

## SECONDARY SCIENCE

## AG53 Biotechnology Agricultural Applications

Course #: AG-53	Grade Level: 11-12
Course Name: Biotechnology Agricultural Applications	Level of Difficulty: Medium
Prerequisites: SC-48 with a "B" or better	# of Credits: 1/2 - 1

### Strand 1: Inquiry Process

*"Science as inquiry is basic to science education and a controlling principle in the continuing organization and selection of students' activities. Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry..."* (National Science Education Standards, 1995).

Inquiry Process establishes the basis for students' learning in science. Students use scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results.

### Concepts

#### Concept 1: Observations, Questions, and Hypotheses

- Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.

#### Concept 2: Scientific Testing (Investigating and Modeling)

- Design and conduct controlled investigations.

#### Concept 3: Analysis, Conclusions, and Refinements

- Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.

#### Concept 4: Communication

- Communicate results of investigations.

### Students should know and be able to...

Concept Number	Concept	PO No	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S1C1	Observations, Questions and Hypotheses	1	<b>Evaluate scientific information for relevance to a given problem</b> <ul style="list-style-type: none"> <li>Students will evaluate scientific information from a variety of sources for an Agriscience Fair project in an area of Agriculture including:                             <ul style="list-style-type: none"> <li>Applications of Agriculture in Biotechnology</li> </ul> </li> </ul>	Relevant	
		2	<b>Develop questions from observation that translate into testable hypotheses</b> <ul style="list-style-type: none"> <li>Students will synthesize questions for experimentation for Agriscience Fair Project or Ag-Issues Career Development Event</li> </ul>	Hypothesis	

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Concept Number	Concept	PO No	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S1C1 (cont.)		3	<b>Formulate a testable hypothesis</b> <ul style="list-style-type: none"> <li>Students will develop testable hypothesis for Agriscience Fair Project or Ag-Issues Career Development Event</li> </ul>		
		4	<b>Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring)</b> <ul style="list-style-type: none"> <li>Through research Students will make a case for their theories.</li> </ul>	Predict Evidence Probability Modeling	
S1C2	Scientific testing (Investigating and Modeling)	1	<b>Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, and organisms) and behavior in all science inquiry.</b> <ul style="list-style-type: none"> <li>Student research for Agriscience Fair Projects will demonstrate safe and ethical procedures. Including:                             <ul style="list-style-type: none"> <li>Demonstrate safe use of microscope</li> <li>Demonstrate safe use of lab chemicals</li> <li>Demonstrate safe use of lab equipment</li> <li>Demonstrate safe use of lab facilities and equipment</li> <li>Demonstrate safe use of greenhouse facilities and equipment</li> </ul> </li> </ul>		
		2	<b>Identify the resources needed to conduct an investigation</b> <ul style="list-style-type: none"> <li>Students will identify and document resources used in the planning and conducting of Agriscience Fair Project. Resources include but are not limited to: industry publications, magazines, internet resources, books, etc.</li> </ul>		

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<b>S1C2 (cont.)</b>		<b>3</b>	<p><b>Design as appropriate protocol (written plan of action) for testing a hypothesis:</b></p> <ul style="list-style-type: none"> <li>▪ <b>Identify dependent and independent variables in a controlled investigation.</b></li> <li>▪ <b>Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).</b></li> <li>▪ <b>Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).</b></li> </ul> <p>▪ Students will design appropriate protocol for Agriscience Fair Projects. Materials and procedures will be recorded in data books for presentation with Agriscience Fair Project.</p>		
		<b>4</b>	<p><b>Conduct a scientific investigation that is based on a research design.</b></p> <ul style="list-style-type: none"> <li>▪ Students will conduct an Agriscience Fair Project based on research design including:                             <ul style="list-style-type: none"> <li>▪ Use and demonstrate investigative procedures including asking questions, formulating testable hypotheses, and selecting appropriate resources</li> <li>▪ Design and conduct experiment to test hypothesis</li> <li>▪ Perform the experiment according to suggested format.</li> <li>▪ Collect data from the experiment.</li> </ul> </li> </ul>		
		<b>5</b>	<p><b>Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.</b></p> <ul style="list-style-type: none"> <li>▪ Students will record observations, notes, sketches, questions, and ideas in a research data book to be submitted with Agriscience Fair Project.</li> </ul>		

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S1C3	Analysis, Conclusions, and Refinements	1	<p><i>Interpret data that show a variety of possible relationships between variables:</i></p> <ul style="list-style-type: none"> <li>▪ <b>Positive relationship</b></li> <li>▪ <b>Negative relationship</b></li> <li>▪ <b>No relationship</b></li> </ul> <p>▪ Students will interpret, evaluate, organize, analyze, make inferences and predict trends from data collected for Agriscience Fair Project to show relationships between variables.</p>	Interpret Evaluate Organize Analyze Inference Trends	
		2	<p><b>Evaluate whether investigational data support or do not support the proposed hypothesis.</b></p> <ul style="list-style-type: none"> <li>▪ Students will:                             <ul style="list-style-type: none"> <li>▪ Evaluate a hypothesis and write one that can be investigated as part of the Agriscience Fair Project</li> <li>▪ Evaluate the cause and effect in a hypothesis</li> <li>▪ Evaluate the variables that must be controlled in order to conduct a controlled experiment</li> <li>▪ Compare the conclusions for the Agriscience Fair Project to the original hypothesis</li> </ul> </li> </ul>		
		3	<p><b>Critique reports of scientific studies (e.g., published papers, student reports)</b></p> <ul style="list-style-type: none"> <li>▪ Students will critique reports of scientific studies published in agricultural periodicals and self evaluate student papers before they are turned in.</li> </ul>		

