

DISEASE CAUSING MICRO-ORGANISMS

What are disease causing micro-organisms?

How many times have we been told to wash our hands before sitting down at the supper table or after touching money and other dirty surfaces? By washing up we think that we're clean and microorganism-free. We have baths, cook our food, treat our sewage and even cover our mouths when we cough and sneeze to prevent the spread of those tiny dirty particles that could make us sick. What many people don't realize is that even after doing all of these things, we are still far from being clean. The number of microorganisms living on and in us is about ten times higher than the number of cells that make up our entire body! Before you try and scrub away those tiny organisms all over your skin, consider that most of these microorganisms are essential to our health.



Disease-causing microorganisms, however, are another matter entirely. They use simple tricks to enter our bodies so they can cause disease. These germs have been studying ways to trick the human immune system for a long time because getting past the body's defences is key for their survival. We may even learn a thing or two about the **immune system** by studying them. Who knew we could learn from something so small?

(All **bolded** terms are found in Glossary at end of this sheet).

What is a microbe?

A microbe – another word for a microorganism – is a tiny individual living thing that is way too small to be seen by the human eye alone. The only way this tiny organism can be seen is by using a microscope. This is why microbes are often called “microscopic organisms.” These organisms are found almost everywhere you can think of here on Earth – in air, water, soil and rock, and even in plants, animals and the human body. Some microbes can live in very hot temperatures, and others can live in the freezing cold. Some need oxygen to grow and stay alive, like you or I, while others survive without it. Below is a list of some good microbes that are found in our bodies.



MICROBES IN THE HEALTHY HUMAN BODY*

Microbe found in:

Ear (outer)	Aspergillus (fungus)
Skin	Candida (fungus)
Small intestine	Clostridium
Intestines	Escherichia coli
Vagina	Gardnerella vaginalis
Stomach	Lactobacillus
Urethra	Mycobacterium
Nose	Staphylococcus aureus
Eye	Staphylococcus epidermis
Mouth	Streptococcus salivarius
Large intestine	Trichomonas hominis (protozoa)

*A selection of usually harmless microbes, some of which help keep our bodies functioning normally. If their numbers become unbalanced, however, these microbes may make us sick. All are bacteria, unless otherwise noted.

Source: <http://www.niaid.nih.gov/publications/a>

While some microbes play an important part in our daily lives by keeping us healthy, others are nothing but bad news. These “bad-news” microbes are called disease-causing microbes and can make humans, animals and plants sick by causing infection and disease. Most microbes belong to four major groups: bacteria, viruses, protozoa or fungi. (To find out more, see the “Bacteria/Viruses/Protozoa” fact sheets). Disease-causing microbes can also be called pathogens, germs or bugs and are responsible for causing infectious diseases. They can also contribute to chronic diseases and conditions, and are now being linked with **coronary artery disease, diabetes, and certain types of cancer, multiple sclerosis and chronic lung disease.**



Microbes – the ones that make us sick.

Infectious diseases caused by disease-causing microbes are responsible for more deaths worldwide than any other single cause! Scientists are working hard to find ways that will control these germs but trying to defeat them is not an easy task. Disease-causing microbes are very good at adjusting to new environments making it hard to find a way to get rid of them. Microbes can quickly develop new features that make them resistant to the drugs that were once able to kill them. This means scientists must try and stay one-step ahead, even though it is hard to do. New diseases caused by recently discovered pathogens are also being identified at an increasing rate. In the past 30 years about 30 new pathogens have been identified!

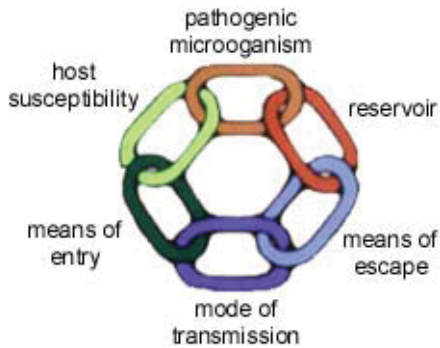
Common Diseases and Infections with their Microbial Causes				
	Bacteria	Fungus	Protozoa	Virus
Athlete's foot	-	▲	-	-
Chickenpox	-	-	-	▲
Common cold	-	-	-	▲
Diarrheal disease	▲	-	▲	▲
Flu	-	-	-	▲
Genital herpes	-	-	-	▲
Malaria	-	-	▲	-
Meningitis	▲	-	-	▲
Pneumonia	▲	▲	-	▲
Sinusitis	▲	▲	-	-
Skin diseases	▲	▲	▲	▲
Strep throat	▲	-	-	-
Tuberculosis	▲	-	-	-
Urinary tract infection	▲	-	-	-
Vaginal infections	▲	▲	-	-
Viral hepatitis	-	-	-	▲

