

BIOTECHNOLOGY STANDARDS



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All Nevadans ready for success in the 21st century

MISSION

To improve student achievement and educator effectiveness by ensuring opportunities, facilitating learning, and promoting excellence



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BUSINESS AND INDUSTRY VALIDATION

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives; or (2) a separate review panel was coordinated with industry experts to ensure the standards include the proper content; or (3) the adoption of nationally-recognized standards endorsed by business and industry.

The Biotechnology standards were validated through active participation of business and industry representatives on the development team.

PROJECT COORDINATOR

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INTRODUCTION

The standards in this document are designed to clearly state what the student should know and be able to do upon completion of an advanced high school Biotechnology program. These standards are designed for a three-credit course sequence that prepares the student for a technical assessment directly aligned to the standards.

These exit-level standards are designed for the student to complete all standards through their completion of a program of study. These standards are intended to guide curriculum objectives for a program of study.

The standards are organized as follows:

Content Standards are general statements that identify major areas of knowledge, understanding, and the skills students are expected to learn in key subject and career areas by the end of the program.

Performance Standards follow each content standard. Performance standards identify the more specific components of each content standard and define the expected abilities of students within each content standard.

Performance Indicators are very specific criteria statements for determining whether a student meets the performance standard. Performance indicators may also be used as learning outcomes, which teachers can identify as they plan their program learning objectives.

The crosswalk and alignment section of the document shows where the performance indicators support the Nevada Academic Content Standards in Science (based on the Next Generation Science Standards) and in English Language Arts and Mathematics (based on the Common Core State Standards). Where correlation with an academic content standard exists, students in the Biotechnology program perform learning activities that support, either directly or indirectly, achievement of the academic content standards that are listed.

All students are encouraged to participate in the career and technical student organization (CTSO) that relates to the Biotechnology program. CTSOs are co-curricular national associations that directly enforce learning in the CTE classroom through curriculum resources, competitive events, and leadership development. CTSOs provide students the ability to apply academic and technical knowledge, develop communication and teamwork skills, and cultivate leadership skills to ensure college and career readiness.

The Employability Skills for Career Readiness identify the “soft skills” needed to be successful in all careers, and must be taught as an integrated component of all CTE course sequences. These standards are available in a separate document.

The **Standards Reference Code** is only used to identify or align performance indicators listed in the standards to daily lesson plans, curriculum documents, or national standards.

Biotechnology: Biotechnology Standards Reference Code: **BIOT**

Example: BIOT.2.3.4

Standards	Content Standard	Performance Standard	Performance Indicator
Biotechnology	2	3	4

CONTENT STANDARD 1.0 : RECOGNIZE THE HISTORICAL, SOCIAL, CULTURAL, AND POTENTIAL APPLICATIONS OF BIOTECHNOLOGY

PERFORMANCE STANDARD 1.1 : DISTINGUISH MAJOR INNOVATORS, HISTORICAL DEVELOPMENTS, AND POTENTIAL APPLICATIONS OF BIOTECHNOLOGY

- 1.1.1 Define biotechnology and investigate current applications of biotechnology in agriculture
- 1.1.2 Research major innovators and historical milestones in the development of biotechnology
- 1.1.3 Discuss emerging technologies and issues associated with agricultural biotechnology
- 1.1.4 Analyze the scope and impact of agricultural biotechnology in today's society
- 1.1.5 Examine how agriculture is a form of genetic engineering
- 1.1.6 Assess the future impact agricultural biotechnology could have on world populations

PERFORMANCE STANDARD 1.2 : DETERMINE REGULATORY ISSUES AND IDENTIFY AGENCIES ASSOCIATED WITH BIOTECHNOLOGY

- 1.2.1 Describe the role of agencies that regulate biotechnology including USDA, FDA, and EPA
- 1.2.2 Interpret the major regulatory issues related to biotechnology
- 1.2.3 Research, evaluate, and articulate a major regulatory issue pertaining to biotechnology

PERFORMANCE STANDARD 1.3 : ANALYZE THE ETHICAL, LEGAL, SOCIAL, AND CULTURAL ISSUES RELATING TO BIOTECHNOLOGY

- 1.3.1 Evaluate the benefits and risks associated with biotechnology
- 1.3.2 Research and debate an ethical issue associated with biotechnology
- 1.3.3 Articulate the implications of an ethical, legal, social, or cultural biotechnology issue

CONTENT STANDARD 2.0 : DEMONSTRATE LABORATORY SAFETY PRACTICES**PERFORMANCE STANDARD 2.1 : SAFELY MANAGE BIOLOGICAL MATERIALS, CHEMICALS, AND WASTES USED IN THE LABORATORY**