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S1C3 (cont.)	<b>Analysis, Conclusions, and Refinements</b>	<b>4</b>	<p><b>Evaluate the design of an investigation to identify possible sources of procedural error, including:</b></p> <ul style="list-style-type: none"> <li>• <b>Sample size</b></li> <li>• <b>Trials</b></li> <li>• <b>Controls</b></li> <li>• <b>Analyses</b></li> </ul> <p>▪ Students will evaluate the design of their Agriscience Fair Projects to determine sources of error. Results will be recorded in data book to be presented with Agriscience Fair project.</p>		
		<b>5</b>	<p><b>Design models (conceptual or physical) of the following to represent “real world” scenarios.</b></p> <ul style="list-style-type: none"> <li>• <b>Carbon cycle</b></li> <li>• <b>Water cycle</b></li> <li>• <b>Phase change</b></li> <li>• <b>Collisions</b></li> </ul> <p>▪ Students will design models to represent “real world” scenarios utilized in their Agriscience Fair projects. Models will be displayed as part of project or in data book as appropriate.</p>		
		<b>6</b>	<p><b>Use of descriptive statistics to analyze data, including:</b></p> <ul style="list-style-type: none"> <li>• <b>Mean</b></li> <li>• <b>Frequency</b></li> <li>• <b>Range</b> (see MHS-S2C1-10)</li> </ul> <p>▪ Students will use descriptive statistics to analyze data for Agriscience Fair Projects. Data will be recorded and explained in data book.</p>		
		<b>7</b>	<p><b>Propose further investigations based on the findings of a conducted investigation.</b></p> <p>▪ Students will propose further investigations based on conclusions of Agriscience Fair Project. These proposals will be included in data book .</p>		

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S1C4	Communications	1	<p><b>For a specific investigation, choose an appropriate method for communicating the results.</b></p> <ul style="list-style-type: none"> <li>▪ Students will choose the appropriate method for communicating results obtained for their Agriscience Fair Project.</li> </ul>		
		2	<p><b>Produce graphs that help communicate data. (see HS-S2C2- 01)</b></p> <ul style="list-style-type: none"> <li>▪ Students will communicate the findings of the experiment in graphic form to help communicate data collected as part of Agriscience Fair Project.</li> </ul>		
		3	<p><b>Communicate results clearly and logically.</b></p> <ul style="list-style-type: none"> <li>▪ Students will communicate findings of research clearly and logically for evaluation in Agriscience Fair.</li> </ul>		
		4	<p><b>Support Conclusions with logical scientific arguments.</b></p> <ul style="list-style-type: none"> <li>▪ Students will support conclusions drawn from Agriscience Fair Project with logical scientific arguments.</li> </ul>		

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### Strand 2: History and Nature of Science

*Knowledge of the nature of science is central to the understanding of the scientific enterprise” (National Assessment of Educational Progress, 2000).*

Scientific investigation grows from the contributions of many people. History and Nature of Science emphasizes the importance of the inclusion of historical perspectives and the advances that each new development brings to technology and human knowledge. This strand focuses on the human aspects of science and the role that scientists play in the development of various cultures.

### Concepts

#### Concept 1: History of Science as a Human Endeavor

- Identify individual, cultural, and technological contributions to scientific knowledge.

#### Concept 2: Nature of Scientific Knowledge

- Understand how science is a process for generating knowledge.

### Students should know and be able to...

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S2C1	History of Science as a Human Endeavor	1	<p><b>Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.</b></p> <ul style="list-style-type: none"> <li>▪ Students will explore the history of agriculture revolution and how it has impacted the quality of life by:                             <ul style="list-style-type: none"> <li>▪ World Population</li> <li>▪ Health</li> <li>▪ Food supply</li> <li>▪ Standard of Living and standards levels</li> <li>▪ Global responsibility</li> </ul> </li> </ul>	Population trends Education Interventions Government controls Government agencies	
		2	<p><b><i>Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.</i></b></p> <ul style="list-style-type: none"> <li>▪ Students will explore the roots and cultures that have impacted Agriscience/Biotechnology and FFA in America.</li> </ul>	Agricultural Trends Sustainable agriculture Agricultural Inventions Biotechnology	

