

Pre-Lab, Skills, and Standards Alignments

HUMAN MITOCHONDRIAL SEQUENCING

In this lab, students prepare a sample of their own DNA from cells obtained by saline mouthwash, use PCR to amplify a section of their own mitochondrial DNA, and agarose gel electrophoresis to confirm the result. DNA is then sent for sequencing, and results are uploaded to the DNALC's *BioServers* website. Students can perform bioinformatic analysis of their own DNA sequences to explore the theories behind how modern humans evolved and how related they are to their classmates and people from around the world.

Lab Length: 4 hours

Suggested Pre-Lab Teaching

- DNA structure and function, DNA replication, heredity
- Central Dogma (genes to proteins)
- Theories of human evolution
- Polymerase Chain Reaction (PCR)

Lab Skills

- Measure small volumes of liquid using micropipettes.
- Isolate DNA from human epithelial cells.
- Amplify DNA sequences using PCR.
- Visualize DNA fragments using agarose gel electrophoresis.
- Utilize bioinformatic tools to perform DNA sequence alignments.

Conceptual Knowledge/Skills

- Explain how to use PCR to amplify DNA.
- 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
<p><u>Engaging in Argument from Evidence</u> Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution 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>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>Science is a Human Endeavor</u> 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.</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.</p>



	<p><u>LS3.A: Inheritance of Traits</u></p> <p>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 segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)</p>	<p>Some system changes are irreversible.</p> <p><u>Patterns</u></p> <p>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>
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AP Biology Lab Alignment	AP Biology Learning Objective	AP Biology Science Skill
Investigation - #3 BLAST Lab	<p>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.</p> <p>EVO-3.B: Describe the types of evidence that can be used to infer an evolutionary relationship.</p> <p>EVO-3.C: Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness.</p>	2D: Represent relationships within a biological model.

NYS Living Environment Standard 1	NYS Living Environment Standard 4
<p>Performance Indicators</p> <p>1.1 Elaborate on basic scientific and personal explanations of natural phenomena.</p> <p>1.3 Work towards reconciling competing explanations; clarify points of agreement and disagreement.</p> <p>2.1 Devise ways of making observations to test proposed explanations.</p>	<p>Performance Indicators</p> <p>1.2 Describe and explain the structures and functions of the human body at different organizational levels.</p> <p>2.1 Explain how the structure and replication of genetic material result in offspring that resemble their parents</p> <p>3.1 Explain the mechanisms and patterns of evolution.</p> <p>4.1 Explain how organisms reproduce their own kind.</p> <p>5.1 Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.</p>