

History of Microbiology

Course

Medical
Microbiology

Unit III

History of
Medical
Microbiology

Essential Question

How do
developments in
the field of
microbiology
relate to patient
care?

TEKS

130.207 (c)
2A-D
4A, 4H

Prior Student Learning

none

Estimated time

4-6 hours

Teacher note:
the main TEKS
cover a
refresher on the
difference
between theory
and hypothesis
and the student
research project.

Rationale

Historical developments in microbiology have advanced the treatment of disease.

Objectives

Upon completion of this lesson, the student will be able to:

- Understand the steps of the scientific method
- Analyze how the scientific method has been applied to lead to break through discoveries in microbiology
- Research and describe the historical development of microbiology as it relates to health care

Engage

Welcome students to class with a snack in your hand and 'accidentally' drop it on the floor. Pick it up and make a big deal about if you should still eat it. Pursue the class to answer WHY it is no longer 'clean or safe' to eat and HOW do they know that. Discuss how people had to discover the idea of germs and lead into the history of Medical Microbiology.

Key Points

- I. A major contribution to the development of microbiology was the invention of the microscope by Anton van Leeuwenhoek and the implementation of the scientific method. Review scientific method:
 - A. Observe then formulate a question
 - B. Develop a hypothesis (educated guess of the answer to the question) that can be tested
 - C. Experiment to discover the answer; remember to not change too many variables and have a control.
 - D. Collect data and graph it
 - E. Analyze the data and draw a conclusion
 - F. Retest the experiment; often done by colleagues.
This is a great place to do a simple experiment and maybe review some lab equipment in the process like a simple gram stain.
- II. Contrasting theories about the origin of microbes led to experiments which greatly impacted the methodologies of microbiology.
 - A. Spontaneous generation vs. germ theory
 1. Contributions of Francesco Redi and Louis Pasteur proving germ theory: Redi developed experiments with food and limited access by open and closed jars finding that maggots

For that reason the key points are an outline as most of the information should be given in student presentations.

were only present where flies could access. Pasture went further with nutrient broths, also showing that organisms did not grow if the broth was treated and protected by a filter, which lead to pasteurization to obtain safer food processing.

B. Robert Koch's Postulates

1. How do you find the organism responsible for a disease and how do you know it's the right organism not just another one that was in the same place at the same time? You use Koch's Postulates which in brief are:

- a. The suspected organism must be constantly associated with the disease.
- b. The organism must be isolated from an infected plant or patient and grown in pure culture.
- c. When a healthy susceptible host is inoculated with the pathogen from pure culture, symptoms of the original disease must develop.
- d. The same pathogen must be re-isolated from plants infected under experimental conditions.

III. Major twentieth-century contributions along the lines of Antibiotics, Vaccines, and Technology (like the electron microscope that enabled visualization of sub cellular structures) have often only been available for the last 50-100 years. Students will hear about many of these through presentations. They should appreciate that many of the advances we take for granted were not available for their grandparents and especially not great-grandparents.

IV. Contributions of Institutions

- A. Pasteur Institute mission is: The Institute Pasteur is a private non-profit foundation which contributes to the prevention and treatment of disease, through research, education, and public health activities. (Taken from www.pasteur.fr)
- B. Center for Disease Control (or CDC) mission is: Collaborating to create the expertise, information, and tools that people and communities need to protect their health – through health promotion, prevention of disease, injury and disability, and preparedness for new health threats. (taken from www.cdc.gov)
- C. National Institutes of Health or NIH mission is: NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce the burdens of illness and disability. (taken from: www.nih.gov)
- D. World Health Organization or WHO (W-H-O not 'who') mission is: WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based

policy options, providing technical support to countries and monitoring and assessing health trends. (taken from www.who.int)

- E. Note to students – *these are great places to start research on history and microorganisms in general when you need a trusted source, these are the experts.*

V. Technological advances in the study of disease and its prevention, and their application, has resulted in the development of the major sub disciplines of microbiology:

- A. Agricultural microbiology
- B. Aquatic microbiology
- C. Industrial microbiology
- D. Medical microbiology
- E. Space microbiology
- F. Environmental microbiology

Be sure to mention which of these areas your research topic focused on. Most of our course will focus on the Medical Microbiology.

Teacher Note: Show an excerpt from the movie “Ben Hur” which depicts the lack of knowledge about the causes and transmission of disease.

