

Biotechnology

Emphasis is placed on genetics, molecular biology, and introductory microbiology as it relates to plants, animals, plant science, and animal science. Topics of study include ethics of biotechnology, cell biology, and basic genetics, mitosis – meiosis, DNA structure, and molecular processes related to DNA, the role of microorganisms in biotechnology, plant and animal reproduction, media preparation for bacteria, plant tissue cultures, and growing plants. Biological sciences, mathematics, and communication skills are reinforced in this course as students complete course work and labs using critical thinking skills. Work-based learning strategies appropriate for this course are field trips and job shadowing. Supervised agricultural experience programs and the FFA leadership activities are integral components of the course and provide many opportunities for practical application of instructional competencies.

Prerequisite: Biology and Agriscience I

Table of Contents

Louisiana Agricultural Education Related Content Standards	2
Content Guideline	
Biotechnology in Agriscience	6
The Scientific Method	6
Leadership Skills	6
Laboratory Safety	7
Use of Lab Equipment and Materials	7
Fundamentals of Biotechnology	7
Investigating The Use of Biotechnology in Plants and Animals	8
Resources	9
Internet Sites	9

Biotechnology	Content Guideline													
<p>Louisiana Agricultural Education Related Content Standards</p>  <p><i>*All benchmarks are not marked for all Agricultural courses.</i></p>	Biotechnology In Agriscience	The Scientific Method	Leadership Skills	Laboratory safety	Use of Lab Equipment & Materials	Fundamentals of Biotechnology	Use of Biotechnology In Plants and Animals							
STRAND: Agricultural Literacy K-12														
Standard: All students will become aware of the characteristics and components of the food and fiber systems.														
a. Agricultural awareness grades K-4														
b. Agricultural literacy grades 5-8		•	•		•									
c. Agricultural literacy grades 9-12	•	•	•	•	•	•	•							
STRAND: Personal Development														
Standard: AgEd/FFA students will develop the necessary interpersonal and communication skills to obtain a job and work effectively and safely in an interactive work environment.														
a. Agricultural communication	•	•	•	•	•	•	•							
b. Team work in agriculture	•	•	•	•	•	•	•							
c. Careers in agriculture	•	•	•	•	•	•	•							
STRAND: Agribusiness														
Standard: AgEd/FFA students will understand the concept of agricultural marketing, management, finance, and entrepreneurship.														
a. Production systems														
b. Selections from various choices			•	•										
c. Factors that make employees successful			•											
d. Agricultural marketing sales and services														
e. Economics of production														
f. Develop a business plan														

Biotechnology	Content Guideline													
<p>Louisiana Agricultural Education Related Content Standards</p>  <p>*All benchmarks are not marked for all Agricultural courses.</p>	Biotechnology In Agriscience	The Scientific Method	Leadership Skills	Laboratory safety	Use of Lab Equipment & Materials	Fundamentals of Biotechnology	Use of Biotechnology In Plants and Animals							
STRAND: Biotechnology in Agriculture														
Standard: AgEd/FFA students will understand the concepts and principles of biotechnology and the relationships biotechnology has with the agricultural environment.														
a. Basic concepts and applications of biotechnology	•	•		•	•	•	•							
b. Impacts and public issues of biotechnology	•				•	•	•							
c. Processes and applications affecting the plant systems	•				•	•	•							
d. Processes and applications affecting animal systems	•				•	•	•							
e. Microbial-biotechnology in agriculture					•	•	•							
STRAND: Animal Systems														
Standard: AgEd/FFA students will understand the concepts and principles of animal science.														
a. Selection of livestock, poultry, and other animals														
b. Anatomy and physiology of livestock, poultry, and other animals							•							
c. Reproduction of livestock, poultry, and other animals							•							
d. Nutrition of livestock, poultry, and other animals														
e. Environmental factors affecting livestock, poultry, and other animal systems														
f. Diseases and parasites of livestock, poultry, and other animals							•							
g. Ethical issues related to livestock, poultry, and other animal systems	•													

