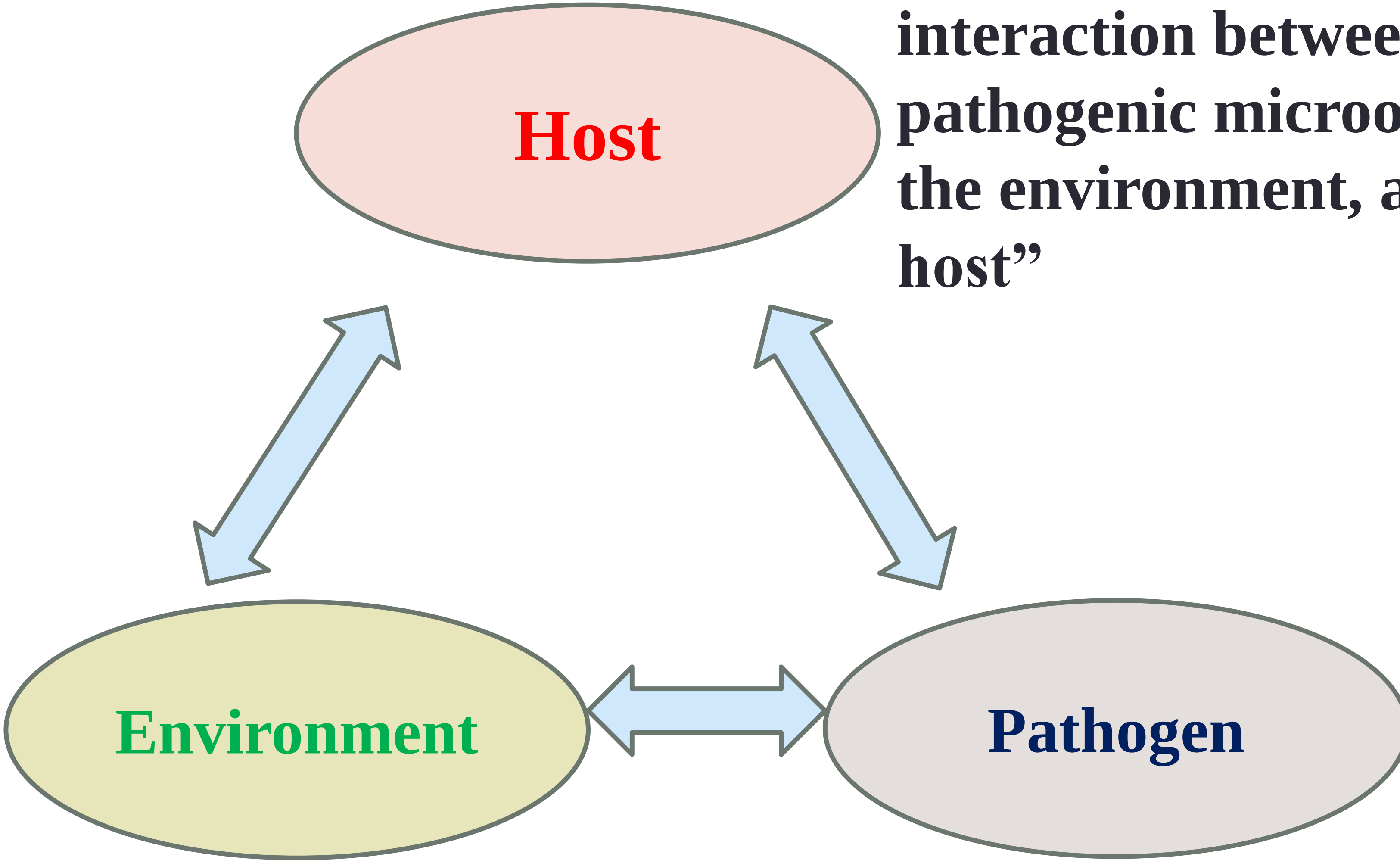
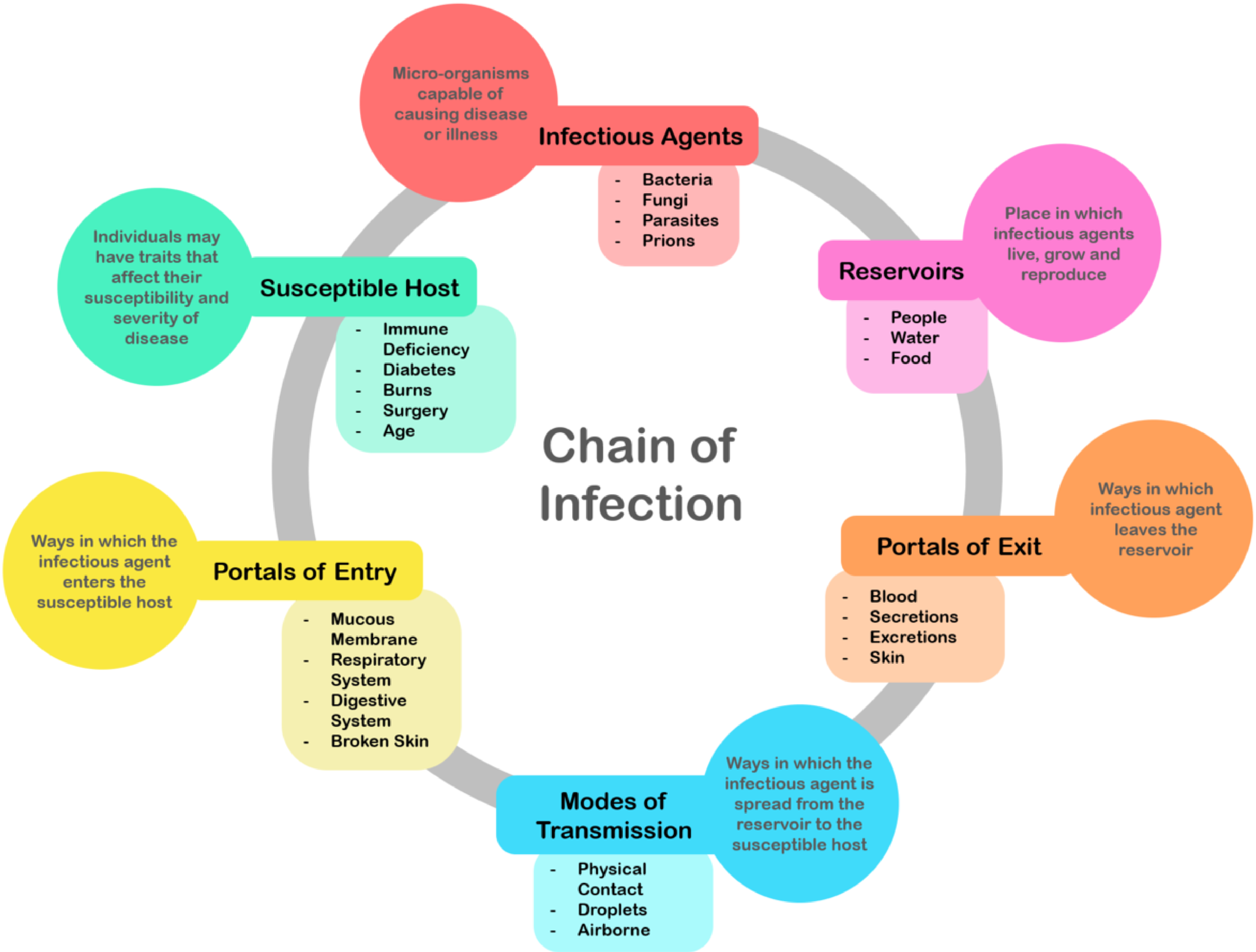
INFECTIOUS DISEASES

Infection is the invasion of an organism's body tissues by disease - causing agents, their multiplication, and the reaction of host tissues to these organisms and the toxin they produce. Infectious disease, also known as transmissible disease or communicable disease, is illness resulting from an infection.

