication of genetic material result in offspring that resemble their parents 3.1 Explain the mechanisms and patterns of evolution.