Biotechnology	Content Guideline													
<p>Louisiana Agricultural Education Related Content Standards</p>  <p><i>*All benchmarks are not marked for all Agricultural courses.</i></p>	Biotechnology In Agriscience	The Scientific Method	Leadership Skills	Laboratory safety	Use of Lab Equipment & Materials	Fundamentals of Biotechnology	Use of Biotechnology In Plants and Animals							
STRAND: Plant Systems														
Standard: AgEd/FFA students will understand the concepts and principles of plant science.														
a. Internal processes affecting plant growth and reproduction						•	•							
b. External environmental factors affecting plant growth and reproduction						•	•							
c. Soil fertility														
d. Plant production						•	•							
e. Landscaping and floriculture														
f. Crops of Louisiana							•							
g. Horticultural crops of Louisiana							•							
h. Agribusiness relating to crop production														
STRAND: Environmental Management														
Standard: AgEd/FFA students will develop an understanding of the interrelationship between people, agriculture, and the environment.														
a. Universal impact of forestry						•	•							
b. Wildlife management and conservation														
c. Environmental quality														

Biotechnology	Content Guideline													
<p>Louisiana Agricultural Education Related Content Standards</p>  <p><i>*All benchmarks are not marked for all Agricultural courses.</i></p>	Biotechnology In Agriscience	The Scientific Method	Leadership Skills	Laboratory safety	Use of Lab Equipment & Materials	Fundamentals of Biotechnology	Use of Biotechnology In Plants and Animals							
<p>STRAND: Agriscience Technology</p>														
<p>Standard: AgEd/FFA students will demonstrate technical skills that reflect successful business and industry practices.</p>														
a. Agriculture power and enery														
b. Energy sources in agriculture														
c. Mathematics in agriscience technology		•												
d. Agriscience welding technology														
e. Agricultural structures and facilities														

Biotechnology

Content Guideline

(The student will be able to . . .)

Unit One

Biotechnology In Agriscience

1. Describe how biotechnology has impacted agricultural production.
2. Explain the importance of biotechnology in producing an adequate supply of food and fiber.
3. Contrast careers in agriculture before and after biotechnology.
4. Describe possible biotechnology solutions to current agricultural problems.
5. Discuss bioethics as it relates to biotechnology in plants and animals.

Unit Two

The Scientific Method

1. Describe the major steps in the scientific method.
2. Design and conduct a controlled experiment dealing with any agriscience subject.
3. Devise a system for recording data.
4. Prepare a report on the experiment conducted.
5. Summarize and discuss research being done in agriscience today.
6. Assess the risks and benefits of biotechnology to society.
7. Summarize data and draw appropriate conclusions.
8. Collect and record data using metric units.
9. Using a computer and Internet sites, as well as printed publications, write a research paper on the subject dealt with in the controlled experiment.

Unit Three

Leadership Skills

1. Conduct a meeting using parliamentary skills.
2. Give a five-minute speech.
3. Demonstrate acceptable work habits.
4. Demonstrate acceptable employee hygiene habits.
5. Discuss and model proper responses to criticism from employer, supervisor, or other person.
6. Conduct a job search and identify advanced training opportunities and the requirements.
7. Demonstrate an understanding of team planning, problem solving, and how communication processes and individuals contribute to the group.
8. Prepare a resume.
9. Demonstrate effective teamwork.
10. Demonstrate good communication skills with others.
11. Present a written and oral report.

Unit Four

Laboratory Safety

1. Identify first aid supplies.
2. Demonstrate proper safety procedures.
3. Monitor, use, store, and dispose of hazardous materials properly.
4. Demonstrate how to follow Material Safety Data Sheets (MSDS) and Occupational Safety and Health Administration (OSHA) standards.
5. Demonstrate the proper use of safety equipment.
6. Identify and explain safety symbols and signs.

