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the science of MICROBES

Activity: Microbes and Disease

from *The Science of Microbes Teacher's Guide*

by Nancy P. Moreno, Ph.D., Barbara Z. Tharp, M.S., Deanne B. Erdmann, M.S., Sonia Rahmati Clayton, Ph.D., and James P. Denk, M.A.

RESOURCES

Free, online presentations of each activity, downloadable activities in PDF format, and annotated slide sets for classroom use are available at www.bioedonline.org/ or www.k8science.org/.

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HIV virus particle. L. Howard, C. Daghlian, Dartmouth College.

INTRODUCTION

Microbial Challenges

Infectious diseases have plagued humans throughout history. Sometimes, they even have shaped history. Ancient plagues, the Black Death of the Middle Ages, and the "Spanish flu" pandemic of 1918 are but a few examples.

Epidemics and pandemics always have had major social and economic impacts on affected populations, but in our current interconnected world, the outcomes can be truly global. Consider the SARS outbreak of early 2003. This epidemic demonstrated that new infectious diseases are just a plane trip away, as the disease was spread rapidly to Canada, the U.S. and Europe by air travelers. Even though the SARS outbreak was relatively short-lived and geographically contained, fear inspired by the epidemic led to travel restrictions and the closing of schools, stores, factories and airports. The economic loss to Asian countries was estimated at $18 billion.

The HIV/AIDS viral epidemic, particularly in Africa, illustrates the economic and social effects of a prolonged and widespread infection. The disproportionate loss of the most economically productive individuals within the population has reduced workforces and economic growth in many countries, especially those with high infection rates. This affects the health care, education, and political stability of these nations. In the southern regions of Africa, where the infection rate is highest, life expectancy has plummeted in a single decade, from 62 years in 1990–95 to 48 years in 2000–05. By 2003, 12 million children under the age of 18 were orphaned by HIV/AIDS in this region.

> For an emerging disease to become established, at least two events must occur: 1) the infectious agent has to be introduced into a vulnerable population, and 2) the agent has to have the ability to spread readily from person to person and cause disease. The infection also must be able to sustain itself within the population and continue to infect more people.

Despite significant advances in infectious disease research and treatment, control and eradication of diseases are slowed by the following challenges.

- The emergence of new infectious diseases
- An increase in the incidence or geographical distribution of old infectious diseases
- The re-emergence of old infectious diseases
- The potential for intentional introduction of infectious agents by bioterrorists
- The increasing resistance of pathogens to current antimicrobial drugs
- Breakdowns in public health systems

Baylor College of Medicine, Department of Molecular Virology and Microbiology, www.bcm.edu/molvir/.

Using Cooperative Groups In The Classroom

Cooperative learning is a systematic way for students to work together in groups of two to four. It provides organized group interaction and enables students to share ideas and to learn from one another. Students in such an environment are more likely to take responsibility for their own learning. Cooperative groups enable the teacher to conduct hands-on investigations with fewer materials.

Organization is essential for cooperative learning to occur in a hands-on science classroom. Materials must be managed, investigations conducted, results recorded, and clean-up directed and carried out. Each student must have a specific role, or chaos may result.

The Teaming Up! model* provides an efficient system for cooperative learning. Four "jobs" entail specific duties. Students wear job badges that describe their duties. Tasks are rotated within each group for different activities so that each student has a chance to experience all roles. For groups with fewer than four students, job assignments can be combined.

Once a model for learning is established in the classroom, students are able to conduct science activities in an organized and effective manner. Suggested job titles and duties follow.

Principal Investigator
- Reads the directions
- Asks the questions
- Checks the work

Maintenance Director
- Follows the safety rules
- Directs the cleanup
- Asks others to help

Reporter
- Records observations and results
- Explains the results
- Tells the teacher when the group is finished

Materials Manager
- Picks up the materials
- Uses the equipment
- Returns the materials

* Jones, R.M. 1990. *Teaming Up!* LaPorte, Texas: ITGROUP.

Red (round) and white (knobby) blood cells. CDC\7320. J. Carr.

