

Environmental Science Institute
The University of Texas at Austin
Biological Weapons and Bioterrorism
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This file contains suggestions for how to incorporate the material from this CD-ROM into curriculum using the Texas Essential Knowledge and Skills for Science, Health, and Health Science Technology.

MIDDLE SCHOOL

Science Grade 6

(6.10) **Science concepts.** The student knows the relationship between structure and function in living systems.

(A) differentiate between structure and function; [Slide 48: What are the types of anthrax toxins? How does each toxin function to infect a cell? Slides 52-59: What are antibodies? How do antibodies treat anthrax? Slide 55: What have been the shortcomings of using antibodies to treat anthrax?]

Health Grade 6

(6.3) **Health information.** The student comprehends and utilizes concepts relating to health promotion and disease prevention.

The student is expected to:

(A) describe various modes of disease transmission; [Slides 6-8: How is anthrax transmitted?]

(C) list noncommunicable and hereditary diseases and respective prevention and treatment techniques. [Slide 8: Is anthrax contagious? Slide 42: How is anthrax currently treated? Slides 44-77: What new methods are being developed to treat and prevent anthrax and other biological weapons?]

(6.4) **Health information.** The student comprehends ways of researching, accessing, and analyzing health information.

The student is expected to:

(B) use critical thinking to research and evaluate health information. [Links: Where can you find reliable information about anthrax and biological weapons? How can you distinguish between fact and fiction when evaluating news and information about biological weapons?]

(6.8) **Influencing factors.** The student comprehends how media and

technology influence individual and community health. The student is expected to:

(A) identify and analyze various media and technologies that influence individual and community health such as computer software and the World Wide Web; [Slide 17-24, 41: How do news stories and internet web sites affect our view of anthrax and biological warfare? What can you do to help your community or classmates stay informed about biological warfare? What is the difference between being afraid and being aware of biological weapons?]

(B) explain the relationship between health needs and technology development such as the development of a Human Immunodeficiency Virus (HIV) vaccine. [Slides 54-69: What new technologies have been developed to help researchers understand and treat anthrax?]

Science Grade 7

(7.3) **Scientific processes.** The student uses critical thinking and scientific problem solving to make informed decisions.

The student is expected to:

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; [Slides 10-14: What methods did the 14th century tartars and 18th century British colonists use to spread disease? Were their methods scientifically viable? Why or why not?]

(D) evaluate the impact of research on scientific thought, society, and the environment; [Slides 65-69: How does new information about biological weapons affect scientists approach to treating diseases? Slides 17-24, 41: How does information affect how people feel about biological warfare?]

(F) connect Grade 7 science concepts with the history of science and contributions of scientists. [Slides 1-40: What are some of the important events in the history of biological warfare? Slide 31: Who are some of the scientists responsible for developing biological weapons? Slide 79: Who are some of the scientists developing treatment methods for anthrax?]

Health Grades 7 and 8

(3) **Health information.** The student comprehends and utilizes concepts relating to health promotion and disease prevention throughout the life span.

The student is expected to:

(A) explain the role of preventive health measures, immunizations, and treatment in disease prevention such as wellness exams and dental check-ups; [Slide 44: What methods are being developed to prevent anthrax outbreaks? Slide 43: What are some of the challenges facing scientists developing vaccines? Slide 46-47: What methods are being developed to treat anthrax? Slide 55: What are some of the challenges facing scientists developing treatments?]

(B) analyze risks for contracting specific diseases based on pathogenic, genetic, age, cultural, environmental, and behavioral factors; [Slides 6,8: What factors influence a person's risk of contracting anthrax?]

Science Grade 8

(8.2) **Scientific processes.** The student uses scientific inquiry methods during field and laboratory investigations. [Analyze the scientific processes used by scientists in developing anthrax treatment and prevention methods]

The student is expected to:

(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology; [Slides 43-47, 55, 77: What questions are scientists trying to answer to come up with new ways to treat and prevent anthrax?]

(B) collect data by observing and measuring; [Slide 46-47, 51, 55, 72: What observations have scientists made about previous outbreaks and current treatment methods?]