"The infectious disease process refers to the interaction between the pathogenic microorganism, the environment, and the host"




Chain of Infection
Infectious Agents
Micro-organisms capable of causing disease or illness
- Bacteria
- Fungi
- Parasites
- Prions
Reservoirs
Place in which infectious agents live, grow and reproduce
- People
- Water
- Food
Portals of Exit
Ways in which infectious agent leaves the reservoir
- Blood
- Secretions
- Excretions
- Skin
Modes of Transmission
Ways in which the infectious agent is spread from the reservoir to the susceptible host
- Physical Contact
- Droplets
- Airborne
Portals of Entry
Ways in which the infectious agent enters the susceptible host
- Mucous Membrane
- Respiratory System
- Digestive System
- Broken Skin
Susceptible Host
Individuals may have traits that affect their susceptibility and severity of disease
- Immune Deficiency
- Diabetes
- Burns
- Surgery
- Age

Infections are caused by infectious agents including viruses, viroids, prions, bacteria, nematodes such as parasitic roundworms and pinworms, arthropods such as ticks, mites, fleas, and lice, fungi such as ringworm, and other macroparasites such as tapeworms and other helminths.

Infectious diseases are a major cause of human suffering in terms of both morbidity and mortality throughout human history.

The spread of infectious diseases was influenced by various steps in human civilization.

For example, parasitic and zoonotic diseases have become more common after domestication of animals, airborne viral and bacterial infections after large settlements and urbanization. Throughout the ages, humanity suffered from large pandemics such as plague, smallpox, cholera, and influenza but also from the more silent killers of chronic infectious diseases such as tuberculosis and syphilis.

Morbidity due to infectious diseases is very common in spite of the progress accomplished in recent decades.
According to the World Health Organization's (WHO) annual estimates,
there are globally 300–500 million cases of malaria,
333 million cases of sexually transmitted diseases (syphilis, gonorrhea, chlamydia, and trichomonas),
33 million cases of HIV/AIDS,
14 million people infected with tuberculosis,
and 3–5 million cases of cholera.

It is often said that

“Epidemiology is the basic science of preventive medicine.”

To prevent diseases, it is important to understand the causative agents, risk factors, and circumstances that lead to a specific disease.
This is even more important for infectious disease prevention, since simple interventions may break the chain of transmission.
Preventing cardiovascular diseases or cancer is much more difficult because it usually requires multiple long-term interventions requiring lifestyle changes and behavior modification, which are difficult to achieve.

Classification of infections

1. ***Primary infection:*** Initial infection with organism in host.
2. ***Reinfection:*** Subsequent infection by same organism in a host (after recovery).
3. ***Superinfection:*** Infection by same organism in a host before recovery.
4. ***Secondary infection:*** When in a host whose resistance is lowered by preexisting infectious disease, a new organism may set up in infection.

Classification of infections

5. ***Focal infection:*** It is a condition where due to infection at localized sites like appendix and tonsil, general effects are produced.
6. ***Cross infection:*** When a patient suffering from a disease and new infection that set up from another host or external source.
7. **Nosocomial infection**: Cross infection occurring in hospital.
8. ***Subclinical infection:*** It is one where clinical affects are not apparent.

Causative agents of infections

- ***Saprophytes:*** They are free living organisms which fail to multiply on living tissue and so are not important in infectious disease.
- ***Parasites:*** They are organisms that can establish themselves and multiply in hosts. They may be pathogens or commensal. Pathogens are those which are capable of producing disease in a host. On the contrary commensal microbes can live in a host without causing any disease.

Types of transmission of parasites

Depending on source or reservoir of infection, transmission of parasites is categorized into 2 types:

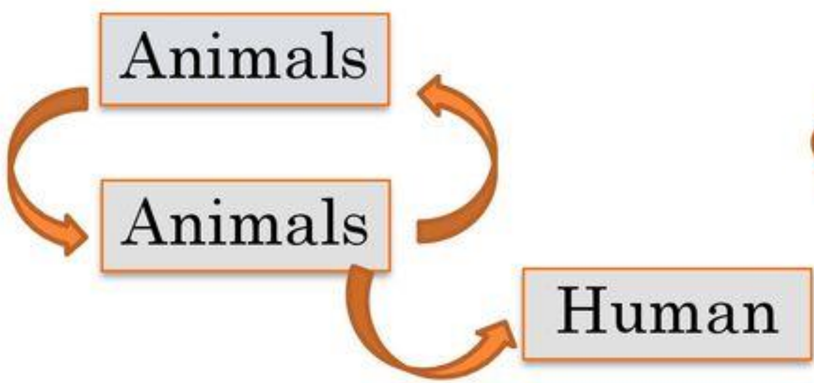
1. Anthroponosis (Pl. Anthroponoses)

Direct transmission

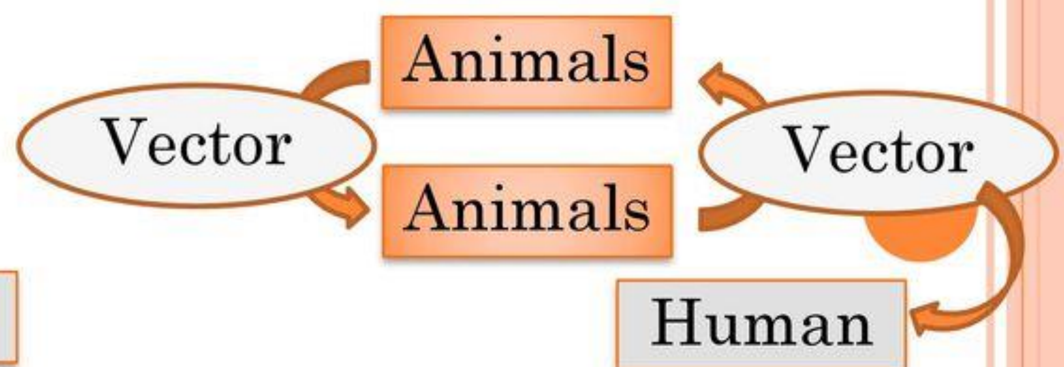
Indirect transmission

2. Zoonosis (pl. Zoonoses)

Direct transmission



Indirect transmission



Sources of infection in Man

Anthroponosis

Man: **Man is himself a common source of infection from a patient or carrier.**

Healthy carrier is a person harboring pathogenic organism without causing any disease to him.

A convalescent carrier is one who has recovered from disease but continues to harbor the pathogen in his body.

Sources of infection in Man

Animals: Infectious diseases transmitted from animals to man are called ***zoonosis***. Zoonosis may be bacterial, (e.g. *Plague* from rat), rickettsial, (e.g. *Murine typhus* from rodent), viral, (e.g. *Rabies* from dog), protozoal, (e.g. *Leishmaniasis* from dogs), helminthic, (e.g. Hydatid cyst from dogs) and fungal (zoophilic dermatophytes from cats and dogs).

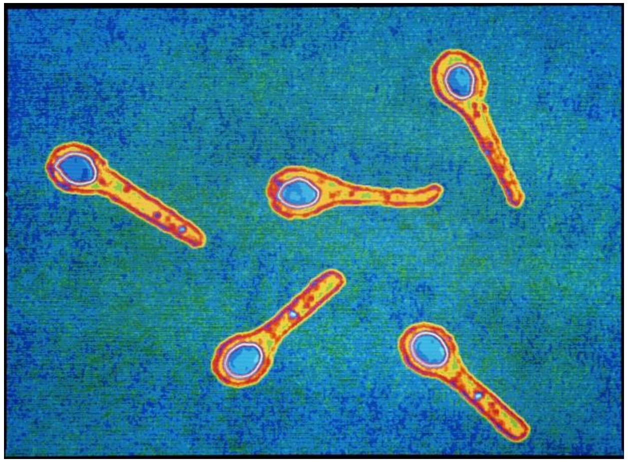
Sources of infection in Man

Insects: The diseases caused by insects are called ***arthropod borne disease***. Insects like mosquitoes, fleas, lice that transmit infection are called **vector**. Transmission may be mechanical (transmission of *Dysentery* or *typhoid bacilli* by housefly) and these are called **mechanical vector**. They are called **biological vector** if pathogen multiplies in the body of vector, e.g. *Anopheles mosquito* in *Malaria*.

