INTRODUCTION

The human body is almost too amazing to be believed.

Consider these facts: Our heart beats around 100,000 times a day, continuously pumping blood through 60,000 miles of blood vessels. And we take more than 25,000 breaths a day. We do all this without even thinking about it. When we touch something, information about what we've touched races to our brain at about 240 miles an hour. And our brain holds five times more information than an entire set of encyclopedias. Our eyes can recognize close to one million different colors and shapes. A sneeze rockets dust out of our nose at nearly 100 miles an hour.

Perhaps one of the most astounding things about the body is that it can repair itself. Except for our teeth, every bit of our body is living, growing tissue. More than 2 trillion new cells are

formed in our body every day. So if we're healthy, tissue can heal and rebuild itself when it's broken or torn.

The human body works nonstop to stay healthy. Even when we mistreat or overwork our body, it does everything it can to stay well. What if we drink or eat things that are unhealthy? First, the kidneys clean our blood with millions of tiny filters. Then the liver works to flush the collected wastes out of our body. What if we push our body too hard during a workout? Overused muscles get extra protein rushed to them so that they can rebuild. And when we stay up too late, our body eventually forces us to sleep—whether we want to or not.

As miraculous and hardworking as the body is, sometimes it gets overwhelmed. This can happen when a person abuses drugs, alcohol, or unhealthy food. Too much of a bad thing always takes its toll. Then the body revolts by giving up and shutting down. Our body is most likely to reach the breaking point when germs are attacking it. When our body cannot combat that attack, we get sick.

Amazingly, only 150 years ago, no one even knew what a germ was. Most people still believed that illness was caused by evil spirits or foul-smelling air or even too much blood in the body. However, Louis Pasteur, working in France, and Robert Koch, working in Germany, had other ideas. In 1865, while examining the remains of

some sour beer under his microscope, Pasteur observed thousands of little dots swimming around. Those wiggly dots were actually bacteria. Pasteur wondered if the bacteria could be the reason the beer had spoiled.

Pasteur and Koch also wondered if bacteria could make people sick. After all, people sometimes got sick when they drank spoiled milk or beer. Pasteur developed a theory: He believed that bacteria floated in the air, and if they landed in beer (or any other drink that could spoil), they could ruin it. Furthermore, he believed that these same tiny dots could drift through the air unseen, invade human beings, and make them ill. Pasteur called this his "germ theory."

Many scientists and doctors thought Pasteur was crazy.

"I'm afraid these experiments will turn against you," one doctor warned Pasteur. "The world into which you wish to take us is really too unbelievable."

This new "world" of germs was, indeed, both hard to believe and frightening. Illnesses could float unseen through the air? Impossible! Tiny bacteria could sneak into a grown man and make him deathly ill? Ridiculous! But in time, scientists and doctors would come to see that Pasteur was right. Disease did not begin on its own inside the human body—it began when a germ entered the body.

So what exactly are germs?

One kind of germ, as Pasteur noticed, is bacteria. Bacteria are living things made of only one cell. They are so small that they can be seen only with a microscope. Bacteria can be found everywhere. Most bacteria are completely harmless. In fact, our own skin is literally covered with millions of bacteria. When bacteria get inside us, our body tries to fight them off. However, the bacteria cells can multiply very rapidly. The fight itself may make us sick. Or the bacteria may carry poisons that are released in the course of the fight, making us even sicker. Common diseases that come from bacteria include pneumonia, strep throat, food poisoning, and typhoid.

Another kind of germ is a tiny animal-like creature called a "protozoan." Like bacteria, protozoa have only one cell and can be seen only with a microscope. Protozoa can enter our bloodstream when an infected mosquito or other insect bites us. Saliva from the insect mixes with our blood, and protozoa stream into our body. Under a microscope, these little creatures look something like oval worms that wriggle and swim. Protozoa are responsible for malaria, sleeping sickness, Lyme disease, and many other illnesses.

The tiniest germ may also be the most frightening germ: It is known as a "virus." Unlike bacteria or protozoa, viruses are not alive. They are basically little chemical packages. A virus attaches to a living cell in the body and within that cell creates new virus germs. Then these

new germs take over more and more cells, faster and faster. Finally, the virus takes over the entire body and makes the person sick. Some viruses can cause fairly harmless diseases, like the common cold. Other viruses are responsible for some very dangerous illnesses: AIDS, yellow fever, rabies, and flu.

