PLAN "O": ANTIBIOTICS

Antibiotics

- Brief history of the germ theory
- History of antibiotics
- How antibiotics work
- Super Bugs and antibiotic resistance

Name: _____ Date: _____

ANTIBIOTICS

Did you know, there are 10x more bacterial cells in your body right now than there are human cells? Bacteria thrive in your gut, but can also be found on your skin. In fact, bacteria are virtually everywhere: plants, air, soil, water, and your kitchen sink, even volcanoes!

Luckily, most of these bacteria are commensal bacteria. What this means is that they cannot infect you and make you sick. Many of them are simply hanging out in your intestines, eating whatever you eat, and everyone is happy; they help you with digestion, you provide the nutrients. Another key reason why these non-harmful bacteria are helpful is because they help to keep the bad bacteria out of your cells by providing a protective barrier.

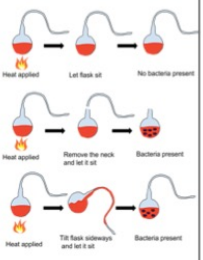
Harmful bacteria are bacteria that invade your cells and are capable of causing disease. We call these pathogenic bacteria. Pathogenic bacteria are equipped to invade our cells: they have the ability to stick to our cells and can create toxins. Though our immune system is pretty on top of this, sometimes we need additional help in order to survive.

Ignaz Semmelweis was a doctor known as the "savior of mothers". He worked as an obstetrician delivering babies in Austria and noticed that far fewer mothers contracted puerperal fever (known as "childbed" fever) if he washed his hands before assisting them in delivery. Childbed fever was common; in the mid-19th century it resulted in death in about one out of every four deliveries at the particular hospital Semmelweis was employed at. However, after he had convinced his colleagues to partake in hand washing before doctoring, the mortality rate was decreased to less than 1% of all births. Unfortunately, during Semmelweis' time of the 1850s, some doctors were offended by his suggestions that they wash their hands, and others flat out did not believe it made a difference. Most people, including doctors, did not realize there could have been tiny microscopic beings that were making us sick.



Streptococcus pyogenes is a strain of bacteria that causes puerperal fever.

Louis Pasteur was a leading scientist in developing the germ theory, and also in disproving organisms appeared from nowhere, an idea called "spontaneous generation."
To disprove spontaneous generation, Pasteur used fermentation techniques used in wine making to prove that microbes must come from somewhere and not simply show up as an act of God. In wine making, many batches of wine would turn out to be sour, and, therefore, would need to be disposed of. Pasteur proved that the sour taste was from bacteria in the wine that use the sugars in wine to produce lactic acid. The same effect was had on beer and milk, causing them to spoil. Pasteur was able to defeat the microbes found in wine by using the scientific method to perform an experiment in which he used broth. When Pasteur covered the broth and then boiled it, it did not spoil.



However, as soon as he removed the cover and exposed the broth to the air, it would become contaminated (his broth had to be exposed to the outside environment in order to grow microbes). We now make sure that wine, beer, and milk need to be heated and covered in order to prevent spoilage.

© Biology Roots, LLC www.biology-roots.com

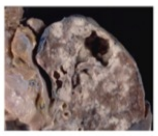
Pasteur also helped to make the connection between bacteria and disease. Around 1865, a mystery disease wiped out silkworms around the world. Pasteur showed that microorganisms, which were only found in the tissues of diseased silkworms, moths, and eggs, caused the disease. They could be seen using a microscope. He found a way of avoiding the disease by identifying the infected eggs, saving the silk industry. This was the first clear evidence of microorganisms causing disease.

About 10 years after Pasteur in 1876, a German microbiologist named Robert Koch was working on an experiment to prove that anthrax (a common disease among farm animals) was caused by bacteria. Though the anthrax bacteria had already been discovered, no one was certain that the bacteria were actually causing the illness among animals. Koch's experiment to prove that the bacteria were indeed making the animals sick was simple: he collected blood from the farm animals that had died of anthrax and introduced it to one group of mice. In another group of mice, he introduced the blood of healthy animals. The mice that were in the cage mixed with the blood of animals that had died from anthrax grew sick and died. The mice that were in the cage mixed with the blood of healthy animals continued to remain healthy. Koch went on to continue to study bacteria and disease and successfully experimented with bacteria in controlled environments to prove to the world that bacteria indeed could make us ill.