TIME

Setup: 15 minutes
Activity: 45 minutes for each of two class periods

SCIENCE EDUCATION CONTENT STANDARDS

Grades 5–8

History and Nature of Science

- Science as a human endeavor: Women and men of various social and ethnic backgrounds—with diverse interests, talents, qualities and motivations—engage in the activities of science, engineering and related fields, such as the health professions.
- Science requires different abilities, depending on such factors as the field of study and type of inquiry.
- Many individuals have contributed to the traditions of science.
- Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time and reach the conclusions that we currently take for granted.

EXTENSION

Have students create world maps illustrating where each of the six diseases highlighted in this activity still may be found. Geographic maps can be downloaded free from the United Nations Cartographic website at www.un.org/Depts/Cartographic/english/htmain.htm/.

Overview

Language arts activity in which students will read about several serious, infamous diseases and collect/discuss information about the pathogens, their modes of transmission and their impacts on society. Students also will create art projects that represent these diseases. Students will learn that many diseases are caused by microbes. Some diseases that have caused serious debilitation and/or loss of human life are cholera, HIV/AIDS, malaria, tuberculosis, smallpox and plague.

MICROBES AND Disease

Organisms that cause diseases are called "pathogens," from the Greek word *pathos,* or suffering. Most pathogens are microbes, such as bacteria, protozoa, fungi or viruses.

Some viruses cause abnormal changes in cells that can lead to cancer. For example, certain types of human papillomavirus (HPV) increase women's risk for cervical cancer. A new vaccine now protects against two types of HPV infection that can cause cervical cancer.

Sometimes, we call these tiny pathogens "germs." Pathogens cause communicable, or infectious, diseases (diseases that can spread from one organism to another). Some diseases are harder to catch than others, because different pathogens are transferred from one organism to another in different ways (through droplets in air or in fluids, through contact with a surface containing the pathogen, from insect bites, etc.). Some pathogens can make you a lot sicker than others, and some can kill.

A widespread outbreak of a disease is called an "epidemic." An epidemic that spreads broadly throughout the world is referred to as a "pandemic." This activity highlights six microbe-based diseases with major global historical impacts: cholera, plague, malaria, smallpox, HIV/AIDS and tuberculosis.

Of course, microbes do not cause all diseases. Invertebrates, such as hookworms, tapeworms, etc., also can make people and animals sick. Other illnesses, such as arthritis, diabetes, heart disease related to atherosclerosis, and some kinds of cancer, are not caused by infections. But in some cases, diseases thought to be unrelated to microorganisms have been found to be infectious after all. Stomach ulcers are a good example. Scientists now know that the most common cause of peptic ulcers is infection by a bacterium called *Helicobacter pylori.*

MATERIALS

Per Group of Students (See Setup)

- Paper and supplies for art projects
- Sheet of paper on which to create an activity concept map
- 6 copies of the 3-2-1 student sheet (p. 3)
- 4 copies of one *Disease Information* sheet (p. 51–56; all members of a group receive the same disease sheet)
- Group concept map (ongoing)

SETUP

Divide the class into six groups of four students. Each group will work with one disease (i.e., one group

DR. TERRENCE TUMPEY, CDC, examines the reconstructed 1918 pandemic influenza virus in a Biosafety Level 3 enhanced lab. The 1918–1919 pandemic killed as many as 50 million people worldwide. By forming a better understanding of the molecular characteristics of the 1918 virus, specifically the ones that made it so virulent and easily transmissible, CDC researchers can work to protect against the spread of other influenza viruses with pandemic potential. CDC\7987 J. Gathany.

investigates and presents information about TB, another group works with plague, etc.).

Make four copies of each *Disease Information* sheet.

Make 36 copies of the 3-2-1 sheet (six copies per group). As each group presents information on a specific disease, all other groups will complete a 3-2-1 sheet for that disease.

Gather a variety of materials for students to use in their art projects. Place materials in a central location.

