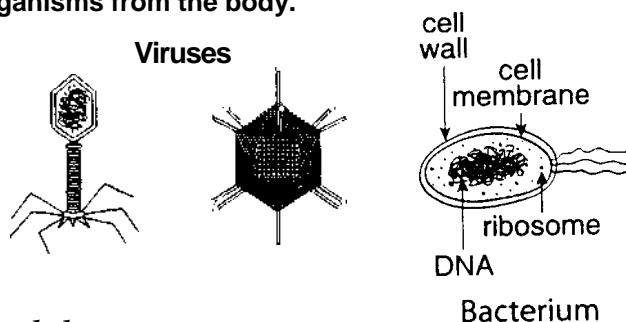


# The Immune System

The immune system maintains homeostasis by removing harmful microorganisms from the body.



## Keep in Mind

You can remember that *antibodies* are produced by the *body* and *antigens* are produced by *pathogens*.

## Key Knowledge

### **Diseases are caused by microbes and pathogens.**

A microbe is a microscopic organism. A pathogen is something that causes a disease. The Regents Exam uses both words to talk about bacteria, fungi, and viruses.

### **Viruses are not alive.**

Viruses cannot reproduce without hosts. Viruses inject their genetic material (DNA or RNA) into living cells and then use the cells' organelles to produce new viruses.

### **Bacteria can be harmful or helpful.**

Harmful bacteria may attack cells directly or produce toxins (poisons) that kill cells. Some useful bacteria help to digest food in the intestines, make bread and cheese, or break down dead organisms to make soil. Bacteria do not have membrane-bound organelles and their DNA floats loosely.

### **White blood cells fight pathogens.**

The immune system uses white blood cells to recognize, engulf, and digest foreign microbes.

### **Pathogens have specific antigens.**

Antigens are foreign proteins or sugars that are found on the membranes of pathogens. Virus-infected body cells produce antigens as well.

### **Antibodies recognize antigens.**

Antibodies are Y-shaped proteins released by white blood cells. When an antibody finds an antigen, it attaches to it and acts as a signal for other white blood cells to break down the pathogen or infected body cell.

### **Antibodies reproduce, and remember which results in immunity.**

When a specific antibody matches an antigen, white blood cells make more copies of this antibody to fight off that kind of pathogen. Years after the first infection, these antibodies are still produced by white blood cells, so that same pathogen cannot make the individual sick again.

# Immunity

Louis Pasteur and Robert Koch developed the germ theory of disease just over 100 years ago. Since then, scientists have developed vaccines and antibiotics that have wiped out many diseases in areas with good medical facilities.

## *Key Knowledge*

### Keep in Mind

Antibiotic resistance can become dangerous if it creates "super germs" that cannot be killed. Using antibiotic soap or taking a partial dose of a prescription antibiotic can expose bacteria to antibiotics without killing them, which can make the antibiotics ineffective against them later.

<b><i>Immunity</i></b>	Once people have fought off a certain virus or bacteria, they will continue making antibodies for it, so they cannot get it in the future. This is called immunity. Some viruses, like the flu, mutate so rapidly that people can get them each year. However, most people can only get chicken pox once because this virus does not mutate rapidly.
<b><i>Vaccines</i></b>	Vaccines contain weakened, altered, dead, or partial microbes. When injected into a person, the white blood cells respond to the antigens by making antibodies. The production of antibodies specific to this microbe then allows the body to protect itself from the real microbe in the future.
<b><i>Antibiotics</i></b>	Antibiotics are selective poisons that can hurt bacteria, but not body cells. For example, since animal cells do not have cell walls, an antibiotic that destroys bacterial cell walls would only harm bacteria. Antibiotics cannot affect viruses because they are not alive.
<b><i>Antibiotic resistance</i></b>	Bacteria reproduce very quickly and mutations accumulate in each generation. If bacteria are exposed to small amounts of antibiotics, most of them will die, but a few will have mutations that allow them to survive. When these mutated bacteria reproduce, their offspring will also be resistant to the antibiotics.
<b><i>Mother's milk</i></b>	When mothers breast-feed their babies, antibodies from the mother are passed on to the baby. These antibodies help infants fight off pathogens while their immune systems are still developing.
<b><i>Allergies</i></b>	Allergies are immune responses to harmless substances like flower pollen, perfume, or foods. The first time someone is exposed to antigens of substances that she is allergic to, her immune system makes antibodies to them. The next time she encounters the substances that she is allergic to, her body will produce an immune response like swelling, sneezing, and itching.