Sources of infection in Man

- ***Some vectors*** may act as **reservoir** host, (e.g. *ticks* in *Relapsing fever* and *Spotted fever*).
- ***Soil:*** Spores of tetanus bacilli, Gas-gangrene infection remain viable in soil for a long time.

Clostridium tetani →



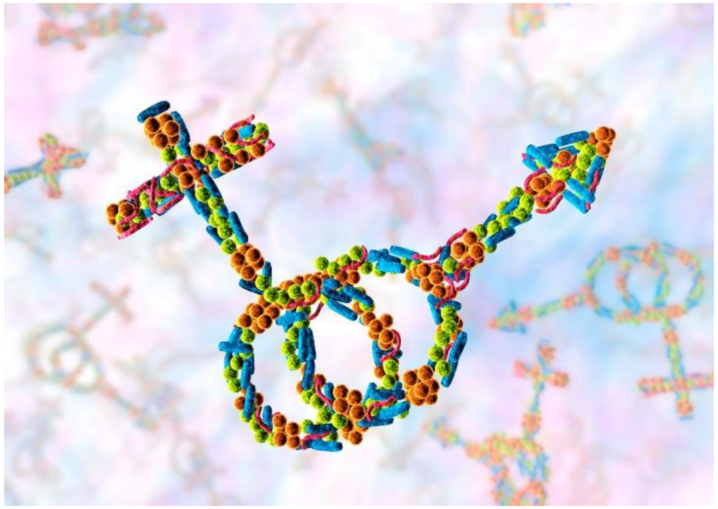
Sources of infection in Man

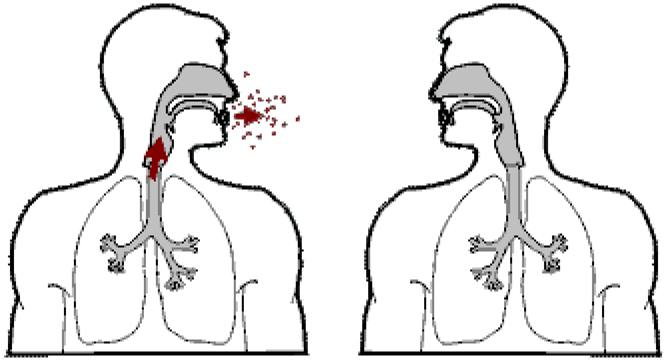
Water: *Vibrio cholerae*, infective hepatitis virus (*Hepatitis A and Hepatitis E)* may be found in water.

Food: Contaminated food may be a source of infection. Presence of pathogens in food may be due to external contamination, (e.g. food poisoning by *Staphylococcus*).

Methods of transmission of infection

- ***Contact (sexual intercourse):*** syphilis, gonorrhea.
- ***Inhalation:*** influenza, tuberculosis, smallpox, measles, mumps, etc.





Methods of transmission of infection

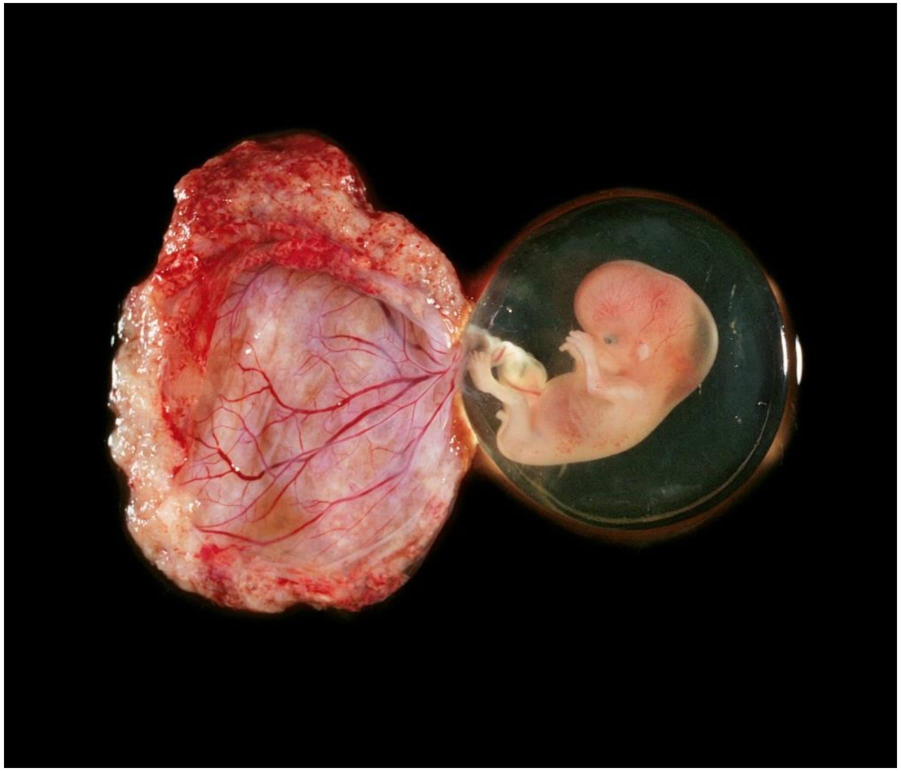
- ***Ingestion:*** cholera (water), food poisoning (food) and dysentery (hand borne).
- ***Inoculation:*** tetanus (infection), rabies (dog), arbovirus (insect) and serum hepatitis, i.e. Hepatitis B (infection).

Human hand contaminated with colonies of bacteria (blue/pink patches)

Methods of transmission of infection

- ***Congenital:*** syphilis,

  rubella, toxoplasmosis, cytomegaloviruses



Methods of transmission of infection

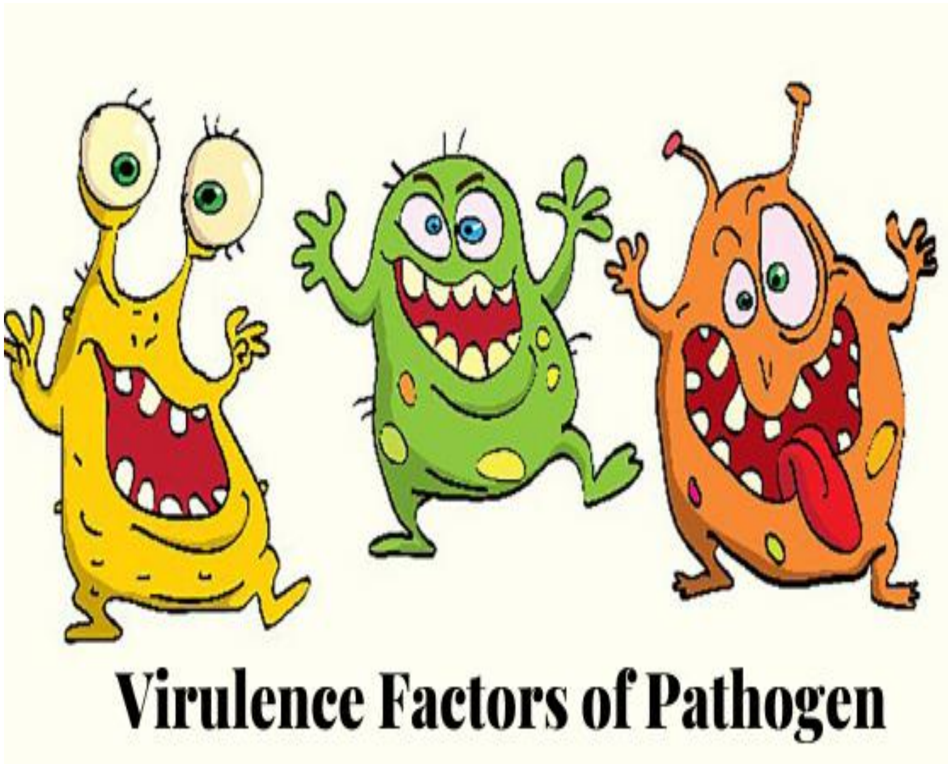
- ***Insects:*** **they act as mechanical vector (dysentery and typhoid by housefly) or biological vector (malaria) of infectious disease**
- ***Jatrogenic and laboratory infections:*** **infection may be transmitted during procedures**