(C) organize, analyze, evaluate, make inferences, and predict trends from direct and indirect evidence; [Slides 42-44, 51, 55, 61, 77: How have researchers combined scientific knowledge with historical and experimental data and information to make decisions about the direction of their research?]

(D) communicate valid conclusions [Slides 72, 77]

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data [Slides 63-73]

HIGH SCHOOL

Biology (See also sections on Health Science Technology)

(4) **Science concepts.** The student knows that cells are the basic structures of all living things and have specialized parts that perform specific functions, and that viruses are different from cells and have different properties and functions.

The student is expected to:

(D) identify and describe the role of bacteria in maintaining health such as in digestion and in causing diseases such as in streptococcus infections and diphtheria. [Slide 8: What type of microorganism is anthrax? With what is the anthrax bacterium first associated? Where is the bacteria naturally found? How do humans normally contract the disease anthrax? Describe the three different types of human anthrax disease.]

Questions from: Putting Anthrax in History: a news hour with Jim Lehrer special for students <http://www.pbs.org/newshour/extra/teachers/lessonplans/health/anthrax/index.html>

(6) **Science concepts.** The student knows the structures and functions of nucleic acids in the mechanisms of genetics. [Slide 55-69: How are scientists using genetics and genetic engineering to improve anti-toxin antibodies?]

Health Grades 9 and 10

(2) Health information. The student is health literate in disease prevention and health promotion throughout the life span. The student is expected to:

(B) analyze the influence of laws, policies, and practices on health-related issues including those related to disease prevention; [Slides 43-44: How have United States laws and regulations affected the development of vaccines against anthrax? What solutions have scientists developed to overcome the difficulties posed by those regulations?]

(C) identify, describe, and assess available health-related services in the community that relate to disease prevention and health promotion; [Links: What government agencies provide information on disease control and prevention? What other agencies provide this information? How can you determine if a source of information is factual?]

(D) develop and analyze strategies related to the prevention of communicable and non-communicable diseases.

(10) Influencing factors. The student evaluates the effect of a variety of environmental factors on community and world health. The student is expected to:

(A) assess the impact of population and economy on community and world health; [Slide 6: How do population and societal patterns in the United States affect our susceptibility to biological weapons? Consider especially our use of mass transit (subways, airlines, buses, trains), centralized business districts. Also consider our methods of agriculture and livestock farming.]

Health Grades 11 and 12

(4) Health information. The student evaluates the validity of health information. The student is expected to:

(A) research current health-related standards related to health information and products from valid sources such as the Centers for Disease Control and Prevention and the Food and Drug Administration [Visit the Website for the Centers For Disease Control and Prevention. What information does this agency provide about anthrax and about biological weapons? How can you

tell that the CDC is a valid source of information? Where else might you expect to find information about anthrax vaccines and/or antibodies?];

(B) analyze health information based on health-related standards [Visit the website of the Food and Drug Administration. Go to the FDA's site topic on bioterrorism (<http://www.fda.gov/cder/drugprepare/default.htm>). What health standards relate to the production of anthrax treatment methods (i.e. vaccines and antibiotics)? What health standards (including medical precautions and notification requirements) relate to preventing an outbreak of anthrax and other infectious agents? See also the FDA news site (<http://www.fda.gov/bbs/topics/NEWS/2002/NEW00811.html>) for updates on food and drug regulations].

Introduction to Health Science Technology

(1) The student applies math, science, English language arts, and social studies in health science. The student is expected to:

(B) apply data from tables, charts, and graphs to estimate and find solutions to health-related problems [Slides 70-77: What are the key parameters in the antibody engineering experiments? How have scientists used data from these experiments to isolate effective anti-toxins?]

(8) The student uses technology to access, process, and retrieve information. The student is expected to:

(B) describe technology applications in the health care industry [Slides 63-69: What role does technology play in development of an improved antibody? What is phage display technology? How has phage display technology helped scientists find a method for quickly developing new antibodies?]

