Texas CTE: Health Science

Medical Microbiology

Implementation. A

1 The provisions of this section shall be implemented by school districts beginning with the 2024- 2025 school year. A.1

2 School districts shall implement the employability skills student expectations listed in §127.15(d)(2) of this chapter (relating to Career and Technical Education Employability Skills) as an integral part of this course. A.2

General requirements. This course is recommended for students in Grades 10-12. Prerequisites: one credit in biology, one credit in chemistry, and at least one credit in a course from the health science career cluster. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course. B

b General requirements. This course is recommended for students in Grades 10-12. Prerequisites: one credit in biology, one credit in chemistry, and at least one credit in a course from the health science career cluster. This course satisfies a high school science graduation requirement. Students shall be awarded one credit for successful completion of this course. B

Introduction. C

1 Career and technical education instruction provides content aligned with challenging academic standards, industry-relevant technical knowledge, and college and career readiness skills for students to further their education and succeed in current and emerging professions. C.1

2 The Health Science Career Cluster focuses on planning, managing, and providing therapeutic services, diagnostic services, health informatics, support services, and biotechnology research and development. C.2

3 The Medical Microbiology course is designed to explore the microbial world, studying topics such as pathogenic and non-pathogenic microorganisms, laboratory procedures, identifying microorganisms, drug-resistant organisms, and emerging diseases. C.3

4 **Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not currently scientifically testable.** C.4

5 **Students are expected to know that:** C.5

- A hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and C.5.A
- B scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed. C.5.B

6 **Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.** C.6

- A Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models. C.6.A
- B Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models. C.6.B

7 **Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information).** C.7

8 **Science consists of recurring themes and making connections between overarching concepts. Recurring themes include systems, models, and patterns. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested, while models allow for boundary specification and provide a tool for understanding the ideas presented. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.** C.8

9 **Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other organizations that foster leadership and career development in the profession such as student chapters of related professional associations.** C.9

10 **Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.** C.10

Knowledge and skills. D

1 **The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:** D.1

A ask questions and define problems based on observations or information from text, phenomena, models, or investigations; D.1.A

B apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; D.1.B

C use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards; D.1.C

D use appropriate tools such as microscopes, slides, streak plates, inoculating loops, Bunsen burners, striker, hot plate, petri dish, agar and other growth mediums, reactive agents, personal protective equipment (PPE), disposable pipettes, lab glassware and instruments, bacterium and other live microbial agents, enzymes, computer software and probes, incubator, and autoclave; D.1.D

E collect quantitative data using the International System of Units (SI) and United States customary units and qualitative data as evidence; D.1.E

F organize quantitative and qualitative data using equipment such as graphing calculator, computer software and probes, graphic organizers; D.1.F

G develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and D.1.G

H distinguish between scientific hypotheses, theories, and laws. D.1.H

2 **The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:** D.2

- A identify advantages and limitations of models such as their size, scale, properties, and materials; D.2.A
- B analyze data by identifying significant statistical features, patterns, sources of error, and limitations; D.2.B
- C use mathematical calculations to assess quantitative relationships in data; and D.2.C
- D evaluate experimental and engineering designs. D.2.D

3 **The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:** D.3

- A develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories; D.3.A
- B communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and D.3.B
- C engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. D.3.C

4 **The student knows the contributions of scientists and engineers and recognizes the importance of scientific research and innovation on society. The student is expected to:** D.4

- A analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student; D.4.A
- B relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists and engineers as related to the content; and D.4.B
- C research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a science, technology, engineering, and mathematics (STEM) or health science field in order to investigate careers. D.4.C

5 **The student examines the field of microbiology in relation to medical care. The student is expected to:** D.5

- A examine the historical development of microbiology as it relates to health care of an individual in modern medicine; and D.5.A
- B compare the roles, functions, and responsibilities of agencies governing infectious disease control. D.5.B

6 The student is expected to perform and analyze results in the microbiology laboratory. The student is expected to: D.6

- A classify microorganisms using a dichotomous key; D.6.A
- B prepare slides and discuss the differences between Gram positive and Gram negative bacteria such as the bacterial cell wall and the use of oxygen; D.6.B
- C identify chemical processes such as enzyme catalyst and osmotic potential of microorganisms; D.6.C
- D identify and discuss technologies used in a laboratory setting such as polymerase chain reaction (PCR), serology, enzyme-linked immunoassay (ELISA), and electrophoresis; D.6.D
- E prepare plates or active mediums to differentiate the factors required for microbial reproduction and growth; D.6.E
- F identify the normal flora microorganisms of the human body; D.6.F
- G identify and differentiate between various pathogens, including opportunistic pathogens, hospital-acquired infections, community-acquired infections, and colonizing microorganisms; D.6.G
- H isolate colonies and describe the morphology of microorganisms; and D.6.H
- I interpret and explain the role of the culture and sensitivity report provided to the clinician. D.6.I

7 The student examines the role of microorganisms in infectious diseases. The student is expected to: D.7

- A outline and explain the infectious disease process, including how pathogenic microorganisms affect human body systems; D.7.A
- B categorize diseases caused by bacteria, including Rickettsia, fungi, viruses, protozoa, arthropods, and helminths; D.7.B
- C explain and interpret the body's immune responses and defenses against infection; D.7.C
- D prepare a bacterial colony and evaluate the effects of anti-microbial agents such as narrow and broad-spectrum antibiotics; D.7.D
- E examine the environmental and social causes of the emergence and reemergence of diseases such as corona viruses, Ebola, malaria, tuberculosis, and polio; D.7.E
- F research and discuss drug aureus-resistant microorganisms, including carbapenem-resistant Enterobacteriaceae, methicillin-resistant Staphylococcus aureus, vancomycin- intermediate/resistant Staphylococci, vancomycin-resistant enterococci, and emergent antibiotic-resistant superbugs; and D.7.F
- G outline the role of governing agencies in monitoring and establishing guidelines based on the spread of infectious diseases. D.7.G

8 **The student recognizes the importance of maintaining a safe environment and eliminating hazardous situations. The student is expected to:** D.8

A identify and apply standard laboratory precautions; D.8.A

B identify and apply microbiological safety practices in accordance with industry standards, including the proper handling, disinfection, and disposal of biological waste and maintenance of containment levels; D.8.B

C identify and apply appropriate personal protection equipment (PPE) and transmission- based precautions, including precautions against droplet, contact, and airborne transmission; D.8.C

D sterilize laboratory and medical equipment and instruments in accordance with industry standards; and D.8.D

E define and select different mechanisms of decontamination such as antiseptics, disinfection, and sterilization. D.8.E