



**SPECIAL REPORT**  
**HIV-AIDS:**  
The Virus and the Epidemic



GOT QUESTIONS?

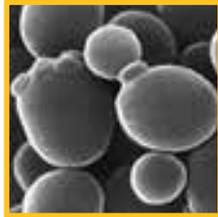
**Get the Facts**

X-PLORE  
X-TECH

**DEFENSE VS  
OFFENSE!**

**MICROBES  
ON THE MOVE!  
IT'S EPIDEMIC**

YEAST



BREAD MOLD



# MICRO MATTERS!

**How are the baker, bread and the microbes shown above related?**

(See box below for answer.)

The world around you is full of life. Besides everything you see, you are surrounded by countless tiny life forms called microbes. “Micro” means “small” and “bios” means “life.” Microbes are too tiny to see without a magnifier or microscope. They

drift in the air, grow on your teeth, rest on your desk and float in your milk.

Microbes are vital to life on Earth. Some microbes live off dead plants and animals, recycling the remains into soil. Other microbes take in carbon

and nitrogen from the atmosphere, and make them available as food or nutrients for other living things. Some microbes are used in food production. Microbes inside

your intestines live off the food you eat and at the same time, help with digestion and manufacture substances needed by the body, such as one form of Vitamin K. These are helpful microbes.

However, some microbes cause diseases in humans and other organisms, such as plants. Living things that cause diseases are called pathogens, from the Greek words, *patho* (disease) and *gen* (producing). Some pathogens are quite large, such as tapeworms, which are parasites that can live in the intestines. Most pathogens, however, are tiny microbes, and are classified as bacteria, fungi, protists or viruses. These tiny pathogens also are called “germs.”

Pathogens cause infectious diseases, which are diseases that can spread from one person to another. Some pathogens are harder to contract than others. Some make you a lot sicker than others. When a widespread outbreak of a disease occurs, it’s called an epidemic, from the Greek words *epi* (upon) and *demos* (people).

## Your Microflora

Bacteria live inside your body and on your skin. You have at least 10 times more bacterial cells inside and on you than cells of your own body. The many different kinds of bacteria that you have are your “microflora.”



## HEY, WHAT HAVE YOU HEARD ABOUT THESE CDS?

We’re talking about Communicable Diseases—

not compact disks! See how much you already know by circling T for True or F for False on the items below. Then, as you read through this magazine, you should be able to spot the correct answers. After you’ve finished reading, come check to see how many you got right (bottom).

- T F 1. Communicable diseases are spread from one person to another.
- T F 2. An epidemic is the needle used for giving a vaccine.
- T F 3. Some pathogens spread easily through the air.
- T F 4. Health inspectors test food for microbes.
- T F 5. Germs in human body fluids sometimes can spread disease.
- T F 6. Magnifiers block light to make things look bigger.
- T F 7. Your body has a built-in immune system to fight disease.
- T F 8. Vaccines work by using your body’s immune system.
- T F 9. You can prevent the spread of communicable disease.
- T F 10. HIV attacks the immune system.

### THE BAKER, BREAD AND MICROBES

The baker used yeast (above left) to make the bread. After a few days, bread mold (above right) will feed and grow on the bread.

**Bonus:** Healthy bacteria (image at the very top) living inside the baker’s intestines will help digest any bread he may eat.

# Microbes on the Move!

## AIR

Some germs are spread through the air. The virus that causes the common cold can spread when someone sneezes near another person. That's why you always should cover your nose and mouth when you sneeze or cough.

## FOOD AND WATER

Food and water can carry pathogens, especially ones that cause diseases in the stomach and intestines. These illnesses usually spread because waste materials from people and animals mix into food and water supplies. In the United States, the public water supply is tested and treated to prevent



diseases from spreading. Health regulations require people who prepare and serve food and beverages to wash their hands with soap and water, and to follow safe food handling practices. Even so, it's always a good idea to wash your hands with soap and water after visiting the restroom and before cooking food or eating.