Luckily, our body is prepared to fight germs. The first line of defense is our skin. Unless skin is broken by a cut, germs cannot get through flesh. However, germs tend to like to collect on our hands and beneath our nails. Then when our hands touch our mouth, eyes, or even nose, these germs find their way into our body. (There's a reason why we're always told to wash our hands!) Other times, germs get inside us through insect or animal bites. And, as Pasteur discovered, some germs simply float through the air. Often, this happens when someone sneezes or coughs and doesn't cover his or her mouth. If we take a breath near the sneezer, the germs come into our body.

Once germs have found their way inside, a kind of alarm goes off. Special cells are alerted to the fact that something dangerous has entered our body. These cells rush to the germs and begin eating them. Other alarms go off, and different cells work to figure out how to keep the germs from hurting us. Altogether, this process of cells working together to keep us healthy is known as "immunity."

Sometimes, however, our immunity fails. This happens either because our body is run down or because the attacking germs are too powerful for our immune system to fight. Bit by bit, the infection spreads. That invisible germ you picked up on your pinkie has now become a disease inside your body. Some infections—if they are not treated—can lead to death, perhaps in a very short time.

In this book, you will read true stories about people who have battled terrible diseases. Some will win the battle, and some will not. The first half of the book presents epidemics: the Black Death, smallpox, yellow fever, polio, and AIDS. Disease has always been around, but epidemics have not. Only when people began living together in large communities, about 5,000 years ago, did epidemics begin appearing. An epidemic, after all, is defined as an illness that spreads quickly throughout communities or cities. When humans lived only in small, scattered groups, epidemics were not possible.

How do we know people suffered from epidemics thousands of years ago? Ancient paintings and sculpture show people who appear to be sick with smallpox and polio. Writings describe terrifying "curses" from the gods that caused the death of entire communities. The remains of mummies show signs of certain diseases on the dried skin. Ancient drawings and doctors' notes have helped modern scientists

conclude that the illness that wiped out a third of the population of Athens, Greece, around 430 B.C. was most likely typhoid fever. And even in the Bible's Old Testament, ten plagues (an older term for epidemics) are described. These plagues may or may not have happened. But we know from the descriptions that people thousands of years ago were at least familiar with epidemics.

The second half of this book presents other kinds of diseases and illnesses. Some of the diseases, like rabies, may suddenly become more common in certain regions. However, because these diseases don't spread quickly from person to person or wipe out communities, they are not considered epidemics. When they occur in large numbers, they are known as "outbreaks."

Only a few generations ago, epidemics and outbreaks often killed, crippled, or badly sickened millions of people. But, as you will discover in the following stories, modern medicine has helped to change that.

And it's amazing when you think about it.

Disease has been around for many thousands of years. But the understanding of disease has been around for barely 150 years. Incredible advances have been made in a very short time. For example, in the early 1800s, some doctors still believed that drilling holes in the head could relieve headaches. Only 200 years later, doctors perform complex brain scans to pinpoint pain.

Still, there are a lot of mysteries. Many things about the human body still stump scientists and doctors. How does the brain really work? How do we store memories? How are emotions created? Why do brains sleep and dream? Answers to these questions could uncover important clues that could help doctors understand many confusing diseases.

Because there is always more to learn, medical research never ends. As advanced as medicine has become in a very short time, disease has still not been conquered. We may seldom see "old" diseases like leprosy, typhoid, tuberculosis, or malaria in the United States. But that doesn't mean that these illnesses aren't raging in other parts of our planet. Countries that are more developed may have drugs to prevent or cure these illnesses, but the illnesses still exist. In fact, only one disease on earth—smallpox—has ever been completely destroyed.

In addition, strange and new diseases appear every year. Sometimes, old diseases are no longer cured by the drugs that once worked. The disease may grow more powerful than the drug. When this happens, an old bug becomes what's known as a "superbug." This is a dangerous new kind of disease that can't be stopped. As recently as March 2011, a new superbug was reported to have spread across the entire United States. Even though cases of these superbugs are rare, they're still fairly frightening.

"It sounds like something out of a scary movie, but it's real," a Los Angeles health official commented. "It's a grim, but important, reminder. Science and medicine may have raced forward to catch up with disease. But disease is still ahead."