Source: <http://www.niaid.nih.gov/publications/a>

How microbes infect us – The Basics

How do we actually get infected with a disease-causing microorganism? Here’s the scoop!

Everyday we come into contact with people or animals that may be infected with disease-causing microbes. This puts us at risk of being exposed to disease.



Becoming infected depends on the link between the pathogen, the environment and the host - the host being you or I. The infection method may be thought of as six different steps that all join together to form a circular chain.



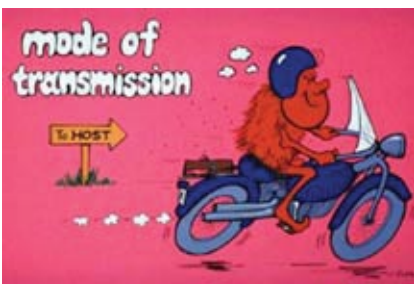
1. The process begins with a certain disease-causing microbe being present. It is the first link in the chain.



2. The second link is the reservoir, the environment where the pathogen can survive. Examples of a reservoir include water, soil and inside someone who is already infected with the germ.



3. Having a way to escape from the reservoir makes up the third link. If we are the reservoir, the pathogenic microorganism can escape when we cough or sneeze.



4. The fourth link of the chain is the mode of transmission from the reservoir to the host. If water is the reservoir, its mode of transmission could be our drinking water supply.



5. To cause infection, the pathogen must find a way inside the host. Finding a means of entry is the fifth link. A pathogen in water would enter us if we drank the water it was in. A pathogen in the air would enter us if we inhaled it.



6. The final link of the chain is how susceptible the host is to infection. Depending on the germ and the disease it causes, some hosts will be easier to infect than others.

For infection to occur each step has to be completed. If even one link of the chain is broken, the process will be interrupted and no infection will occur. For example, the chain could be broken at link four, mode of transmission, or link six, host susceptibility. *Both are shown here* ▶



How microbes infect us – The Specifics

Every type of germ has its own way of sneaking inside you to make you sick. By figuring out how germs infect us we have a better chance of avoiding infection in the future. Germs can be spread in many different ways. They can travel through the air, pass directly from person to person, are present on surfaces contaminated by someone who is infected and be spread by someone who may not even know they're sick. To find out more about the ways these bad bugs cause infection, keep reading!

Just how can microbes travel through the air? It's not as hard as you may think. When someone coughs or sneezes without covering his/her mouth germs can spread everywhere! If you have a cold and cough without covering your mouth, your germs will travel through the air to where someone else may breathe them in. This gives the germs access to another host it can infect and is the most common way to get infected with cold and flu viruses or the bacterium that causes tuberculosis. When we think about how many times we see people cough or sneeze without covering their mouth, it's easy to understand why so many people get sick during the cold and flu season, or why tuberculosis is known for being so contagious.

Besides traveling through the air, there is another way germs are passed from person to person and it involves close, personal contact. How does this type of transmission work? Well, we have more than 500 types of microbes living in our mouths at this very moment. That's a lot of microbes! Some of these microbes are good, while others are – you guessed it – the disease-causing kind. One way these microbes get passed from one person to another is by kissing. Another way is by direct contact through sexual intercourse.