## CONTACT INFECTION

Germs in human body liquids like blood or saliva, or from infected sores, can spread diseases. These microbes spread by touch or direct contact.

You also can pick up germs by touching things that have body fluids or microbes on them. That's why it's not good to chew your friend's ABC (already been chewed) gum. *Yuk!*

Microbes are everywhere—and the best defense is a good offense. ✕



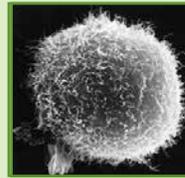
**It's Not Just Food.** Did you know you can catch *Salmonella* from contact with turtles, lizards, frogs and other reptiles?

# Defense vs. Offense!



Your body has several ways to protect against and fight germs. Your skin and the moist linings of your body's inside surfaces like your nose, eyes and mouth are the first lines of defense. They work by keeping potential invaders outside the body. Next, there are germ-killing proteins in your tears and saliva to help keep invaders from getting any farther.

If pathogens get past these defenses, your body has a built-in system—called the immune system—to find and



**A white blood cell.**

destroy microbes. This billion-cell army always is on guard. The soldiers of the immune system are several dozen different kinds of white blood cells. Each type of white blood cell has a special job. Some will attack any foreign particle in the body. For instance, "eating" cells gobble up any infected cells or invaders in the bloodstream. Other white blood cells target and destroy specific invaders. Some of these specialized cells make products called antibodies that help tag the invaders so they can't get into new cells or multiply in the bloodstream.

Vaccines use the body's immune system to protect against diseases such as polio, measles and tetanus. Vaccines contain dead or weakened microbes, which are recognized and attacked by the immune system as invaders. The immune system "remembers" information about the weakened microbe in the vaccine, and later is able to fight off future infections—even if a new invader is a much stronger version of the one that was contained in the vaccine.

## THE TINIEST OF TRAVELERS . . .

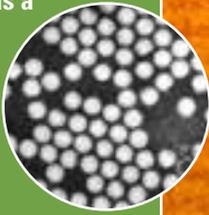
With family and friends, you can demonstrate one way microbes travel from person to person. You will need:

- One teaspoon of glitter (any color) in a small plastic bag
- A group of friends and family

Pour a teaspoon of glitter into a plastic sandwich bag. Only you know that the glitter represents "bacteria and viruses." Put your hand inside the plastic bag and wiggle it around. Take your "shiny" hand out of the bag and shake hands with two people. Then have them shake hands with two or three more people. These people should also shake hands. When everyone has had a handshake, ask them to check their hands. Surprised? Everyone and everything you touch has microorganisms on it. Some of these can make you sick. That's why it's a good idea to keep your hands clean. ✕

# It's Epidemic

**POLIO**, an ancient disease caused by a virus, became a serious threat to humanity during the first half of the 20th century. Though not often fatal, polio injures or destroys nerve cells that control muscles, leading to paralysis. Franklin Roosevelt had the disease as a young adult and often wore leg braces or used a wheelchair to get around.



When he was President of the U.S., he led a national effort to develop vaccines for many illnesses. Polio was eventually eliminated from the U.S., and most of the world, but still affects children and adults, particularly in Afghanistan, India, Nigeria and Pakistan.

Poliovirus: CDC/1875-Dr. F. Murphy, S. Whitefield

**PLAGUE** has existed for a very long time. Caused by the bacterium, *Yersinia pestis*, plague is transmitted by fleas that have bitten infected rodents.



Contact with infected fluids or airborne droplets containing bacteria also spreads the disease. One form of plague, called Black Death, occurred during the Middle Ages (1300s). It claimed about 25 million lives in Europe, or one of every four people, in just four years. As many as 3,000 cases of plague are reported world-wide each year.