Activity

- I. Research a historical development in microbiology and present how that development affected patient care.
- II. Complete a Koch’s postulate laboratory investigation. Many are available online.
- III. Recreate a germ theory experiment using chicken broth – open and closed container.

Assessment

Project Rubric

Materials

Internet access or Library access
Gram stain supplies or other simple experiment
Two containers of broth one open and one closed
Optional lab on Koch’s postulate

Fong, Elizabeth, *Microbiology for Health Careers*, Fifth Edition

Bergquist, Lois M., *Microbiology-Principles and Health Science Applications*, W.B. Saunders Co., 2000.

<http://www.slic2.wsu.edu:82/hurlbert/micro101/pages/Chap1.html>

Accommodations for Learning Differences

For reinforcement, the student will design a poster depicting a scientist and their major contributions to microbiology.

For enrichment, the student will create a video highlighting the key contributions in microbiology.

National and State Education Standards

National Health Science Cluster Standards

HLC01.01 Academic Foundations

Health care workers will know the academic subject matter required (in addition to state high school graduation requirements) for proficiency within their area. They will use this knowledge as needed in their role.

TEKS

130.207(c)(2) (A) know the definition of science and understand that it has limitations, as specified in section (b)(2) of this sub section;

130.207(c)(2)(B) know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

130.207(c)(2)(C) know 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;

130.207(c)(2)(D) distinguish between scientific hypothesis and scientific theories;

130.207(c)(4)(A) research and describe the historical development of microbiology as it relates to health care of an individual; and

130.207(c)(4)(H) research roles, functions, and responsibilities of agencies governing infectious disease control.

Texas College and Career Readiness Standards

English Language Arts

II. A. Locate explicit textual information and draw complex inferences, analyze, and evaluate the information within and across texts of varying lengths.

II. B. Understand new vocabulary and concepts and use them accurately in reading writing and speaking.

II. C. Describe, analyze, and evaluate information within and across literary and other texts from a variety of cultures and historical periods.

III. B. Develop effective speaking styles for both group and one-on-one situations.

IV. A. Apply listening skills as an individual and as a member of a group in a variety of settings.

IV. B. 2. Listen actively and effectively in one-on-one communication situations.

Social Studies

I. A. Spatial analysis of physical and cultural processes that shape the human experience.

I.B. Spatial analysis of physical and cultural processes that shape the human experience.

IV.A. Critical examination of texts, images, and other sources of information.

Blast from the Past

A research project on developments in the field of microbiology

<u>Objective</u>	research and describe the historical development of microbiology as it relates to health care of an individual.
<u>Select</u>	one of the following developments in the field of microbiology to research.
<u>Create</u>	a visual aid in power point, on poster board or other creative media.
<u>Present</u>	details about the historical development (The Who, What, When, Where, Why) and how it has impacted health care of an individual or patient care.

Due Date: _____ **Assigned Topic:** _____

Topics to Choose From:

- Anton van Leeuwenhoek and the microscope
- Robert Koch and his work with anthrax, germ theory and gel media
- Joseph Lister and his technique for isolating a pure bacterial culture
- Louis Pasteur and developing an attenuated virus for vaccine
- Emil von Behring and Shibasaburo Kitasato working together in the discovery of diphtheria antitoxin serum
- Paul Ehrlich and his work with antibodies and treatments for syphilis
- Theobald Smith and F.L. Kilbourne and their work with zoonotic infections and arthropod vectors
- Francis Peyton Rous and his work with cancer causing viruses
- Alexander Fleming and his work with penicillin
- Gerhard J. Domagk and his work with Prontosil to kill *Streptococcus*
- Oswald Avery, Colin MacLeod, and Maclyn McCarty and their work with DNA
- Other contributions as approved by instructor

Research Notes

Who:

What:

When:

Where:

Why:

How (has it impacted patient care):

Graded using the Project Rubric

Name _____ Topic _____ Class _____

Scoring Criteria	5. Excellent	4. Good	3. Needs Improvement	2. Needs Much Improvement	1. Missing
Clearly/effectively communicates the main idea or theme. (Who, What)					
Information clearly provided. Strong examples used to describe the theme, objective. (When, Where, Why)					
Clearly explains HOW the historical breakthrough impacted patient care.					
Illustrations follow a logical reasoning.					
Each image and font size is legible to <i>entire</i> audience.					
Totals:					

Scale:

22-25 -- A Excellent

18-21 -- B Good

14-17 -- C Needs Some Improvement

10-13 -- D Needs Much Improvement

5-9 -- F Missing vital information

Total: _____ /25 = _____