Medical Microbiology

Subject: Career Development and Career and Technical Education
Grade: 10
Expectations: 44
Breakouts: 183

(a) Introduction.

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.
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.
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.
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.
5. Students are expected to know that:
    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
    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.
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.
    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.
    b. Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.
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).

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.

9. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

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

(b) Knowledge and Skills Statements

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) demonstrate verbal and non-verbal communication in a clear, concise, and effective manner;

(i) demonstrate verbal communication in a clear manner

(ii) demonstrate verbal communication in a concise manner

(iii) demonstrate verbal communication in a[n] effective manner

(iv) demonstrate non-verbal communication in a clear manner

(v) demonstrate non-verbal communication in a concise manner

(vi) demonstrate non-verbal communication in a[n] effective manner

(B) demonstrate the ability to cooperate, contribute, and collaborate as a member of a team; and

(i) demonstrate the ability to cooperate as a member of a team

(ii) demonstrate the ability to contribute as a member of a team

(iii) demonstrate the ability to collaborate as a member of a team

(C) locate, evaluate, and interpret career options, opportunities, and postsecondary transitions relating to the field of microbiology.

(i) locate career options relating to the field of microbiology

(ii) evaluate career options relating to the field of microbiology

(iii) interpret career options relating to the field of microbiology

(iv) locate career opportunities relating to the field of microbiology

(v) evaluate career opportunities relating to the field of microbiology

(vi) interpret career opportunities relating to the field of microbiology

(vii) locate postsecondary transitions relating to the field of microbiology

(viii) evaluate postsecondary transitions relating to the field of microbiology

(ix) interpret postsecondary transitions relating to the field of microbiology

(2) 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:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(i) ask questions based on observations or information from text, phenomena, models, or investigations

(ii) define problems based on observations or information from text, phenomena, models, or investigations

(B) apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(i) apply scientific practices to plan descriptive investigations

(ii) apply scientific practices to plan comparative investigations

(iii) apply scientific practices to plan experimental investigations

(iv) apply scientific practices to conduct descriptive investigations

(v) apply scientific practices to conduct comparative investigations

(vi) apply scientific practices to conduct experimental investigations

(vii) use engineering practices to design solutions to problems

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

(i) use appropriate safety equipment during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(ii) use appropriate safety equipment during classroom investigations as outlined in Texas Education Agency-approved safety standards

(iii) use appropriate safety equipment during field investigations as outlined in Texas Education Agency-approved safety standards

(iv) use appropriate safety practices during laboratory investigations as outlined in Texas Education Agency-approved safety standards

(v) use appropriate safety practices during classroom investigations as outlined in Texas Education Agency-approved safety standards

(vi) use appropriate safety practices during field investigations as outlined in Texas Education Agency-approved safety standards

(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;

(i) use appropriate tools

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

(i) collect quantitative data using the International System of Units (SI) as evidence

(ii) collect quantitative data using the United States customary units as evidence

(iii) collect qualitative data as evidence

(F) organize quantitative and qualitative data using equipment such as graphing calculator, computer software and probes, graphic organizers;

(i) organize quantitative using equipment

(ii) organize qualitative data using equipment

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and

(i) develop models to represent phenomena, systems, processes, or solutions to engineering problems

(ii) use models to represent phenomena, systems, processes, or solutions to engineering problems

(H) distinguish between scientific hypotheses, theories, and laws.

(i) distinguish between scientific hypotheses, theories, and laws

(3) 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:

(A) identify advantages and limitations of models such as their size, scale, properties, and materials;

(i) identify advantages of models

(ii) identify limitations of models

(B) analyze data by identifying significant statistical features, patterns, sources of error, and limitations;

(i) analyze data by identifying significant statistical features

(ii) analyze data by identifying patterns

(iii) analyze data by identifying sources of error

(iv) analyze data by identifying limitations

(C) use mathematical calculations to assess quantitative relationships in data; and

(i) use mathematical calculations to assess quantitative relationships in data

(D) evaluate experimental and engineering designs.

(i) evaluate experimental designs

(ii) evaluate engineering designs

(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(i) develop explanations supported by data and consistent with scientific ideas

(ii) develop explanations supported by data and consistent with scientific principles

(iii) develop explanations supported by data and consistent with scientific theories

(iv) develop explanations supported by models and consistent with scientific ideas

(v) develop explanations supported by models and consistent with scientific principles

(vi) develop explanations supported by models and consistent with scientific theories

(vii) propose solutions supported by data and consistent with scientific ideas

(viii) propose solutions supported by data and consistent with scientific principles

(ix) propose solutions supported by data and consistent with scientific theories

(x) propose solutions supported by models and consistent with scientific ideas

(xi) propose solutions supported by models and consistent with scientific principles

(xii) propose solutions supported by models and consistent with scientific theories