*Yersinia pestis*, Oregon State Public Health Laboratory, CDC/1978, J. Stauffer

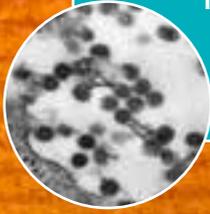


*Mycobacterium tuberculosis*, CDC/9997, J. Carr

Evidence suggests that **TUBERCULOSIS (TB)** first appeared in ancient Egypt and was common in ancient Greece and Rome. It wasn't until 1882, however, that the bacterium that causes TB was seen under a microscope. TB spreads from one person to another through sneezing or coughing, which puts TB bacteria in the air. TB usually infects the lungs. In the 1940s, scientists discovered the first of several drugs now used to treat TB. For a while, TB began to disappear in the United States. But TB has come back. About 12,000 new cases are reported each year in the U.S. Of all the infectious diseases in the world today, TB kills the most people, and is a leading killer of people with HIV.

X-Files Magazine, Vol. 01 © Baylor College of Medicine

**MEASLES** is a highly contagious virus that is transmitted by coughing, sneezing and even talking. The first vaccine was developed in the 1960s, then later was improved. It gives lifelong resistance to about 95% of those who receive it, and is given to children when they are 9–15 months old. However, there are still more than one million children in the world who die each year from measles.



Rubella virions. CDC10221 Dr. F. Murphy, S. Whitfield

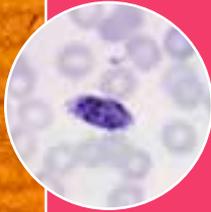
During World War I, a pandemic of **INFLUENZA** (flu) occurred. In 1918–19, soldiers traveling across the states and overseas transported the virus back and forth around the world. Thousands died, not by gunfire, but from the effects of the flu virus. In the U.S., whole towns were kept isolated until the disease ran its course.



Flu killed 25–40 million people in two years. While there is no drug today that will cure flu, there is a vaccine to help prevent it. The vaccine does not always provide complete protection, however, because the virus continues to mutate, or change. H1N1 is an example of a new variety of flu.

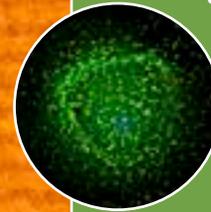
Influenza virion. CDC10073 Dr. F. Murphy

**MALARIA** is caused by protozoans (free-living single celled organisms) that are passed on to people by mosquito bites. Since the 1600s, quinine, made from the bark of the cinchona tree, has been used to treat malaria. Researchers have since developed other medicines that relieve the first attack of malaria. But there still is no effective vaccine. Experts estimate that malaria kills close to one million people every year, and that about 200 million persons currently suffer from it. There are about 1,500 cases in the U.S. each year.



Plasmodium ovale. CDC6844 S. Glenn

**AIDS** is another killer that appeared in the 1980s. People with AIDS have developed problems with their immune systems. As a result, they can suffer from several diseases

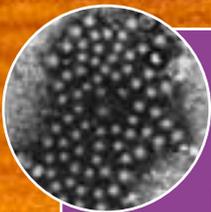


at once, including tuberculosis and some cancers. Since HIV, the virus that causes AIDS, is transported through body fluids, personal behavior in our society today is being shaped in response to this epidemic.

HIV particles assembling at the surface of an infected macrophage. Gross, L. (2006) Reconfirming the Traditional Model of HIV Particle Assembly. PLoS Biol 4(12): e445. doi:10.1371/journal.pbio.004445. Creative Commons License 2.5.

## DIFFERENT ORGANISMS RESPONSIBLE FOR EPIDEMICS THAT KILLED MILLIONS OF PEOPLE – AND CHANGED HISTORY – CONTINUE TO AFFECT THE WORLD IN WHICH WE LIVE.

The **HEPATITIS C virus (HCV)** was first identified in 1988, and nearly 3.9 million Americans are infected today. Caused by a virus that inflames the liver, 75% of people infected with HCV will remain infected for life. The infection is spread by behaviors, such as needle sharing, which involve contact with the blood of infected people. There is no vaccine currently available, so the best prevention is avoiding risky behaviors.



