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Now that you have watched the documentary, read "The Story of Smallpox and Other Eurasian Germs" attached to this packet.

11. Describe what you have learned about Smallpox including the causes, symptoms, means for spreading the disease, and how immunity to the disease can be developed.

a. Causes:

b. Symptoms:

c. Means for spreading disease:

d. Developing immunity:

12. After reading "The Story of Malaria and Other Deadly Tropical Germs", what are some of the effective, simple, relatively inexpensive ways to prevent the spread of diseases such as Malaria? In your opinion, why are these options not being used more widely by African nations? Explain.

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The Story Of... Smallpox and other Deadly Eurasian Germs

Much of the credit for European military success in the New World can be handed to the superiority of their weapons, their literary heritage, even the fact they had unique load-bearing mammals, like horses. These factors combined, gave the conquistadors a massive advantage over the sophisticated civilizations of the Aztec and Inca empires.

But weapons alone can't account for the breathtaking speed with which the indigenous population of the New World were completely wiped out.

Within just a few generations, the continents of the Americas were virtually emptied of their native inhabitants – some academics estimate that approximately 20 million people may have died in the years following the European invasion – up to 95% of the population of the Americas.

No medieval force, no matter how bloodthirsty, could have achieved such enormous levels of genocide. Instead, Europeans were aided by a deadly secret weapon they weren't even aware they were carrying: **Smallpox**.

Smallpox is a viral infection which usually enters the body through the nose or throat. From here the virus travels to the lungs, where it multiplies and spreads to the lymphatic system. Within a few days, large pustules begin to appear all over the victim's skin.

Starting with the hands and the face, and then spreading to cover the rest of the body, each blister is packed full of smallpox DNA. If punctured, these blisters become highly infectious, projecting fresh smallpox particles into the air and onto surrounding surfaces -such as someone else's skin. It is a disease that requires close human contact to replicate and survive.

The total incubation period lasts 12 days, at which point the patient will either have died or survived. But throughout that period, if gone unchecked, they may have passed the disease to an enormous number of people. But the disease requires close human contact to replicate and survive.

Smallpox is a remarkably effective, and remarkably stable, infection – research has shown that over the course of 10 years, as few as three individual bases may change in a strain's DNA. The disease found an effective formula thousands of years ago, and there's no reason to change it.

So where does this deadly disease come from, and why was it linked to Europeans?

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For thousands of years, the people of Eurasia lived in close proximity to the largest variety of domesticated mammals in the world – eating, drinking, and breathing in the germs these animals bore. Over time, animal infections crossed species, evolving into new strains which became deadly to man. Diseases like smallpox, influenza and measles were in fact the deadly inheritance of the Eurasian farming tradition – the product of thousands of years spent farming livestock.

These epidemic Eurasian diseases flourished in dense communities and tended to explode in sudden, overwhelming spates of infection and death. Transmitted via coughing, sneezing and tactile infection, they wreaked devastation throughout Eurasian history – and in the era before antibiotics, thousands died.

But not everyone.

With each epidemic eruption, some people survived, acquiring antibodies and immunities which they passed on to the next generation. Over time, the population of Europe gained increased immunity, and the devastating impact of traditional infections decreased.

Yet the people of the New World had no history of prior exposure to these germs. They farmed only one large mammal – the llama – and even this was geographically isolated. The llama was never kept indoors, it wasn't milked and only occasionally eaten – so the people of the New World were not troubled by cross-species viral infection.

When the Europeans arrived, carrying germs which thrived in dense, semi-urban populations, the indigenous people of the Americas were effectively doomed. They had never experienced smallpox, measles or flu before, and the viruses tore through the continent, killing an estimated 90% of Native Americans.

Smallpox is believed to have arrived in the Americas in 1520 on a Spanish ship sailing from Cuba, carried by an infected African slave. As soon as the party landed in Mexico, the infection began its deadly voyage through the continent. Even before the arrival of Pizarro, smallpox had already devastated the Inca Empire, killing the Emperor Huayna Capac and unleashing a bitter civil war that distracted and weakened his successor, Atahuallpa.

In the era of global conquest which followed, European colonizers were assisted around the world by the germs which they carried. A 1713 smallpox epidemic in the Cape of Good Hope decimated the South African Khoi San people, rendering them incapable of resisting the process of colonization. European germs also wreaked devastation on the aboriginal communities of Australia and New Zealand.