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S2C1 (cont.)		3	<p><b>Analyze how specific changes in science have affected society</b></p> <ul style="list-style-type: none"> <li>▪ Students will study the progress of Agriculture from the small subsistence farm to the large corporations of today and analyze and describe the benefits, limitations and consequences of the developments in Biotechnology and how it has affected society.</li> </ul>	Transportation Storage Facilities Research Facilities	Ag-Issues CDE
		4	<p><b>Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.</b></p> <ul style="list-style-type: none"> <li>▪ Students will prepare an essay/speech/visual presentation on ethical considerations related to using biotechnology to:                             <ol style="list-style-type: none"> <li>1. improve human health with biotechnology</li> <li>2. produce and process food with biotechnology</li> <li>3. improve production of animals with biotechnology</li> <li>4. improvement in plant science with biotechnology</li> </ol> </li> </ul>		

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S2C2	Nature of Scientific Knowledge	1	<p><b>Specify the requirements of a valid, scientific explanation (theory), including that it be:</b></p> <ul style="list-style-type: none"> <li>▪ <b>Logical</b></li> <li>▪ <b>Subject to peer review</b></li> <li>▪ <b>Public</b></li> </ul> <p>▪ Respectful of rules of evidence</p> <p>▪ In preparation for the Agriscience Fair or Ag-Issues Career Development Event students will specify the requirements for valid, scientific explanation.</p>		
		2	<p><b>Explain the process by which accepted ideas are challenged or extended by scientific innovation.</b></p> <ul style="list-style-type: none"> <li>▪ In preparation for the Agriscience Fair Project or Ag-Issues Career Development Event students must be able to explain the process by which accepted ideas are challenged.</li> </ul>		
		3	<p><b>Distinguish between pure and applied science.</b></p> <ul style="list-style-type: none"> <li>▪ Students will distinguish between pure and applied science through their exploration of Biotechnology.</li> </ul>	Agriscience, Agronomy , Animal Science , Aquaculture, Biology, Biotechnology, Botany, Computational Science, Earth Science, Entomology, Environmental science, Forestry, Horticulture, Life science , Physical science , Zoology Genetically modified organism FDA USDA	
		4	<p><b>Describe how scientists continue to investigate and critically analyze aspects of theories.</b></p> <ul style="list-style-type: none"> <li>▪ Students will describe the process by which genetically modified organisms are prepared for widespread human use/ consumption.</li> </ul>		

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**Strand 3: Science in Personal and Social Perspectives**

Science in Personal and Social Perspectives emphasizes developing the ability to design a solution to a problem, to understand the relationship between science and technology, and the ways people are involved in both. Students understand the impact of science and technology on human activity and the environment. This strand affords students the opportunity to understand their place in the world – as living creatures, consumers, decision makers, problem solvers, managers, and planners.

**Concepts**

**Concept 1: Changes in Environments**

- Describe the interactions between human populations, natural hazards, and the environment.

**Concept 2: Science and Technology in Society**

- Develop viable solutions to a need or problem.

**Concept 3: Human Population Characteristics**

- Analyze factors that affect human populations.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S3C1	Changes in Environments	1	<p><b>Evaluate how the processes of natural ecosystems affect, and are affected by, humans.</b></p> <ul style="list-style-type: none"> <li>▪ Students will answer the following questions:</li> <li>▪ How have humans affected their environment through the use of:                             <ul style="list-style-type: none"> <li>▪ New technology? Biotechnology</li> <li>▪ Genetic modifications/ selection?</li> </ul> </li> <li>▪ How have humans been affected by their environment?</li> </ul>	Ecosystem Environment Pollution Game Management Point source pollution Nonpoint source pollution Agriculture pollution	ABS 4.0

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S3C1 (cont.)		2	<p><b>Describe the environmental effects of the following natural and/or human caused hazards:</b></p> <ul style="list-style-type: none"> <li>▪ <b>Flooding</b></li> <li>▪ <b>Drought</b></li> <li>▪ <b>Earthquakes</b></li> <li>▪ <b>Fires</b></li> <li>▪ <b>Pollution</b></li> <li>▪ <b>Extreme Weather</b></li> </ul> <ul style="list-style-type: none"> <li>▪ Students will describe how biotechnology can help make changes in the environment:                             <ul style="list-style-type: none"> <li>▪ Acid rain</li> <li>▪ Drought and Flood resistant plants</li> <li>▪ Organism transmitted through plant GMO</li> <li>▪ Affluent from industry</li> <li>▪ Affluent from agriculture</li> <li>▪ Genetically modified organisms</li> </ul> </li> </ul>	Genetically modified organism Acid rain affluent	
		3	<p><b>Assess how human activities (e.g., clear cutting, water management, tree thinning) can affect the potential for hazards</b></p> <ul style="list-style-type: none"> <li>▪ Students will identify the necessity of natural resource s and explain proper management of these resources and assess the potential problems with mismanagement.</li> </ul>	Water table Water cycle Conservation Precipitation Aquifer Erosion	ABS 4.0
		4	<p><b>Evaluate the following factors that affect the quality of the environment:</b></p> <ul style="list-style-type: none"> <li>• <b>Urban development</b></li> <li>• <b>Smoke</b></li> <li>• <b>Volcanic dust</b></li> </ul> <ul style="list-style-type: none"> <li>▪ Students will explore how biotechnology can influence urbanization, smoke, and volcanic dust and it's effects on agriculture and the environment.</li> </ul>	Urbanization particulate	ABS 4.0

