Maryland CTE Programs of Study

Biotechnology III (2025)

GENERAL REQUIREMENTS. This course is recommended for students in Grades 11-12, and Biotechnology I and II are the prerequisites. 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 In Biotechnology III advanced course, students deepen their understanding of biotechnology through independent research and hands-on laboratory experiences. Emphasis is placed on designing and conducting experiments using advanced techniques such as CRISPR, next-generation sequencing, and bioprocessing. Students analyze and present research findings while engaging in ethical and societal discussions related to biotechnology innovations. This course

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prepares students for work-based learning experiences, including internships, while offering opportunities to earn 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 co-curricular 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 reflect 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

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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 the procedures and articulating goals. 3.D.2

3 Use mathematical concepts for measurement and conversion (Fahrenheit vs. Celsius), ratios and proportions as well as fraction and decimal conversions. 3.D.3

E The student advances technical proficiency and knowledge in biotechnology to support research and development. The student is expected to: 3.E

1 Explore advanced concepts in biotechnology, such as bioinformatics, proteomics, and pharmacogenomics, and their applications in healthcare. 3.E.1

2 Analyze case studies of biotechnology innovations addressing social determinants of health and improving community resilience. 3.E.2

3 Examine the role of biotechnology in the development of treatments, medical devices, and diagnostic tools for addressing global health challenges. 3.E.3

F The student demonstrates advanced laboratory techniques and integrates professional safety practices. The student is expected to: 3.F

1 Perform advanced molecular techniques such as next-generation sequencing, protein engineering, and immunoassays. 3.F.1

2 Implement advanced quality control measures and troubleshoot laboratory protocols to ensure experimental accuracy and compliance. 3.F.2

3 Maintain adherence to OSHA 30 safety protocols while demonstrating proficiency in using specialized biotechnology tools and equipment. 3.F.3

G The student designs and conducts independent research projects to support work-based learning or further study. The student is expected to: 3.G

1 Develop a research proposal, including objectives, methodology, and anticipated outcomes, aligned with biotechnology industry practices. 3.G.1

2 Conduct independent experiments using advanced techniques and document findings in a detailed lab notebook. 3.G.2

3 Present research findings in written, verbal, and multimedia formats consistent with academic and industry standards. 3.G.3

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H **The student applies core academic skills to biotechnology practices at an advanced level. The student is expected to:** 3.H

1. Utilize technical writing skills to draft grant proposals, scientific abstracts, and research papers. 3.H.1
2. Apply statistical models and computational tools to analyze large datasets, such as gene expression or bioinformatics data. 3.H.2
3. Use advanced mathematical concepts, including logarithmic scales and exponential functions, to interpret experimental results. 3.H.3

I **The student evaluates the ethical, legal, and societal implications of advanced biotechnology practices. The student is expected to:** 3.I

1. Analyze ethical considerations in the use of biotechnology for personalized medicine, genetic modification, and biomanufacturing. 3.I.1
2. Discuss the impact of intellectual property laws, regulatory standards, and patenting on biotechnology innovation. 3.I.2
3. Investigate the societal consequences of emerging technologies, such as artificial intelligence in drug development or CRISPR in agriculture. 3.I.3

J **The student prepares for professional experiences and work-based learning in the biotechnology field. The student is expected to:** 3.J

1. Demonstrate professional communication and collaboration skills through team-based laboratory projects. 3.J.1
2. Complete a mock job interview or resume tailored to biotechnology careers, highlighting relevant certifications and skills. 3.J.2
3. Participate in work-based learning opportunities, internships, or simulated projects to develop real-world biotechnology experience. 3.J.3

K **The student earns dual or articulated credits through advanced coursework in biotechnology. The student is expected to:** 3.K

1. Complete advanced biotechnology coursework aligned with local post-secondary institutions to earn dual or articulated credits. 3.K.1
2. Collaborate with industry partners and post-secondary programs to explore career pathways in biotechnology research and development. 3.K.2
3. Document skills mastered in the course through an academic portfolio that aligns with higher education or industry expectations. 3.K.3