

Module: Stop the Outbreak! Solve a Mystery Using DNA Fingerprinting

Topics: Molecular biology, electrophoresis, epidemiology, scientific method, controls, DNA structure.



Overview: This lesson is designed to take place onboard the Seattle Children's Science Adventure Lab, a mobile science laboratory. Students are presented with a real-world scenario involving a possible common source for an outbreak of infectious gastroenteritis among students who recently went on a field trip to a food festival. On the mobile lab, students compare DNA fingerprints from simulated samples collected from the food vendors and an infected patient. After practicing how to use a micropipette, they load gels and use electrophoresis to separate DNA fragments in the samples by size. By comparing the banding patterns (the DNA fingerprint) of the samples collected from the food vendor to the DNA from the infected patient, they identify the source of the outbreak.

Throughout the lesson, as part of the 5E Instructional Model, Science Adventure Lab instructors and classroom teachers serve as "facilitators" and "coaches," guiding students through the inquiry process.

Grade Levels: This module is appropriate for students in Grades 6-8.

Time Required: Minimum time required to complete this module is 90 minutes.

Lab Equipment Used: Gel electrophoresis apparatus and power supplies, reagents for DNA analysis, micropipettes.

Health Issue: DNA contains the genetic instructions for the development and functioning of all known living organisms. Analysis of DNA from microorganisms such as bacteria can be used to study outbreaks of infection and determine whether patients are infected with the same strain. Studying the genes of bacteria can also be used to help understand how microorganisms can cause disease in humans and animals.

Objectives:

- To develop an understanding of some of the basic scientific principles involved in DNA fingerprinting and gel electrophoresis.
- To develop the laboratory skills and knowledge required to conduct an experiment and test hypotheses by weighing evidence, analyzing and interpreting data.
- To expose students to authentic equipment and tools used by researchers at Seattle Children's Research Institute.
- To empower students with the confidence that they can be successful in science.
- To encourage students to pursue careers in science and healthcare.



Selected State and National Academic Standards

Grade Level	Washington State Science Standards
6-8	<ul style="list-style-type: none"> EALR 2: Inquiry A - Scientific inquiry involves asking and answering questions and comparing the answer with what scientists already know about the world. EALR 2: Inquiry B - Different kinds of questions suggest different kinds of scientific investigations. EALR 4: Life Science 3B - Every organism contains a set of genetic information (instructions) to specify its traits. This information is contained within genes in the chromosomes in the nucleus of each cell.

Grade Level	Washington State Health and Fitness Standards
6-8	<ul style="list-style-type: none"> EALR 2: Component 2.2: Understands stages of growth and development. Understands hereditary factors that affect growth, development, and health.

Grade Level	Washington State Math Standards
6	<ul style="list-style-type: none"> 6.3.A Identify and write ratios as comparisons of part-to-part and part-to-whole relationships. 6.6.H Make and test conjectures based on data (or information) collected from explorations and experiments.
7	<ul style="list-style-type: none"> 7.2.A Mentally add, subtract, multiply, and divide simple fractions, decimals and percents. 7.6.H Make and test conjectures based on data (or information) collected from explorations and experiments.
8	<ul style="list-style-type: none"> 8.5.H Make and test conjectures based on data (or information) collected from explorations and experiments.

Grade Level	National Science Education Standards
5-8	<p>Science Standard A (Science as Inquiry) All students should develop abilities necessary to do scientific inquiry and understanding about scientific inquiry <i>Fundamental concept:</i> Think critically and logically to make the relationships between evidence and explanations.</p> <p>Standard C (Life Science) All students should develop an understanding of reproduction and heredity. <i>Fundamental concept:</i> Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of genes.</p> <p>Science Standard E (Science and Technology) All students should develop understandings about science and technology. <i>Fundamental concept:</i> Technology is essential to science because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry and analysis.</p> <p>Science Standard G (History and Nature of Science) As a result of activities in grades 5-8, all students should develop an understanding of science as a human endeavor. <i>Fundamental concept:</i> Women and men of various social and ethnic backgrounds – and with diverse interests, talents, qualities, and motivations – engage in the activities of science, engineering, and related fields such as the health profession.</p>