Koch won a Nobel Prize in 1905 for his contributions into the medical world, and he also helped to develop one of the first antibiotics, which he called "magic bullets." He and a colleague named Paul Ehrlich worked together to try to find a drug that would both attach to the bacteria and kill it. A formula known as "drug no. 606" finally worked, and was sold under the name "Salvarsan". Salvarsan was used to treat syphilis, specifically. Many people one time thought syphilis was a disease for the immoral. Syphilis is a sexually transmitted disease caused by the bacteria *Treponema pallidum*.

Though Koch and Ehrlich made a successful "magic bullet" to help treat syphilis, the first widespread antibiotic was a Sulfur-based drug known as "Sulfa Drugs." Developed in 1935 by Gerhard Domagk, it was used to treat a variety of diseases. Sulfa drugs would inhibit the ability for bacteria to create folic acid. Folic acid is required for bacteria to make DNA. So essentially, sulfa drugs prevented bacteria from from reproducing and multiplying. However, many bacteria have grown resistant to sulfa drugs.

Tuberculosis s caused by *Mycobacterium tuberculosis* and is one of the oldest bacterial diseases to devastate mankind- known for wiping out generations of Egyptian pharaohs. Tuberculosis can spread through the air and usually attacks the lungs. Coughing, sneezing, even simply breathing, were means of contracting the disease, though it was typically spread within households where people were near each other. Necrosis is a term used to describe cell injury or death. The picture at right depicts a lung from a victim of tuberculosis. The large hole in the lung is due to the necrosis caused by *M. tuberculosis*.