PROCEDURE

1. Ask students, *Do you think diseases have changed history? Do any diseases affect society today?* Tell students that they will be learning about diseases that have had impacts worldwide.
2. Provide each group with a set of *Disease Information* sheets for a single disease. Each student should receive his or her own copy of the sheet.
3. Instruct each student to read the information on his or her sheet. Depending on students' reading levels, you may need to provide assistance with the readings.
4. Have students within each group jointly create a concept map to summarize the important ideas from the group's *Disease Information* sheet. (At this point, students should be familiar with concept maps.) Then, have each group use its newly-created concept map to prepare a presentation about its assigned disease.
5. Distribute six copies of the 3-2-1 sheet to each group.
6. Have each group present its overview to the class. After each presentation, allow all groups, including the one that just presented, five to six minutes to complete a 3-2-1 sheet on the presentation. Repeat the process until all student groups have made their presentations.
7. As an assessment, have each group work collectively to create a piece of art that illustrates one of the diseases covered, and then write a paragraph explaining how the artwork represents the chosen disease(s).
8. Ask a student representative from each group to present the group's artwork in class, along with related information from the readings or other sources.
9. Allow groups to add information to their concept maps.

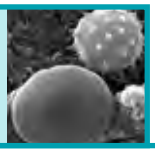
DID YOU KNOW?

Leeches *(Hirudo medicinalis)* have been used to treat diseases for centuries and still are used in some cases today. In fact, leech saliva does contain several important compounds with medicinal applications. Leeches produce a substance, called hirudin, that prevents blood from clotting. They also produce a compound, called a vasodilator, that enlarges (dilates) blood vessels and stimulates blood flow. In addition, leeches produce an anesthetic so that it doesn't hurt when they attach!

NEW THREATS

New diseases continue to emerge that could affect human populations worldwide. One recent example, bird flu (avian influenza), primarily affects birds, but it can be transmitted to humans. So far, human-to-human transmission has been very rare. However, investigators are concerned that the current strain of bird flu may mutate and become capable of spreading directly from one person to another.

Red (round) and white (knobby) blood cells. CDC\7320 J. Carr.



3-2-1

Group _____ Disease _____

3

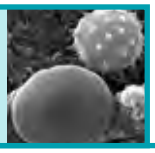
What are three new things you learned?

2

What are two things that surprised you?

1

What is one question you have?



Red (round) and white (knobby) blood cells. CDC\7320 J. Carr.

DISEASE INFORMATION

Tuberculosis

Tuberculosis, a disease also known as "TB," has affected humans for thousands of years. For most of that time, there was no known cure and very little understanding of the disease. In the past, TB sometimes was called "consumption," because it seemed to devour people from the inside.

TB is one of the deadliest diseases known to man. At one point, it was the leading cause of death in the U.S. Its dark history is reflected in novels, artwork and dramas. Back in the 1800s, some people even thought TB was caused by vampires. *It's true!* The symptoms of TB look like characteristics often associated with vampires (red, swollen eyes that are sensitive to bright light, pale skin, and worst of all, coughing up blood). In fact, some people thought TB sufferers caught the disease from dead family members who visited at night.

Mycobacterium tuberculosis, **bacterium that causes TB.** CDC\8433 E. White.

An Invisible Enemy

We have come a long way since then, and scientists have developed effective treatments against TB. Caused by the *Mycobacterium tuberculosis* bacteria, TB can be deadly for people who do not get proper treatment. The disease most often infects the lungs, because it is transmitted through the air we breathe. However, it can attack any body organ or system.

How TB Spreads

TB spreads from person to person through the air. When someone who is infected with tuberculosis sneezes, coughs, talks or spits, TB bacteria are released into the air. Anyone nearby who breathes in these bacteria can become infected. If a person with TB does not receive treatment, he or she could infect an average of 10 to 15 people each year.

People infected with TB bacteria may not show symptoms or develop the disease. In fact, only about 10% of otherwise healthy people infected with TB bacteria ever become sick. The other 90% are said to have a latent TB infection. These people do not get sick and do not transmit the disease.

However, some people with latent TB infection do become ill when they get older. Therefore, they may choose to take antibiotics right away to prevent the disease from occurring later in life.

Babies and young children have an increased risk for catching TB because their immune systems are not yet mature. Other people at higher risk for contracting (catching) TB are those with weakened immune systems, such as people with HIV (the virus that causes AIDS), diabetes, cancer, kidney disease or other serious medical conditions. People who abuse drugs or alcohol also are more likely to develop this illness.

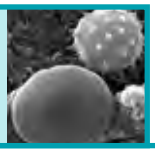
Where Things Stand Today

Until the 1940s, there was no cure for TB. But with education, improvements in public health care and the creation of new antibiotics, the numbers of deaths from TB dropped dramatically in the U.S. and Europe. To cure the disease, patients were required to take antibiotics for six months.