Hepatitis virions. CDC8153

The **SMALLPOX** virus shaped history in the Americas. Beginning in the 1500s, European explorers brought smallpox to the New World, where it destroyed more than 1/3 of the native population. Smallpox is transmitted mainly through direct contact with sores, body fluids and contaminated clothing. The first vaccine ever used was invented over 200 years ago by William Jenner, an English physician, to prevent smallpox. Since that time, great efforts have been made to eliminate smallpox through vaccination. According to the World Health Organization, the smallpox virus no longer exists outside of labs in the U.S. and Russia, where it is kept for research purposes.



Smallpox virions. CDC11849 Dr. F. Murphy, S. Whitfield



# PLAY SAFE!

*Think Michael asked his friends how to keep himself safe before jumping out of a plane?*

*Of course not. Michael learned how to sky dive safely from professionals before he jumped.*

*Don't jump blindly into any situation.*

*Learn. Consider your options.*

*Then decide what is best for you.*

# HIV/AIDS: the Virus and the Epidemic



*Everyone has heard of HIV and AIDS. You might even know someone infected with the virus called 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 answer to the last question is simple: What you don't know can kill you.*



## **The Difference Between HIV and AIDS**

HIV (human immunodeficiency virus) is the very serious virus that causes the deadly illness called AIDS (acquired immunodeficiency syndrome). HIV originated from a

related virus found in west-central African chimpanzees. How the virus transferred to humans is not known. But it is likely that the virus “jumped” to a human during the butchering of chimpanzee meat for food. During the infection process, the virus mutated into the strain we call HIV.

HIV kills specialized white blood cells, called CD4+ cells, needed by the human body's immune system to fight disease. These cells send signals that activate the immune system when they detect “intruders,” like viruses or bacteria.

An HIV virus particle cannot reproduce on its own. Instead, it invades and takes over the internal machinery of a CD4+ cell to produce and release new virus copies into the body.

Some people with HIV do not experience any symptoms and may feel healthy for several years after being infected. But over time, as the virus becomes active, it kills more

and more CD4+ blood cells.

People who carry the virus are referred to as being “HIV-positive.” Eventually, they lose the ability to battle infections and diseases. People infected with HIV often develop specific illnesses or types of infections associated with this virus. When this happens, they are considered to have AIDS, which is the late stage of HIV infection.



**Only condoms offer protection against HIV, and even condoms do not provide complete safety.**

Microbes that might not make another person sick can be life threatening for people with AIDS, because their immune systems are severely damaged (or compromised).

*Continued*



**In 2007, 29% of all newly diagnosed HIV/AIDS cases in the U.S., were in persons between 13 and 29 years of age.**

A simple blood test can show if a person has the HIV virus. However, doctors must look for specific symptoms, such as a decrease in the number of certain blood cells, to determine if a patient's illness has progressed from an HIV infection to AIDS. Since it may take years for these symptoms to appear, or for a person to begin feeling ill, HIV is considered to have a long incubation period (length of time between infection by a disease-causing microbe and the appearance of symptoms). Thus, it is possible for someone to have the virus in his or her body without knowing it. All the while, this person could be spreading HIV to others.

### **Facts, Myths and 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 by dirty needles 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 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. Unfortunately, not everyone is able to get the new medicines.

Every year, millions of people become infected with HIV. Millions more die from infections associated with AIDS. In 2008, the number of people living with HIV/AIDS worldwide continued to grow, reaching an estimated 34 million people, with 2.7 million people becoming newly

infected with HIV. The highest proportion of new HIV infections in the U.S. are occurring among African Americans, and among women and adolescent girls from all ethnic groups.