Health Science Technology I

(10) The student uses standard precautions to control the spread of infection [Visit the anthrax information site at the Centers for Disease Control and Prevention (<http://www.bt.cdc.gov/Agent/Anthrax/Anthrax.asp>). Scroll down to the section on infection control. Refer to these documents when considering the following questions.]

(A) identify the cycle of the infectious process [What is the incubation period for inhalation anthrax? For other types of anthrax? What are the criteria used in detecting and identifying an outbreak?];

(B) identify guidelines of standard precautions;

(C) demonstrate skills related to infection control.

[What recommendations are presented in these documents for health care professionals responding to an outbreak of an infectious disease? Do you know who to contact if you suspect a bioterrorism event has occurred in your community? What are the standard precautions used when treating infected patients?]

Health Science Technology II

(1) The student applies math, science, English language arts, and social studies in health science. The student is expected to:

(C) communicate using medical terminology [Glossary: Define and distinguish the following terms related to the development of improved antibodies: bacteria, virus, toxin, antibody, receptor, binding site, affinity, serum, polyclonal, monoclonal, DNA, mutant, wild type, incubation period];

(H) associate the disease process with changes in homeostasis [Using information from the Centers For Disease Control and Prevention (<http://www.bt.cdc.gov/Agent/Anthrax/Anthrax.asp>), further investigate the effects of the anthrax toxin. What changes does the toxin effect to cause a fatal reaction? How does this demonstrate the need for an antitoxin agent in addition to an antibiotic?]

(I) identify the changes in structure and function due to trauma and disease [Slide 48-50: How does the anthrax toxin affect cell structure? The toxin has three parts. Review the effects of each toxin on the cell. Why is it important to block the protective agent (PA) toxin? Slides 52-59: How does the structure of the improved antibody optimize this process?]

(K) research and describe the role of an international society in the prevention and containment of disease [Slides 26-40: Why is it important to involve other countries in preventing bioterrorism outbreaks? What types of foreign interactions affect a nation's susceptibility to bioterrorism? Is it possible to enforce global safety precautions for the prevention and control of infectious diseases?]

Scientific Research and Design

(5) The student knows how to analyze published research. The student is expected to:

(A) identify the scientific methodology used by a researcher [Slides 42-77: What methods have researchers used to develop improved antibodies? At what stage in the scientific method is the study of improved antibodies?]

(7) The student knows how to collect, organize, and evaluate qualitative and quantitative data obtained through experimentation. The student is expected to:

(D) evaluate data using statistical methods to recognize patterns, trends, and proportional relationships [Slides 70-76: What trends are demonstrated in the antibody data presented in the report? What is the relationship between a variant's off rate (k_{off}), it's half life ($t_{1/2}$), and it's effectiveness as an anti-toxin (survival rate)?].

(8) The student knows how to synthesize valid conclusions from qualitative and quantitative data. The student is expected to:

(C) identify limitations within the research process and provide recommendations for additional research [Slide 77: What areas have been targeted for further research of anti-toxin antibodies?].

Medical Microbiology

(5) The student knows the role of microbes in infectious diseases. The student is expected to:

(B) classify microorganisms using a dichotomous key [Slide 8: What type of microorganism is anthrax?];

Pathophysiology

(6) The student knows a variety of human diseases. The student is expected to:

(A) research and report on the nature of diseases according to etiology, signs and symptoms, diagnosis, prognosis, and treatment options [Slide 5: What are the difficulties involved in detecting and diagnosing anthrax? Slides 43, 55: What methods have been used in the past to treat and prevent anthrax? Slide 47: Why is it important to develop antibodies that defend against the anthrax toxin and not just the bacteria?];

(B) research and report advanced technologies for the diagnosis and treatment of disease [Slides 63-69: How has technology improved researchers' ability to develop engineered antibodies?];

(7) The student knows the effects of disease prevention and control. The student is expected to:

(C) evaluate treatment options for diseases [Slides 43, 55: What are some of the advantages and disadvantages of present and past anthrax treatment methods? Slide 51: What special problem do engineered anti-toxins solve in treating late-stage anthrax?];

(D) research and describe diseases that threaten world health and propose intervention strategies