Pre-Lab, Skills, and Standards Alignments

BIOINFORMATICS: TRACING HUMAN EVOLUTION

Students will analyze mitochondrial sequence data to test models of human evolution, and address questions such as: Were Neanderthals direct ancestors of modern humans? Did we all arise from a single founding population in Africa? Guided use of DNALC online bioinformatic tools *BioServers* and *DNA Subway* will help students answer these questions and more.

Lab Length: 2.5 hours

Suggested Pre-Lab Teaching

- DNA Structure and function, DNA replication, heredity
- Theories of human evolution
- Cladograms and phylogenetic trees
- Polymerase Chain Reaction (PCR)

Lab Skills

- Perform BLAST searches and online DNA sequence alignments.
- Use computer software to build phylogenetic trees.

Conceptual Knowledge/Skills (Post Lab)

- Describe the utility of mitochondrial DNA in the study of genealogy and human origins.
- Use DNA sequence data to support or refute a hypothesis about human origins.
- Use DNA sequence data to explain evolutionary relationships between organisms, living and extinct.

New York State Science Learning Standards/NGSS

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
Engaging in Argument from Evidence Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. Analyzing and Interpreting Data 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.	LS4.A: Evidence of Common Ancestry and Diversity 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) LS3.A: Inheritance of Traits Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The	Science is a Human Endeavor Science and engineering are influenced by society and society is influenced by science and engineering. Technological advances have influenced the progress of science and science has influenced advances in technology. Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. Patterns Different patterns may be observed

	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 segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)	at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

AP Biology Lab Alignment	**AP Biology Learning Objective**	**AP Biology Science Skill**
Investigation - #3 BLAST Lab	**SYI-3.A:** 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. **EVO-3.B:** Describe the types of evidence that can be used to infer an evolutionary relationship. **EVO-3.C:** Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness.	**2D:** Represent relationships within a biological model.

NYS Living Environment *Standard 1*	**NYS Living Environment** *Standard 4*
Performance Indicators 1.1 Elaborate on basic scientific and personal explanations of natural phenomena. 1.3 Work toward reconciling competing explanations; clarify points of agreement and disagreement. 2.1 Devise ways of making observations to test proposed explanations.	**Performance Indicators** 1.2 Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles). 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.