Touching objects or surfaces that have been dirtied with germs is a way of being indirectly exposed to disease-causing microbes. This commonly occurs by accidentally passing feces from your hands to your mouth or the mouths of others. Sound confusing? Let's look at an example. Let's say someone is sick with a type of bacteria that causes diarrhea. They use the bathroom often but don't take the time to properly wash their hands each time. Their hands are now contaminated with the bacteria and when they touch another surface, like a telephone or the TV remote control, it becomes contaminated too. When someone else comes along and uses either of these things, the bacteria will transfer to their hands making them contaminated. If the newly contaminated hands are not washed before the person touches their mouth, the bacteria will have a way inside that person and be able to cause infection. This is what we call fecal-oral transmission. An important fact to remember is that indirect transmission may also occur in a more direct way. Something as simple as shaking hands with someone who coughed or sneezed on the same hand you're shaking will pass the germs. Indirect spread is not limited to diarrheal illnesses – it is possible to pass different types of germs this way. This type of transmission is common in daycare centres because there are many children who are in contact with each other and with objects that may be contaminated, and we all know how much young children like putting things in their mouths!



Different germs and the infections they cause

When it comes to germs, there is nothing predictable about them. Not only do they infect you in different ways, they can also cause different sorts of infections. These infections are divided into three different groups based on the length of time they make you sick. Each infection type is explained below.

Acute infections last for a short amount of time and can be severe. These infections cause symptoms such as tiredness, muscle aches, coughing and sneezing. An example of an acute infection is the common cold. Acute infections last about two to twenty-four days with the average infection time being about one week.

Chronic infections last anywhere from days to months to a lifetime and usually develop from acute infections. Sometimes people with chronic infections may not even know they're infected because they won't have any symptoms. An example of chronic infection is **Hepatitis C**. Most people with Hepatitis C don't even know they're infected and recovery is rare. About 85% of infected people become chronically infected with serious signs of liver damage not appearing until at least 20 years after the infection begins.

The symptoms of a **latent** infection may or may not come back after the initial symptoms have disappeared. Latent infections are unique because they may "wake-up" and reactivate anytime after the infection appears to have gone away. They can go from being inactive to active and back again for months or years. In an active state, the germs can spread and infect other people, but once in an inactive state, the germs remain hidden inside the body without effect. An example of a latent infection is the chickenpox. After the initial infection, the virus will hide in the body and may appear again years later to cause the painful disease commonly known as **Shingles**.

How can I be safe from these germs?

To avoid getting or spreading germs you must get rid of them and there are different ways you can stop them in their tracks before they make you sick. Let's learn how!

Washing your hands is one of the easiest and most effective things you can do to get rid of germs. To make sure that all the germs on your hands are gone, you should briskly wash your hands with soap and water for at least 15 seconds – the same amount of time it takes to sing the alphabet or Happy Birthday. You should always wash your hands before making or eating food and after coughing, sneezing, blowing your nose, changing a diaper and using the bathroom.

There are also medicines called **vaccines** that will prevent you from getting sick. There are vaccines to prevent **measles, whooping cough, chickenpox** and meningitis. There are also vaccines for those who travel around the world to areas that may have some diseases that aren't common here. These vaccines will prevent infection with **yellow fever, polio, typhoid fever, hepatitis A, cholera, rabies** and other infections.

Our work has just begun...

It was once thought that with the invention of different medications and vaccines that science had won the war between humans and disease-causing microbes. We now know this isn't the case because new microbes and diseases are still being discovered and old microbes that were once thought defeated are re-emerging. Strange new diseases seem to appear out of nowhere, especially now that more people are traveling internationally. Environmental changes to a microbe can also make it a health threat to humans, creating an even bigger concern now that different issues like global warming seem to be taking effect. The battle between humans and disease-causing microbes is far from over... in fact; you may say its just beginning.

Want some more information? Check out these great websites!

<http://www.niaid.nih.gov>
www.sdnhm.org/exhibits/epidemic/naturalhistory.html

GLOSSARY

Acute (infection): severe, short-term illness that has a rapid onset.

Athlete's Foot: a contagious fungal foot infection that causes the feet to itch, blister and crack.

Autoimmune disease: when the immune system attacks our body's own cells, tissues and organs, thinking that they are unwanted invaders.

Cancer: any harmful growth or tumor caused by irregular and uncontrolled cell division; it may spread to other parts of the body through the lymphatic system or the blood stream.