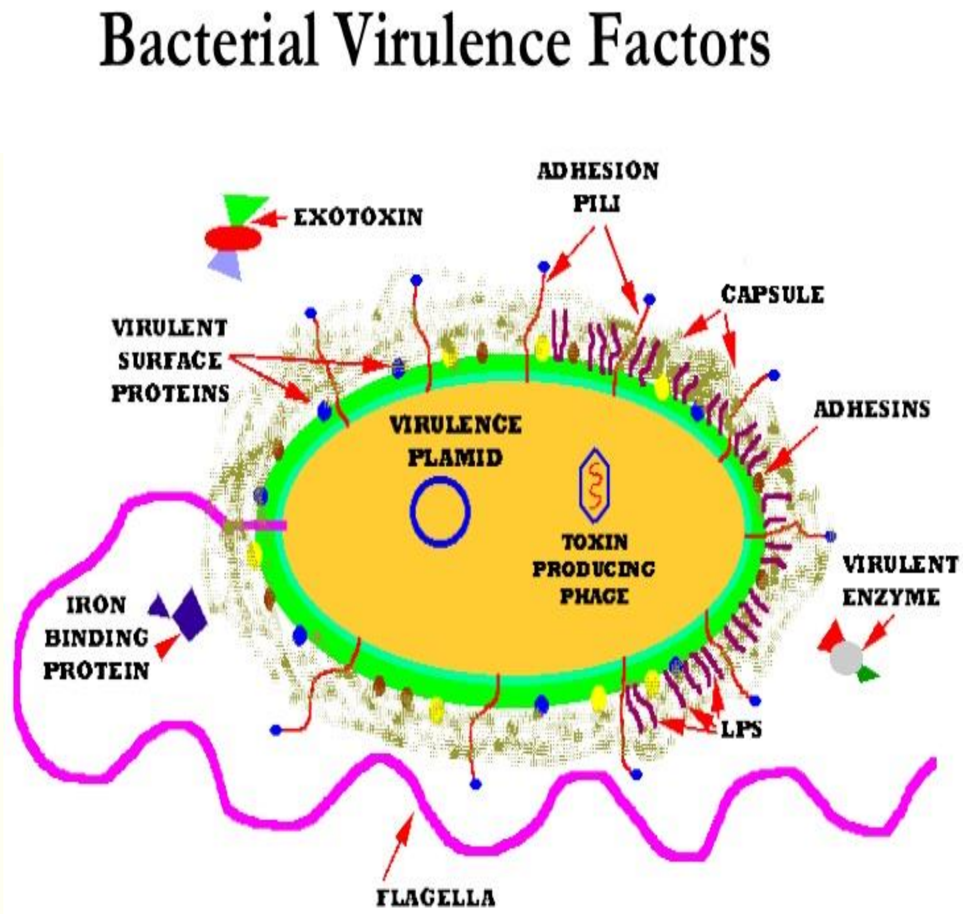
Characters of pathogens

- Bacteria should be able **to enter** the body.
- Organism should be able **to multiply** in the tissue.
- They should be able **to damage** the tissue.
- They must be capable **to resist** the host defense.

Pathogenecity **is referred to the ability of microbial species to produce disease.**

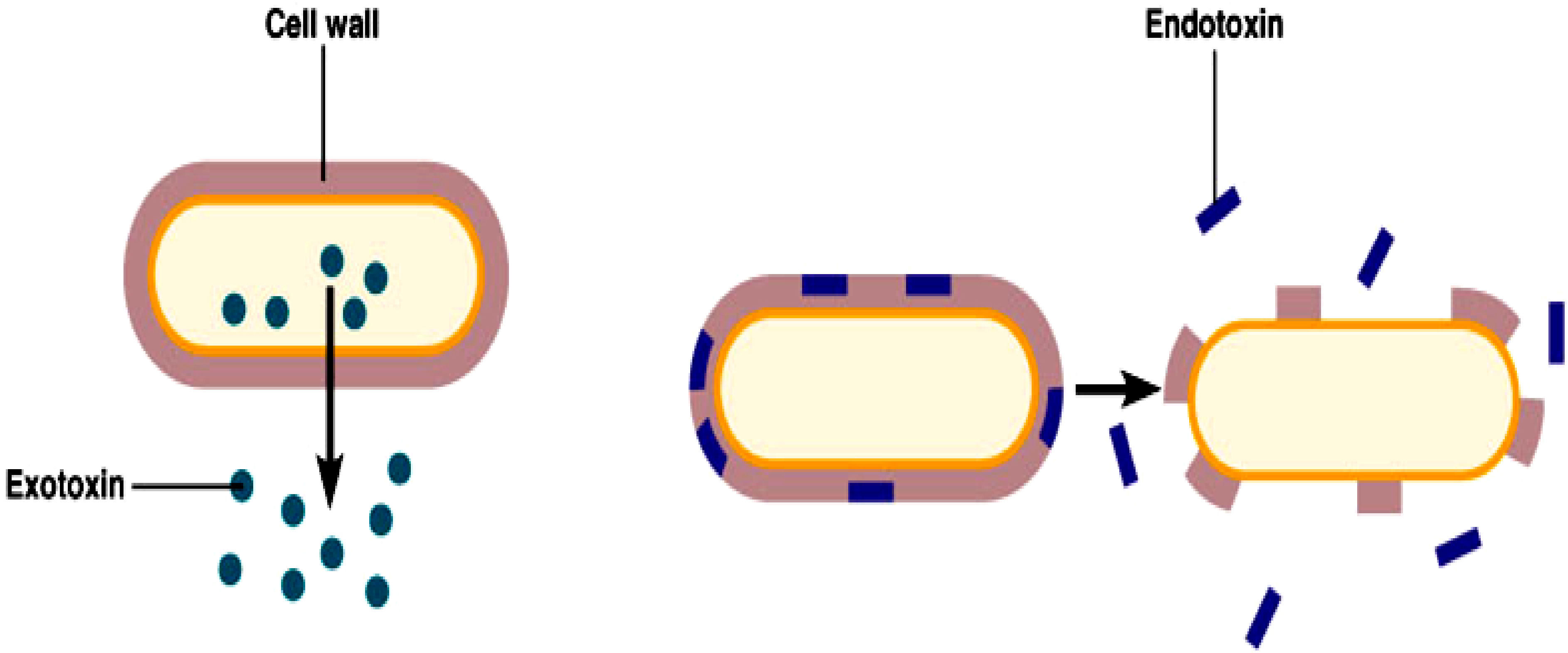
Virulence **is referred to the ability of microbial strains to produce disease.**





Factors of Virulence

- ***Invasiveness*** is the ability of organism to spread in a host tissue after establishing infection. Less invasive organisms cause ***localized*** lesion. Highly invasive organisms cause ***generalized*** infection (septicemia).
- ***Toxigenicity.*** Bacteria produce two types of toxins – ***exotoxins*** & ***endotoxins***



(a) **Exotoxins** are produced inside mostly gram-positive bacteria as part of their growth and metabolism. They are then secreted or released following lysis into the surrounding medium.

(b) **Endotoxins** are part of the outer portion of the cell wall (lipid A; see Figure 4.12c) of gram-negative bacteria. They are liberated when the bacteria die and the cell wall breaks apart.

