Name: _____ Date: _____ Block: _____

What causes antibiotic resistance? - Kevin Wu

Watch the film and highlight the underlined words. Then annotate each paragraph for main ideas and supporting details.

My Notes

What if I told you there were trillions of tiny bacteria all around you? It's true. Microorganisms called bacteria were some of the first life forms to appear on earth. Though, they consist of only a single cell, their total biomass is greater than that of all plants and animals combined. And they live virtually every-where: on the ground, in the water, on your kitchen table, on your skin, even inside you. Don't reach for the panic button just yet.

Although you have 10 times more bacterial cells inside you than your body has human cells, many of these bacteria are harmless or even beneficial, helping digestion and immunity. But there are a few bad apples that can cause harmful infections, from minor inconveniences to deadly epidemics.

Fortunately, they were amazing medicines designed to fight bacterial infections. Synthesized from chemicals or occurring naturally in things like mold, these antibiotics kill or neutralize bacteria by interrupting cell wall synthesis or interfering with vital processes like protein synthesis, all while leaving human cells unharmed. The deployment of antibiotics over the course of the 20th century has rendered many previously dangerous diseases easily treatable.

But today, more and more of our antibiotics are becoming less effective. Did something go wrong to make them stop working? The problem is not with the antibiotics, but the bacteria they were made to fight and the reason lies in Darwin's "Theory of Natural Selection".

Just like any other organisms, individual bacteria can undergo random mutations. Many of these mutations are harmful or useless, but every now and then one comes along that gives its organism an edge in survival. And for a bacterium a mutation making it resistant to a certain antibiotic gives quite the edge.

As the non-resistant bacteria are killed off, which happens especially quickly in antibiotic rich environments like hospitals, there is more room and resources for the resistant ones to thrive, passing along only the mutated genes that help them do so. Reproduction isn't the only way to do this. Some can release their DNA upon death to be picked up by other bacteria, while others use a method called conjugation, connecting through pili to share their genes. Over time, the resistant genes proliferate, creating entire strains of resistant super-bacteria.

So, how much time do we have before these superbugs take over? Well, in some bacteria it's already happened. For instance, some strands of **Staphylococcus Aureus**, which causes everything from skin infections to pneumonia and

sepsis, have developed into MRSA, becoming resistant to β-lactam antibiotics like penicillin, methicillin and oxacillin. Thanks to a gene that replaces the protein β-lactams normally target and bind to, MRSA can keep making its cell walls unimpeded.

Other super-bacteria like Salmonella even sometimes produce enzymes like Beta-lactamase that breakdown antibiotic attackers before they can do any damage. And E. coli, a diverse group of bacteria that contain strains that cause diarrhea and kidney failure, can prevent the function of antibiotics like quinolones by actively booting any invaders that manage to enter the cell.

But there is good news. Scientists are working to stay one step ahead of the bacteria and although development of new antibiotics has slowed in recent years, the **World Health Organization** has made it a priority to develop novel treatments. Other scientists are investigating alternate solutions such as phage therapy, or using vaccines to prevent infections.

Most importantly, curbing the excessive and unnecessary use of antibiotics such as for minor infections that can resolve on their own, as well as changing medical practice to prevent hospital infections can have a major impact by keeping more non-resistant bacteria alive as competition for resistant strains. In the war against super-bacteria de-escalation may sometimes work better than an evolutionary arms race.

The main idea of this article is: **Bacteria are becoming more resistant to antibiotics thus making more antibiotics weaker.** Using your notes above, write three complete sentences in your own words that give details/facts to support this message.

Reflect on the article's statement that **New drugs and/or methods must be developed to combat these new resistant bacteria.** In the box below develop a thoughtful answer to the question: What could happen if we fail or are unable to make new treatments? What new laws may come about because of this issue?

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My Notes

What if I told you there were trillions of tiny bacteria all around you? It's true. _____ called the bacteria were some of _____ to appear on earth. Though, they consist of only a single cell. Their total biomass is greater than that of all plants and animals combined. And they live _____, on the ground, in the water, on your kitchen table, on your skin, even inside you. Don't reach for the panic button just yet.

Although you have 10 times more bacterial cells inside you within your body has human cells, many of these bacteria are harmless or even _____, helping digestion and immunity. But there are a few bad apples that can cause harmful _____, from minor inconveniences to deadly epidemics.

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But today, more and more of our antibiotics are becoming _____. Did something go wrong to make them stop working? The problem is not with the antibiotics, but the bacteria they were made to fight and the reason lies in Darwin's "Theory of Natural Selection".

Just like any other organisms, individual bacteria can undergo _____ _____. Many of these mutations are harmful or useless, but every now and then one comes along that gives its organism an edge in survival. And for a bacterium a mutation making it _____ to a certain antibiotic gives quite the edge.

As the non-resistant bacteria are killed off, which happens especially quickly in antibiotic rich environments like hospitals, there is more room and resources for the _____, passing along only the mutated genes that help them do so. Reproduction isn't the only way to do this. Some can release their DNA upon death to be picked up by other bacteria, while others use a method called conjugation, connecting through pili to share their genes. Over time, the resistant genes proliferate, creating entire strains of _____.

So, how much time do we have before these superbugs take over? Well, in some bacteria it's _____. For instance, some strands of Staphylococcus Aureus, which causes everything from skin infections to

pneumonia and sepsis, have developed into MRSA, becoming resistant to β-lactam antibiotics like penicillin, methicillin and oxacillin. Thanks to a gene that replaces the protein β-lactams normally target and bind to, MRSA can keep making its _____.

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