Maryland CTE Programs of Study

Biomedical Science III (2025)

GENERAL REQUIREMENTS. This course is recommended for students in Grades 10-12, and Biomedical Science 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 Biomedical Science Program of Study immerses students in scientific principles, laboratory techniques, clinical practices, and professional skills essential for success in today's healthcare and biotechnology fields. Throughout the program, students learn to address complex biomedical challenges, incorporate ethical and regulatory considerations, and remain adaptable to rapidly evolving technologies and healthcare demands. By completing the Biomedical Science program, graduates are well-prepared to advance into higher education, seek industry-recognized credentials, and contribute to developing innovative medical treatments, pharmaceuticals, devices, and solutions that enhance individuals', families', and communities' health and resilience.** 2.C

D **Biomedical Science III builds upon the foundational concepts and skills introduced in Biomedical Science II, guiding students into more advanced areas of biomedical research, diagnostics, and innovation. Students refine essential techniques such as DNA extraction, protein analysis, and genetic engineering through hands-on laboratory work. They deepen their understanding of clinical testing, bioinformatics, and epidemiology, developing the ability to interpret complex data, propose evidence-based interventions, and address real-world healthcare :hallenges. Students also strengthen their professional competencies—:ollaboration, problem-solving, technical communication, and ethical decision-making—while exploring industry standards, regulatory considerations, and**

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emerging technologies. By the end of Biomedical Science II, students will have honed a versatile skill set, positioning them for success on the BACE exam, future coursework, and meaningful contributions to the biomedical field. 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 biomedical science 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 biomedical science 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 healthcare. 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 healthcare 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 biomedical science 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 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 demonstrates the necessary skills to perform and document advanced laboratory techniques with accuracy and professionalism. The student is expected to: 3.E

1 Practice precise micropipetting to measure and transfer small liquid volumes accurately. 3.E.1

2 Conduct DNA gel electrophoresis to analyze genetic material and interpret basic banding patterns. 3.E.2

3 Maintain clear, organized laboratory records that detail procedures, observations, and results. 3.E.3

F The student demonstrates the necessary skills to apply advanced laboratory techniques and bioanalytical methods to investigate and address biomedical challenges. The student is expected to: 3.F

1 Apply aseptic techniques and bacterial plating methods to culture, isolate, and identify microorganisms in controlled settings. 3.F.1

2 Utilize micropipetting to ensure precise measurement and transfer of samples, supporting experiments such as DNA extraction, restriction enzyme digests, and DNA gel electrophoresis. 3.F.2

3 Perform protein gel electrophoresis and perform and or interpret hydrophobic interaction chromatography (HIC) to purify and analyze proteins for therapeutic and diagnostic applications. 3.F.3

4 Conduct bacterial transformations and use recombinant DNA technology to explore genetic engineering and biomanufacturing processes. 3.F.4

5 Employ computational and analytical skills, including graphing software and applied math, to create standard curves, interpret laboratory data, and draw evidence-based conclusions from experimental results. 3.F.5

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G **The student demonstrates the necessary skills to conduct clinical analyses and interpret biomedical data in ways that support patient-centered care and inform population health strategies. The student is expected to:** 3.G

1. Interpret karyotyping to identify chromosomal abnormalities and evaluate their implications for patient diagnosis and treatment. 3.G.1
2. Carry out quantitative ELISA procedures to detect biomolecules, analyze results, and understand their relevance in disease monitoring and public health interventions. 3.G.2
3. Interpret audiograms to assess hearing loss and consider appropriate medical interventions, including hearing assistive technologies and bioengineering solutions. 3.G.3
4. Execute blood typing and tissue typing procedures to guide safe transfusions, organ transplants, and immunological compatibility. 3.G.4
5. Integrate knowledge of bioethics, epidemiology, and the interrelationship between body systems and health/disease when proposing clinical interventions, reflecting on how social determinants of health influence patient outcomes. 3.G.5

H **The student demonstrates the necessary skills to operate laboratory equipment, software, and technology for reliable data acquisition, analysis, and decision-making in biomedical research. The student is expected to:** 3.H

