Unit Summary

The hands-on activities in Frey's Inquiry Investigations™ *Biotechnology Techniques* Module link to core science concepts, making them an excellent complement to existing curricula. Students investigate gel electrophoresis, extracting DNA from plant cells, DNA structure and replication, restriction enzymes, restriction site mapping, genetic engineering, the Human Genome Project, and gene expression.

The Inquiry Investigations™ *Biotechnology Techniques* Module consists of four investigative units featuring twelve 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 biotechnology.

Unit 1: Understanding DNA

Lab 1: DNA Structure and Replication

In **Activity 1**, students study the structure of DNA and simulate the process of DNA replication.

Suggested *Going Further* investigations encourage students to examine and compare RNA to DNA.

Lab 2: Extracting DNA

In **Activity 1**, students prepare an onion lysate solution for use in **Activity 2**.

In **Activity 2**, students isolate and observe DNA from onion cells. Students examine the physical characteristics of their isolated DNA sample.

Suggested *Going Further* investigations provide students the opportunity to further examine their isolated DNA sample under a microscope. Students are also encouraged to compare their isolated DNA sample to other long-chain macromolecules.

Unit 2: Biotechnology Techniques I – Gel Electrophoresis

Lab 3: Simulating Gel Electrophoresis

In **Activity 1**, students use simulated restriction enzymes to simulate the digestions of two double-stranded DNA molecules. Students also determine the number of fragments generated and the size (number of base pairs) of each.

In **Activity 2**, students learn about the principles of gel electrophoresis.

Suggested *Going Further* investigations allow students to research additional restriction enzymes and further investigate the restriction enzyme digestion process.

Lab 4: Exploring Molecules Using Gel Electrophoresis

In **Activity 1**, students use gel electrophoresis to separate dye molecules based on their molecular mass and charge.

In A**ctivity 2**, students use gel electrophoresis to separate cleaved DNA samples and sort them based on molecular mass and charge.

Suggested *Going Further* investigations encourage students to design their own electrophoresis system. Students can also research how gel electrophoresis is used by scientists in the field of forensic science.

Lab 5: Mapping Restriction Site Landmarks of a DNA Sample

In **Activity 1**, students use a molecular mass standard curve to determine the base pair size of DNA fragments. Students also map the restriction site landmarks of a bacteriophage lambda (λ) DNA sample.

Suggested *Going Further* investigations provide students with an exercise to help them practice loading samples into agarose gel wells. Students can also further investigate the Human Genome Project and its contributions to society.

Unit 3: Biotechnology Techniques II – Gene Expression

Lab 6: A Closer Look at Bio-Engineering

In **Activity 1**, students simulate the creation of a recombinant DNA molecule.

Suggested *Going Further* investigations encourage students to research genetic engineering and how they encounter it in everyday life.

Lab 7: How Genes Express Themselves

In **Activity 1**, students determine the effect of temperature regulation on gene expression.

Suggested *Going Further* investigations prompt students to investigate how different temperatures affect *S. marcescens*.

Unit 4: Comprehensive Inquiry Investigation

Lab 8: Culminating Lab

In **Activity 1**, students demonstrate the process of bacterial transformation and calculate transformation efficiency.

In **Activity 2**, students use a simulated DNA chip to determine which genotype of the ApoE gene an individual has. Students also predict how genetic factors play a role in an individual's health.

Suggested *Going Further* investigations allow students to develop their own agar growth medium and research how the environmental and agricultural industries use plasmids.