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More victims of colonization were killed by Eurasian germs, than by either the gun or the sword, making germs the deadliest agent of conquest.

The Story Of... Malaria and other Deadly Tropical Germs

The role that germs have played in history, is not confined to those that originated in the temperate parts of the world. As anyone who has ever travelled into the tropics will know, this region is also plagued by infection.

The viruses found in the cooler parts of the planet have evolved to benefit from seasonal variations in temperature. Influenza is one such virus, which thrives during the winter, when humans are forced together into confined spaces. Tropical diseases are luckier: they thrive year-round in the heat and humidity of their region. These diseases exist at a fairly constant level, and are therefore known as endemic.

A virus such as influenza is one of the simplest biological organisms on earth – it's little more than a strain of DNA. The parasites responsible for endemic tropical germs, however, are far more complex – they are tiny animals which are born and multiply inside the metabolic system of another creature. Parasites responsible for some of the nastiest diseases of the tropical world include trypanosomiasis (sleeping sickness), schistosomiasis (blood flukes), parasitic worms and, most deadly of all, malaria.

Malaria-carrying mosquitos require temperatures of more than 68 degrees Fahrenheit, which is why malaria-carrying mosquitoes are only found in tropical parts of the world. Endemic throughout tropical Africa and other parts of the tropical world, particularly Papua New Guinea – malaria is responsible for more deaths every year than any other infectious disease. Malaria kills one African child every thirty seconds and accounts for over a million deaths a year around the world.

Malarial mosquitoes inject tiny parasites into the blood of their victim. The parasites head for the liver, where they multiply and then explode into the blood. As they invade healthy red blood cells they generate a sticky glue on the outer surface which forces the blood to stick to the sides of capillaries and arteries. Instead of a healthy flow of fresh oxygen-carrying blood around the body, malaria causes anemia and organ malfunction through iron and oxygen deprivation. In the most serious cases – if it affects the blood supply to vital organs of the body, like the liver, heart or brain – the disease can be fatal. 'Cerebral malaria' is the name given to the most serious manifestation of the disease, where patients slip into coma because the blood supplying their brain has become too sticky.

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The name 'malaria', meaning bad air, was coined during the colonial era to describe a disease that struck without warning and without discrimination. This single disease was the most serious obstacle to European conquest of the tropical world, responsible for thousands of settler deaths throughout the eighteenth and nineteenth centuries.

Yet, mysteriously, the immigrants' African neighbors seemed to survive. Cattle and horses imported from Europe also seemed to drop dead as soon as they entered the Tropics. So what allowed African cattle, as well as their owners, to survive these tropical germs?

The answer was simple evolution.

Over centuries of exposure to parasitic infections like malaria and sleeping sickness, tropical Africans and the livestock they bred had developed degrees of resistance – and even immunity in some cases.

The African way of life was designed to avoid mosquito-borne infection. Africans made their homes in high, dry areas when they could, away from the natural habitat of the mosquito. Also, African communities remained fairly small, which limited the level of disease transmission.

Unfortunately, the arrival of colonizing Europeans, with their steam trains, machine guns and dreams of industrial wealth, wreaked terrible damage on these centuries-old mechanisms of survival. Torn from their villages, forced to live and work together in massive numbers and in unsanitary conditions, tropical Africans fell ill as never before. The scourge of malaria throughout Africa today is, in part, the consequence of the destruction of a way of life which had existed for thousands of years.

Today, malaria is holding back progress on the continent of Africa. Besides killing millions of children under five, higher rates of transmission mean that adults now also become sick and suffer debilitation. This cripples economic productivity and traps the population in a cycle of poverty. In spite of a literacy rate of 80%, the tropical nation of Zambia has 10% child mortality and one of the poorest economies in the world – it's no coincidence that most Zambians are infected by malaria at least five times a year.

But there is hope. Malaria is treatable – and even eradicable. New drugs offer the hope of cheap vaccination for the most vulnerable in society, while education programs aim to rid the tropical world of the scourge of mosquitoes. Simple measures, such as the use of insecticide-treated bed nets, can have a dramatic effect. In the 1950s, the World Health Organization instituted a global malaria eradication program, and succeeded in ridding the disease from large parts of the tropical world.

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Most significantly, the islands of Singapore and Thailand were liberated from the disease and have since seen massive economic benefits. Today, Singapore is among the richest nations in the world, proving that the obstacle of tropical germs is not insurmountable.