

Inquiry Investigations™
Biotechnology Techniques MODULE - 1278357
Grades: 7-10

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California Content Standards
Science
Grade 7

CONTENT STANDARD	CA.1.	Life Science: Cell Biology: All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept:
PERFORMANCE STANDARD	1.a.	<p>Students know cells function similarly in all living organisms.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.b.	<p>Students know the characteristics that distinguish plant cells from animal cells, including chloroplasts and cell walls.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA
PERFORMANCE STANDARD	1.c.	<p>Students know the nucleus is the repository for genetic information in plant and animal cells.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.2.	Life Science: Genetics: A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences.

		As a basis for under-standing this concept:
PERFORMANCE STANDARD	2.c.	<p>Students know an inherited trait can be determined by one or more genes.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	2.d.	<p>Students know plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	2.e.	<p>Students know DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT	CA.7.	Life Science: Investigation and Experimentation: Scientific progress is made by

STANDARD		asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:
PERFORMANCE STANDARD	7.a.	<p>Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis
PERFORMANCE STANDARD	7.c.	<p>Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off

		<ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Virtual Laboratory: Restriction Enzyme Cleavage of DNA
PERFORMANCE STANDARD	7.d.	<p>Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	7.e.	<p>Communicate the steps and results from an investigation in written reports and oral presentations.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Virtual Laboratory: Restriction Enzyme Cleavage of DNA

California Content Standards
Science
Grade 8

CONTENT	CA.1. Physical Science: Motion: The velocity of an object is the rate of change of its
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STANDARD		position. As a basis for understanding this concept:
PERFORMANCE STANDARD	1.f.	<p>Students know how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping
CONTENT STANDARD	CA.3.	Physical Science: Structure of Matter: Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:
PERFORMANCE STANDARD	3.c.	<p>Students know atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication
CONTENT STANDARD	CA.6.	Physical Science: Chemistry of Living Systems (Life Science): Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:
PERFORMANCE STANDARD	6.a.	<p>Students know that carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	6.b.	<p>Students know that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	6.c.	<p>Students know that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA

CONTENT STANDARD	CA.9.	Physical Science: Investigation and Experimentation: Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:
PERFORMANCE STANDARD	9.c.	Distinguish between variable and controlled parameters in a test. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
PERFORMANCE STANDARD	9.d.	Recognize the slope of the linear graph as the constant in the relationship $y = kx$ and apply this principle in interpreting graphs constructed from data. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping
PERFORMANCE STANDARD	9.e.	Construct appropriate graphs from data and develop quantitative statements about the relationships between variables. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping
PERFORMANCE STANDARD	9.f.	Apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including speed = distance/time, density = mass/volume, force = pressure x area, volume = area x height). <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
PERFORMANCE STANDARD	9.g.	Distinguish between linear and nonlinear relationships on a graph of data. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping

California Content Standards
Science
Grade 9

CONTENT STANDARD	CA.5.	Physics: Electric and Magnetic Phenomena: Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept:
PERFORMANCE STANDARD	5.a.	Students know how to predict the voltage or current in simple direct current (DC)

		<p>electric circuits constructed from batteries, wires, resistors, and capacitors.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge
CONTENT STANDARD	CA.2.	Chemistry: Chemical Bonds: Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:
PERFORMANCE STANDARD	2.a.	<p>Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication
CONTENT STANDARD	CA.5.	Chemistry: Acids and Bases: Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:
PERFORMANCE STANDARD	5.g.	<p>Students know buffers stabilize pH in acid-base reactions.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping
CONTENT STANDARD	CA.10.	Chemistry: Organic Chemistry and Biochemistry: The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:
PERFORMANCE STANDARD	10.a.	<p>Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	10.c.	<p>Students know amino acids are the building blocks of proteins.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	10.f.	<p>Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.1.	Biology/Life Sciences: Cell Biology: The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:
PERFORMANCE STANDARD	1.a.	<p>Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.</p>

		<ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA
PERFORMANCE STANDARD	1.b.	<p>Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
PERFORMANCE STANDARD	1.c.	<p>Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.d.	<p>Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.e.	<p>Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.g.	<p>Students know the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.h.	<p>Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.</p>