CHAPTER 1

The Sinister Evil of the Black Death

It was a morning like any other morning in the harbor town of Messina, Sicily, just south of Italy. Perhaps it was a bit warm for late October, but no one minded. For years, the weather had been cold and rainy. Crops had died, and people had starved by the thousands throughout Europe. This year, however, the sun had shone more often than not, and the fields were full of grain. Finally, it seemed, life was getting back to normal.

"Attention!" people shouted from the docks. "Ships are coming in!"

Moving slowly into the harbor were twelve Italian ships. The year was 1347, and Italians had only recently begun trading with merchants in eastern Asia. It was a long journey to Asia, but it was a journey worth taking. Exotic spices, silks, and jewels fascinated Europeans, and they were willing to pay a lot of money for those items.

Now, as the ships drew closer, dockworkers could see the colorful flags that indicated that this fleet was indeed returning from Asia. Excitement grew, and townspeople began gathering near the docks. Children shouted, and jumped up and down. Sometimes the sailors had strange creatures and brightly colored birds with them when they came ashore. Everyone wanted the best view of the ships and the hundreds of sailors who would be lining the decks and waving as they anchored.

But something was wrong.

"Where is everyone?" a young boy whispered to his mother.

Suddenly, a hush fell over the docks. Only one or two men could be seen on the deck of each ship. In fact, one ship appeared to have no one at all on board as it sailed dangerously close to the ship in front of it. As the ships drew close to the docks, a gasp rippled through the crowd. The faces of the few sailors on deck were ghostly white. Huge black lumps grew on their necks, and many of them had blood and pus covering their clothing. One sailor was entirely covered in oozing red sores.

"Quickly!" mothers called to their children. "Don't let the sailors get near you!"

Many of the sailors had died on the journey from Asia, but now the men who had survived stumbled from the ships in agony. Some collapsed, crying out for help. Others staggered

toward the crowd, but the crowd shrank back in horror. The dockworkers whispered nervously to one another. They had never seen anything like this before. What was it? What should they do? Finally, the workers shouted to the sailors to return to their ships.

"You may dock here tonight, but you must stay on board your ships. In the morning, you must leave Messina."

The people of Messina thought they would be safe from this terrible disease. After all, the sailors never even entered the town, and nobody got near them. That night, the only "cargo" that left the ships was the black rats that ran down the dock ropes and into Messina looking for food. In the morning, the ghostly ships sailed soundlessly away into the fog.

In less than a week, however, dozens of dockworkers began feeling a strange chill. Then, in every case, the men noticed a dark swelling on their necks, under their arms, or in their groin. At first, the lump was no bigger than a grape. Practically overnight, however, it grew to the size of an egg. Then dark and reddish spots appeared on the dockworkers' bodies. The men became overwhelmed with pain and fever and thirst. In the final stages, they vomited and grew delirious. Many died within 72 hours of first feeling the strange chill.

Then the disease moved swiftly into the town of Messina, killing 10, then 20, then more than

50 people a day. Every time someone died, the church bells tolled. Within three weeks of the arrival of the deadly ships, the church bells rang nonstop. Terrified, the people of Messina fled their homes, often leaving all their belongings behind and their front doors wide open. They rushed to neighboring cities, where they believed they'd escape this evil disease.

But in every instance, the chill followed those who fled. Soon, hundreds—and then thousands—were dying all over Sicily. In some towns, more than half of the people died. And with every day, the disease swept farther north and moved on into other European countries.

What had happened? Where had this terror of death come from? Everyone knew that the Italian sailors had brought the illness with them, but where had they caught it? And how had they given it to the people of Sicily? Slowly, a story drifted over the miles from Asia.

Italian merchants had built a thriving city on the northern shore of the Black Sea, in the area of eastern Europe that is now Ukraine. This port city, called Caffa, served as an important stop on the Silk Road, the overland trading route on which silk and other valuable goods were carried from eastern Asia to Europe. From Caffa, where the Silk Road ended, Italian sailors loaded their ships and headed back to Europe to sell their exotic goods to eager customers.

For more than fifty years, the Mongols, who

ruled Caffa, had allowed the Italians to run Caffa as if they owned it. After all, an increase of trade benefited the Mongols as much as it benefited the Italians. Still, many Mongols were not happy with the situation. They felt that the Italians were intruders. Over the course of several years, brawls between the two groups led to more serious fighting and the death of thousands of people. Sometimes the Italians sought safety in Caffa, with its high stone walls that kept the Mongols out. The Mongols responded, however, by surrounding the city. They believed that sooner or later the Italians would have to come out.