However, over time, drug-resistant forms of TB began to emerge. Doctors discovered that some patients stopped taking their medicine as soon as they felt better, instead of completing the course of antibiotics designed to kill all of the bacteria. In these cases, the surviving TB bacteria changed, or mutated, so that the original antibiotic became less effective. Eventually, the antibiotic-resistant TB bacteria were passed on to other people, who then developed forms of TB that were even more difficult to treat.

There are many reasons why TB still exists, including lack of medical facilities, cost of antibiotics and poor hygiene. The disease remains a very serious health problem today. Each year, almost nine million new cases of TB are reported worldwide, and nearly two million people die from the disease.

Without better treatment, it is estimated that over the next 15 years, almost one billion people will become infected with TB bacteria, more than 150 million will become sick, and more than 36 million people will die.



Red (round) and white (knobby) blood cells. CDC\7320 J. Carr.

DISEASE INFORMATION

Malaria

What do you know about malaria? In the United States, we don't hear much about this disease, because it was eradicated (removed completely) from our country in the 1950s.

But malaria still is a serious threat in warmer and poorer regions of the world, including India, Africa, Central and South America, and tropical parts of Asia. The World Health Organization reports that each year, 300–500 million new cases of malaria are diagnosed, and more than one million people—mostly young children—die from it.

Notice the bulging "stomach" of this *Anopheles* mosquito. It has just had a blood meal. CDC\7950 J. Gathany.

A Microscopic Parasite

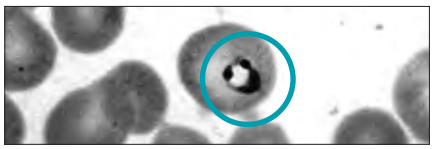
Malaria is a life-threatening disease caused by *Plasmodium*, a parasite in the protozoan group. A parasite is an organism that lives in, with, or on another organism (or host), from which it obtains nutrients and to which it causes harm. The malaria parasite is carried by female *Anopheles* (ah-NOF-il-eez) mosquitoes. The symptoms of malaria—severe headache, high fever, shaking, vomiting and chills—appear about 9 to 14 days after an infected mosquito bites a human. There are four strains (forms) of malaria. All are very serious, and one strain often is fatal.

Once a person is infected, the parasite attacks and destroys red blood cells. It also blocks blood vessels leading to the brain or other organs. If medicine isn't obtained, or if that particular strain of malaria is resistant to (not killed by) the medicine, a malaria infection can quickly become deadly.

The Cycle of Malaria Infection

We know that when a female *Anopheles* mosquito bites a person who already has malaria, the mosquito takes in malaria parasites and becomes a carrier. When the mosquito bites someone else, it transmits parasites to (infects) that person. But it's not clear if the parasite kills the mosquito. It is possible that the mosquitoes are not affected by the malaria parasite.

Once the *Plasmodium* parasite enters a person's bloodstream, it travels to the liver, where it begins to grow and multiply. During this incubation period, before the parasite has fully developed, the person will not feel ill, and may not even know he or she is infected. When the parasite moves from the liver to the blood stream, the person will begin to feel symptoms. At this point, the disease has developed enough to infect any *Anopheles* mosquito that may bite this newly infected person, and the cycle of infection continues.



This photograph shows a Malaria parasite (*Plasmodium sp.*) inside a red blood cell. CDC\1456 M. Melvin.

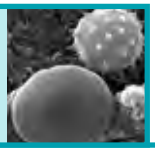
People also can get malaria from having a blood transfusion or organ transplant, or by sharing used needles. A pregnant mother infected with malaria can give the disease to her child. But malaria cannot spread from casual contact between people. You can't get it if someone sneezes on you.

Still a Deadly Disease

During the 20th Century, malaria was eliminated from most parts of the world that are not hot year-round. But it was not wiped out everywhere, and it may be making a comeback. Evidence suggests that *Anopheles* mosquitoes have become resistant to pesticides that previously killed them. Meanwhile, vaccines that once prevented infection, along with the drugs used to treat malaria, are becoming less effective. Some experts think malaria may be moving into new parts of the world, including places where it once had been eliminated.