Factors of Virulence

- ***Communicability*** **is the ability of parasite to spread from one host to another. It determines the survival and distribution of organism in a community.**
- ***Coagulase*** **(S.aureus) which prevents phagocytosis by forming fibrin barrier around bacteria.**
- ***Fibrinolysin*** **promotes the spread of infection by breaking down the fibrin barrier in tissues.**

Factors of Virulence

- ***Hyaluronidase*** **split hyaluronic acid (component of connective tissue).**
- ***Leucocidins*** **damage polymorphonuclear leucocytes.**
- ***Ig A1 proteases:*** **split IgA and inactivates its antibody activity.**
- ***Hemolysin*** **is produced by some organisms capable of destroying erythrocytes.**

Infecting dose

- The *minimum infection dose* (MID) or *minimum lethal dose* (MLD) is the minimum number of organism required to produce clinical evidence of infection or death of susceptible animal.

Types of infectious diseases

may be

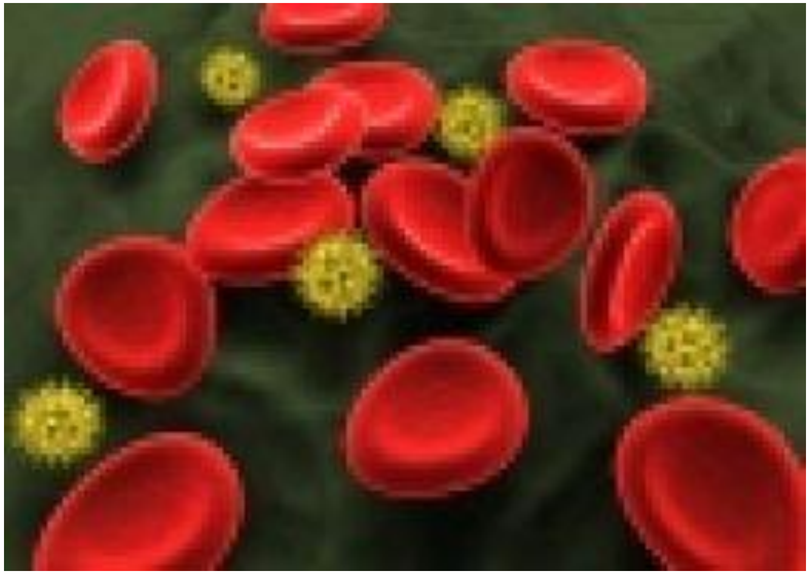
localized or ***generalized***

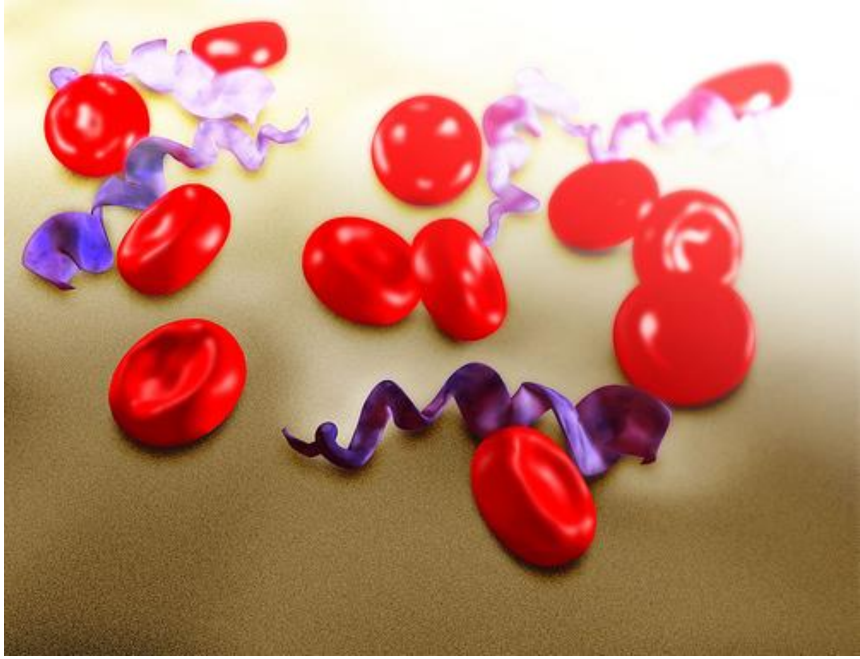
superficial

or

deep

Circulation of bacteria in the blood is known as *bacteremia* (*viruses – virusemia*).





Types of infectious diseases

- Depending on the spread of infectious disease in the community they may be classified into different types.
- ***Endemic*** diseases are ones that are constantly present in a particular area. Typhoid fever is endemic in most parts of India.
- An ***epidemic*** disease is one that spreads rapidly, involving many persons in an area at the same time. Influenza causes annual winter epidemics in the cold countries.

Types of infectious diseases

- A ***pandemic*** is an epidemic that spreads through many areas of the world involving very large numbers of persons within a short period (Influenza, cholera, plaque).
- **Epidemics** vary in the rapidity of spread. Waterborne disease such as cholera and hepatitis may cause explosive outbreaks, while disease, which spreads by person-to-person contact evolve

  more slowly.

DIFFERENCE BETWEEN EPIDEMIC AND PANDEMIC

BYJU'S
The Learning App

EPIDEMIC

- An epidemic is an outbreak of disease that affects many in a population and begins to spread rapidly.
- An outbreak of disease is considered an epidemic if it affects a certain number of people within a short period of time, typically within 2 weeks.

PANDEMIC

- Pandemic is a larger epidemic. A pandemic covers several countries or spreads from one continent to another.
- In pandemic outbreaks, the number of people affected or killed doesn't matter as much as the rate of spread and how far it has spread.

Types of infectious diseases

- ***Septicemia*** is the condition where bacteria circulates and multiplies in the blood, forms toxic products and causes swinging type of fever.
- ***Pyemia*** is a condition where pyogenic bacteria produces septicemia with multiple abscesses in the internal organs such as the spleen, liver and kidney.

Stages of infectious disease

Incubation period

Prodromal period

Invasive stage

Decline stage

Convalescence

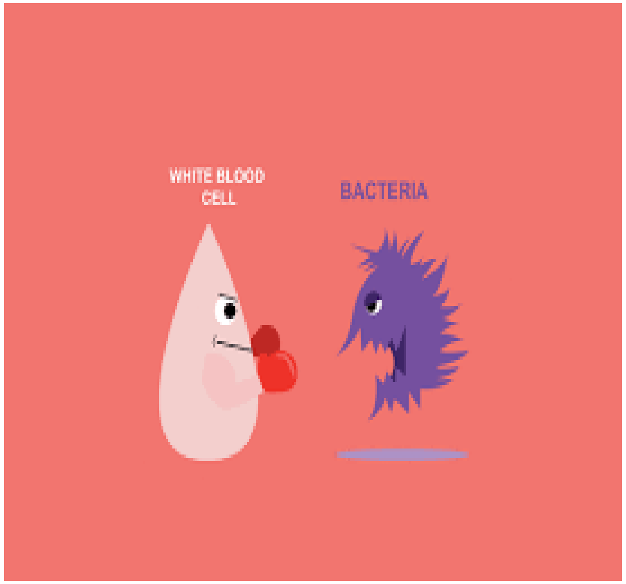
Stages of infectious disease

- ***Incubation period*** – no symptoms.
- ***Prodromal period*** – mild and generalized symptoms (fever, weakness, headache).
- ***Invasive stage*** – symptoms specific to the disease.
- ***Decline stage*** – symptoms subside.
- ***Convalescence*** – no symptoms, health returns to normal.