One such siege began in 1346. But this time something was different. Many of the Mongol soldiers were terribly sick with a ghastly and mysterious disease. Many died within three days of noticing a black lump on their body. Soon, there were more bodies than the Mongols could bury, and the rotting corpses seemed to spread the disease faster. In terror and anger, the Mongols came up with a grisly plan.

One by one, corpses were placed on catapults and flung high into the air and over the walls of Caffa. Many of the bodies were so diseased and rotted that they exploded when they hit the streets and buildings of Caffa. The horrified Italians rushed to either bury the broken remains or dump them over the walls into the Black Sea. But it was too late. The dreaded disease took

hold almost immediately. No one knows for sure, but some reports claimed that the disease nearly wiped out the entire city—tens of thousands of people died. In desperation, ship owners and sailors sailed away, hoping to escape death. But the disease sailed with them. And then it spread across Europe.

Disease and hardship were not new to most Europeans. They had suffered wars, famine, years of terribly cold and wet weather known as the "Little Ice Age," and an assortment of killer illnesses. But nobody had ever seen anything like this. Many people were certain that it was the end of the world.

"It created such fear," a friar in Italy wrote, "that if a son fell ill, his own father refused to stay with him. If the father did dare come near him, he was sure to die himself after three days. Whole households died, right down to the cats and the cattle."

As the mysterious plague spread, drastic measures were taken. Those who were dying were routinely abandoned with no one to comfort them in their final hours. In some cities, when plague was discovered in a household, the house was boarded up from the outside. The living were left with the dead, to die in the darkness. Sometimes, the townspeople set fire to these houses. But the surest way, people thought, to escape this plague was to run from it.

And anyone who had enough money rushed off to the countryside or to other parts of Europe, farther north, where no illness had yet been reported.

And so, in this way, the disease was carried to nearly every part of Europe. Since records were not kept, it's hard to know exactly how many people died. However, it's estimated that within five years 30 to 60 percent of the *entire population* of the continent of Europe was killed by this gruesome plague. If this happened in the United States today, that would be equal to 100 to 200 million people dying. In every family of four, at least one or two members would be gone. Everyone would lose several friends. You'd be lucky to have even a 50 percent chance of survival.

As hard as this is for us to imagine today, it was even more baffling to people in the mid-1300s.

"I wish I had never been born, or at least had died before these times," wrote the great Italian poet, Petrarch. "When has any such thing been heard or seen? The houses are left vacant, cities are deserted, and fields are too small for all the dead. . . ."

By the time the plague reached Scandinavia in the far north, the disease had become so fierce that it sometimes swept through towns and killed every single person. In one town, the only survivor was a young girl who disappeared into

the woods. Years later, she was discovered, a wild and frightened young woman who had somehow survived on her own.

Why, Europeans wondered, was this happening?

Many truly believed that this plague had been sent by God as punishment for their wicked behavior. In response, thousands of men and women walked from town to town, beating themselves and each other with metal-tipped whips. Blood streamed down their backs and legs. Sometimes they whipped one another into unconsciousness. They hoped that God would see them punishing themselves and spare them from the disease.

Many others believed that the sickness came from the devil or some other evil power. It was common to believe in witches and other agents of evil during the 1300s. Countless men and women were killed by townspeople simply for being different. These people were assumed to be working for the devil. Mentally ill, elderly, handicapped, and mentally challenged people were often targets. Many of these unfortunate victims were drowned, stoned, or tortured to death.

However, the most frequent target for blame was Jewish people. Jews had long been mistreated in Europe. They were thought of as outsiders in a society that was almost totally Christian. Some people called Jews "Christ-killers" and accused

them of ridiculous and horrible crimes, such as killing babies as sacrifices to the devil. Others believed that Jews were secretly plotting to take over all of Europe.

In any event, everyone wanted someone to blame for this terrible plague. And Jewish people were the easiest target. Because many Jews followed religious laws about their food and drink, they often did not use the same wells for water that the rest of the townspeople used. Suddenly, like wildfire, rumors began spreading that Jews had infected wells throughout Europe. It was all part of their evil plot!