Although scientists believe most deaths from malaria are preventable, this disease remains a major global health concern. It also is preventing development in some of the poorest countries in the world. For example, in Africa, on average, a child dies from malaria *every 30 seconds*. And even if a child survives malaria, he or she often is left with learning problems or brain damage.

The U.S. is not entirely free from malaria. Approximately 1,200 infections and 13 deaths from malaria are reported here each year, mostly among travelers and immigrants from parts of the world where malaria remains a problem. Further, *Anopheles* mosquitoes still exist in the U.S., so it is possible for the mosquitoes to reintroduce malaria into the U.S.

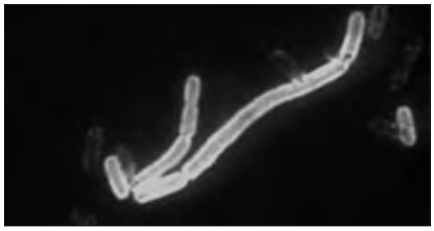


Red (round) and white (knobby) blood cells. CDC\7320 J. Carr.

DISEASE INFORMATION

Plague

When you hear about "the plague," you probably think of the Middle Ages, when the Bubonic form of plague killed millions of people throughout Europe, Asia and Africa. In Europe, as many as 2.5 million people—one third of the population—died between 1347 and 1350. It has been said that there weren't enough people left alive to bury the victims. At the time, people didn't know what caused plague and no cure was available. So there was panic whenever an outbreak occurred. Many works of literature and art depict the terror surrounding the plague and the horrible effects it had on the population.



***Yersinia pestis*, the bacterium responsible for the plague.** Oregon Health Authority, Public Health-CDC\1918 L. Stauffer.

Maybe you think plague is gone and part of history, like the Middle Ages. If so, you'll be surprised to learn that it is alive and well. Today, we have protective vaccines and medications that cure people with plague, so it takes far fewer lives than other deadly diseases. But the name alone continues to cause fear. And although we know much more about plague than medieval people did, it continues to kill people even today.

Rodents!

Plague is a disease that affects animals and humans. It is caused by the bacterium, *Yersinia pestis*. This bacterium was named after Alexandre Yersin, the scientist credited with discovering how the disease spread during an epidemic in 1894. (How would you like to have a deadly bacterium named after you?)

Yersinia pestis bacteria are carried by fleas and the wild rodents on which they live (often rats and squirrels). Plague outbreaks are rare these days, but still can happen in places where infected rodents and their fleas live in people's homes. In the Middle Ages, it was much more common for homes to be infested with rats and fleas—which is one reason why so many people were infected with plague then.

There are three different kinds of plague. Bubonic plague is an infection of the lymph nodes, which are glands located throughout the body that help to fight off illness by acting as filters for bacteria and viruses. Septicemic plague is an infection of the blood. Pneumonic plague is an infection of the lungs. The type of plague a person gets depends on how he or she was infected in the first place. Septicemic plague can cause a victim's skin to turn very dark purple. That's why plague sometimes was called the "Black Death."

The most recent outbreak of plague in the U.S. was in 1924. But it still exists here, mostly in the Southwest and Midwest. And while only about 2,000 cases of plague are reported worldwide each year, it remains a very serious disease. If you get plague and don't get treatment, it can kill you.

One Small Pest = A Huge Health Risk

Most often, plague is spread when an infected flea bites a person, or when someone handles an animal infected

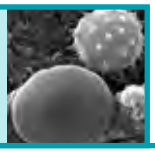
Oriental rat flea, shown with a clump of plague bacteria blocking its stomach. The blockage forces bacteria to be passed to a new host once the flea bites it. CDC\2025.

with plague. It also is possible to catch plague through the air, if someone with pneumonic plague sneezes near you.

A few days after infection, sudden fever, chills, headache, nausea, weakness, and painful, swollen lymph nodes may develop. These are symptoms of plague. The disease advances quickly, so it is important to see a doctor as soon as possible after infection. Most plague patients who are treated quickly and properly with antibiotics will recover fully. But if left untreated, plague can invade the lungs and bloodstream. Once in the lungs, plague can be spread by sneezing or coughing, and it is far more difficult to cure. About half of all people with this kind of plague die.