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(i) communicate explanations individually in a variety of settings

(ii) communicate explanations individually in a variety of formats

(iii) communicate explanations collaboratively in a variety of settings

(iv) communicate explanations collaboratively in a variety of formats

(v) communicate solutions individually in a variety of settings

(vi) communicate solutions individually in a variety of formats

(vii) communicate solutions collaboratively in a variety of settings

(viii) communicate solutions collaboratively in a variety of formats

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using empirical evidence

(5) 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:

(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;

(i) analyze scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(iv) analyze scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(v) evaluate scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(vi) evaluate scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(vii) evaluate scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(viii) evaluate scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(ix) critique scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(x) critique scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(xi) critique scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(xii) critique scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(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

(i) relate the impact of past research on scientific thought, including research methodology

(ii) relate the impact of past research on scientific thought, including cost-benefit analysis

(iii) relate the impact of past research on scientific thought, including contributions of diverse scientists as related to the content

(iv) relate the impact of past research on scientific thought, including contributions of diverse engineers as related to the content

(v) relate the impact of past research on society, including research methodology

(vi) relate the impact of past research on society, including cost-benefit analysis

(vii) relate the impact of past research on society, including contributions of diverse scientists as related to the content

(viii) relate the impact of past research on society, including contributions of diverse engineers as related to the content

(ix) relate the impact of current research on scientific thought, including research methodology

(x) relate the impact of current research on scientific thought, including cost-benefit analysis

(xi) relate the impact of current research on scientific thought, including contributions of diverse scientists as related to the content

(xii) relate the impact of current research on scientific thought, including contributions of diverse engineers as related to the content

(xiii) relate the impact of current research on society, including research methodology

(xiv) relate the impact of current research on society, including cost-benefit analysis

(xv) relate the impact of current research on society, including contributions of diverse scientists as related to the content

(xvi) relate the impact of current research on society, including contributions of diverse engineers as related to the content

(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.

(i) research STEM careers

(ii) explore resources in order to investigate STEM careers

(6) The student examines the field of microbiology in relation to medical care. The student is expected to:

(A) examine the historical development of microbiology as it relates to health care of an individual in modern medicine; and

(i) examine the historical development of microbiology as it relates to health care of an individual in modern medicine

(B) compare the roles, functions, and responsibilities of agencies governing infectious disease control.

(i) compare the roles, functions, and responsibilities of agencies governing infectious disease control

(7) The student is expected to perform and analyze results in the microbiology laboratory. The student is expected to:

(A) classify microorganisms using a dichotomous key;

(i) classify microorganisms using a dichotomous key

(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;

(i) prepare slides [of] Gram positive bacteria

(ii) prepare slides [of] Gram negative bacteria

(iii) discuss the differences between Gram positive and Gram negative bacteria

(C) identify chemical processes such as enzyme catalyst and osmotic potential of microorganisms;

(i) identify chemical processes

(D) identify and discuss technologies used in a laboratory setting such as polymerase chain reaction (PCR), serology, enzyme-linked immunoassay (ELISA), and electrophoresis;

(i) identify technologies used in a laboratory setting

(ii) discuss technologies used in a laboratory setting

(E) prepare plates or active mediums to differentiate the factors required for microbial reproduction and growth;

(i) prepare plates or active mediums to differentiate the factors required for microbial reproduction and growth

(F) identify the normal flora microorganisms of the human body;

(i) identify the normal flora microorganisms of the human body

(G) identify and differentiate between various pathogens, including opportunistic pathogens, hospital-acquired infections, community-acquired infections, and colonizing microorganisms;

(i) identify various pathogens, including opportunistic pathogens

(ii) identify various pathogens, including hospital-acquired infections

(iii) identify various pathogens, including community-acquired infections

(iv) identify various pathogens, including colonizing microorganisms

(v) differentiate between various pathogens, including opportunistic pathogens

(vi) differentiate between various pathogens, including hospital-acquired infections

(vii) differentiate between various pathogens, including community-acquired infections

(viii) differentiate between various pathogens, including colonizing microorganisms

(H) isolate colonies and describe the morphology of microorganisms; and

(i) isolate colonies of microorganisms

(ii) describe the morphology of microorganisms

(I) interpret and explain the role of the culture and sensitivity report provided to the clinician.

