Animal and Plant Biotechnology

Subject Code: 012010

Course & Unit Description

Course Description:

Learners will apply principles of chemistry, microbiology and genetics to plant and animal research and product development. They will describe the importance of biotechnology in society, and analyze the issues that have affected agricultural biotechnology. Students will apply genetic principals to determine genotypes and phenotypes. Students will describe the parts and functions of animal and plant cells and their importance in biochemistry.

Unit: Agricultural Biotechnology in our Society

The learner will research and identify techniques, uses, and concerns of biotechnology.

Benchmark: 3.10 Business Regulation, Law and Related Issues

Level 1: Identify and describe government regulations and societal issues related to a specific business enterprise or environmental project

Indicators

3.10.07 Research history, politics and policies related to issues

3.10.08 Assess the impact of issues affecting the industry and recommend solutions

Academic Standards

English Standards:	Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)
Math Standards:	Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)
Social Studies Standards:	Evaluate the consequences of geographic and environmental changes resulting from governmental policies and human modifications to the physical environment. (Geography B, 11-12)

Unit: Agricultural Biotechnology Issues

The learner will research, identify and explain standards, guidelines, and implications for biotechnology.

Benchmark: 3.10 Business Regulation, Law and Related Issues

Level 1: Identify and describe government regulations and societal issues related to a specific business enterprise or environmental project

Indicators

3.10.02 Explain the purpose and impact of government regulations

3.10.06 Identify governmental agencies and non-governmental organizations that impact agricultural/environmental issues

3.10.07 Research history, politics and policies related to issues

3.10.08 Assess the impact of issues affecting the industry and recommend solutions

Academic Standards

English Standards:	Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)

Math Standards: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)

Social Studies Standards: Evaluate the consequences of geographic and environmental changes resulting from governmental policies and human modifications to the physical environment. (Geography B, 11-12)

Benchmark: 3.6 Information Management

Level 1: Select and use a computer and computer application for a specific purpose

Indicators

3.6.02 Conduct research using the Internet techniques to enhance the final product. (Writing Process F, 11-12)

Academic Standards

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Benchmark: 3.7 Communication Skills

Level 1: Integrate a variety of communication techniques to gather and convey information to an individual or small group

Indicators

(no indicators chosen)

Academic Standards

English Standards: Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Social Studies Standards: Evaluate the reliability and credibility of sources. (Social Studies Skills and Methods A, 9 -10)

Unit: Safety and Laboratory Procedures

Students will demonstrate proper safety procedures and protocols in the laboratory. Students will administer first aid and demonstrate a proper respond to an emergency when necessary. Students will perform inspections, lubricate and maintain equipment while following the manufacturer's recommended operating procedures and adjustment specifications.

Benchmark: 2.1 Laboratory Preparation and Maintenance

Level 1: Use aseptic techniques to protect media and test results

Indicators

2.1.01 Maintain a sterile environment (e.g., flame sterilization, heat, filtration, pressure, chemical)
2.1.02 Select and apply appropriate glassware/equipment cleaning method for intended use
2.1.03 Prepare solutions/mixtures applying the concepts of polarity, saturation and solubility
2.1.04 Use precision weighing and measuring techniques (e.g., analytical balance, micropipette)
2.1.05 Select and apply appropriate sterilization methods for solutions/mixtures
2.1.06 Use and maintain the integrity of stock reagents
2.1.07 Select and utilize appropriate storage method for solutions/mixtures, equipment and biologicals
2.1.08 Demonstrate aseptic laboratory techniques

Academic Standards

English Standards: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)

Math Standards: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

4.1 Safety Procedures

Level 1: Follow safety procedures in general situations with basic tools and equipment, evaluate work environment and seek assistance to rectify the problem

Indicators

4.1.01 Demonstrate knowledge of safety rules and regulations
4.1.02 Interpret safety signs and symbols
4.1.03 Model safe attitudes and behaviors (e.g., lifting, climbing)
4.1.04 Identify safety hazards and take corrective measures
4.1.05 Use safety equipment in accordance with established procedures
4.1.06 Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary

Academic Standards

English Standards: Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)

4.2 Stationary and Mobile Equipment Maintenance

Level 1: Inspect and provide basic maintenance to basic machinery, instruments, stationary and mobile equipment and facility

Indicators

4.2.01 Perform a machine condition inspection
4.2.03 Ensure presence and function of safety systems and hardware
4.2.08 Maintain machinery, equipment, instruments and facility cleanliness, appearance, and safety
4.2.11 Calibrate metering, monitoring, and sensing equipment

Academic Standards

English Standards: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)

Math Standards: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

Benchmark: 4.3 Equipment Operation

Level 1: Inspect and safely operate precalibrated equipment

Indicators

4.3.01 Follow manufacturer's recommended operating procedures and adjustment specifications
4.3.02 Describe function, limitations, and proper use of equipment, equipment controls and instrumentation
4.3.03 Perform pre-operation inspection and adjustments
4.3.04 Perform appropriate start-up, operating and shut-down procedures
4.3.06 Perform post-operating inspection and adjustments

Academic Standards

English Standards: Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)

Math Standards: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

Unit: Biotechnology Research and Analysis

Students will create a problem-based study applying scientific methodology and drawing conclusions based on observations and/or data analysis and present findings.