A Disease that Won't Die

Plague is not likely to be eradicated (eliminated). Even with new technology, improved conditions, and good healthcare in most modern cities, plague and *Yersinia pestis* bacteria remain strong opponents. In fact, overcrowding, combined with a lack of proper sanitation and pest control in some poorer countries, has increased the chances for another plague outbreak. Like the fleas that carry it, this disease is tough to kill.



Red (round) and white (knobby) blood cells. CDC\7320. J. Carr.

DISEASE INFORMATION

Cholera

Are you familiar with the phrase, "Don't drink the water"? It's usually heard when someone is traveling, especially outside of the U.S. Our water treatment system is very good, so the water in our homes usually is healthy to drink. Also, laws in this country help to ensure that our food sources generally are safe.

But this is not the case everywhere. When you visit some countries, you may be warned not to drink water from the faucet, not to drink beverages containing ice, and not to eat any food unless you have cooked or peeled it. There's a good reason for these warnings. Sometimes, uncooked food and untreated water can make you sick!

Crabs have been a repeated source of cholera in the U.S. and elsewhere, even though they are rarely eaten raw. CDC\5318.

Something in the Water and Food

Every year, many people around the world get dangerous diseases from food and water that are not safely prepared or treated. One of these diseases is cholera, an infection of the intestines caused by the bacterium, *Vibrio cholerae*. We don't have many cases of cholera in the U.S. In fact, it has been rare in much of the world for 100 years or more. Unfortunately, it still affects millions of people in Asia, Africa, and other places that suffer from poor hygiene, unsanitary conditions, and lack of money for proper medical care and medicine.

Many people who get cholera do not feel ill. Some experience nothing more serious than a bad case of diarrhea. But about 10% of cholera victims suffer life-threatening symptoms, including continuous diarrhea, vomiting and leg cramps. These people lose body fluids so quickly that they become severely dehydrated, and even may go into shock. Without medication, they can die within hours.

Wash Your Hands, Please

Cholera is spread by contaminated (dirty or spoiled) water and food. Most often, contamination happens when human and/or animal waste (feces) gets into our water or food. It's disgusting, but that's the way it usually happens.

Vibrio cholerae bacteria infect the intestine and remain in the body for one to two weeks. If an infected person who is preparing food doesn't wash his or her hands after using the bathroom, he or she might spread the bacteria to the food. Anyone who eats this food might get sick. Other kinds of intestinal diseases are spread in the same way. That's why you often see signs in restaurant bathrooms, reminding employees to wash their hands before returning to work.

In places with poor sewage systems or improper water treatment, human waste can get into the water supply. In these places, many people can become sick with cholera. That's how some outbreaks happen.

But cholera isn't always caused by human waste. *Vibrio cholerae* bacteria can exist naturally in salty rivers and coastal waters, where shellfish (crabs, clams, oysters, etc.) live. If shellfish are boiled for less than 10 minutes, steamed for less than 30 minutes, left unrefrigerated for several hours, or eaten raw, they can cause cholera and other diseases.

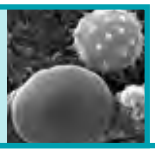
***Vibrio cholerae* bacteria, which cause cholera.** Dartmouth College\L. Howard, C. Daghlian.

The Danger Today

Cholera outbreaks have occurred throughout the world for thousands of years. Stories from ancient Greece, and even earlier, report epidemics of cholera-like illnesses. The disease was common in the U.S. in the 1800s, but it no longer is a major concern, because we have modern water treatment, food preparation and sewage systems.

Cholera is easy to prevent with good sanitation and water treatment. It can be cured by giving fluids along with antibiotics, if necessary. But some countries do not have the resources needed to fight a cholera outbreak, so this disease continues to present a very real threat to human life.

