



## AGRICULTURAL BIOTECHNOLOGY 3.0 STUDY GUIDE

Biotechnology, one of the state’s fastest growing programs, certifies that individuals have a knowledge and skill set applicable to entry level positions in the agricultural industry, plant and animal biotechnology laboratories and much more.

The certification standards for the Agricultural Biotechnology exam are based on the standards and benchmarks taught in the Florida’s Agricultural Biotechnology program at the secondary level. Each standard is weighted based on industry needs and feedback and are noted below. The number of questions per standard is determined by the industry weight. A complete listing of Florida’s Agricultural Biotechnology standards and corresponding benchmarks are available from the Florida Department of Education.

| Standard | Description   | Resource  | Weight |
|----------|---|---|--------|
| 13       | Identify the historical, social, cultural and potential applications of biotechnology                         | Introduction to Biotechnology: Chapters 1, 2, 7, 9, 14  | 8%     |
| 14       | Conduct scientific investigation and apply results  | Introduction to Biotechnology: Chapter 3  | 8%     |
| 15       | Practice agricultural laboratory safety   | MyCAERT E-Unit FEBT AG 13-3: Managing Biological and Chemical Materials<br>MyCAERT E-Unit FEBT AG 13-4 Managing Laboratory Wastes   | 7%     |
| 16       | Apply genetic principles to agricultural production   | Introduction to Biotechnology: Chapters 5, 6, 7   | 8%     |
| 17       | Demonstrate laboratory skills as applied to biotechnology   | Introduction to Biotechnology: Chapters 6, 11, 13<br>MyCAERT E-Unit FEBT AG 14-3: Aseptic Techniques<br>MyCAERT E-Unit FEBT AG 14-9: Working with Cell Cultures<br>MyCAERT E-Unit FEBT AG 14-11: Electrophoresis<br>MyCAERT E-Unit FEBT AG 14-5: Preparing Solutions, Reagents, and Buffers<br>MyCAERT E-Unit FEBTAG14-2: Operating Equipment | 13%    |
| 18       | Demonstrate the application of biotechnology to Agriculture, Food and Natural Resources (AFNR)                | Introduction to Biotechnology: Chapters 2, 4, 6, 8, 9, 10, 12   | 13%    |
| 22       | Recognize and follow quality control procedures and regulatory guidelines                                     | Introduction to Biotechnology: Chapter 14   | 8%     |
| 23       | Analyze the historical, social, cultural and potential applications of agricultural biotechnology             | Introduction to Biotechnology: Chapters 4, 6, 7, 9, 12, 15  | 8%     |
| 24       | Demonstrate proper tissue/cell culture techniques   | Introduction to Biotechnology: Chapter 8<br>MyCAERT E-Unit FEBT PL 24-2: Propagating Plants by Tissue Culture   | 8%     |
| 25       | Demonstrate the application of biotechnology to the Agriculture, Food and Natural Resources (AFNR) industries | Introduction to Biotechnology: Chapters 9, 11, 13, 14   | 12%    |
| 26       | Demonstrate leadership, employability, communication and human relation skills                                | Introduction to Biotechnology: Chapter 16   | 7%     |

## AGRICULTURE BIOTECHNOLOGY 2

### STANDARD 13

### 8 QUESTIONS

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Students should be familiar with the history of biotechnology, including (but not limited to) key scientists and technological advancements.

*Sample Question: What scientist(s) were responsible for determining the structure of the DNA molecule?*

Students should be able to explain examples of biotechnology and how they have impacted agriculture. This includes examples of biotechnology in food production, food processing, food preservation, and food safety.

*Sample Question: What method of food preservation is being used when bacteria in milk produce lactic acid, turning the milk into yogurt?*

Students should be able to recognize benefits and risks associated with biotechnology.

*Sample Question: What is a disadvantage of having genetic diversity in a species?*

### STANDARD 14

### 8 QUESTIONS

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Students should know the differences between scientific laws and scientific theories.