3.11 Research and Analysis

Level 1: Conduct a study or survey, select descriptive statistics, create graphical displays and draw conclusions

Indicators

3.11.01 Identify research problems and structure a statistical experiment, simulation or study related to the problem

3.11.02 Create a hypothesis and set the probability of acceptance based on review of valid literature

3.11.03 Establish and implement procedures for systematic collection, organization, and use of data

3.11.04 Select and apply sampling methods that appropriately represent the population to be studied

3.11.05 Create, interpret and use tabular and graphical displays and descriptive statistics to describe data

3.11.06 Compute measures of central tendency and dispersion to interpret results and draw conclusions

3.11.07 Describe the relationships among variables using correlations and draw conclusions

3.11.08 Draw conclusions based on observations and/or data analysis and disseminate information to interested parties

Academic Standards

English Standards: Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 8-10; Research A, 11-12)

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Science Standards: Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations. (Scientific Inquiry A, 9-10)

Benchmark: 3.6 Information Management

Level 1: Select and use a computer and computer application for a specific purpose

Indicators

3.6.03 Create and utilize documents using word processors, spreadsheets, databases and electronic mail

Academic Standards

English Standards: Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product. (Writing Process F, 11-12)

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Unit: The Raw Materials of Biotechnology

Students will differentiate components of a cell and describe anabolic and catabolic reactions.

Benchmark: 2.2 Biological Chemistry

Level 1: Differentiate organic and inorganic compounds

Indicators

2.2.01 Describe the properties of atoms and the formulation of compounds
2.2.02 Identify compounds using both common and chemical nomenclature
2.2.03 Apply the concepts of stoichiometry and the laws of thermodynamics to chemical reactions
2.2.04 Identify structure of cells and the function of their components
2.2.05 Identify components and describe the functions of nucleic acids, carbohydrates, lipids, amino acids
2.2.06 Describe the metabolism (anabolic and catabolic) of nucleic acids, carbohydrates, lipids and amino acids and the role of enzymes in these reactions

Academic Standards

English Standards: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
Math Standards: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)
Science Standards: Explain that cells are the basic unit of structure and function of living organisms, that once life originated all cells come from pre-existing cells, and that there are a variety of cell types. (Life Sciences A, 9-10)

Benchmark: 2.6 Cell Biology and Culturing Techniques

Level 1: Conduct microscopic identification and propagation of cells

Indicators

2.6.01 Compare and contrast prokaryotic and eukaryotic cells

Academic Standards

English Standards: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
Science Standards: Explain that cells are the basic unit of structure and function of living organisms, that once life originated all cells come from pre-existing cells, and that there are a variety of cell types (Life Sciences A, 9-10)

Unit: DNA Structure and Function

Students will learn the physiological structures and functions of a cell.

Benchmark: 2.3 Genetics

Level 1: Use mono-and Di-hybrid crosses to predict genotype and phenotype

Indicators

2.3.03 Explain, model and predict the three dimensional shape, bonding patterns (covalent and hydrogen bonds) and antiparallel nature of deoxyribonucleic acid (DNA)
2.3.04 Model the Central Dogma Theory (e.g., replication, transcription, translation)
2.3.05 Describe the processes involved in gene regulation (e.g., histone acytelation, RNA stability, co-translational modifications and post-translational modifications)

Academic Standards

English Standards: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math Standards: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)

Science Standards: Explain the genetic mechanisms and molecular basis of inheritance. (Life Sciences C, 9-10)

Unit: Punnett Square

Learners will predict the likelihood of characteristics of offspring by using principles of genetic transfer.