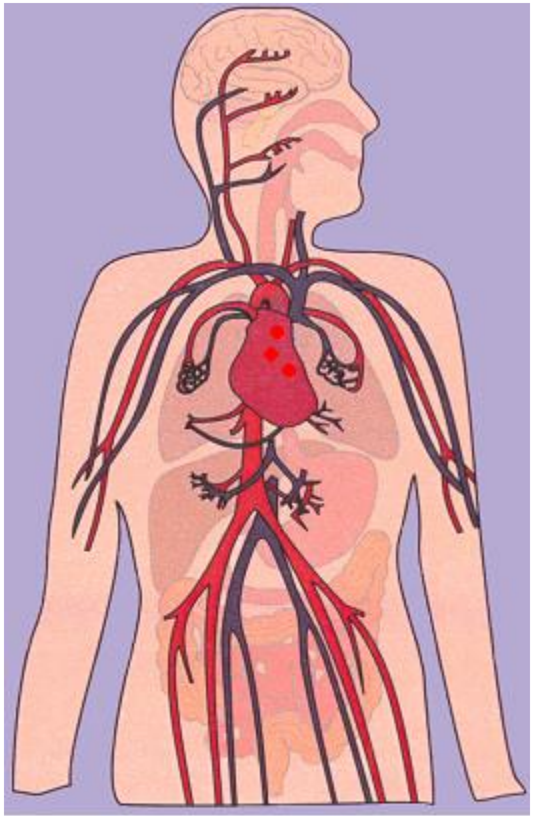
What Is the Immune System?

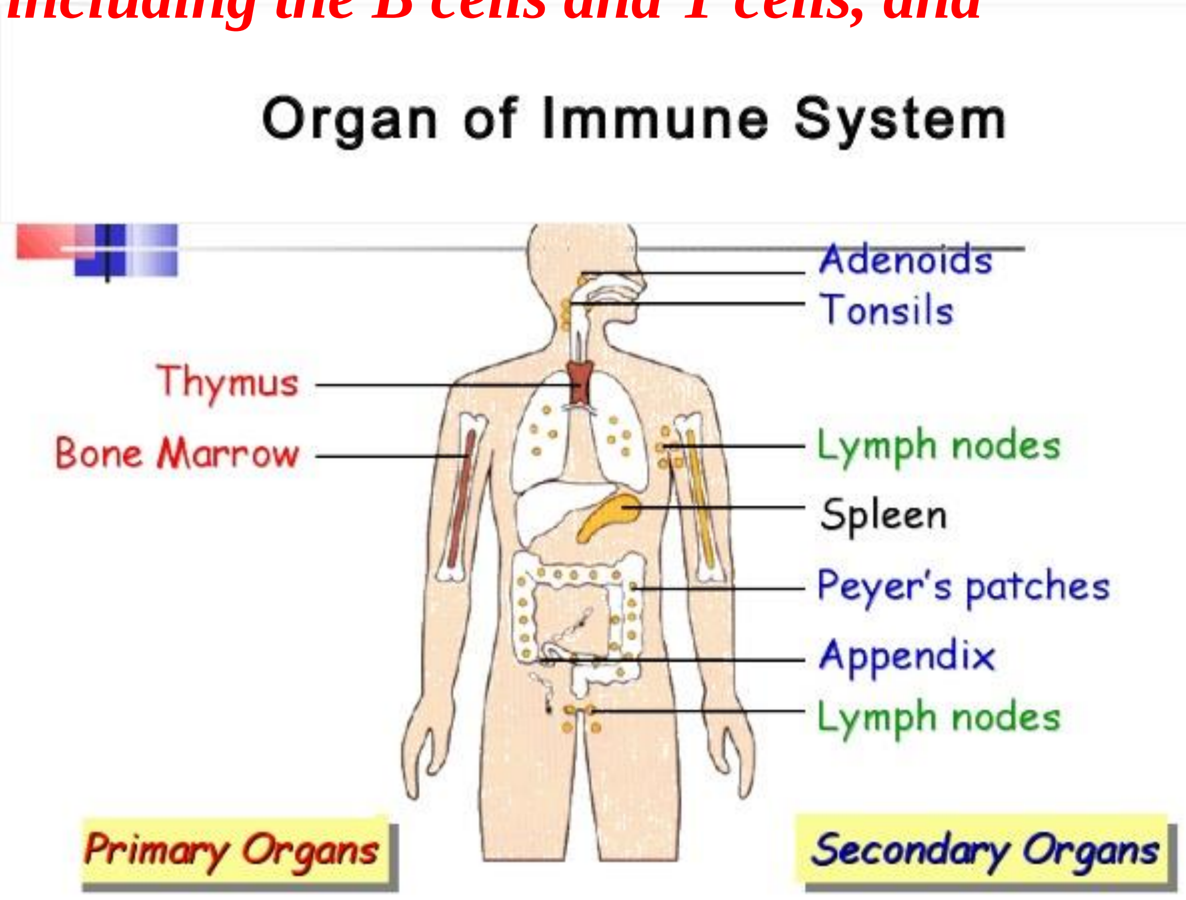
The immune system is the body's defense against infections.

The immune system attacks germs and helps keep us healthy.

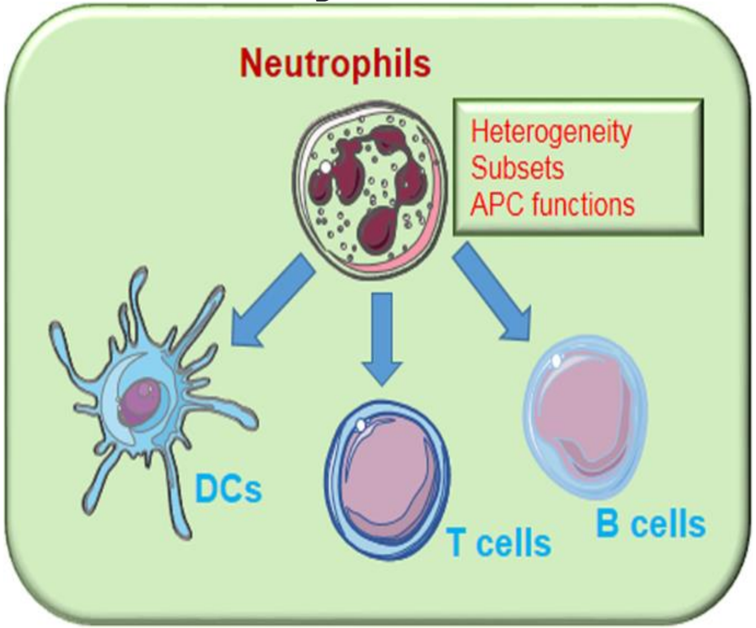


The immune system **is what protects our body from diseases and infections. It's the body system that produces the immune response to defend our body from foreign substances, cells, and tissues.**
The immune system includes various parts of the body including the ***thymus, spleen, lymph nodes, special deposits of lymphoid tissue*** **(such as those in the gastrointestinal tract and bone marrow),** ***macrophages, lymphocytes including the B cells and T cells, and antibodies*****.**

