Pre-Lab, Skills, and Standards Alignments

DNA BARCODING: USING DNA BARCODES TO IDENTIFY AND CLASSIFY LIVING THINGS

In this laboratory, students use DNA barcoding to identify plants, fungi, or animals—or products containing them. DNA is extracted from samples, the barcode region is amplified by PCR, and the PCR product is sequenced. *DNA Subway*, an online bioinformatics site, is used to search a DNA database for close matches to sample sequences and to construct phylogenetic trees that show evolutionary relatedness.

Lab Length: 6 hours

Suggested Pre-Lab Teaching

- DNA structure, function and replication
- Central Dogma (genes to proteins)
- Polymerase Chain Reaction (PCR)
- Taxonomy and classification of living things
- Cladograms and phylogenetics

Lab Skills

- Measure small volumes of liquid using micropipettes.
- Isolate DNA from plant or invertebrate tissues.
- Amplify DNA sequence using PCR.
- Visualize DNA using agarose gel electrophoresis.
- Utilize bioinformatic tools to perform BLAST searches, view sequence alignments, and create phylogenetic trees.

Conceptual Knowledge/Skills (Post Lab)

- Explain how PCR is used to amplify DNA.
- Interpret experimental sequence results to identify species of sample being tested.
- Use phylogenetic trees to show evolutionary relationships.

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'	Patterns Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced; thus requiring improved investigations and experiments. Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Stability and Change Change and rates of change can be

	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) 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)	quantified and modeled over very short or very long periods of time. Some system changes are irreversible. Nature of Science: Science is a Human Endeavor 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.

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. 1.2 Hone ideas through reasoning, library research, and discussion with others, including experts. 2.1 Devise ways of making observations to test proposed explanations. 3.1 Use various methods of representing and organizing observations and insightfully interpret the organized data. 3.2 Apply statistical analysis techniques when appropriate to test if chance alone explains the results.	**Performance Indicators** 1.1 Explain how diversity of populations within ecosystems relates to the stability of ecosystems. 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. 6.2 Explain the importance of preserving diversity of species and habitats. 7.2 Explain the impact of technological development and growth in the human population on the living and nonliving environment.

