Pre-Lab, Skills, and Standards Alignments

EXTENDED JUMPING GENES:
USING AN* ALU *INSERTION POLYMORPHISM TO STUDY HUMAN POPULATIONS

This lab examines a region of DNA from chromosome 16 that can contain a short nucleotide sequence called *Alu* within a noncoding region of the chromosome. Students will prepare a sample of their own DNA from cells obtained by saline mouthwash, use PCR to amplify the targeted locus, and agarose gel electrophoresis to determine the presence or absence of this *Alu*, which jumped into the chromosome tens of thousands of years ago. Class data is used as part of an exploration of allele frequencies and Hardy-Weinberg equilibrium, and a Simulation Server is used to model principles of population genetics.

Lab Length: 6 hours

Suggested Pre-Lab Teaching

- DNA structure, function, and replication
- Central Dogma (genes to proteins)
- Mendelian genetics
- Polymerase Chain Reaction (PCR)

Lab Skills

- Measure small volumes of liquid using micropipettes.
- Isolate DNA from human epithelial cells.
- Amplify DNA sequence using PCR.
- Visualize DNA using agarose gel electrophoresis.
- Calculate allele frequencies and apply Hardy-Weinberg equilibrium.
- Utilize online tools to simulate principles of population genetics.

Conceptual Knowledge/Skills (Post Lab)

- Explain how PCR is used to amplify DNA.
- Predict experimental results.
- Interpret experimental results to determine class allele frequencies.
- Use class data to explore Hardy Weinberg Equilibrium.
- Explain how selection, gene flow and genetic drift affect allele frequencies in populations.

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.	LS1.A: Structure and Function 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) 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 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) LS3.B: Variation of Traits 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) (NYSED) Environmental factors can cause mutations in genes. Only mutations in sex cells can be inherited. (HS-LS3-2)	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. Scale, Proportion, and Quantity Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. 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.

AP Biology Lab Alignment	AP Biology Learning Objective	AP Biology Science Skill
Investigation #2 - Hardy Weinberg Equilibrium *Extension of* AP Biology Investigation #9 – Restriction of Enzyme Analysis of DNA	**EVO-1.K:** Describe the conditions under which allele and genotype frequencies will change in a population **EVO-1.L**: Explain the impacts on the population if any of the conditions of Hardy-Weinberg are not met **IST – 1.P:** Explain the use of genetic engineering techniques in analyzing or manipulating DNA.	**6D:** Explain the relationship between experimental results and larger biological concepts, processes, or theories.

NYS Living Environment *Standard 1*	**NYS Living Environment** *Standard 4*
Performance Indicators 1.1 Elaborate on basic scientific and personal explanations of natural phenomena 2.1 Devise ways of making observations to test proposed explanations.	**Performance Indicators** 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. 5.1 Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.