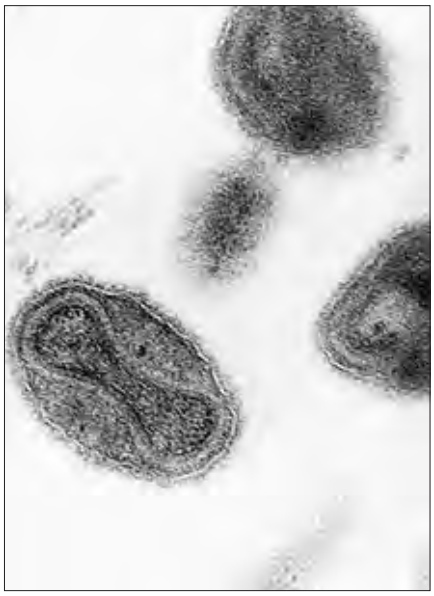
The most recent cholera pandemic (worldwide outbreak) began in Asia in 1961. It spread to Europe and Africa and, by 1991, to Latin America, where there had been no cholera for more than 100 years. This outbreak has killed thousands of people and continues to spread. Cholera can be a risk for anyone traveling to places where outbreaks are occurring.



Smallpox

Red (round) and white (knobby) blood cells. CDC\7320 J. Carr.

Smallpox has been in the news quite a lot recently. Maybe you heard about it first after the terrorist attacks in 2001. Since then, there has been a lot of talk about the possible use of "biological weapons," including smallpox, to infect and even kill a large number of people.



This photograph reveals the internal structure of a smallpox virus. CDC\1849 F. Murphy, S. Whitfield.

An Ancient Nemesis

Smallpox is a very contagious disease caused by the Variola (smallpox) virus. Scientists believe it originated in humans in India or Egypt more than 3,000 years ago. Since then, smallpox has been one of our deadliest diseases. Smallpox epidemics once spread throughout entire continents. (An epidemic is a widespread outbreak of a disease.) Many of those who got smallpox died, and some those who survived were blinded and physically marked by the disease with scars.

The name, "smallpox," refers to the bumps that infected people get on their faces and bodies, and in their throats, mouths and noses. There are two common forms of smallpox: Variola major and Variola minor. (The word, "variola," comes from the Latin word for "spotted.") Both forms lead to sores on the skin, fever, headache and other flu-like symptoms. However, Variola major is a far more deadly disease. It is estimated that 30% of the people who have caught this illness have died.

Smallpox affects only humans. It does not make animals sick, and it is not transmitted by insects. There is no cure for smallpox, but there now is a vaccine that can prevent infection, even up to four days after a person has been exposed to the Variola virus. However, some people should not get the vaccine, including pregnant women and people with skin problems, a weakened immune system or some other medical problems.

Chicken pox is not a mild form of smallpox. Although it causes similar (but less disfiguring) sores, it is caused by a different virus.

It's in the Air

Most often, smallpox is transmitted when a person infected with the disease sneezes or coughs near someone else. If the infected person has a fever and rash, he or she is able to spread smallpox to others until the very last blister heals. The disease is easiest to spread during the 7–10 days after the rash first appears. Although smallpox is deadly, it takes direct and fairly prolonged face-to-face contact to spread smallpox to another person.

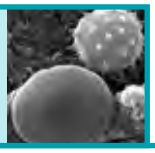
It also is possible to catch smallpox from contaminated objects, such as blankets or clothing. In very rare cases, smallpox has been spread through the ventilation systems of buildings, trains and other closed places.

Shown above, the *Vaccinia* vaccine can prevent infection from smallpox. It does not contain the smallpox virus. CDC\2676 J. Gathany.

Usually, it takes 12–14 days for a person who has been exposed to smallpox to be able to spread the disease. During this time, the virus is multiplying inside the person and usually causes no symptoms.

Some Risk Remains

Following a worldwide vaccination program, smallpox was eliminated globally by 1980. The last U.S. case was in 1949. But smallpox still exists in laboratories, so it is possible that another outbreak could occur. Since the disease has been eradicated (eliminated) for more than 25 years, almost no one has been vaccinated against it recently. Therefore, very few people have immunity. If there is an outbreak, it might not be possible to vaccinate every person exposed to smallpox in time to prevent them from being infected. This combination of factors makes any future smallpox epidemic extremely dangerous.



Red (round) and white (knobby) blood cells. CDC\7320. J. Carr.

