Pre-Lab, Skills, and Standards Alignments

GMO: DETECTING GENETICALLY MODIFIED FOODS

Genes that encode herbicide resistance, insect resistance, drought tolerance, frost tolerance, and other traits have been added to many commercial plants—including most of the corn and soybeans grown in the United States. In this laboratory, students isolate DNA from processed food products. Then, polymerase chain reaction (PCR) and gel electrophoresis are used to identify a promoter that drives the expression of most plant transgenes. Bioinformatics tools allow students to predict the outcome of the experiment and discover genes and functions transferred into GM plants.

Lab Length: 6 hours

Suggested Pre-Lab Teaching

- DNA structure and function
- Central Dogma (genes to proteins)
- Gene expression
- Genetic engineering

Lab Skills

- Measure small volumes of liquid using micropipettes.
- Isolate DNA from food products.
- Amplify DNA sequences using PCR.
- Visualize DNA using agarose gel electrophoresis.
- Utilize online bioinformatic tools to predict lab results.
- Follow a multi-step procedure to complete a controlled experiment.

Conceptual Knowledge/Skills (Post Lab)

- Explain the steps of PCR to amplify DNA.
- Interpret lab results to determine if food products are genetically modified.
- Discuss the benefits and challenges of gene editing.

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.	LS3.B: Variation of Traits Advances in biotechnology have allowed organisms to be modified genetically. (HS-LS3-2) 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)	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. Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide

	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) LS4.B: Natural Selection The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3) LS4.D: Biodiversity and Humans Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (HS-LS4-6) ETS1.A: Defining and Delimiting an Engineering Problem Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)	evidence for causality in explanations of phenomena. Cause and Effect Systems can be designed to cause a desired effect. Systems and System Models Systems can be designed to do specific tasks.

AP Biology Lab Alignment	AP Biology Learning Objective	AP Biology Science Skill
Extension of AP Biology Investigation #9 – Restriction Enzyme Analysis of DNA	**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. 2.2 Explain how the technology of genetic engineering allows humans to alter genetic makeup of organisms. 3.1 Explain the mechanisms and patterns of evolution.