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S3C1 (cont.)		5	<p><b>Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality and biodiversity.</b></p> <ul style="list-style-type: none"> <li>Students will choose an agricultural issue dealing with environmental quality and explain both sides of the issue including possible biotechnology solutions and evaluation of the current method of conservation.</li> </ul>	Agricultural Issues	ABS 4.0
S3C2	Science and Technology in Society	1	<p><b>Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:</b></p> <ul style="list-style-type: none"> <li><b>Various forms of alternative energy</b></li> <li><b>Storage of nuclear waste</b></li> <li><b>Abandoned mines</b></li> <li><b>Greenhouse gases</b></li> <li><b>Hazardous wastes</b></li> </ul> <p>Students will:</p> <ul style="list-style-type: none"> <li>identify the sources of pollution and analyze various methods of remediation of various types of waste products and explain ways that we can prevent agricultural pollution.</li> <li>identify uses and benefits of bio-fuels</li> <li>Analyze the cost/ benefit that biotechnology can have on removing hazardous wastes from the environment</li> </ul>	Agricultural pollution Remediation Biodegradable Recycling	
		2	<p><b>Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.</b></p> <ul style="list-style-type: none"> <li>Students will recognize the importance of basing arguments on through understanding of the core concepts of science and base conclusions of Agriscience Fair Project on core concepts and principles of biotechnology.</li> </ul>		

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S3C2 (cont.)		3	<p><b>Support a position on a science or technology issue.</b></p> <ul style="list-style-type: none"> <li>▪ The Agricultural Issues assignment will give students the opportunity to support a position on a biotechnology issue. Students will present research for this assignment is like a scripted debate on an Agriscience issue.</li> </ul>		
		4	<p><b>Analyze the use of renewable and nonrenewable resources in Arizona:</b></p> <ul style="list-style-type: none"> <li>• water</li> <li>• land</li> <li>• soil</li> <li>• minerals</li> <li>• air</li> <li>▪ Students activities in the greenhouse using water resources and quality, different types of soil mediums, plant nutrients, air quality and water application methods</li> </ul>		
		5	<p><b>Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).</b></p> <ul style="list-style-type: none"> <li>▪ Through the Agricultural Issues assignment students will evaluate methods used to manage natural resources and suggest better alternatives to their management.</li> </ul>		

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S3C3	Human Population Characteristics	1	<p><b>Analyze social factors that limit the growth of a human population, including:</b></p> <ul style="list-style-type: none"> <li>• affluence</li> <li>• education</li> <li>• access to health care</li> <li>• cultural influences</li> <li>• expert Knowledge required plant growers</li> <li>• types of growers</li> <li>• career opportunities</li> </ul> <p>▪ Students will determine how biotechnology will address these issues</p>		
		2	<p><b>Describe biotic (living) and abiotic (nonliving) factors that affect human populations.</b></p> <p>▪ Students will:</p> <ul style="list-style-type: none"> <li>▪ Describe and identify the components of an ecosystem both biotic and abiotic</li> <li>▪ describe and explain factors that affect populations size and growth in various areas of the world.</li> <li>▪ describe and explain factors that affect plant growth and development</li> </ul>	Biotic Abiotic	
		3	<p><b>Predict the effect of a change in a specific factor on a human/animal population.</b></p> <p>▪ Through the America the Bountiful Video Series students will make observations and predict the changes that new ideas, situations, and technologies have on the growth of a population both animal and human.</p>		

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**Strand 4: Life Science**

*“The fundamental goal of life sciences is to attempt to understand and explain the nature of life” (NAEP 2000).*

Life Science expands students’ biological understanding of life by focusing on the characteristics of living things, the diversity of life, and how organisms and populations change over time in terms of biological adaptation and genetics. This understanding includes the relationship of structures to their functions and life cycles, interrelationships of matter and energy in living organisms, and the interactions of living organisms with their environment.

**Concepts**

**Concept 1: The Cell**

- Understand the role of the cell and cellular processes.

**Concept 2: Molecular Basis of Heredity**

- Understand the molecular basis of heredity and resulting genetic diversity.

**Concept 3: Interdependence of Organisms**

- Analyze the relationships among various organisms and their environment.

**Concept 4: Biological Evolution**

- Understand the scientific principles and processes involved in biological evolution.