Unit Five

Proper Use of Laboratory Equipment & Materials

1. Demonstrate aseptic techniques.
2. Perform mathematical calculations and conversions.
3. Make stock reagents and solutions.
4. Demonstrate how to maintain reagent integrity.
5. Demonstrate how to monitor the physical properties of a solution.
6. Demonstrate proper procedures in sterilizing and preparing equipment.
7. Demonstrate the making of and distributing media.
8. Explain how to maintain reagent integrity.
9. Maintain an accurate inventory of laboratory equipment and supplies.
10. Demonstrate proper weighing and measuring techniques.
11. Demonstrate proper procedures for handling and storing biological materials.
12. Demonstrate the proper use of specialized equipment in the laboratory.

Unit Six

Fundamentals of Biotechnology

1. Describe the components of DNA and RNA. Compare the differences and similarities of DNA and RNA.
2. Compare the replication of DNA with the making of RNA from DNA.
3. Describe and explain the processes of mitosis and meiosis, comparing the differences in plants and animals.
4. Explain the relationship of DNA to chromosomes and genes.
5. Compare the processes of transcription and translation.
6. Describe and compare prokaryotic and eukaryotic cells.
7. Explain the importance of single celled organisms to agriculture.
8. Summarize the differences between prokaryotic, animal, and plant cells.
9. Explain the variations in the different type cells.
10. Describe cellular structure.
11. State examples of agricultural uses of cellular structures.
12. Explain the functions of the various parts of the cells.
13. Describe the Mendel Theory of Genetics.

14. Demonstrate the use of a Punnett square in solving regular genetics, incomplete dominance, sex linked, and co-dominance problems.
15. Explain the relationship of cellular science and biotechnology.

Unit Seven

Investigating The Use of Biotechnology in Plants and Animals

1. Explain how inheritance in plants and animals is regulated.
2. Describe the process of pollination in plants and fertilization in animals.
3. Give examples of how some viral and bacterial vectors change the genetics of plants and animals.
4. Explain how biotechnology is used along with regular plant and animal breeding.
5. Explain DNA transformation and the functions of restriction endonuclease and ligase
6. Do a transformation lab where an organism is genetically transformed.
7. Demonstrate cell transformation and show how transformed bacteria may be used to genetically engineer plants.
8. Show how small amounts of DNA may be increased by polymerase chain reaction.
9. Demonstrate DNA electrophoresis and explain its use in biotechnology.

Resources

- Achberger, Eric C., Ph.D. *LSU Microbiology & Molecular Biology Workshop Lab Manual*.
(Available free to anyone who attends the free workshop offered each summer at LSU.)
- Herren, Ray V. (2000). *The Science of Agriculture: A Biological Approach*. Clifton Park, New York: Delmar Publishers.
- Lurquin, Paul (2002). *High Tech Harvest: Understanding Genetically Modified Food Plants*. Scranton, Pennsylvania: Westview Press.
- Smith, Roberta (2000). *Plant Tissue Culture: Techniques and Experiments*. San Diego, California: Academic Press.
- National Research Council - Committee on Genetically Modified Pest-Protected Plants.
Genetically Modified Pest-Protected Plants: Science and Regulation
- Trigiano, Robert N. and Gray, Dennis J. (1999). *Plant Tissue Culture Concepts and Laboratory Exercise*. Boca Raton, Florida: CRC Press

Internet Sites

- www.biores-irl.ie/biozone/plants.html (2003). Plant Biotechnology.
- www.agen.ufl.edu/~foodsaf/wi004.html (2003). University of Wisconsin, Foods from Agricultural Biotechnology.
- www.ncbi.nlm.nih.gov/ (2003). National Center for Biotechnology Information.
- www.nature.com/nbt/ (2003). Nature Biotechnology.
- www.bio.org/ (2003). Biotechnology Industry Organization.
- www.cato.com/biotech/ (2003). Biotechnology Information Directory Section.
- www.bio.com/ (2003). Bio.Com.
- www.whypiotech.com/ (2003). Council for Biotechnology Information.