1. Use Microsoft Office (Excel, Word, PowerPoint) to compile, analyze, and present data, ensuring clear documentation and professional communication of findings. 3.H.1
2. Employ Vernier probes, sensors, and Logger Pro data acquisition software to measure physiological and environmental parameters accurately and consistently. 3.H.2
3. Operate microscopes, thermal cyclers, and other specialized laboratory instruments, ensuring fidelity in experimental protocols and reproducibility of results. 3.H.3
4. Apply bioinformatics and DNA sequence analysis tools to investigate infectious agents, genetic variations, and to inform the development of new biomedical interventions. 3.H.4
5. Troubleshoot equipment and software issues proactively, maintaining an organized and efficient laboratory environment that supports quality assurance and safety standards. 3.H.5

I **The student demonstrates the necessary skills to design, analyze, and communicate scientific experiments, leveraging scientific experimentation skills to inform innovative biomedical interventions. The student is expected to:** 3.I

1. Design and conduct reliable scientific experiments that align with research questions related to topics such as infectious disease, antibiotic resistance, cancer diagnostics, and regenerative medicine. 3.I.1

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2 Analyze and interpret laboratory data, construct graphs by hand or using graphing software, and apply statistical methods to interpolate, extrapolate, and draw meaningful conclusions. 3.I.2

3 Communicate experimental results and conclusions both orally and in writing, employing technical writing and presentation skills that meet industry standards. 3.I.3

4 Incorporate bioethics, regulatory considerations, and intellectual property issues into research design and dissemination, reflecting the importance of responsible innovation. 3.I.4

5 Adapt experimental methodologies using problem-solving and creative thinking skills, refining approaches to enhance the accuracy, relevance, and impact of research findings. 3.I.5

J The student demonstrates the necessary professional, collaborative, and forward-thinking skills to function effectively in interdisciplinary biomedical teams and adapt to current and future healthcare challenges. The student is expected to: 3.J

1 Work collaboratively, employing planning, organizing, time management, and decision-making techniques to support project goals, from vaccine production initiatives to gene therapy research. 3.J.1

2 Engage in peer review, provide constructive feedback, and uphold professional standards in laboratory and clinical simulations, fostering an environment of continuous improvement. 3.J.2

3 Utilize problem-solving and creative thinking skills to address emerging challenges, such as antibiotic resistance or xenotransplantation, and develop new interventions or refine existing medical technologies. 3.J.3

4 Reflect on the evolving landscape of biomedical science careers, understanding bioethics, the design process, and global impacts of health technologies, including organ allocation policies and clinical trial protocols. 3.J.4

5 Demonstrate professionalism and leadership by documenting the design process, managing projects efficiently, and communicating effectively with diverse stakeholders, ensuring that biomedical solutions are ethically sound, clinically relevant, and socially responsible. 3.J.5

K The student applies critical thinking and problem-solving skills to enhance patient care outcomes. The student is expected to: 3.K

1 Identify and address patients' needs in a variety of healthcare scenarios, adapting techniques to specific situations. 3.K.1

2 Recognize symptoms of common diseases and conditions, including their implications for care planning and interventions. 3.K.2

3 Analyze social determinants of health and propose solutions to improve patient well-being. 3.K.3

4 Collaborate with interdisciplinary healthcare teams to develop patient-centered care plans. 3.K.4

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5 Evaluate patient progress and adjust care strategies to meet changing health needs. 3.K.5

L The student demonstrates readiness for postsecondary opportunities and workplace experiences in biomedical science fields. The student is expected to: 3.L

1 Seek dual credit or other advanced academic courses to prepare for college-level studies. 3.L.1

2 Participate in internships, apprenticeships, or job shadowing opportunities to gain practical experience. 3.L.2

3 Build a professional portfolio highlighting technical, analytical, and communication skills. 3.L.3

M The student demonstrates the capacity to continuously learn and adapt within the evolving biomedical industry. The student is expected to: 3.M

1 Stay informed about new research findings, emerging diseases, and updated best practices. 3.M.1

2 Consider pursuing relevant certifications, including the BACE exam, to validate skill mastery. 3.M.2

3 Reflect on personal career goals, identifying necessary education, training, and professional development opportunities. 3.M.3