- 2.1.1 Identify and describe hazards associated with biological and chemical materials
- 2.1.2 Read and interpret Safety Data Sheets (SDS)
- 2.1.3 Maintain a safe environment by properly identifying and disposing of laboratory waste

PERFORMANCE STANDARD 2.2 : DEMONSTRATE UNDERSTANDING OF REQUIRED SAFETY PRACTICES AND PROCEDURES

- 2.2.1 Define health and safety regulations, including Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), Nevada Division of Environmental Protection (NDEP), and Right to Know
- 2.2.2 Demonstrate procedures for documenting hazards and compliance
- 2.2.3 Identify and demonstrate proper use of personal protective equipment (PPE)
- 2.2.4 Demonstrate proper use of laboratory safety equipment (e.g., eye wash, fire blanket, fire extinguisher, spill kit)
- 2.2.5 Discuss universal precautions associated with biological and chemical hazards

CONTENT STANDARD 3.0 : DEMONSTRATE LABORATORY SKILLS AS APPLIED TO BIOTECHNOLOGY**PERFORMANCE STANDARD 3.1 : MAINTAIN AND INTERPRET BIOTECHNOLOGY LABORATORY RECORDS**

- 3.1.1 Demonstrate accurate and ethical record keeping and data collection
- 3.1.2 Validate records and data by incorporation of peer review
- 3.1.3 Analyze data and draw conclusions
- 3.1.4 Propose future investigations based on data analysis and conclusions

PERFORMANCE STANDARD 3.2 : DEMONSTRATE PROPER LABORATORY PROCEDURES

- 3.2.1 Properly operate laboratory equipment and measurement devices
- 3.2.2 Perform procedures according to directions
- 3.2.3 Demonstrate aseptic techniques in the laboratory
- 3.2.4 Develop an appropriate standard operating procedure (SOP) (*e.g., SOP for making a sandwich*)
- 3.2.5 Demonstrate the preparation of solutions using appropriate quantities and standard protocols

CONTENT STANDARD 4.0 : PERFORM MICROBIOLOGY, MOLECULAR BIOLOGY, ENZYMOLOGY, AND IMMUNOLOGY PROCEDURES**PERFORMANCE STANDARD 4.1 : PERFORM MICROBIOLOGY PROCEDURES**

- 4.1.1 Differentiate types of organisms and demonstrate how to handle them safely
- 4.1.2 Research and describe the use of biotechnology to identify microbes

PERFORMANCE STANDARD 4.2 : PERFORM MOLECULAR BIOLOGY PROCEDURES

- 4.2.1 Explain the structures of DNA and RNA and how genotype can influence phenotype
- 4.2.2 Explain the molecular basis for heredity
- 4.2.3 Summarize the use of tools and techniques in DNA and RNA manipulations
- 4.2.4 Analyze factors and probabilities that influence gene expression
- 4.2.5 Extract DNA
- 4.2.6 Perform or simulate the process of polymerase chain reaction (PCR)
- 4.2.7 Perform or simulate electrophoretic techniques and interpret electrophoresis fragmentation patterns

PERFORMANCE STANDARD 4.3 : PERFORM ENZYMOLOGY AND IMMUNOLOGY PROCEDURES

- 4.3.1 Describe how antibodies are formed and how they can be used in biotechnology applications
- 4.3.2 Investigate the use of antibody specificity for antigens to test for the presence of protein (e.g., ELISA, Western Blot, Antibody Staining)
- 4.3.3 Describe enzymes, the changes they cause in foods, and the physical and chemical parameters that affect enzymatic reactions

CONTENT STANDARD 5.0 : DEMONSTRATE THE APPLICATION OF BIOTECHNOLOGY TO AGRICULTURE, FOOD, AND NATURAL RESOURCES (AFNR)

PERFORMANCE STANDARD 5.1 : EVALUATE THE APPLICATION OF GENETIC ENGINEERING TO IMPROVE PRODUCTS OF AFNR SYSTEMS

- 5.1.1 Explain biological, social, agronomic, and economic reasons for genetic modification of eukaryotes
- 5.1.2 Diagram the processes and describe the techniques used to produce transgenic eukaryotes
- 5.1.3 Compare and contrast the use of natural organisms and genetically engineered organisms in the treatment of wastes
- 5.1.4 Describe the benefits and risks associated with the use of biotechnology to increase productivity and improve quality of species

PERFORMANCE STANDARD 5.2 : PERFORM BIOTECHNOLOGY PROCESSES USED IN AFNR SYSTEMS

- 5.2.1 Explain the functions of hormones in animals
- 5.2.2 Describe the processes used to produce animal hormones from transgenic organisms
- 5.2.3 Compare and contrast bioengineering and conventional pathways used in food processing
- 5.2.4 Process food using biotechnological tools and applications
- 5.2.5 Explain the process of fermentation
- 5.2.6 Diagram the process used in producing biodiesel from biomass
- 5.2.7 Illustrate the process used in producing methane from biomass