Benchmark: 2.3 Genetics

Level 1: Use mono-and Di-hybrid crosses to predict genotype and phenotype

Indicators

2.3.01 Predict and explain offspring genotypes and phenotypes using Mendel's Laws and Punnett Square

2.3.02 Explain alternative forms of transmission (e.g., Non-Mendelian inheritance)

2.3.03 Explain, model and predict the three dimensional shape, bonding patterns (covalent and hydrogen bonds) and antiparallel nature of deoxyribonucleic acid (DNA)

2.3.07 Discuss alternative types of gene expression (e.g., sex-limited, sex-linked, partial dominance, epistatic, pleiotropic)

Academic Standards

English Standards: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math Standards: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)

Science Standards: Explain the genetic mechanisms and molecular basis of inheritance. (Life Sciences C, 9-10)

Unit: From Test Tube to Table

The learner will be able to precipitate DNA from a solution and interpret the results. The learner will describe the importance of biotechnology in society, and analyze the issues that have affected agricultural biotechnology.

Benchmark: 2.5 Molecular Biology Technology

Level 1: Precipitate DNA from a solution and interpret results

Indicators

2.5.08 Transform and transfect with recombinant DNA and detect and analyze product/cells using bioassays

Academic Standards

Science Standards: Summarize the historical development of scientific theories and ideas within the study of life sciences. (Life Sciences G, 11-12)

Benchmark: 3.1 Marketing

Level 1: Promote a product or service using basic strategies for packaging, display and publicity

Indicators

3.1.01 Select target market and consumers
3.1.02 Research products and service design(s) and determine the technical feasibility of new products
3.1.03 Conduct market research and analysis
3.1.07 Promote products and services
3.1.08 Develop public relations campaigns

Academic Standards

English Standards: Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Social Studies Standards: Analyze how scarcity of productive resources affects supply, demand, inflation and economic choices. (Economics A, 11-12)

Benchmark: 3.10 Business Regulation, Law and Related Issues

Level 1: Identify and describe government regulations and societal issues related to a specific business enterprise or environmental project

Indicators

3.10.02 Explain the purpose and impact of government regulations
3.10.03 Identify local, state and federal regulations relative to compliance
3.10.06 Identify governmental agencies and non-governmental organizations that impact agricultural/environmental issues
3.10.07 Research history, politics and policies related to issues
3.10.08 Assess the impact of issues affecting the industry and recommend solutions

Academic Standards

English Standards: Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)

Math Standards: Construct convincing arguments based on analysis of data and interpretation of graphs. (Data Analysis F, 8-10)

Social Studies Standards: Evaluate the consequences of geographic and environmental changes resulting from governmental policies and human modifications to the physical environment. (Geography B, 11-12)

Benchmark: 3.11 Research and Analysis

Level 1: Conduct a study or survey, select descriptive statistics, create graphical displays and draw conclusions

Indicators

3.11.01 Identify research problems and structure a statistical experiment, simulation or study related to the problem
3.11.02 Create a hypothesis and set the probability of acceptance based on review of valid literature
3.11.03 Establish and implement procedures for systematic collection, organization, and use of data
3.11.04 Select and apply sampling methods that appropriately represent the population to be studied
3.11.05 Create, interpret and use tabular and graphical displays and descriptive statistics to describe data
3.11.06 Compute measures of central tendency and dispersion to interpret results and draw conclusions
3.11.07 Describe the relationships among variables using correlations and draw conclusions
3.11.08 Draw conclusions based on observations and/or data analysis and disseminate information to interested parties

Academic Standards

English Standards: Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted. (Research A, 8-10; Research A, 11-12)

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Science Standards: Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations. (Scientific Inquiry A, 9-10)

Benchmark: 3.12 Agrosecurity and Biosecurity

Level 1: Identify agrosecurity and biosecurity risks for an enterprise

Indicators

3.12.06 Implement biosecurity procedures to prevent cross-site contamination

Academic Standards

English Standards: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Benchmark: 3.2 Sales and Customer Service

Level 1: Use customer service and sales techniques to foster positive relationships with customers and conduct sales

Indicators

(no indicators chosen)

Academic Standards

English Standards: Use a variety of strategies to enhance listening comprehension. (Communication A, 8-10; Communication A, 11-12)

Math Standards: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

Benchmark: 3.6 Information Management

Level 1: Select and use a computer and computer application for a specific purpose

Indicators

3.6.02 Conduct research using the Internet

3.6.03 Create and utilize documents using word processors, spreadsheets, databases and electronic mail

3.6.04 Conduct oral/visual presentation using presentation software

3.6.08 Adhere to common security guidelines for technology

Academic Standards

English Standards: Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product. (Writing Process F, 11-12)

Math Standards: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)

Benchmark: 3.7 Communication Skills

Level 1: Integrate a variety of communication techniques to gather and convey information to an individual or small group

Indicators

3.7.08 Develop reports and documents that organize information accurately and use formatting techniques for user friendliness

Academic Standards

English Standards:	Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)
Math Standards:	Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)
Social Studies Standards:	Evaluate the reliability and credibility of sources. (Social Studies Skills and Methods A, 9 -10)