*Sample Question: What is the term for a statement of what a researcher believes will happen during experimentation?*

Students should be able to evaluate a scientific experiment. This includes being able to:

- identify the type of scientific research being conducted
- use the scientific method
- identify parts of an experiment
- evaluate data and draw conclusions

*Sample Questions: When designing and conducting an experiment, what is the purpose of a "control group"?  
What term is used to describe an experiment that produces similar results each time the experiment is conducted?*

### STANDARD 15

### 7 QUESTIONS

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Students should be able to practice basic agricultural laboratory safety. This includes:

- identify first aid supplies, personnel, and emergency protection areas
- identify safety symbols and signs
- read and interpret Materials Safety Data Sheets (MSDS)
- be familiar with types and uses of Personal Protective Equipment (PPE)
- know procedures to safely use, store, and dispose of hazardous materials
- know procedures to safely use, store, and dispose of biological materials

*Sample Questions: What piece of Personal Protective Equipment is used to protect skin on hands from contact with biologically hazardous materials?  
What should be done to all potentially biologically hazardous materials before disposing of them?*

**STANDARD 16****8 QUESTIONS**

Students should be able to explain the genetic processes that control how traits are inherited.

*Sample Question: What does it mean for an animal to be homozygous for a particular gene?*

Students should be able to identify genotypic and phenotypic factors that influence trait expression.

*Sample Question: What factor causes phenotypic differences in clones?*

Students should be familiar with the structure and function of DNA. This includes:

- chemical and physical properties of DNA
- history of discovery of DNA's structure

*Sample Question: What four nucleotides make up the code for genes within the DNA molecule?*

Students should be able to explain the process of protein synthesis using appropriate terminology.

*Sample Question: What is the function of messenger RNA (mRNA) in building proteins?*

Students should be able to describe methods and tools scientists use to manipulate and study genes within an organism.

*Sample Question: What is the term for an egg cell from which the nucleus has been removed?*

**STANDARD 17****13 QUESTIONS**

Students should know how to operate laboratory equipment and measurement devices. This includes maintaining proper aseptic technique.

*Sample Question: What device is used to separate fragments of DNA according to their length?*

Students should be able to prepare and identify the proper uses of buffers, reagents, solutions, and media.

*Sample Question: What term is commonly used to identify the combination of water and nutrients used to grow cell cultures?*

Students should be familiar with tools and techniques for working with cell cultures. This includes how to:

- isolate cell cultures
- maintain cell cultures
- quantify cell cultures
- store cell cultures

*Sample Question: What is the use of a streak plate in working with cell cultures?*

Students should be familiar with the tools and techniques of DNA and RNA manipulation (genetic engineering). This includes methods for:

- extracting and purifying DNA
- isolating specific sequences of DNA or RNA
- replicating genetic material
- moving genetic material into desired cells

*Sample Question: What technique is used to produce millions of copies of a DNA sequence WITHOUT using bacteria to amplify the DNA?*

Students should be able to identify current uses of biotechnology in medicine, agriculture, and environmental science. This includes the use of antibodies in biotechnology applications.

*Sample Question: What are antibodies?*

### STANDARD 18

### 13 QUESTIONS

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Students should be able to explain reasons for genetic modification of eukaryotes.

*Sample Question: What is a benefit of using genetic engineering to improve a plant species instead of more traditional selective breeding?*

Students should be familiar with current uses of agricultural biotechnology in the agriculture, food and natural resources industry today.

*Sample Question: How does *Bacillus thuringiensis* (Bt) production in bioengineered corn help to prevent damage from the European Corn Borer?*

Students should be able to diagram the process of producing transgenic eukaryotes.

*Sample Question: What are two of the methods that can be used to insert foreign DNA into host cells?*

Students should be able to identify foods produced through fermentation.

*Sample Question: What item is a production of fermentation?*

Students should be able to explain the process of making biofuels from biomass. This includes:

- identifying sources of biomass
- describing characteristics that make biomass useful for biofuel production
- producing alcohol, biodiesel, and methane from biomass

*Sample Question: Why is it easier to make ethanol from starch-based biomass (ex. Corn kernels), rather than from cellulose-based biomass (ex. Grasses)?*

Students should be familiar with enzymes. This includes:

- their functions in living organisms
- their uses in the food industry
- physical and chemical factors that affect enzymatic reactions
- how biomanufactured enzymes are produced

*Sample Question: What is an example of a food that changes form due to enzymatic reactions?*

Students should be familiar with the following concepts regarding plant breeding and production:

- basic plant biology
- the selective plant breeding process
- methods for cloning plants from specialized plant parts
- traditional and modern methods of plant pest, weed, and disease control
- distinguish between agronomic traits and quality traits in a plant species

*Sample Question: Why is pollination control important in the selective plant breeding process?*

Students should be familiar with the following concepts regarding animal biotechnology:

- basic animal biology
- the selective breeding process
- functions of hormones in animals

*Sample Question: Why is superovulation generally used in animal reproductive biotechnology?*

## AGRICULTURE BIOTECHNOLOGY 3

### STANDARD 22

### 8 QUESTIONS

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Students should be able to describe the need for regulation in the biotechnology industry. This includes defining regulation and identifying groups who contribute to developing regulation for biotechnology.