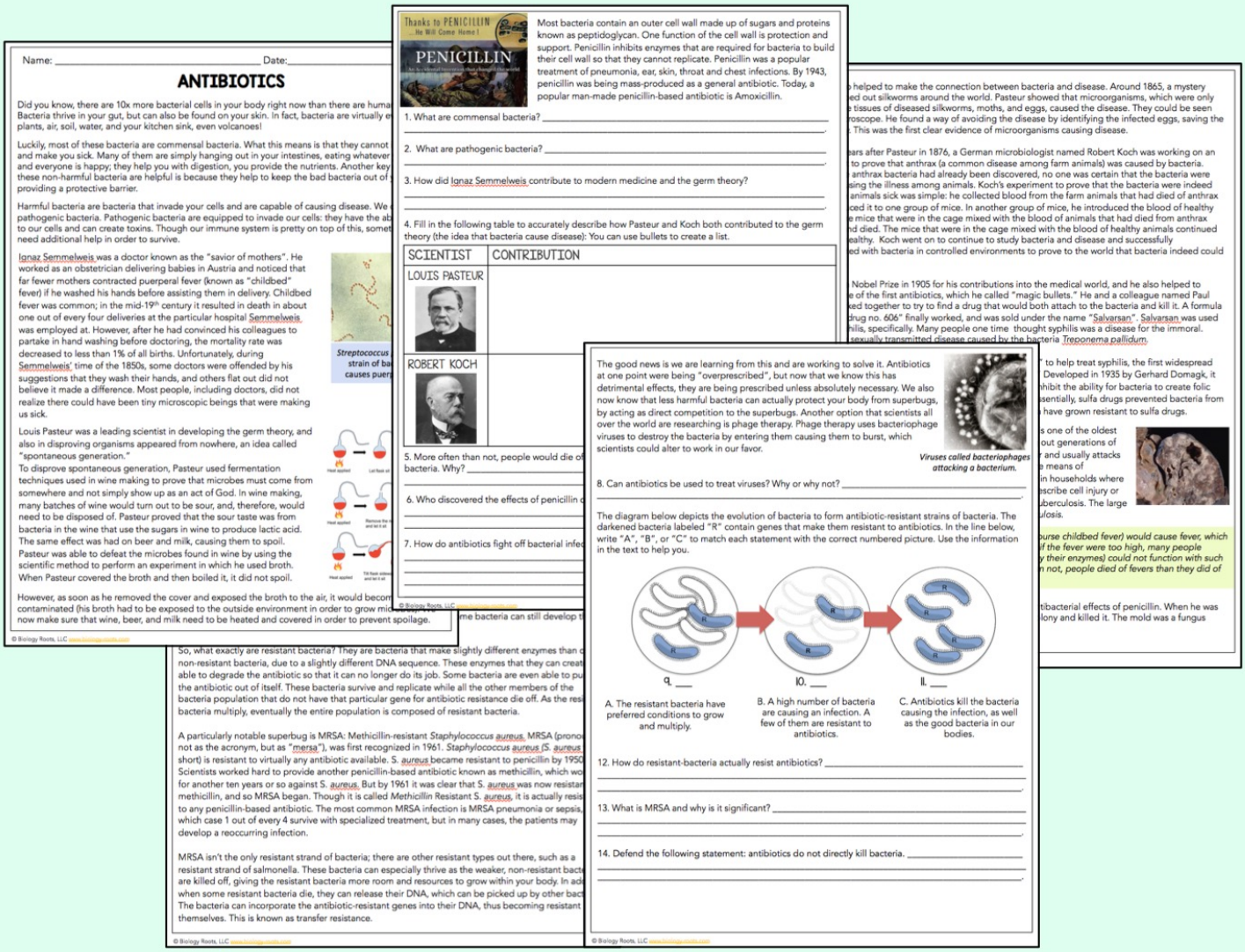


Many diseases, such as tuberculosis, pneumonia (and of course childbed fever) would cause fever, which is an immune response to ward off the bacteria. However, if the fever were too high, many people would die of the fever itself because their body (specifically their enzymes) could not function with such high temperatures, thus resulting in death. More often than not, people died of fevers than they did of necrosis caused by bacteria.

In 1928, Alexander Fleming accidentally discovered the antibacterial effects of penicillin. When he was working in the laboratory, some mold fell into a bacteria colony and killed it. The mold was a fungus called *Penicillium notatum*.

© Biology Roots, LLC www.biology-roots.com

ANSWER KEY AND CLASS PACKET VERSION INCLUDED



ANTIBIOTICS

5 pages that explore a brief history of the germ theory (Semmelweis, Pasteur, Koch) and how devastating bacterial infections could be.

Also included are the history and discovery of antibiotics such as Sulfa-drugs and penicillin, and how antibiotics work.

Finally students are introduced to the development of Super Bugs: resistant bacteria and how they evolved to be that way.

biology roots

Classroom resources to promote *scientific literacy* and curiosity.

Thank you so much for supporting biology roots

I am so excited that you will be using my resources to *benefit* your classroom. Listed below are some categories of products that I offer in my TpT store:

Digital Interactive Notebooks	Complete Units- No prep!
Paper Interactive Notebooks	Super Duper Science Sub Plans
Captivating Presentations	Terrific Task Cards

Copyright Notice and Terms of Use © Vanessa Jason ("Biology Roots")

All rights reserved by author. This product is to be used by the original purchaser only. This purchase grants one license for personal use. Duplication for other classes or by other teachers or for use in school wide distribution is strictly forbidden. Posting Biology Roots products on the internet in any form is strictly forbidden and violates the DMCA. Not for public display, including ANY websites. Violations are subject to the penalties of the Digital Millennium Copyright Act.



It IS Okay to...	It is NOT Okay to...
Use this for *personal use only* in your classroom as often as you would like, every year!	• Share this resource with your coworkers or friends unless you buy additional licenses, • (1 per each additional teacher), which are offered at a discount. • Post this item to your school website, personal website, file-sharing website, ANY website, without consent from the author, Vanessa Jason.

biology roots

Sign up for my newsletter to receive exclusive offers.