PERFORMANCE STANDARD 5.3 : USE BIOTECHNOLOGY TO MONITOR AND EVALUATE PROCEDURES PERFORMED IN AFNR SYSTEMS

- 5.3.1 Compare and contrast selective breeding and genetic engineering approaches for crop and livestock improvement
- 5.3.2 Assess the benefits, risks, and opportunities associated with using biotechnology to promote animal health
- 5.3.3 Describe the use of biotechnology in bioremediation
- 5.3.4 Describe the processes involved in treatment of biological and industrial chemical wastes
- 5.3.5 Explain the trade-offs associated with agricultural biotechnology practices on wild populations and biodiversity
- 5.3.6 Define industrial biotechnology and describe the benefits and risks associated with its use in the manufacturing of food, fabrics, plastics, and other products

CONTENT STANDARD 6.0 : EXPLORE CAREERS IN AGRICULTURAL BIOTECHNOLOGY**PERFORMANCE STANDARD 6.1 : ANALYZE REQUIREMENTS FOR CAREERS IN AGRICULTURAL BIOTECHNOLOGY**

- 6.1.1 Describe the educational requirements and responsibilities for various positions within the biotechnology industry
- 6.1.2 Develop a portfolio documenting education, experiences, and acquired skills for a specific career
- 6.1.3 Demonstrate understanding of the career development planning process and the process of life-long learning

CONTENT STANDARD 7.0 : SUPERVISED AGRICULTURAL EXPERIENCE (SAE)

PERFORMANCE STANDARD 7.1 : UNDERSTAND THE BENEFITS OF AN SAE PROGRAM

- 7.1.1 Accurately maintain SAE record books
- 7.1.2 Actively pursue individual achievement related to SAE area

CONTENT STANDARD 8.0 : LEADERSHIP TRAINING IN FFA**PERFORMANCE STANDARD 8.1 : RECOGNIZE THE TRAITS OF EFFECTIVE LEADERS AND PARTICIPATE IN LEADERSHIP TRAINING THROUGH INVOLVEMENT IN FFA**

- 8.1.1 Expand leadership experience by serving as a chapter officer or on a committee
- 8.1.2 Exhibit leadership skills by demonstrating proper parliamentary procedure
- 8.1.3 Participate in a career development event, such as Agriscience Fair, Agriculture Issues, or related CDE, at the local level or above
- 8.1.4 Actively pursue necessary steps to receive higher degrees in FFA

PERFORMANCE STANDARD 8.2 : UNDERSTAND THE IMPORTANCE OF SCHOOL AND COMMUNITY AWARENESS

- 8.2.1 Participate in a school improvement or community development project

CROSSWALKS AND ALIGNMENTS**CROSSWALKS (ACADEMIC STANDARDS)**

The crosswalk of the Biotechnology Standards shows links to the Nevada Academic Content Standards in Science (based on the Next Generation Science Standards – Disciplinary Core Ideas Arrangement) and in English Language Arts and Mathematics (based on the Common Core State Standards). The crosswalk identifies the performance indicators in which the learning objectives in the Biotechnology program support academic learning. The performance indicators are grouped according to their content standard and are crosswalked to the Nevada Academic Content Standards in Science, English Language Arts, and Mathematics.

ALIGNMENTS (MATHEMATICAL PRACTICES)

In addition to correlation with the Nevada Academic Content Standards for Mathematics, many performance indicators support the Mathematical Practices. The following table illustrates the alignment of the Biotechnology Standards Performance Indicators and the Mathematical Practices. This alignment identifies the performance indicators in which the learning objectives in the Biotechnology program support academic learning.

ALIGNMENTS (SCIENCE AND ENGINEERING PRACTICES)

In addition to correlation with the Nevada Academic Content Standards for Science, many performance indicators support the Science and Engineering Practices. The following table illustrates the alignment of the Biotechnology Standards Performance Indicators and the Science and Engineering Practices. This alignment identifies the performance indicators in which the learning objectives in the Biotechnology program support academic learning.

CROSSWALKS (COMMON CAREER TECHNICAL CORE)

The crosswalk of the Biotechnology Standards shows links to the Common Career Technical Core. The crosswalk identifies the performance indicators in which the learning objectives in the Biotechnology program support the Common Career Technical Core. The Common Career Technical Core defines what students should know and be able to do after completing instruction in a program of study. The Biotechnology Standards are crosswalked to the Agriculture, Food & Natural Resources Career Cluster™ and the **Career Pathway** Career Pathway.