Career-Technical Credit Transfer (CT)²
Biotechnology for Food, Plant and Animal Science Career-Technical Assurance Guide (CTAG)
Created: November 16, 2016

Introduction

The following programs/courses, indicated by a Career-Technical Articulation Number (CTAN), are eligible for transfer among Ohio's Public Secondary (CT)2 approved programs/courses and state institutions of higher education. This document presents the course in this CTAG:

CTBTC001 - Biotechnology Principles

CTBTC002 - Bioinformatics expired effective Summer 2023.

This CTAN identifies the learning outcomes that are equivalent or common in introductory technical courses. For students to receive credit under these agreements, the career-technical programs and the state institutions of higher education must document that their course/program content matches the learning outcomes in the CTANs. In accordance with Ohio Revised Code 3333.162, industry standards and certifications provide documentation of student learning.

Accessing Credit

Students that have met the requirements for credit for each CTAN will appear in the CTAV system that public colleges and universities access to award credit. Institutions must have the student's permission to officially post the CTAG to their transcript. Students can grant this permission as part of the WebXam. If a student did not grant permission as part of the WebXam, they will still need to confirm with colleges and universities that they want credit for the CTAG course.

Institutional Approval

Secondary: Secondary institutions must have pathway approval from the Ohio Department of Education. Certificate of Affirmation assurances are now incorporated into the CTE-26 application process.

Colleges/Universities: Postsecondary institutions must submit course through CEMS for review and approval by a faculty panel.

CTBTC001 Biotechnology Principles	Credits: 3 Semester Hours

Course Description: This course covers the foundation of modern biotechnology. It reviews the history and foundational principles of the science. Students will learn the theoretical basis of DNA, RNA, and protein detection, analysis, manipulation, and engineering. Present and future applications of Biotechnology as they relate to areas such as industrial applications, medicine, environment, and agriculture will be explored.

Requirements for Credit:

- Successfully complete ODE secondary course **Animal and Plant Biotechnology (012010)** and earn a qualifying score on the corresponding End-of-Course examination.
- Within 3 years of completing the approved secondary program, matriculate to an institution of higher education with an approved or comparable program.

Learning Outcome Alignment
All learning outcomes that are considered essential are marked with an asterisk*.

Post-Secondary Learning Outcomes The student will be able to:	Competencies in ODE Career Field Technical Content Standards
1. * Describe the history of and evaluate the implications of biotechnology in society and its regulation, e.g., bioethics, food production, medicine, bioinformatics, agriculture, forensics, aquatics, the environment, industry, and manufacturing.	1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice). 1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety datasheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization. 1.3.8. Verify compliance with computer and intellectual property laws and regulations. 1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational, and professional ethical standards. 1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization. 1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings. 1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments. 1.5.8. Identify how multicultural teaming and globalization can foster development

	of new and improved products and services and recognition of new opportunities. 3.1.17 Describe biotechnology product safety assessment. 3.1.18 Identify the purpose of a bioreactor and its use in the agricultural industry.
2.* Demonstrate an understanding of the process of DNA replication, protein synthesis, and gene regulation mechanisms as well as the basics of gene expression analysis and its applications.	3.5.6. Use microbial taxonomy and classification systems to identify organisms. 3.5.7. Compare and contrast cellular structure and functions of prokaryotic and eukaryotic cells. 3.3.3. Transform deoxyribonucleic acid (DNA) to alter bacterial metabolism, reproduction, cell structures and their functions. 3.4.4. Model the Central Dogma Theory (e.g., replication, transcription, translation). 3.6.1 Use a Punnett square to predict and explain Mendel's Laws, genotype and phenotype. 3.6.2. Explain epigenetics and provide examples of its effects. 3.6.3. Model, predict and diagram the three-dimensional shape, types of bonds (covalent and hydrogen bonds) and antiparallel nature of DNA. 3.6.4. Model the Central Dogma Theory (e.g., replication, transcription, translation). 3.6.5. Describe post-transcriptional and post-translational modification of RNA and describe its function. 3.6.8 Analyze DNA using common laboratory techniques (e.g. DNA isolation, gel electrophoresis, restriction enzyme digest, Southern Blotting, Northern Blotting).
3. * Explain the theoretical basis of genome analysis, including Sanger sequencing and current sequencing technologies, and the importance of genome projects, e.g., Human Genome Project, Human Microbiome Project, Environmental Genome Project.	3.6.9 Use bioinformatics to analyze DNA and proteins. 3.6.12. Evaluate genomes in relation to food, plant, animals, and natural resources. 3.6.17 Describe genome sequencing and the information gained from it. 3.6.21 Explain gene by environment interactions.
4.* Explain the theoretical basis of recombinant DNA technologies, and its applications in biotechnology, e.g., genetically modified products, therapeutic products, DNA cloning, clinical diagnosis, energy applications.	3.6.6 Explain gene editing including the process, possible benefits, and potential risks. 3.6.8. Analyze DNA using common laboratory techniques (e.g. DNA isolation, gel electrophoresis, restriction enzyme digest, Southern Blotting, Northern Blotting). 3.6.10 Explain cloning techniques including vector preparation, transformation, and selection. 3.6.14 Transform bacteria with exogenous DNA to alter bacterial metabolism, reproduction, cell structures and their functions. 3.6.19 Define genetically modified organisms and explain their impact on society. 3.6.20. Describe how vectors (e.g., plasmids, transposons, viruses) are used to transform host and microorganisms.

5.* Explain the theoretical basis of PCR, gel electrophoresis, and basic chromatography techniques for separating and identifying nucleic acids, carbohydrates, proteins, and biological metabolites.	3.6.8 Analyze DNA using common laboratory techniques (e.g. DNA isolation, gel electrophoresis, restriction enzyme digest, Southern Blotting, Northern Blotting) 3.6.16. Describe molecular behavior and the structure of large molecules, including carbohydrates, lipids, proteins and nucleic acids.
6.*Explore biotechnology fields and career opportunities within each.	1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers. 1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience. 1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options. 1.1.4. Describe the role and function of professional organizations, industry associations and organized labor and use networking techniques to develop and maintain professional relationships.

Requirements and Credit Conditions:

1. The receiving institution must have a comparable program, major, or course that has been approved through submission to the Ohio Department of Higher Education (CT) [2] approval process for the CTAN listed in this document.
2. Credits apply to courses in the specified technical area at Ohio's public institutions of higher education, if the institution offers courses in the specific technical area. In the absence of an equivalent course, and when the institution offers the technical program, the receiving institution will guarantee to grant and apply an equivalent credit value of the Career-Technical Articulation Number (CTAN) toward the technical requirements of the specific degree/certificate program.
3. A career-technical student seeking credit under the terms of this CTAG must apply and be accepted to the college within three years of completing a career-technical course, unless otherwise noted.
4. A career-technical student who meets all eligibility criteria will receive the credit hour value for the comparable course as offered at the receiving state institution of higher education.
5. The admission requirements of individual institutions and/or programs are unaffected by the implementation of (CT)² outcomes.
6. The transfer of credit, through this CTAG, will not exempt a student from the residency requirements at the receiving institution.

Biotechnology for Food, Plant and Animal Science Panel Participants
2013-2015

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