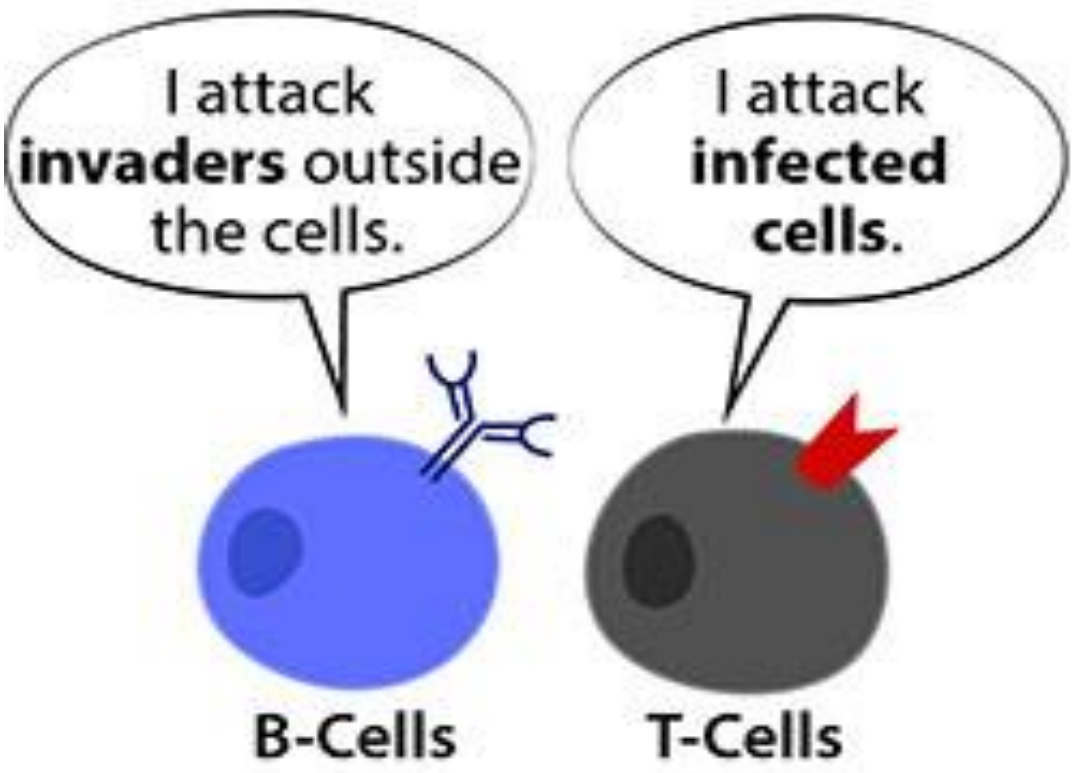




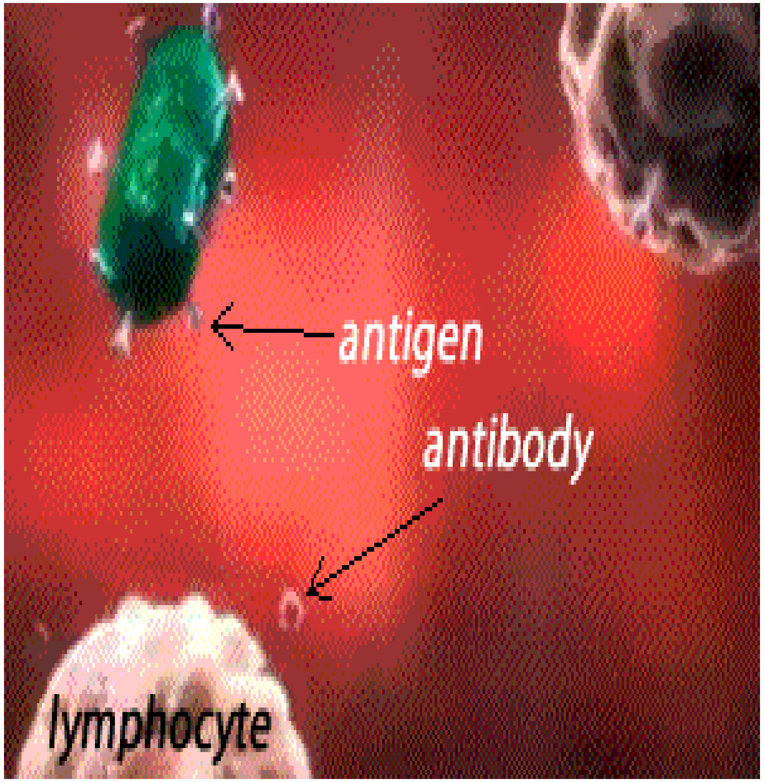
Many cells and organs work together to protect the body. White blood cells, also called leukocytes, play an important role in the immune system.
Some types of white blood cells, called phagocytes, chew up invading organisms. Others, called lymphocytes, help the body remember the invaders and destroy them.
One type of phagocyte is the neutrophil, which fights bacteria. When someone might have bacterial infection, doctors can order a blood test to see if it caused the body to have lots of neutrophils. Other types of phagocytes do their own jobs to make sure that the body responds to invaders.



The two kinds of lymphocytes are *B lymphocytes* and *T lymphocytes*. Lymphocytes start out in the bone marrow and either stay there and mature into B cells, or go to the thymus gland to mature into T cells. B lymphocytes are like the body's military intelligence system — they find their targets and send defenses to lock onto them. T cells are like the soldiers — they destroy the invaders that the intelligence system finds.

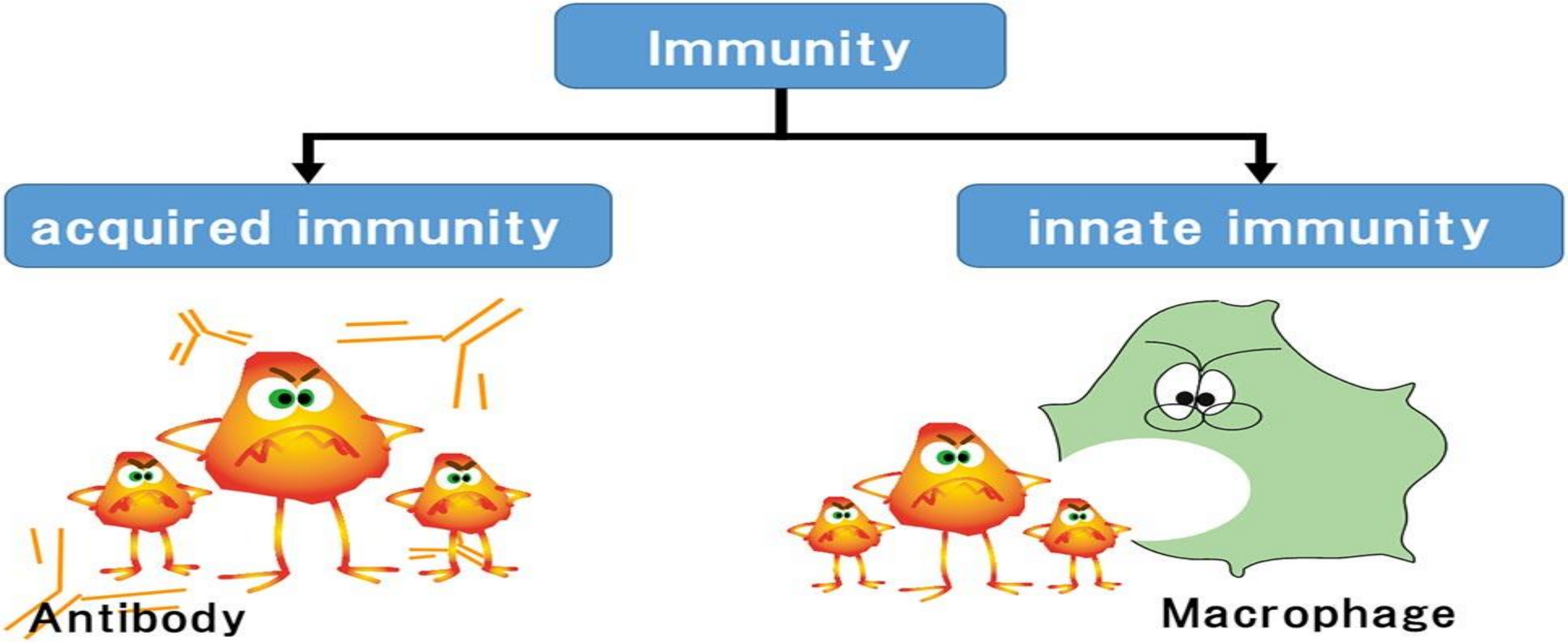


Immunity to a disease is achieved through the presence of antibodies to that disease in a person's system. Antibodies are proteins produced by the body to neutralize or destroy toxins or disease-carrying organisms. Antibodies are disease-specific. For example, measles antibody will protect a person who is exposed to measles disease, but will have no effect if he or she is exposed to mumps.