DISEASE INFORMATION

HIV/AIDS

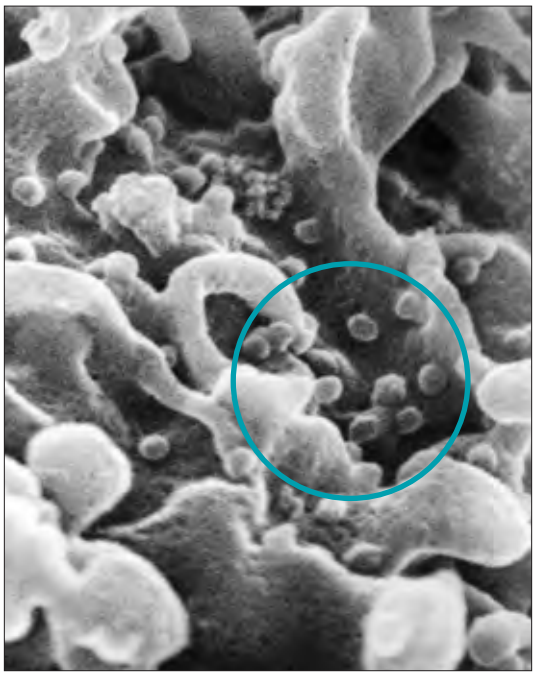
Everyone has heard of HIV and AIDS. You might even know someone infected with HIV. But what, exactly, is HIV? What's the difference between AIDS and HIV? And why is it important for you to know about it?

The Difference Between HIV & AIDS

HIV (human immunodeficiency virus) is the very serious—and always deadly—virus that causes the disease called AIDS (acquired immunodeficiency syndrome). Scientists and doctors aren't sure exactly when or where the HIV virus developed, but they know it has been present in the U.S. since the late 1970s. They also know that the HIV virus kills specialized blood cells needed by the body's immune system to fight disease.

Over time, as the virus kills more and more of these blood cells, people who carry the virus (referred to as HIV-positive) lose the ability to battle infections and diseases. People infected with HIV often develop specific illnesses or types of infections associated with this virus. At that point, they are considered to have AIDS. Microbes that might not make another person sick can be life threatening for people with AIDS, because their immune systems are weakened.

A simple blood test can show if a person has the HIV virus. On the other hand, doctors have to look for specific symptoms, such as a decrease in the number of certain blood cells, to determine if a patient's illness has progressed to AIDS. It may take years for these symptoms to appear or for a person to begin feeling ill, so HIV is considered to have a long incubation period (length of time between when the disease-causing microbe enters the body and when symptoms develop). Thus, it is possible for someone to have the virus in his or her body and not know it. All the while, this person could be spreading HIV to others.



The multiple round bumps are pockets with HIV virus that have formed on the surface of a cell. CDC\C. Goldsmith, P. Feorino, E. Palmer, W. McManus.

Facts, Myths & Hope

You can become infected with HIV if you come in close contact with body fluids, such as blood, of someone who has the virus. Most often, HIV is spread through unprotected sex or by sharing needles for drug use. HIV-positive mothers can infect their babies during pregnancy or birth, or by breast-feeding. It also is possible to become infected if dirty needles are used when getting tattoos or piercings.

You cannot get HIV or AIDS through saliva, sweat or tears; from mosquitoes; or from an animal bite, such as from a dog or cat. Some animals can carry viruses that are similar to HIV, but these viruses do not affect humans.

Twenty years ago, about half of all people with HIV developed AIDS within ten years. But in the last decade, powerful new drugs have been created to slow the progress of HIV. Other medicines also are being developed to prevent or treat life-threatening AIDS-related illnesses. The side effects of treatment are very serious, but many people infected with HIV now are able live longer than they would have in the past.

A Universal Problem

Unfortunately, not everyone is able to get the new medicines, and millions of people continue to die from AIDS every year. By the end of 2003, more than 500,000 people in the U.S had died from AIDS—about as many people as live in Las Vegas or Oklahoma City. In 2006, about 2.9 million people around the world died from AIDS; 39.5 million people were living with HIV; and 4.3 million people became newly infected with HIV. Today, about one of every 300 Americans over the age of 13 is HIV-positive.

HIV doesn't care who you know, how old you are, how wealthy or poor you may be, the color of your skin, your gender, or your sexual orientation. If you do risky things, you may become infected. And once you're infected, you have HIV forever. While new drug treatments are helping some people with HIV live longer, more normal lives, there is no cure for this disease.