Jewish people were hunted down, beaten, tortured, and killed. They were forced to wear hats with horns to show their connection to the devil. They were driven from their homes and thrown out on the streets on bitter winter nights. Finally, when people realized that just as many Jews as Christians were dying from the plague, the attacks began slowing down. Still, this would remain the worst massacre of Jewish people for 600 years—until the Holocaust during World War II.

Unable to find someone to blame for this plague, Europeans tried to figure out how to keep from catching what had become commonly known as the "Terrible Death." (It was actually not referred to as the "Black Death" until centuries later. No one is sure how the disease got this name, though it is thought to refer to

the black spots that cover the body right before a victim dies.)

"Corrupted and poisonous air must be avoided at all times," one doctor wrote. "To breathe foul air is to breathe in death."

In other words, most doctors in the 1300s believed that if the air smelled bad, it contained terrible diseases. The only problem was that practically *all* of the air in towns and cities smelled bad. There was no sewage or garbage collection. Pigs and cows roamed the streets. Dead animals were left to rot wherever they died. And it was no better at home where most people slept in the same room with their goats and chickens. Add to this the fact that people rarely bathed or changed clothes in the 1300s, and you have one stinky environment.

The solution? Many people firmly believed that if they carried sweet-smelling flowers or spices under their noses at all times, they could ward off the plague. At home, they built huge smoky fires in their fireplaces to "smoke out" the bad smells. One king had two fireplaces built in his bedroom. In the worst heat of the summer, he constantly sat between the two raging fires, believing that the heat and smoke would purify the air.

Doctors also recommended avoiding deep sleep. The foul air, doctors pointed out, could sneak up on unaware sleepers. Looking a sick person in the eye was also discouraged. It was

believed that poisoned air could shoot right out of the eyes of a plague victim and attack a healthy person. Drinking a lot of wine and eating raw snake meat were also suggested. One doctor even instructed people to stand on their heads for long periods of time.

Obviously, none of these precautions worked. The plague raged on. Since people were unable to avoid catching it, they demanded a cure.

Naturally, it was impossible for fourteenth century doctors to come up with a cure when they had no idea what was causing the Black Death. So they did mainly what they had always done for diseases that caused fevers and swelling. For more than a thousand years, doctors had believed that these kinds of illnesses were caused by having too much blood in the body. Treatment, then, was what was known as "bloodletting." Doctors cut patients' arteries and drained them of blood. During the Black Death, there was no treatment more popular than bloodletting.

Of course, the combination of the plague and serious loss of blood only made matters worse. Not one person was saved by being drained of so much blood.

In desperation, people turned to witchcraft and magic. It was believed that the word "abracadabra" (still used by magicians today) had magical qualities. Many people printed the word on a cloth, which they wore around

their neck for protection. And people who were believed to be witches came to be paid good money for cures. That was certainly a far cry from being blamed for the plague. Suddenly, all kinds of strange cures were being created. One drink that was believed to be a cure contained earthworms, dirt, horse urine, and beer!

But in the end, the only thing that worked was time. By late 1351, the Black Death had finally run its course. More than 75 million people had died, and Europe was just a shell of what it had been only five years earlier. Towns were deserted, castles were empty, and ports were full of abandoned ships. Farms and fields were overgrown. Livestock wandered into the hills, ownerless and hungry.

The same plague would return to Europe 300 years later, in the 1600s. While far fewer people would die during this second epidemic, understanding and treatment of the disease had barely changed. Bloodletting was still used by most doctors. Scientists, of course, had no concept of germs. And most people continued to believe that plagues were the result of bad odors or evil.

Truly, on that late October day in 1347, when the people of Messina had ordered the sick sailors back onto their ships, they must have believed that they were safe. So how had the Black Death gotten from the ships to the town?

It would take another 550 years to piece the puzzle together. In 1347, no one would have believed it. But today we know what happened.

Around 1900 a French scientist named Alexandre Yersin discovered that the Black Death and related plagues were the result of bacteria germs carried by rats. Fleas got the disease when they bit the rats. Then fleas jumped onto humans for a bite, and passed the disease along to them. In the 1300s, when people shared their straw and mud houses with their goats, chickens, and sometimes even pigs, fleas were everywhere. And nearly every house had numerous mice and rats running around.

No one ever thought twice about these rodents—or about the dozen black rats that had scurried down the ropes of the Italian ships to the docks of Messina. These unremarkable visitors had carried the fleas that introduced the plague that would change Europe forever.