Ultimately, HIV doesn't care who you know, how old you are, how wealthy or poor you may be, where you live, the color of your skin, your gender, or your sexual orientation. If you do risky things, you



**Preventive safety measures and early detection of the virus is the only way to protect yourself and stop the spread of HIV/AIDS.**

may become infected. And once you're infected, you have HIV forever. While new drug treatments are helping some people with HIV to live longer, more normal lives, there is no cure for this disease. Preventive safety measures and early detection of the virus are the only ways to protect yourself and stop the spread of HIV/AIDS. **X**

Sources: Centers for Disease Control and Prevention, National Institute of Allergy and Infectious Diseases, World Health Organization.



***Pssssssssst!***  
by Barbara Tharp

I heard it from a friend, who heard it from a friend,  
who heard it from a friend . . .

Have you ever played a game where you pass the message from person to person around the room? If so, you might have noticed that the message often changes as it goes around, and that by the end, it's not what it started out to be! Sometimes, it can be pretty funny to see how the message gets twisted.

Gossip is a lot like that, except that in real life, gossip can hurt. That's because gossip usually is about something personal or private. Sometimes, the story is true, but often, it is a lie or exaggeration.

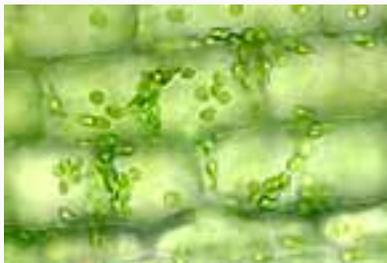
Even if it is true, gossip normally is something a person would rather not have others know. If anyone ever has gossiped about you, you know how this feels. You can stop the gossip—just don't pass it on. Remember, it could be *you* next time!

# HOW DOES IT WORK?

## microscopes

Microbes are too small to see with the naked eye. You need a microscope to observe these tiny life forms.

When you look through a microscope, lenses make



The *Elodea* plant (top photo) is an important part of lake ecosystems. It provides a habitat for many aquatic organisms, and is an important food source for waterfowl. The microscopic image (lower photo) is the *Elodea* plant magnified 1,000 times (1,000x).

what you are looking at appear larger. With the right combination of lenses, objects can be magnified as much as 2,000 times using a light microscope. Electron microscopes, which are more powerful, can magnify objects up to a million times.

The “power” of a magnifying lens is the measure of how much larger it makes something appear. Simply put, a 10-power lens (10x) makes objects appear ten times larger than they actually are.

In the world of microbes, protists are relatively large in size. Most protozoans only have to be magnified about 100 times (100x) to be seen. Bacteria are made of only one simple cell and are much smaller than protists. Most bacteria have to be magnified at least 1,000 times (1,000x) to be observed.

Viruses are the tiniest microbes. They are not able to grow and reproduce on their own. Viruses invade cells and, once inside, force them to manufacture more viruses. Most viruses have to be magnified around 250,000 times to be visible. The image of a cell with HIV particles (right) was taken with a transmission

electron microscope, which shines light through a specimen. At 6,000x, the virus particles look like dots.

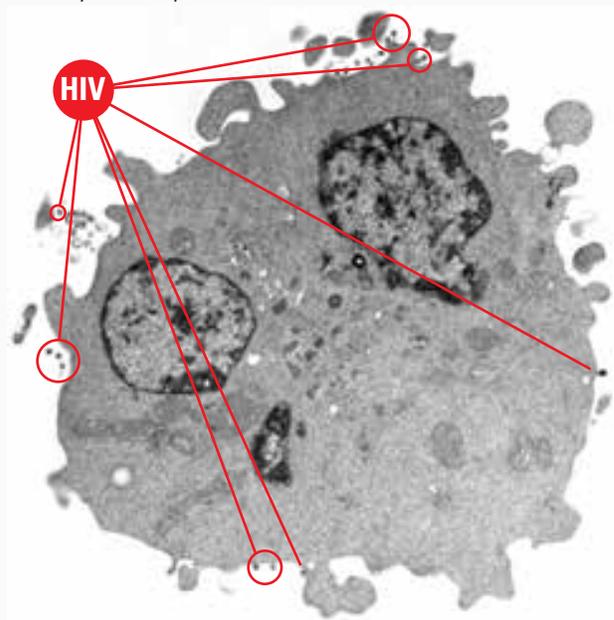
## scanning electron microscopes (SEMs)