Chickenpox: a very contagious viral infection that causes a blistering red rash.

Cholera: an acute infectious disease of the small intestine that causes frequent watery diarrhea, vomiting, muscle cramps and severe dehydration.

Chronic (infection): illness that lasts for a long time, or that shows a common reappearance.

Chronic Lung Disease: a long-term illness that affects the function of the lungs.

Coronary artery disease: the build-up of cholesterol in the inside layers of the arteries.

Diabetes: a metabolic illness characterized by excessive urine discharge and constant thirst. Known as: diabetes mellitus or diabetes insipidus.

Hepatitis A: an infection of the liver caused by a virus that is usually spread by swallowing infected food and water. It is also known as infectious hepatitis.

Hepatitis C: an infection of the liver caused by a virus that is usually spread by blood and blood products and sometimes through sexual contact.

Immune System: a system (including the thymus, bone marrow and lymphoid tissue) that protects the body from foreign substances and pathogenic organisms by producing an immune response.

Latent (infection): in a dormant or hidden stage. Also known as hidden or silent infections.

Lymphoid tissue: makes up the lymphatic system – the spaces and vessels between the body organs and tissues through which lymph circulates and removes bacteria and other unwelcome invaders from the body.

Malaria: an infectious disease that is passed to humans by female mosquitoes. It affects the red blood cells and has fever, chills and sweating as its symptoms.

Measles: an acute, contagious, infectious disease caused by a virus. It usually occurs in children and causes red spots on the skin, fever and inflammation of the air passages of the head and throat.

Meningitis: inflammation of the membrane that covers the brain and spinal cord, caused by either a bacteria (bacterial meningitis) or a virus (viral meningitis). Its symptoms are fever, vomiting, intense headache and stiff neck.

Multiple sclerosis: an autoimmune disease that affects the central nervous system – the brain, spinal cord and optic nerves. The fatty tissue that surrounds the nerves is lost in many areas leaving scar tissue behind. When the fatty tissue called myelin is missing, the nerves cannot do their job of passing signals to and from the brain, resulting in the symptoms that are associated with this disease.

Pneumonia: acute or chronic inflammation of the lungs.

Polio: a viral infection that attacks the nerve cells that activate the muscles, the brainstem (the base of the brain that connects with the spinal cord) and the spinal cord.

Rabies: an acute, infectious and often fatal disease that attacks the central nervous system (brain and spinal cord) and is passed to humans by the bite of an infected animal.

Shingles: a disease in adults caused by the same virus that causes chickenpox in children. It causes an inflammation of the spinal and cranial sensory nerve cells that will result in the appearance of blisters or cysts along the affected nerve path. It usually affects only one side of the body and causes sudden, severe attacks of pain.

Sinusitis: inflammation of a sinus or the sinuses, especially in the nasal area.

Strep Throat: a throat infection that causes fever and inflammation of the tonsils.

Thymus: a small glandular organ found behind the top of the breastbone. It's mostly made up of lymphatic tissue and is the site of T cell (a type of white blood cell) differentiation.

Tuberculosis: an infectious disease that is characterized by the formation of tubercles on the lungs and other tissues of the body. A tubercle is a nodule or swelling, especially a mass of lymphocytes (white blood cells) and epithelioid cells (cells that resemble epithelium) that form the wound of tuberculosis.

Typhoid fever: an acute, infectious disease caused by bacteria that is spread by contaminated food or water. Its symptoms include fever, headache, coughing, bleeding intestines and rose-coloured spots on the skin.

Urinary Tract Infection: an infection of any organ (kidneys, ureters, urethra) of the urinary tract (tract involved in the formation and excretion of urine).

Vaccine: a mixture made up of weak or dead disease-causing microbes that is given to prevent, improve or treat an infectious disease.

Whooping cough: a bacterial infection that has symptoms including runny nose, low-grade fever, inflammation of the eye membrane and a characteristic cough that ends in a 'whoop' caused by the forceful inspiration of air.

Yellow fever: an infectious tropical disease that is passed by mosquitoes. Those infected will have high fever, jaundice (a yellowing of the skin), black vomit, an absence of urination and bleeding in the digestive tract.