**Concept 5: Matter, Energy, and Organization in Living Systems (Including Human Systems)**

- Understand the organization of living systems, and the role of energy within those systems.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C1	The Cell	1	<p><b>Describe the role of energy in cellular growth, development, and repair.</b></p> <ul style="list-style-type: none"> <li>▪ Students will describe the role of energy in cellular growth, development and repair in plants and animals                             <ul style="list-style-type: none"> <li>▪ Photosynthesis</li> <li>▪ Respiration</li> <li>▪ Transpiration</li> <li>▪ ATP</li> </ul> </li> </ul>	Photosynthesis Respiration Transpiration ATP	ABS 2.1 Biotechnology for Plants Animals and the Environment: Unit 1 – lesson 2

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources	
S4C1 (cont.)		2	<p><b>Compare the form and function of prokaryotic and eukaryotic cells and their cellular components.</b></p> <ul style="list-style-type: none"> <li>▪ Compare the form and function of prokaryotic and eukaryotic cells and their cellular components in plants and animals:                             <ul style="list-style-type: none"> <li>▪ Plasma membrane</li> <li>▪ DNA</li> <li>▪ ER</li> <li>▪ Ribosome</li> <li>▪ Vacuoles</li> <li>▪ Golgi apparatus</li> <li>▪ Mitochondria</li> <li>▪ Chloroplast</li> <li>▪ Nucleus</li> <li>▪ microtubules</li> </ul> </li> </ul>	Plasma membrane DNA ER Ribosome Vacuoles Golgi apparatus Mitochondria Chloroplast Nucleus microtubules	ABS 2.1 Biotechnology for Plants Animals and the Environment: Unit 1 – lesson 2	
		3	<p><b>Explain the importance of water to cells.</b></p> <ul style="list-style-type: none"> <li>▪ Explain the importance of water to cells for plants and animals</li> </ul>			ABS 3.0 Biotechnology for Plants Animals and the Environment: Unit 1 - lesson 2
		4	<p><b>Analyze mechanisms of transport of materials (e.g., water, ions, macromolecules) into and out of cells:</b></p> <ul style="list-style-type: none"> <li>• <b>passive transport</b></li> <li>• <b>active transport</b></li> <li>▪ Analyze the mechanism of transport of materials in and out of plant and animal cells:                             <ul style="list-style-type: none"> <li>▪ Passive transport                                     <ul style="list-style-type: none"> <li>▪ Diffusion</li> <li>▪ Osmosis</li> </ul> </li> <li>▪ Active transport                                     <ul style="list-style-type: none"> <li>▪ Cell membrane pumps</li> <li>▪ Endocytosis</li> <li>▪ exocytosis</li> </ul> </li> </ul> </li> </ul>			

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C1 (cont.)		5	<p><b>Describe the purposes and processes of cellular reproduction.</b></p> <ul style="list-style-type: none"> <li>▪ Identify and compare the difference between mitosis and meiosis and their purposes                             <ul style="list-style-type: none"> <li>▪ Mitosis                                     <ul style="list-style-type: none"> <li>▪ has six stages or phases   <ul style="list-style-type: none"> <li>▪ Interphase</li> <li>▪ Prophase</li> <li>▪ Metaphase</li> <li>▪ Telophase</li> <li>▪ Cytokinesis</li> </ul> </li> <li>▪ Purpose- growth of organism</li> </ul> </li> <li>▪ Meiosis                                     <ul style="list-style-type: none"> <li>▪ Sex cells or gametes produced (egg or sperm)</li> <li>▪ Occurs in two divisions- the second division ends with haploid number of chromosomes</li> </ul> </li> </ul> </li> </ul>	Mitosis Meiosis Haploid Diploid Triploid Interphase Prophase Metaphase Anaphase Telophase Cytokinesis	Biotechnology for Plants Animals and the Environment Unit 1- Activity 2-1

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C2	Molecular Basis of Heredity	*1	<p><b>Analyze the relationships among nucleic acids (DNA, RNA), genes, and chromosomes.</b></p> <ul style="list-style-type: none"> <li>▪ Determine the relationship among DNA, genes and chromosomes of plants and animals                             <ul style="list-style-type: none"> <li>▪ DNA- Deoxyribonucleic acid- the molecule that codes genetic information for all living things.</li> <li>▪ RNA- ribonucleic acid (3 types- messenger, transfer, ribosomal)</li> <li>▪ Gene- segment of a chromosome containing heredity traits</li> <li>▪ Gene expression- process of making DNA information available to a cell</li> <li>▪ Genes have dominant and recessive traits</li> <li>▪ Homozygous- same traits</li> <li>▪ Heterozygous- different traits</li> <li>▪ Chromosomes- linear strand composed of DNA and protein- found in nucleus of cell, containing genes</li> </ul> </li> </ul>	DNA RNA Gene Gene expression Homozygous Heterozygous Chromosomes	Biotechnology for Plants, Animals and the Environment Unit1Lesson 2
		2	<p><b>Describe the molecular basis of heredity, in viruses and living things, including DNA replication and protein synthesis.</b></p> <ul style="list-style-type: none"> <li>▪ Describe the structure and function of DNA and its role in heredity                             <ul style="list-style-type: none"> <li>▪ DNA molecule is spiraling, double-stranded, and consist of a ribose, sugar and phosphate backbone on each side</li> <li>▪ Four nucleotides adenine (A), thiamine (T), Cytosine (C), and guanine (G)</li> <li>▪ Gene expression- process of making DNA information available to the cell</li> <li>▪ Selection- choosing parents of the next generation</li> </ul> </li> <li>▪ Describe the process of protein synthesis including:                             <ul style="list-style-type: none"> <li>▪ DNA through transcription creates mRNA, which goes through transcription creating proteins</li> <li>▪ Transcription- process of making an RNA that is complimentary to strand of DNA.</li> </ul> </li> </ul>		Biotechnology for Plants Animals and the Environment: Unit 1- Activity 2-2

