

# Unit Summary

The hands-on activities in Frey's Inquiry Investigations™ Genetics and Inheritance Module link to core science concepts, making them an excellent complement to existing curricula. Students investigate DNA structure and replication, the Human Genome, Mendelian genetics, the Hardy-Weinberg principle, DNA sequencing, how to diagnose genetic diseases, family pedigrees, and how to determine genotypes and phenotypes using Punnett squares.

The Inquiry Investigations™ Genetics and Inheritance Module consists of four investigative units featuring twenty hands-on laboratory activities. Each unit begins with a thorough introduction of the science skills and concepts presented in the lab activities that follow. The lab investigations can be performed in sequence (see pacing chart) or separately based upon the time available.

Suggested *Going Further* investigations allow students to design and carry out their own investigations, expanding their knowledge and understanding of genetics and inheritance concepts.

## Unit 1: The DNA Connection

### Lab 1: DNA Structure and Replication

In **Activity 1**, students assemble models of adenine, thymine, guanine, and cytosine. Students also model how these bases are paired together.

In **Activity 2**, students learn about and model DNA replication.

In **Activity 3**, students model the secondary structure of a DNA molecule, the double helix.

Suggested *Going Further* investigations challenge students to investigate RNA and how DNA is denatured when exposed to extreme heat. Students are encouraged to investigate why guanine–cytosine base pairs denature at a higher temperature than adenine–thymine base pairs.

## Unit 2: Genetics and Heredity

### Lab 2: A Closer Look at Genes and Probability

In **Activity 1**, students use a Punnett square to analyze the results of a monohybrid cross.

In **Activity 2**, students model the gametes of a purebred tall pea plant and of a purebred short pea plant.

In **Activity 3**, students simulate a genetic cross to demonstrate the law of incomplete dominance.

In **Activity 4**, students establish the genotypes and phenotypes for an F<sub>2</sub> generation of a dihybrid cross.

Suggested *Going Further* investigations direct students to research the BRCA-1 gene. Students are also directed to determine the frequency of some common traits within their class or families.

### Lab 3: Genetic Diversity

In **Activity 1**, students model the phases of Meiosis I and II and the phenomenon of crossing over. They also learn about the role chromosomes play in reproduction.

Suggested *Going Further* investigations direct students to research what happens if chromosomes do not separate properly. They also follow a gene as the chromosome on which it is located undergoes meiosis.

## Unit 3: Human Genetics and Inheritance

### Lab 4: Heredity of Human Traits

In **Activity 1**, students determine the frequency of traits within their class.

In **Activity 2**, students calculate the genotype frequencies of a trait using the Hardy-Weinberg principle.

In **Activity 3**, students construct and analyze a pedigree for a family trait.

In **Activity 4**, students use Punnett squares to identify possible genotypes.

Suggested *Going Further* investigations ask students to play the role of a genetic counselor and to use the Hardy-Weinberg principle to determine genotypes of sample populations.

### Lab 5: Understanding the Human Genome

In **Activity 1**, students simulate using restriction enzymes and gel electrophoresis to create a DNA fingerprint.

In **Activity 2**, students sequence DNA using the Sanger sequencing method.

In **Activity 3**, students create karyotypes for four individuals to determine their health.

In **Activity 4**, students analyze electrophoresed DNA samples to determine the health of an unborn child.

In **Activity 5**, students analyze electrophoresed DNA samples to determine the health of three sisters.

Suggested *Going Further* investigations allow students to play the role of a genetic counselor and discuss the pros and cons of genetic testing.

### Lab 6: Human Diversity

In **Activity 1**, students simulate a blood typing procedure on simulated blood samples and analyze the results.

Suggested *Going Further* investigations ask students to research how blood typing can be used in forensics to help solve a mystery. Students are also asked to investigate the distribution of blood types throughout the world.

## Unit 4: Comprehensive Inquiry Investigation

### Lab 7: Culminating Lab

In **Activity 1**, students use DNA fingerprinting to solve a mystery.

In **Activity 2**, students determine the number of individuals within their class that show several common traits and use the Hardy-Weinberg equation to determine the allele and genotype frequencies for the class population.

Suggested *Going Further* investigations ask students to investigate the “founder effect”.