*Sample Question: What is the purpose of governmental regulation in the biotechnology industry?*

Students should be able to describe the function of major agencies that regulate biotechnology in the United States.

*Sample Question: What is one role of the USDA's Food Safety and Inspection Service (USDA-FSIS)?*

Students should be familiar with the approval process for a new bioengineered food product.

*Sample Question: What government agency must give approval that a new bioengineered food product is safe for consumers?*

### STANDARD 23

### 8 QUESTIONS

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Students should be familiar with major innovators and milestones in the development of biotechnology.

*Sample Question: When John Gurdon developed a procedure for nuclear transfer, what was he able to do for the first time?*

Students should have an understanding of potential future impacts of biotechnology.

*Sample Question: What is one potential environmental benefit of producing pest-resistant crop varieties?*

Students should be familiar with ethical issues in the field of biotechnology (bioethics). This includes:

- causes of ethical differences
- major concerns in human biotechnology
- major concerns in animal biotechnology
- major concerns in plant biotechnology

*Sample Question: What aspect of stem cell research often leads to ethical controversy?*

Student should be able to recognize intellectual property issues associated with bioethics including (but not limited to) bioprospecting, biopiracy, and patent rights.

*Sample Question: When a scientist travels to a location to collect biological samples that may be helpful in scientific research, what are they doing?*

**STANDARD 24****8 QUESTIONS**

Students should be able to identify and describe methods for maintaining aseptic technique for a tissue culture facility, including required equipment and techniques.

*Sample Question: What is the purpose of a laminar airflow hood in a tissue culture facility?*

Students should be able to explain the effects of growth hormones on tissue/cell cultures.

*Sample Question: Why are plant hormones often added to growth media in tissue culture?*

Students should be able to explain the steps to produce plants using tissue culture methods using proper terminology.

*Sample Question: What is often the source material of explants for tissue culture?*

Student should be able to explain benefits of plant tissue culture.

*Sample Question: What are the major benefits of plant tissue culture?*

**STANDARD 25****12 QUESTIONS**

Students should be able to explain opportunities, benefits and risks of using biotechnology to promote animal health.

*Sample Question: What are the major benefits of using biotechnology to promote animal health?*

Students should be familiar with the production of biofuels from biomass. This includes:

- sources of biomass
- how to produce ethanol from biomass
- how to produce biodiesel from biomass
- how to produce methane from biomass
- positive and negative aspects of the technologies used to create biofuels from biomass

*Sample Question: What term describes a fermented fuel that is produced by microbes as they consume sugar molecules from cellulose?*

Students should be familiar with use of biotechnology in bioremediation. This includes:

- methods for biotreatment of biological and chemical wastes
- advantages and disadvantages of using bioremediation to clean up pollution

*Sample Question: What is enhanced bioremediation?*

Students should be familiar with the effects of agricultural practices on the environment. This includes:

- understanding the importance of biodiversity
- explaining positive and negative impacts of agriculture and biotechnology on the environment
- recognizing methods to reduce the impacts of agriculture and biotechnology on the environment

*Sample Questions: What trait, if engineered into crops, can help reduce the amount of pesticides sprayed? What is a method that can be used to prevent insects from becoming resistant to pesticide products in bioengineered crops?*

Students should be able to identify several methods for monitoring the impact of agricultural practices on the environment. This includes (but is not limited to) immunoassays, indicator species, biosensors, etc.

*Sample Question: What electronic instrument measures physical change in a biosensor produced in response to the environment?*

Students should be able to explain different methods to manage laboratory wastes.

*Sample Question: When is it appropriate to send laboratory wastes to a landfill?*

## STANDARD 26

## 7 QUESTIONS

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Student should be able to identify advanced training opportunities and educational requirements for a job in the field of biotechnology.

*Sample Question: At what type of educational institution can a student earn a Ph.D. (doctorate) degree?*

Student should be familiar with careers in the biotechnology industry. This includes being familiar with the major sectors of the biotechnology industry and jobs available in each.

*Sample Question: What are two examples of jobs in the research and development sector of biotechnology?*