Maryland CTE Programs of Study

Biotechnology II (2025)

GENERAL REQUIREMENTS. This course is recommended for students in Grades 10-12, and Biotechnology I is the prerequisite. 1

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INTRODUCTION 2

A Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions. 2.A

B The Health and Human Services Career Cluster promotes whole health in individuals and communities through diverse services. This sector includes technical, mental, and therapeutic services and personal care supported by medical and social sciences. By addressing social determinants of health and leveraging health data and science, this Cluster aims to enhance the overall health and resilience of individuals, families, and communities. 2.B

C The Biotechnology Program of Study focuses on research and development in the medical field, including biotechnology and scientific research. Professionals in this field develop new treatments, pharmaceuticals, devices, and innovative medical technologies to advance healthcare. Through hands-on laboratory experiences, students develop the technical skills and knowledge necessary to conduct research, analyze data, and contribute to the development of treatments, medical devices, and cutting-edge technologies. The program integrates core academic skills in biology, chemistry, and mathematics with industry-aligned standards to ensure students are prepared for certifications such as the Biotechnology Aptitude and Competency Exam (BACE). Graduates of the program will leave with certifications, college credits, and the technical and professional skills needed to pursue careers in biotechnology or further education in fields such as molecular biology, bioinformatics, or biomedical engineering. 2.C

D Biotechnology II builds upon the foundational skills from the Biotechnology I course. This course emphasizes advanced laboratory techniques and applied biotechnology skills. Students will master aseptic techniques, DNA analysis, protein assays, and data analysis while preparing for industry certifications. Key topics include biomanufacturing, bioinformatics, and the regulatory environment of biotechnology. By the end of the course, students will be prepared to earn the

Biotechnology Aptitude and Competency Exam (BACE) and will explore opportunities for dual or articulated college credits. 2.D

E **Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.** 2.E

F **Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.** 2.F

KNOWLEDGE AND SKILLS 3

A **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:** 3.A

1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work. 3.A.1
2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn. 3.A.2
3. Employ effective reading, writing, and technical documentation skills. 3.A.3
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies. 3.A.4
5. Demonstrate leadership skills and collaborate effectively as a team member. 3.A.5
6. Implement safety procedures, including proper use of software and following privacy guidelines. 3.A.6
7. Exhibit an understanding of legal and ethical responsibilities in the biotechnology field, following copyright laws and regulations. 3.A.7
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting. 3.A.8

B **The student identifies various career pathways in the biotechnology field. The student is expected to:** 3.B

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles in biotechnology. 3.B.1
2. Create a professional resume and portfolio that reflects skills, projects, certifications, and recommendations. 3.B.2
3. Demonstrate effective interview skills for roles in biotechnology fields. 3.B.3

C **The student develops technology and digital literacy skills. The student is expected to:** 3.C

1. Use technology as a tool for research, organization, communication, and problem-solving. 3.C.1

2 Use digital tools, including computers, mobile devices, collaboration platforms, and cloud services, to access, manage, and create information. 3.C.2

3 Demonstrate proficiency in using emerging and industry-standard technologies. 3.C.3

4 Understand ethical and legal considerations for technology use, including the principles of data protection, copyright, and responsible technology use. 3.C.4

D The student integrates core academic skills into biotechnology practices. The student is expected to: 3.D

1 Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards. 3.D.1

2 Apply English concepts such as writing informative texts when documenting procedures and articulating goals. 3.D.2

3 Show proficiency in reading and following multi-step protocols as written in an SOP. 3.D.3

4 Use mathematical concepts for measurement and conversion (metric to metric), ratios and proportions, fraction and decimal conversions, and mathematical solution calculations needed in biotechnology protocols. 3.D.4

E The student builds on foundational biotechnology skills and demonstrates advanced knowledge in biotechnology applications. The student is expected to: 3.E

1 Explain advanced principles of molecular biology, genetics, protein chemistry, gene expression, and biochemistry related to biotechnology. 3.E.1

2 Analyze the role of biotechnology in addressing social determinants of health and promoting individual and community wellness. 3.E.2

3 Investigate current advancements in biotechnology research, including emerging treatments, pharmaceuticals, and medical devices. 3.E.3

F The student demonstrates advanced laboratory skills and complies with professional safety standards. The student is expected to: 3.F

1 Perform advanced techniques such as transformation, recombinant protein production, and purification with column chromatography, protein analysis by electrophoresis, ELISA and/ or spectrophotometry. Compare methods of diagnosis and molecular analysis such as nucleic acid gels, protein gel, Western, ELISA, and spectrophotometry. If equipment is available, perform quantitative PCR, and CRISPR gene editing. 3.F.1

2 Implement OSHA 30 safety protocols in laboratory settings, including risk assessment and incident response. 3.F.2

3 Safely handle and store biological samples, reagents, and hazardous materials according to industry standards. 3.F.3

G The student demonstrates proficiency in research design, analysis, and technical reporting. The student is expected to: 3.G

1. Design and conduct complex biotechnology experiments, incorporating controls and replicates to ensure accuracy. 3.G.1
2. Analyze quantitative experimental data using a standard curve. 3.G.2
3. Produce detailed lab reports and scientific presentations that meet industry and academic standards. 3.G.3

H The student applies core academic skills to biotechnology practices. The student is expected to: 3.H

1. Demonstrate technical writing skills by creating research proposals, abstracts, and summaries. 3.H.1
2. Apply algebraic and statistical concepts to model and explain sources of uncertainty and interpret significant figures. 3.H.2
3. Use scientific literature and databases to support research findings and explore biotechnology innovations. 3.H.3

I The student evaluates ethical, legal, and societal considerations in biotechnology. The student is expected to: 3.I

1. Analyze ethical issues associated with gene editing, personalized medicine, and biopharmaceutical development. 3.I.1
2. Investigate laws and regulations governing biotechnology research, intellectual property, and product approvals. 3.I.2
3. Discuss the societal implications of biotechnology innovations on healthcare, the environment, and the economy. 3.I.3

J The student demonstrates professional skills and explores career pathways in biotechnology research and development. The student is expected to: 3.J

1. Participate in simulated workplace scenarios to practice problem-solving, teamwork, and communication skills. 3.J.1
2. Explore career pathways in biotechnology and identify required education, certifications, and technical skills for entry-level positions. 3.J.2

K The student prepares for and demonstrates competency through the Biotechnology Aptitude and Competency Exam (BACE). The student is expected to: 3.K

1. Understand the structure and content areas of the Biotechnology Aptitude and Competency Exam (BACE), including molecular biology, laboratory safety, and biotechnology applications. 3.K.1
2. Engage in targeted review sessions and practice assessments to address areas of improvement and reinforce technical knowledge. 3.K.2
3. Complete mock exams and practical assessments aligned with BACE standards to demonstrate readiness for the certification. 3.K.3
4. Register for and take the Biotechnology Aptitude and Competency Exam (BACE) to validate entry-level biotechnology competencies. 3.K.4