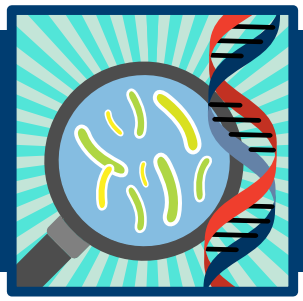
UNIT: TUBERCULOSIS
LESSON 2: IMMUNE SYSTEM ACTIVATE!
Activity 2A: *The Key to TB*
Activity 2B: *Raising the Bar for Graph Analysis*



TEXAS BIOMEDICAL RESEARCH INSTITUTE
HEALTH STARTS WITH SCIENCE

Objectives:

1. Explain key terms using context clues.
2. Interpret graphical data.
3. Investigate the global impact of TB, from health to economic impacts.
4. Investigate how the body responds to TB infection.
5. Compare body responses to the three types of TB.
6. Evaluate the use of immunotherapy as a treatment for infectious diseases, like TB.

Lesson Support Information

The transformed article, *Immune System - Activate*, gives students the opportunity to gain insight into the peer review process used in science. Before science research study outcomes are shared with the public, the study undergoes a rigorous review by other scientists. The peer review process is conducted by scientists who have expertise in the field but who were not part of the study. The reviewers critically examine the study, evaluating study methods, data, and conclusions which are supported by the data. Reviewers provide feedback to the researchers or reject the study completely. This robust review process increases the reliability and validity of study before findings are released to the general public. In this activity, students are peer reviewers, analyzing data from a real research study. Students critically evaluate the data from the study to check for alignment between the data and the study's conclusions.

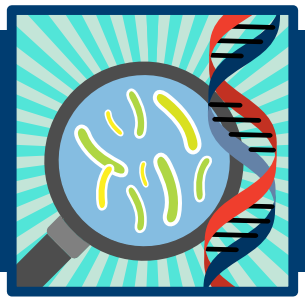
General Information

On a global scale, TB persists as the ninth leading cause of death from an infectious pathogen. The scientific name for TB is ***Mycobacterium tuberculosis (M.tb or TB)***. This bacterium can be spread by an infected person through a simple cough. Our bodies have an immune system which works to protect us from infectious invaders, like TB. But sometimes, pathogens, like TB, mutate, evolving in ways which makes our immune system less effective. Scientists conduct experiments to better understand the complex interactions between our immune system and infectious diseases. Information or data from these experiments can help scientists anticipate potential mutations to develop effective treatments and cures for infectious diseases like TB.

Although TB is commonly known as a "lung disease", once inside the body, the TB bacterium can attack any part of the body. The TB bacteria can migrate to the kidneys, spine, or brain. If left untreated, TB can be fatal.

NIH SEPA Project #1R25GM142021-01A1

UNIT: TUBERCULOSIS
LESSON 2: IMMUNE SYSTEM ACTIVATE!
Activity 2A: *The Key to TB*
Activity 2B: *Raising the Bar for Graph Analysis*



Tuberculosis – An Ancient Adversary

Dr. Larry Schlesinger, President and CEO of Texas Biomedical Research Institute has over 30-years-experience researching the TB bacterium. According to Dr. Schlesinger, known world-wide as a leading TB researcher, it takes 1,000,000 TB bacteria to cause a mild skin infection but only 5 TB bacteria to infect a lung. Based on his research, Dr. Schlesinger contends says TB has likely been around as long as humans have existed, making it a very ancient adversary.

When someone is infected with TB, every cough or sneeze can spread the TB bacteria where it stays suspended in the air by aerosols, microscopic droplets of water that hang suspended in the air. Aerosols can stay suspended in the air for hours, long after the infected person has left the area. The TB bacteria can even be spread when someone speaks or sings! We breath in aerosols all the time. Most of harmless, but if aerosols contain TB, the lungs are the first to be infected. Should the TB bacteria land on a surface and that surface is not disinfected or exposed to sunlight, the TB bacteria can survive for up to six months!

Types of TB

There are two types of TB infection: latent TB and TB disease. When TB bacteria enter the lungs, most people's immune system quickly take care of the bacteria, killing it before it can do any harm. The risk of latent TB becoming active increases if the immune system is compromised. Conditions or diseases, such as heart disease or diabetes, can compromise the immune system, creating conditions which are optimal for latent TB to become active. The key to TB's persistence is its ability to adapt and evolve, finding ways to hide within our own bodies where it can stay hidden for years. TB is not only found in the lungs. It can travel around the body, most often migrating to the brain, kidneys, and spine. Usually, the body's immune system is able to fight the infection on its own and some people never know they have it.

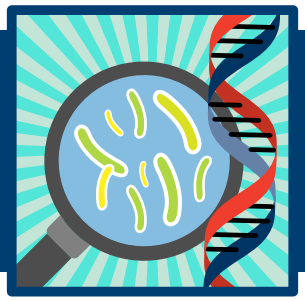
Immune System Responses

Our skin is the immune system's first line of defense. The skin has multiple layers with each layer creating a protective barrier against viruses and bacteria (collectively called pathogens). When skin layers are broken, like through a scrape or cut, it is easier for pathogens to enter our bodies. Fortunately, skin layers also contain immune cells which attack invasive pathogens.

Unlike the skin, lung tissue is relatively thin. To facilitate respiration (aka breathing), the inside passageways in the lungs can be only one or two cells thick. In addition, the lungs secrete mucus, keeping the lungs moist which helps with the exchange of oxygen and carbon dioxide (aka respiration). The combination of thin and moist tissue makes it a perfect habitat for pathogens, like TB, to stick to cell surfaces where they can then infect cells. But there is good news: the body's immune system sends out specialized cells to attack the bacteria.

NIH SEPA Project #1R25GM142021-01A1

UNIT: TUBERCULOSIS
LESSON 2: IMMUNE SYSTEM ACTIVATE!
Activity 2A: *The Key to TB*
Activity 2B: *Raising the Bar for Graph Analysis*



When the body detects TB bacteria, the body initiates an ***immune response***, causing the release of macrophages. The first macrophages to attack the TB bacteria are released by the thymus gland. Known as T cells or T helper cells these immune system cells rush to the lungs. Specialized receptors on the surface of the T cells attach to proteins on the surface of the TB bacteria. The T cells surround (called encapsulation) the bacteria. The T cells attach to receptors on the surface of the TB bacteria and destroy the bacteria. If the amount of TB is excessive, multiple T cells surround the T cell, forming a granuloma. The TB bacteria is not killed, but trapped inside the granuloma, preventing it from causing harm.

NIH SEPA Project #1R25GM142021-01A1