

Pre-Lab, Skills, and Standards Alignments

DNA RESTRICTION ANALYSIS

The DNA restriction analysis experiment demonstrates that DNA can be precisely manipulated with enzymes that recognize and cut specific target sequences. In this lab, restriction enzymes—the scissors of molecular biology—are used to digest DNA from the bacteriophage Lambda. The resulting DNA fragments are then visualized by agarose gel electrophoresis, allowing students to identify a “mystery” enzyme through comparison with controls.

Lab Length: 3.5 hours

Suggested Pre-Lab Teaching

- DNA structure and function
- Central Dogma (genes to proteins)
- Enzyme function

Lab Skills

- Measure small volumes of liquid using micropipettes.
- Prepare DNA digests with different restriction enzymes.
- Visualize DNA using agarose gel electrophoresis.
- Interpret agarose gel electrophoresis results.

Conceptual Knowledge/Skills

- Explain the principles of agarose gel electrophoresis, and how it was used to visualize the results of a DNA digest.
- Compare experimental and control results to identify a mystery enzyme.
- Use a DNA restriction map to predict the results of a DNA digest.
- Describe how restriction enzymes can be used in genetic engineering.

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>Planning and Carrying Out Investigations</u> Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and the design: decide on types, how much, and accuracy of data needed to provide reliable measurements and consider</p>	<p><u>LS1.A: Structure and Function</u> 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)</p> <p><u>LS3.B: Variation of Traits</u> (NYSED) Advances in biotechnology have allowed organisms to be modified genetically. (HS-LS3-2)</p>	<p><u>Structure and Function</u> Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</p> <p><u>Patterns</u> 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>



limitations on the precision of the data, and refine accordingly.		<p><u>Cause and Effect</u> Systems can be designed to cause a desired effect.</p> <p><u>Scale, Proportion, and Quantity</u> Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.</p> <p><u>Nature of Science: Science is a Human Endeavor</u> Technological advances have influenced the progress of science and science has influenced advances in technology.</p>
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AP Biology Lab Alignment	AP Biology Learning Objective	AP Biology Science Skill
Investigation #9: Biotechnology Restriction Enzyme Analysis of DNA	IST – 1.P: Explain the use of genetic engineering techniques in analyzing or manipulating DNA.	6.D: Explain the relationship between experimental results and larger biological concepts, processes, or theories.

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. 2.1 Devise ways of making observations to test proposed explanations.</p>	<p>Performance Indicators</p> <p>1.3 Explain how a one-celled organism is able to function despite lacking the levels of organization present in more complex organisms. 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. 5.1 Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.</p>