		<ul style="list-style-type: none"> Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.j	<p>Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.</p> <ul style="list-style-type: none"> Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.2.	Biology/Life Sciences: Genetics: Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:
PERFORMANCE STANDARD	2.a.	<p>Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	2.b.	<p>Students know only certain cells in a multicellular organism undergo meiosis.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	2.c.	<p>Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
CONTENT STANDARD	CA.3.	Biology/Life Sciences: Genetics: A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:
PERFORMANCE STANDARD	3.a.	<p>Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques II - Gene Expression Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.4.	Biology/Life Sciences: Genetics: Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept:
PERFORMANCE STANDARD	4.a.	<p>Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.</p> <ul style="list-style-type: none"> Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	4.b.	<p>Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.</p> <ul style="list-style-type: none"> Teacher Resource CD: Understanding DNA

PERFORMANCE STANDARD	4.d.	<p>Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
PERFORMANCE STANDARD	4.e.	<p>Students know proteins can differ from one another in the number and sequence of amino acids.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	4.f.	<p>Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.5.	<p>Biology/Life Sciences: Genetics: The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:</p>
PERFORMANCE STANDARD	5.a.	<p>Students know the general structures and functions of DNA, RNA, and protein.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	5.b.	<p>Students know how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into</p>

		<p>mRNA.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	5.c.	<p>Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA • Virtual Laboratory: Restriction Enzyme Cleavage of DNA
PERFORMANCE STANDARD	5.d.	<p>Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
PERFORMANCE STANDARD	5.e.	<p>Students know how exogenous DNA can be inserted into bacterial cells to alter their</p>

		<p>genetic makeup and support expression of new protein products.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
CONTENT STANDARD	CA. 7.	Biology/Life Sciences: Evolution: The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:
PERFORMANCE STANDARD	7.b.	<p>Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
CONTENT STANDARD	CA. 10.	Biology/Life Sciences: Physiology: Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:
PERFORMANCE STANDARD	10.d.	<p>Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
CONTENT STANDARD	CA. 1.	Investigation and Experimentation: Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
PERFORMANCE STANDARD	1.a.	<p>Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA

		<p>Fragments</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis
PERFORMANCE STANDARD	1.e.	<p>Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
PERFORMANCE STANDARD	1.g.	<p>Recognize the usefulness and limitations of models and theories as scientific representations of reality.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	1.i.	<p>Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules
PERFORMANCE STANDARD	1.j.	<p>Recognize the issues of statistical variability and the need for controlled tests.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How

		Plasmids Transfer Genes
PERFORMANCE STANDARD	1.k.	<p>Recognize the cumulative nature of scientific evidence.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.l.	<p>Analyze situations and solve problems that require combining and applying concepts from more than one area of science.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	1.m.	<p>Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression

California Content Standards
Science
Grade 10

CONTENT STANDARD	CA.5.	Physics: Electric and Magnetic Phenomena: Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept:
PERFORMANCE STANDARD	5.a.	<p>Students know how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge

CONTENT STANDARD	CA.2.	Chemistry: Chemical Bonds: Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:
PERFORMANCE STANDARD	2.a.	Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication
CONTENT STANDARD	CA.5.	Chemistry: Acids and Bases: Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:
PERFORMANCE STANDARD	5.g.	Students know buffers stabilize pH in acid-base reactions. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping
CONTENT STANDARD	CA.10.	Chemistry: Organic Chemistry and Biochemistry: The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:
PERFORMANCE STANDARD	10.a.	Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	10.c.	Students know amino acids are the building blocks of proteins. <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	10.f.	Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins. <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.1.	Biology/Life Sciences: Cell Biology: The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:
PERFORMANCE STANDARD	1.a.	Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings. <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA
PERFORMANCE STANDARD	1.b.	Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the

		<p>temperature, ionic conditions, and the pH of the surroundings.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
PERFORMANCE STANDARD	1.c.	<p>Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.d.	<p>Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.e.	<p>Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.g.	<p>Students know the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.h.	<p>Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	1.j.	<p>Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.</p>

		<ul style="list-style-type: none"> Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.2.	Biology/Life Sciences: Genetics: Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:
PERFORMANCE STANDARD	2.a.	<p>Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	2.b.	<p>Students know only certain cells in a multicellular organism undergo meiosis.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	2.c.	<p>Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	2.f.	<p>Students know the role of chromosomes in determining an individual's sex.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis Teacher Resource CD: Biotechnology Techniques II - Gene Expression Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.3.	Biology/Life Sciences: Genetics: A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:
PERFORMANCE STANDARD	3.a.	<p>Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques II - Gene Expression Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	3.d.	<p>Students know how to use data on frequency of recombination at meiosis to estimate genetic distances between loci and to interpret genetic maps of chromosomes.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes

		<ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.4.	Biology/Life Sciences: Genetics: Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept:
PERFORMANCE STANDARD	4.a.	<p>Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	4.b.	<p>Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	4.d.	<p>Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression
PERFORMANCE STANDARD	4.e.	<p>Students know proteins can differ from one another in the number and sequence of amino acids.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Understanding DNA
PERFORMANCE STANDARD	4.f.	<p>Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.</p> <ul style="list-style-type: none"> • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
CONTENT STANDARD	CA.5.	Biology/Life Sciences: Genetics: The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:
PERFORMANCE STANDARD	5.a.	<p>Students know the general structures and functions of DNA, RNA, and protein.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using

		<p>Gel Electrophoresis</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA
<p>PERFORMANCE STANDARD</p>	<p>5.b.</p>	<p>Students know how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Teacher Resource CD: Understanding DNA
<p>PERFORMANCE STANDARD</p>	<p>5.c.</p>	<p>Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis • Teacher Resource CD: Biotechnology Techniques II - Gene Expression • Teacher Resource CD: Understanding DNA

		<ul style="list-style-type: none"> Virtual Laboratory: Restriction Enzyme Cleavage of DNA
PERFORMANCE STANDARD	5.d.	<p>Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis Teacher Resource CD: Biotechnology Techniques II - Gene Expression
PERFORMANCE STANDARD	5.e.	<p>Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis Teacher Resource CD: Biotechnology Techniques II - Gene Expression
CONTENT STANDARD	CA.7.	Biology/Life Sciences: Evolution: The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:
PERFORMANCE STANDARD	7.b.	<p>Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques II - Gene Expression
CONTENT STANDARD	CA.10.	Biology/Life Sciences: Physiology: Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:
PERFORMANCE STANDARD	10.d.	<p>Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
CONTENT STANDARD	CA.1.	Investigation and Experimentation: Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands,

		students should develop their own questions and perform investigations. Students will:
PERFORMANCE STANDARD	1.a.	<p>Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression • Teacher Resource CD: Biotechnology Techniques I - Gel Electrophoresis
PERFORMANCE STANDARD	1.e.	<p>Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
PERFORMANCE STANDARD	1.g.	<p>Recognize the usefulness and limitations of models and theories as scientific representations of reality.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	1.i.	<p>Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and</p>

		<p>succession of species in an ecosystem).</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules
PERFORMANCE STANDARD	1.j.	<p>Recognize the issues of statistical variability and the need for controlled tests.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes
PERFORMANCE STANDARD	1.k.	<p>Recognize the cumulative nature of scientific evidence.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression
PERFORMANCE STANDARD	1.l.	<p>Analyze situations and solve problems that require combining and applying concepts from more than one area of science.</p> <ul style="list-style-type: none"> • Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication • Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction • Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA • Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands • Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis • Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge • Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments • Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping • Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules • Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off • Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes • Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression

		<ul style="list-style-type: none"> Virtual Laboratory: Restriction Enzyme Cleavage of DNA
PERFORMANCE STANDARD	1.m.	<p>Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.</p> <ul style="list-style-type: none"> Biotechnology Techniques: Unit 1 Lab 1 Activity 1: DNA Structure and Replication Biotechnology Techniques: Unit 1 Lab 2 Activity 1: Preparing a Plant Tissue for DNA Extraction Biotechnology Techniques: Unit 1 Lab 2 Activity 2: Extracting Cellular DNA Biotechnology Techniques: Unit 2 Lab 3 Activity 1: Using Restriction Enzymes to Cut DNA Strands Biotechnology Techniques: Unit 2 Lab 3 Activity 2: Sorting DNA Using Gel Electrophoresis Biotechnology Techniques: Unit 2 Lab 4 Activity 1: Determining Molecular Mass and Charge Biotechnology Techniques: Unit 2 Lab 4 Activity 2: Identifying DNA Fragments Biotechnology Techniques: Unit 2 Lab 5 Activity 1: Restriction Site Mapping Biotechnology Techniques: Unit 3 Lab 6 Activity 1: Engineering Recombinant DNA Molecules Biotechnology Techniques: Unit 3 Lab 7 Activity 1: Turning Genes On and Off Biotechnology Techniques: Unit 4 Lab 8 Activity 1: Discover How Plasmids Transfer Genes Biotechnology Techniques: Unit 4 Lab 8 Activity 2: The DNA Chip and Gene Expression Teacher Resource CD: Biotechnology Techniques II - Gene Expression Virtual Laboratory: Restriction Enzyme Cleavage of DNA

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