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C2 (cont.)		<b>3</b>	<b>Explain how genotypic variation occurs and results in phenotypic diversity.</b>  <ul style="list-style-type: none"> <li>▪ Distinguish how the various types of mutations may act as a source of genetic diversity.</li> </ul>	Punnett square Gametes traits	Biotechnology for Plants Animals and the Environment- Unit 1 Activity 4-1
		<b>4</b>	<b>Describe how meiosis and fertilization maintain genetic variation.</b>  <ul style="list-style-type: none"> <li>▪ Describe how genetic information is passed from parents to offspring                             <ul style="list-style-type: none"> <li>▪ Mitosis and the phases- daughter cells formed</li> <li>▪ Meiosis and the phases- sex cells or gametes are formed</li> <li>▪ Gametes- sex cells</li> <li>▪ Phenotype- outward appearance</li> <li>▪ Genotype- genetic makeup</li> <li>▪ Using the Punnett square                                     <ul style="list-style-type: none"> <li>▪ Single traits</li> <li>▪ Multiple traits</li> </ul> </li> </ul> </li> </ul>		Biotechnology for Plants Animals and the Environment Unit 2 lesson 5

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Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C3	Interdependence of Organisms	1	<p><b>Identify the relationships among organisms within populations, communities, ecosystems, and biomes.</b></p> <ul style="list-style-type: none"> <li>Identify the relationship among organisms within a population, community, ecosystem and biomes</li> </ul>	Organism Population Community Ecosystem biome	
		*2	<p><b>Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment.</b></p> <ul style="list-style-type: none"> <li>Describe and explain the patterns and interrelationships among producers, consumers, and decomposers in an ecosystem</li> <li>Describe the abiotic factors that influence an environment</li> </ul>		
		*3	<p><b>Assess how the size and the rate of growth of a population are determined by birth rate, death rate, immigration, emigration, and carrying capacity of the environment.</b></p> <ul style="list-style-type: none"> <li>Assess how the size of endangered animal populations are influenced by birth rate, death rate and the carrying capacity of the environment (ex. California condor habitat ranged over most of West and isolated populations on east coast- their natural prey became extinct endangering these birds)</li> </ul>		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C4	Biological Evolution	1	<p><b>Identify the following components of natural selection, which can lead to speciation:</b></p> <ul style="list-style-type: none"> <li>• <b>potential for a species to increase its numbers</b></li> <li>• <b>genetic variability and inheritance of offspring due to mutation and recombination of genes</b></li> <li>• <b>finite supply of resources required for life</b></li> <li>• <b>selection by the environment of those offspring better able to survive and produce offspring</b></li> </ul> <p>▪ Students will identify the components of natural selection, which can lead to speciation</p>	Natural selection Mutation Recombination of genes	Biotechnology for Plants, Animals and the Environment Unit 2 Lesson 5
		2	<p><b>Explain how genotypic and phenotypic variation can result in adaptations that influence an organism’s success in an environment.</b></p> <p>▪ Students will explain how genotypic and phenotypic variation can result in adaptations that influence an organism’s success in an environment. For example the “white deaf” gene in great Danes.</p>		
		*3	<p><b>Describe how the continuing operation of natural selection underlies a population’s ability to adapt to changes in the environment and leads to biodiversity and the origin of new species.</b></p> <p>▪ Students will describe how the continuing operation of natural selection underlies a population’s ability to adapt to changes in the environment by describing the creating of new type of plants through the use of biotechnology</p>		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C4 (cont.)		*4	<p><b>Predict how a change in an environmental factor (e.g., rainfall, habitat loss, non-native species) can affect the number and diversity of species in an ecosystem.</b></p> <ul style="list-style-type: none"> <li>▪ Predict how the change in an environmental factor such as loss of habitat to urbanization will affect the number and diversity of species in an ecosystem. Development of new type of plants to meet the needs of a changing environment</li> </ul>		
		5	<p><b>Analyze how patterns in the fossil record, nuclear chemistry, geology, molecular biology, and geographical distribution give support to the theory of organic evolution through natural selection over billions of years and the resulting present day biodiversity.</b></p> <ul style="list-style-type: none"> <li>▪ Analyze and predict the effects of chemical, organic, physical, and thermal changes in the living and non-living components in a greenhouse ecosystem.</li> </ul>		
		6	<p><b>Analyze, using a biological classification system (i.e., cladistics, phylogeny, morphology, DNA analysis), the degree of relatedness among various species.</b></p> <ul style="list-style-type: none"> <li>▪ Determine the classification system for identifying organisms</li> <li>▪ Create and classify different organisms</li> <li>▪ Evaluate and predict adaptations of an organism prompted by environmental changes</li> </ul>		CDE Nursery Operations

