Maryland CTE Programs of Study

Biotechnology I (2025)

GENERAL REQUIREMENTS. This course is recommended for students in Grades 9-12, and there are no 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

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D **The Biotechnology I course provides students with a foundational understanding of biotechnology and its applications in healthcare, research, diagnostic labs, and industry. Students explore the history, principles, and ethical considerations of biotechnology while developing essential laboratory skills. Topics include basic molecular biology, genetics, laboratory safety, and OSHA standards. By the end of the course, students will gain the knowledge and skills to begin preparation for the Biotechnology Aptitude and Competency Exam (BACE) in subsequent courses.** 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 legal documentation 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

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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, including manufacturing and use of biotechnology products and diagnostics. 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

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E **The student demonstrates foundational knowledge and skills in biotechnology and its applications. The student is expected to:** 3.E

1. Explain the role of biotechnology in advancing healthcare, agriculture, environmental sustainability, and its impact on individuals, families, and communities. 3.E.1
2. Describe key principles of biology, chemistry, and genetics as they relate to biotechnology. 3.E.2
3. Identify and differentiate between major biotechnology sectors, including diagnostic laboratories, biomanufacturing, pharmaceuticals, agricultural biotechnology, medical devices, and bioinformatics. 3.E.3
4. Describe the range of careers in biotechnology and the education, certification, and skills required for each. 3.E.4

F **The student applies appropriate laboratory safety procedures and regulatory compliance standards. The student is expected to:** 3.F

1. Demonstrate compliance with OSHA laboratory safety practices, including proper use of PPE and hazard communication protocols. 3.F.1
2. Follow Good Laboratory Practices (GLP), including documentation, labeling, and maintenance of laboratory equipment. 3.F.2
3. Explain the importance of regulatory agencies (e.g., FDA, USDA, EPA) in ensuring biotechnology product safety and quality. 3.F.3

G **The student demonstrates foundational laboratory skills and proficiency with biotechnology tools and equipment. The student is expected to:** 3.G

1. Operate basic laboratory equipment such as microscopes, spectrophotometers, micropipettes, serological pipettes, electronic balances, incubators, and centrifuges safely and effectively following standard operating procedures. 3.G.1
2. Accurately measure and transfer liquids using micropipettes and graduated instruments. 3.G.2
3. Perform aseptic techniques, including pipetting and sterile media preparation, to minimize contamination in laboratory settings. 3.G.3

H **The student demonstrates knowledge of molecular biology and biochemistry principles relevant to biotechnology. The student is expected to:** 3.H

1. Describe the chemical structure and biological functions of biomolecules including DNA, RNA, proteins, and enzymes. 3.H.1
2. Explain the processes of DNA replication, transcription, and translation in the context of the central dogma. 3.H.2
3. Relate principles of chemistry and genetics to biotechnology techniques used in diagnostics, manufacturing, and research. 3.H.3

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he student demonstrates the ability to conduct scientific research and analyze ata. The student is expected to: 3.I

1. Maintain the scientific method to design and conduct experiments using testable hypotheses, control groups, and appropriate variables. 3.I.1
2. Utilize data collection techniques and organize findings using charts, graphs, and tables. 3.I.2
3. Interpret data from laboratory experiments and draw evidence-based conclusions. 3.I.3
4. Identify sources of error and propose improvements to experimental protocols based on results. 3.I.4

J The student develops an understanding of biotechnology-related technical skills aligned with industry standards. The student is expected to: 3.J

1. Demonstrate proficiency in DNA extraction, electrophoresis, and PCR techniques to analyze genetic material. 3.J.1
2. Demonstrate proficiency in basic cell culture, including inoculating plates, inoculating broth, microbe identification by colony morphology, proper use of microscopes, and use of selective and differential media. 3.J.2
3. Conduct basic protein analysis techniques such as chromatography and spectrometry. 3.J.3

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

1. Demonstrate effective written and verbal communication skills in the context of laboratory documentation and reporting. 3.K.1
2. Apply mathematical concepts such as ratios, proportions, solution calculations, and statistical analysis to interpret experimental data and to complete laboratory protocols. 3.K.2
3. Use critical thinking and problem-solving skills to troubleshoot experimental errors and optimize procedures. 3.K.3

L The student explores ethical, legal, and societal issues related to biotechnology. The student is expected to: 3.L

1. Examine the ethical implications of genetic modification, cloning, and other biotechnological advancements. 3.L.1
2. Describe the roles of governing agencies and GLP governing biotechnology research and product development. 3.L.2
3. Discuss the role of biotechnology in addressing public health, global health challenges, environmental issues, and economic development. 3.L.3