(i) interpret the role of the culture report provided to the clinician

(ii) interpret the role of the sensitivity report provided to the clinician

(iii) explain the role of the culture report provided to the clinician

(iv) explain the role of the sensitivity report provided to the clinician

(8) The student examines the role of microorganisms in infectious diseases. The student is expected to:

(A) outline and explain the infectious disease process, including how pathogenic microorganisms affect human body systems;

(i) outline the infectious disease process, including how pathogenic microorganisms affect human body systems

(ii) explain the infectious disease process, including how pathogenic microorganisms affect human body systems

(B) categorize diseases caused by bacteria, including Rickettsia, fungi, viruses, protozoa, arthropods, and helminths;

(i) categorize diseases caused by bacteria, including Rickettsia

(ii) categorize diseases caused by bacteria, including fungi

(iii) categorize diseases caused by bacteria, including viruses

(iv) categorize diseases caused by bacteria, including protozoa

(v) categorize diseases caused by bacteria, including arthropods

(vi) categorize diseases caused by bacteria, including helminths

(C) explain and interpret the body's immune responses and defenses against infection;

(i) explain the body's immune responses

(ii) explain the body's defenses against infection

(iii) interpret the body's immune responses

(iv) interpret the body's defenses against infection

(D) prepare a bacterial colony and evaluate the effects of anti-microbial agents such as narrow and broad-spectrum antibiotics;

(i) prepare a bacterial colony

(ii) evaluate the effects of anti-microbial agents

(E) examine the environmental and social causes of the emergence and reemergence of diseases such as corona viruses, Ebola, malaria, tuberculosis, and polio;

(i) examine the environmental causes of the emergence of diseases

(ii) examine the social causes of the emergence of diseases

(iii) examine the environmental causes of the reemergence of diseases

(iv) examine the social causes of the reemergence of diseases

(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

(i) research drug aureus-resistant microorganisms, including carbapenem-resistant Enterobacteriaceae

(ii) research drug aureus-resistant microorganisms, including methicillin-resistant Staphylococcus aureus

(iii) research drug aureus-resistant microorganisms, including vancomycin-intermediate Staphylococci

(iv) research drug aureus-resistant microorganisms, including vancomycin-resistant Staphylococci

(v) research drug aureus-resistant microorganisms, including vancomycin-resistant enterococci

(vi) research drug aureus-resistant microorganisms, including emergent antibiotic-resistant superbugs

(vii) discuss drug aureus-resistant microorganisms, including carbapenem-resistant Enterobacteriaceae

(viii) discuss drug aureus-resistant microorganisms, including methicillin-resistant Staphylococcus aureus

(ix) discuss drug aureus-resistant microorganisms, including vancomycin-intermediate Staphylococci

(x) discuss drug aureus-resistant microorganisms, including vancomycin-resistant Staphylococci

(xi) discuss drug aureus-resistant microorganisms, including vancomycin-resistant enterococci

(xii) discuss drug aureus-resistant microorganisms, including emergent antibiotic-resistant superbugs

(G) outline the role of governing agencies in monitoring and establishing guidelines based on the spread of infectious diseases.

(i) outline the role of governing agencies in monitoring guidelines based on the spread of infectious diseases

(ii) outline the role of governing agencies in establishing guidelines based on the spread of infectious diseases

(9) The student recognizes the importance of maintaining a safe environment and eliminating hazardous situations. The student is expected to:

(A) identify and apply standard laboratory precautions;

(i) identify standard laboratory precautions

(ii) apply standard laboratory precautions

(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;

(i) identify microbiological safety practices in accordance with industry standards, including the proper handling of biological waste

(ii) identify microbiological safety practices in accordance with industry standards, including the disinfection of biological waste

(iii) identify microbiological safety practices in accordance with industry standards, including the disposal of biological waste

(iv) identify microbiological safety practices in accordance with industry standards, including the maintenance of containment levels

(v) apply microbiological safety practices in accordance with industry standards, including the proper handling of biological waste

(vi) apply microbiological safety practices in accordance with industry standards, including the disinfection of biological waste

(vii) apply microbiological safety practices in accordance with industry standards, including the disposal of biological waste

(viii) apply microbiological safety practices in accordance with industry standards, including the maintenance of containment levels

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

(i) identify appropriate personal protection equipment (PPE)

(ii) apply appropriate personal protection equipment (PPE)

(iii) identify appropriate transmission-based precautions, including precautions against droplet transmission

(iv) identify appropriate transmission-based precautions, including precautions against contact transmission

(v) identify appropriate transmission-based precautions, including precautions against airborne transmission

(vi) apply appropriate transmission-based precautions, including precautions against droplet transmission

(vii) apply appropriate transmission-based precautions, including precautions against contact transmission

(viii) apply appropriate transmission-based precautions, including precautions against airborne transmission

(D) sterilize laboratory and medical equipment and instruments in accordance with industry standards; and

(i) sterilize laboratory equipment in accordance with industry standards

(ii) sterilize medical equipment in accordance with industry standards

(iii) sterilize instruments in accordance with industry standards

(E) define and select different mechanisms of decontamination such as antiseptics, disinfection, and sterilization.

(i) define different mechanisms of decontamination

(ii) select different mechanisms of decontamination