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Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C5	Matter, Energy, and Organization in Living Systems (Including Human Systems)	1	<p><b>Compare the processes of photosynthesis and cellular respiration in terms of energy flow, reactants, and products.</b></p> <ul style="list-style-type: none"> <li>▪ Compare the difference between the processes of photosynthesis and respiration as to how the energy flows, the reactants and the resulting products.</li> <li>▪ Explain to students :                             <ul style="list-style-type: none"> <li>▪ Capturing of light energy through photosynthesis</li> <li>▪ Chloroplast: site of photosynthesis</li> <li>▪ Converting light to chemical energy: Light dependant reactions</li> <li>▪ Fixing chemical energy as glucose: light independent reactions</li> <li>▪ Energy release using glycolysis and cellular respiration                                     <ul style="list-style-type: none"> <li>▪ Glycolisis</li> <li>▪ Fermentation</li> <li>▪ Cellular respiration</li> </ul> </li> </ul> </li> </ul>		Plant Growth and Development Unit – Land lab experiments (gardens + greenhouse labs)
		2	<p><b>Describe the role of organic and inorganic chemicals (e.g., carbohydrates, proteins, lipids, nucleic acids, water, ATP) important to living things.</b></p> <ul style="list-style-type: none"> <li>▪ Describe the role of organic and inorganic chemicals:                             <ul style="list-style-type: none"> <li>▪ Distinguish between amino acids and fatty acids</li> <li>▪ Distinguish between saturated and unsaturated fats</li> <li>▪ Define energy of activation in regard to enzyme activity</li> <li>▪ Describe the primary, secondary, tertiary, and quaternary structure of proteins, list and describe the roles of carbohydrates, lipids, and proteins in living organisms</li> </ul> </li> </ul>		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S4C5 (cont.)		*3	<p><b>Diagram the following biogeochemical cycles in an ecosystem:</b></p> <ul style="list-style-type: none"> <li>• <b>water</b></li> <li>• <b>carbon</b></li> <li>• <b>nitrogen</b></li> </ul> <ul style="list-style-type: none"> <li>▪ Diagram and identify the basic process of the natural ecosystem                             <ul style="list-style-type: none"> <li>▪ water cycle</li> <li>▪ nitrogen cycle</li> <li>▪ carbon cycle</li> <li>▪ oxygen cycle</li> </ul> </li> <li>▪ Students will complete tissues cultures to greenhouse projects.</li> </ul>		
		*4	<p><b>Diagram the energy flow in an ecosystem through a food chain.</b></p>		
		5	<p><b>Describe the levels of organization of living things from cells, through tissues, organs, organ systems, organisms, populations, and communities to ecosystems.</b></p> <ul style="list-style-type: none"> <li>▪ Describe the levels of organization of living things starting with:                             <ul style="list-style-type: none"> <li>▪ cells</li> <li>▪ tissue</li> <li>▪ organ</li> <li>▪ organ system</li> <li>▪ organism</li> <li>▪ population of species</li> <li>▪ species</li> <li>▪ community</li> <li>▪ ecosystem</li> <li>▪ biosphere</li> </ul> </li> </ul>		Biotechnology for Plants, Animals and the Environment Unit 1 Lesson 2

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**Strand 5: Physical Science**

*The physical science component ... should probe the following major topics: matter and its transformations, energy and its transformations, and the motion of things” (NAEP 2000).*

Physical Science affords students the opportunity to increase their understanding of the characteristics of objects and materials they encounter daily. Students gain an understanding of the nature of matter and energy, including their forms, the changes they undergo, and their interactions. By studying objects and the forces that act upon them, students develop an understanding of the fundamental laws of motion, knowledge of the various ways energy is stored in a system, and the processes by which energy is transferred between systems and surroundings.

**Concepts****Concept 1: Structure and Properties of Matter**

- Understand physical, chemical, and atomic properties of matter.

**Concept 2: Motions and Forces**

- Analyze relationships between forces and motion.

**Concept 3: Conservation of Energy and Increase in Disorder**

- Understand ways that energy is conserved, stored, and transferred.

**Concept 4: Chemical Reactions**

- Investigate relationships between reactants and products in chemical reactions.

**Concept 5: Interactions of Energy and Matter**

- Understand the interactions of energy and matter.