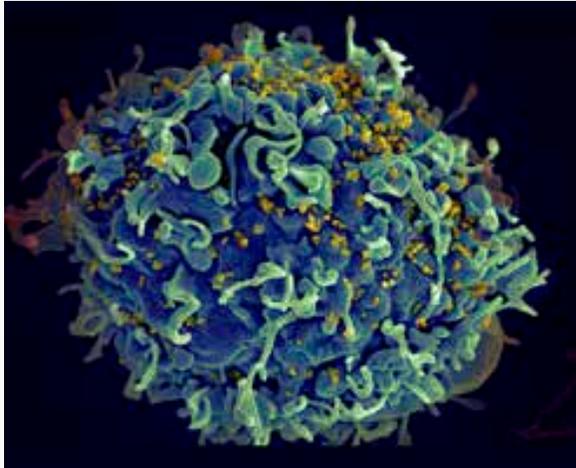
Medical researchers and other scientists today have powerful tools for observing and studying microbes. One such tool is the scanning electron microscope, or SEM.

This type of microscope uses electrons to view and photograph structures too tiny to be seen with an ordinary light microscope. It allows scientists to see three-dimensional aspects of infectious agents, living organisms and nonliving surfaces.

To create the images, a filament inside an electron “gun” shoots a beam of electrons down through a stack of electromagnetic lenses onto a specimen, held in a vacuum chamber below. The beam continually scans

The transmission electron micrograph image (below), taken at 6,000x, is of a blood cell infected with HIV. Notice how tiny each HIV virion is compared to the cell! It would take 800 HIV particles side-by-side to equal the thickness of a human hair.





This is a colorized SEM microscope image of a single HIV-infected human blood cell. The HIV virus is shown in yellow.

across the sample, which responds by emitting electrons from its own surface. These are collected by a detector inside the sample chamber.

This process results in a simultaneous recreation of the sample's surface on a viewing screen. With the twist of a dial, or the wiggle of a mouse (in newer models), the specimen's contours can be explored in any magnification, from about eight times the actual size up to hundreds of thousands of times—as much as a million times!

Watching the image on the screen is like looking out the window of a plane. The landscape “below” continually changes as your “plane” flies above or around it, zooming in and out or hovering for a photo.

Other research instruments can be attached to the SEM to extend the range of information a specimen can yield. One tool produces a spectrum of elements present in a given sample. Software programs are utilized to further analyze a sample's size, shape and other physical characteristics.

Most modern SEMs are controlled by computer software, and require samples to be dry and coated with a thin film of gold. Some SEMs also can vary the pressure in the sample chamber, or even introduce water vapor. This makes it possible to observe fresh samples (like medical tissues) in their natural state and introduces the dimension of time. For example, crystals now can be seen dissolving and resolidifying in real time.

Microscopes like the SEM have allowed researchers to see the external and internal appearance of microbes. Still, scientists and engineers continue to develop more powerful SEMs and other tools, including new microscopes that allow us to see cells at the subatomic level. These advancements in microscope technology will help solve a host of medical problems.

## cutting edge tools

Today, cutting edge tools and techniques enable scientists to isolate and examine things as small as individual virus particles and their components. The image to the right is of a high resolution electron microscope.

Joanita Jakana and Matthew Dougherty, of the National Center for Macromolecular Imaging at Baylor College of Medicine (below), look at two virus images obtained using the electron microscope. The virus image on Joanita's left monitor was taken directly from the microscope. On the right monitor is a 3-D structural composite of the virus, created with specialized software developed by Mr. Dougherty.



The National Center for Research Resources, National Institutes of Health, supports several centers dedicated to visualizing 3-D structures within cells and viruses (<http://www.ncrr.nih.gov>). X

# GET THE FACTS!



get the facts

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