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Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S5C1	Structure and Properties of Matter	*1	<p><b>Describe substances based on their physical properties.</b></p> <ul style="list-style-type: none"> <li>▪ Identify the different units of measure in a liquid                             <ul style="list-style-type: none"> <li>- ppm or mg/L      - ppb or mcg/L</li> <li>- ppt or g/L        - epm or meq/L</li> </ul> </li> <li>▪ Explain how Ph affects water quality                             <ul style="list-style-type: none"> <li>- pH is a measure of hydrogen ions in water</li> <li>- <u>scale</u> - ranges from 0-14 with number 7 being neutral</li> <li>- pH scale is <u>logarithmic</u></li> </ul> </li> <li>▪ Explain how temperature affects water quality                             <ul style="list-style-type: none"> <li>- <u>heat capacity</u> of water is very high making it resistant to changes in temperature</li> <li>- <u>Thermal stress</u> or shock occurs in plants when temperature in greenhouse changes more than 10 to 315degrees in a 24 hr period</li> </ul> </li> <li>▪ Describe how salinity affects water quality                             <ul style="list-style-type: none"> <li>- <u>salinity</u> is the measure of total concentration of all dissolved ions in water</li> </ul> </li> <li>▪ Explain the difference between total alkalinity and total hardness</li> <li>▪ Explain the nitrogen cycle as it applies to the plants.                             <ul style="list-style-type: none"> <li>- Nitrobacter - converts nitrites to nitrates</li> <li>- Nitrosomonas – converts ammonia to nitrites</li> </ul> </li> </ul>	TDS pH	
		*2	<p><b>Describe substances based on their chemical properties.</b></p> <ul style="list-style-type: none"> <li>▪ Describe and define the different ions found in water                             <ul style="list-style-type: none"> <li>- ions - cations - anions - salts</li> </ul> </li> <li>▪ List cations and anions found in water                             <ul style="list-style-type: none"> <li>- cations (K<sup>+</sup>, Na<sup>+</sup>, Mg<sup>+2</sup>, Ca<sup>+2</sup>)</li> <li>- anions (Cl<sup>-</sup>, SO<sub>4</sub><sup>-2</sup>, HCO<sub>3</sub><sup>-</sup>, CO<sub>3</sub><sup>-2</sup>)</li> </ul> </li> <li>▪ List some of the major ionic components                             <ul style="list-style-type: none"> <li>- Na<sup>+</sup> -K<sup>+</sup> - Mg<sup>++</sup> - Ca<sup>++</sup> - CO<sub>3</sub><sup>-2</sup> - HCO<sub>3</sub><sup>-</sup> - NO<sub>3</sub><sup>-</sup> - PO<sub>4</sub><sup>-3</sup> - Cl<sup>-</sup></li> </ul> </li> </ul>	Ions Cations Anions	

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/ Integration/ Resources
S5C1 (cont.)		*3	<p><b>Predict properties of elements and compounds using trends of the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).</b></p> <ul style="list-style-type: none"> <li>▪ List and explain the different dissolved gases that determine the basic suitability of plant survival                             <ul style="list-style-type: none"> <li>- DO – Dissolved Oxygen</li> <li>- Nitrogen</li> <li>- Ammonia</li> <li>- Chlorine</li> <li>- Nitrites</li> </ul> </li> <li>- Carbon dioxide</li> <li>- Ammonium</li> <li>- Hydrogen sulfide</li> <li>- Methane</li> </ul>		
		4	<p><b>Separate mixtures of substances based on their physical properties.</b></p> <ul style="list-style-type: none"> <li>▪ Describe the breakdown of organic material in water                             <ul style="list-style-type: none"> <li>- Total organic carbon</li> <li>- COD – chemical oxygen demand</li> <li>- Chlorophyll</li> <li>- Oil and grease</li> <li>- Pesticides</li> </ul> </li> <li>▪ Describe factors that will affect water quality                             <ul style="list-style-type: none"> <li>- Soil -- clay/sand</li> <li>- Rainfall or runoff</li> <li>- Evaporation (solar radiation)</li> <li>- Light/photosynthesis</li> <li>- Odor – factors that contribute to odor in water</li> <li>- Color                                     <ul style="list-style-type: none"> <li>- Forel-u<del>e</del> color scale</li> <li>- Borger Color System</li> </ul> </li> </ul> </li> <li>▪ Test water for (DO, Nitrites, Nitrates, pH, Hardness, Chlorine, Ammonia, etc.</li> </ul>		
		5	<p><b>Describe the properties of electric charge and the conservation of electric charge.</b></p> <ul style="list-style-type: none"> <li>▪ Water molecule polarity</li> </ul>		

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S5C2		9	<p><b>Represent the force conditions required to maintain static equilibrium.</b></p> <ul style="list-style-type: none"> <li>▪ Describe physical interactions of matter and energy in plants systems such as the principles of fluid dynamics including:                             <ul style="list-style-type: none"> <li>▪ Archimedes screw (an ancient water-raising device made up of a spiral tube coiled about a shaft)</li> <li>▪ Bernoulli's principle (increase in speed of fluid produces a decrease in pressure)</li> <li>▪ Hydrostatic pressure</li> </ul> </li> </ul>		
S5C5	Interactions of Energy and Matter	5  9  CTE	<p>Apply kinetic molecular theory to the behavior of matter (e.g., gas laws).</p> <p><b>Quantify the relationships among electric potential, current, and resistance in an ohmic system.</b></p> <ul style="list-style-type: none"> <li>▪ Quantify the relationship among electric potential, current, and resistance in an electrical system used in greenhouse.</li> </ul> <p>Describe technology in a greenhouse that can be used to add in plant production.</p> <ul style="list-style-type: none"> <li>▪ photosynthesis</li> <li>▪ characteristics of light</li> <li>▪ photoperiod</li> <li>▪ light quality</li> </ul>		

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