There are two subsystems within the immune system

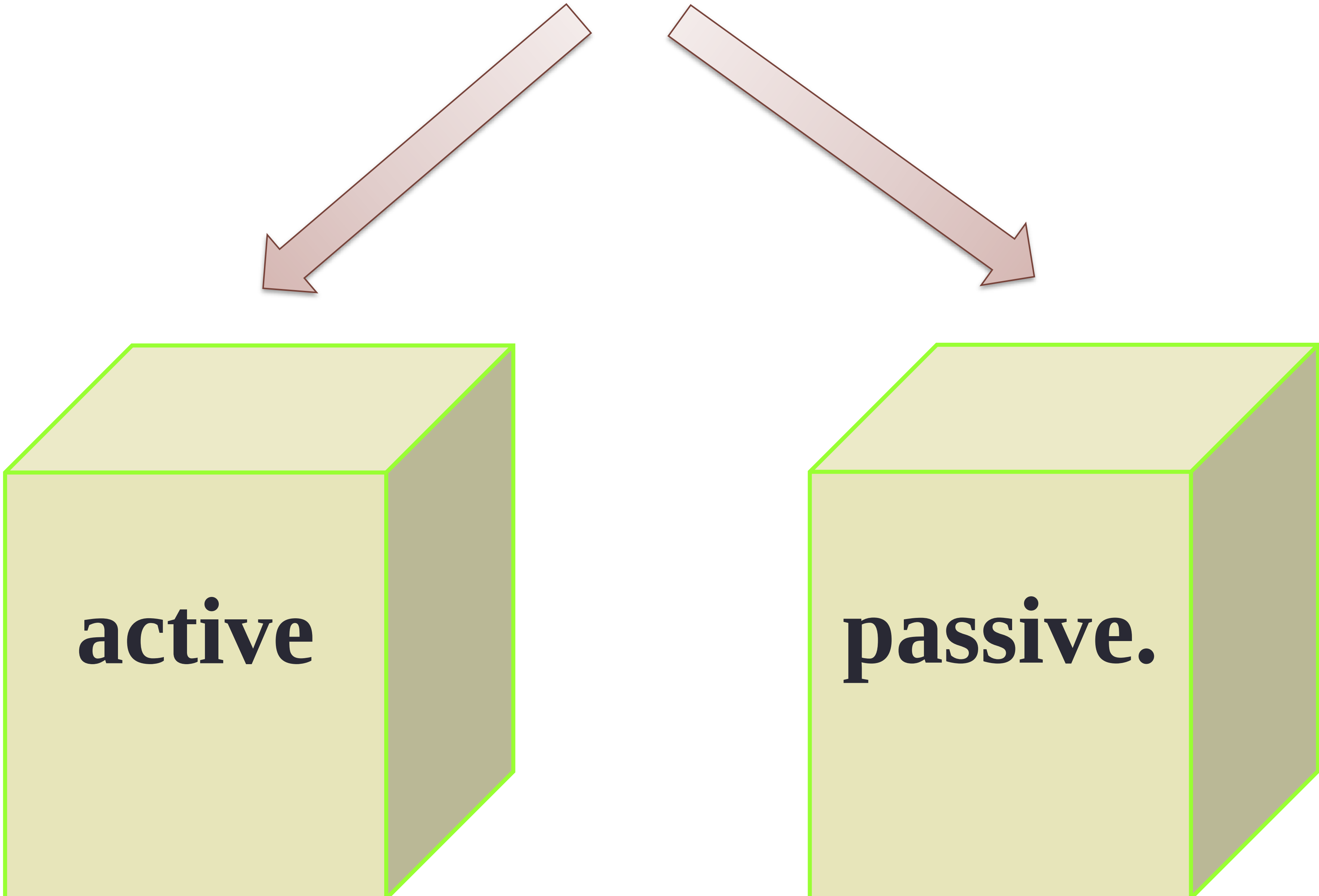
Both of these subsystems are closely linked and work together whenever a germ or harmful substance triggers an immune response.



The adaptive (specific) immune system **makes antibodies and uses them to specifically fight certain germs that the body has previously come into contact with. This is also known as an "acquired" (learned) or specific immune response. Because the adaptive immune system is constantly learning and adapting, the body can also fight bacteria or viruses that change over time**

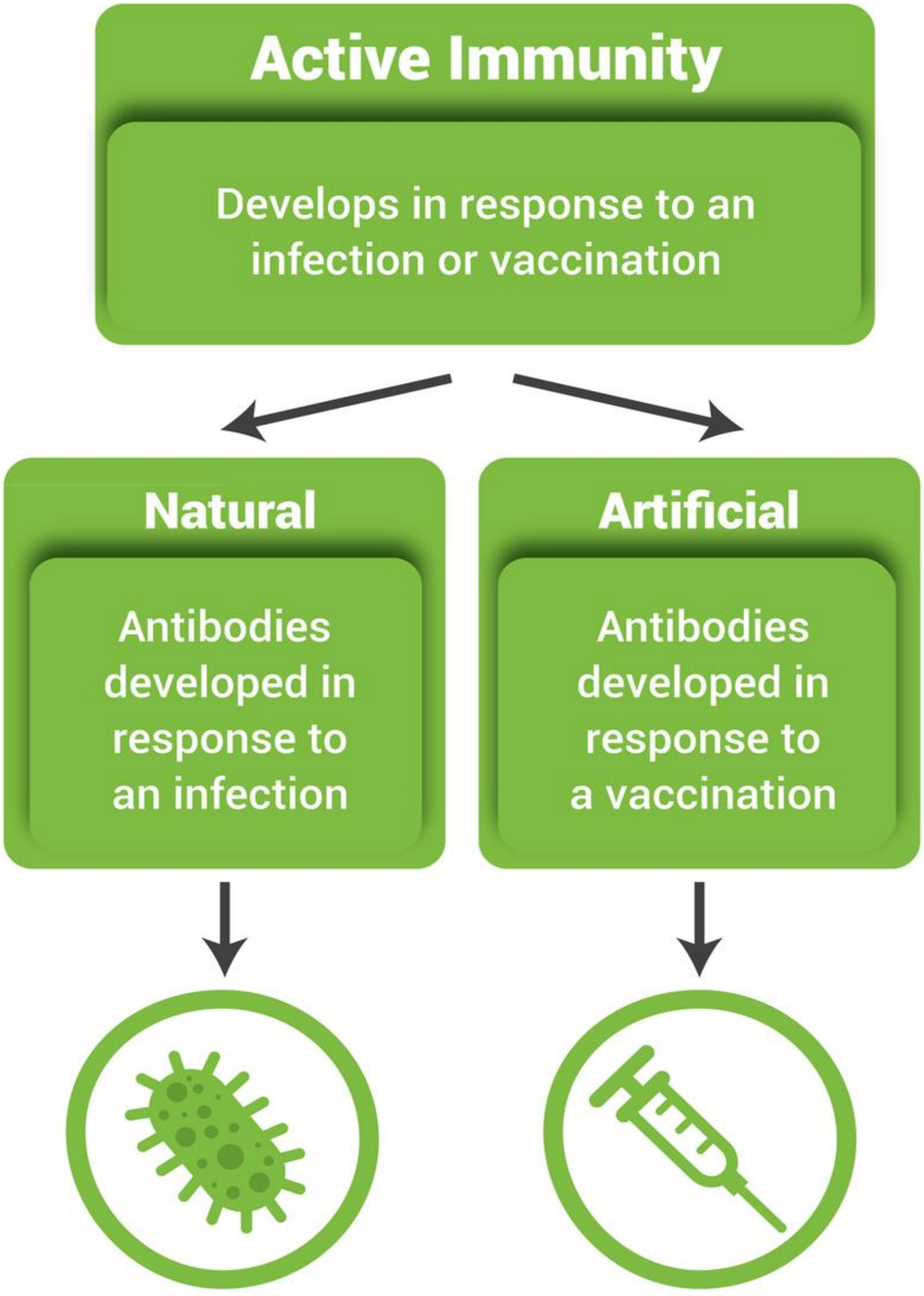
The innate immune system **provides a general defense against harmful germs and substances, so it's also called the non-specific immune system. It mostly fights using immune cells such as natural killer cells and phagocytes ("eating cells"). The main job of the innate immune system is to fight harmful substances and germs that enter the body, for instance through the skin or digestive system.**

There are two types of immunity

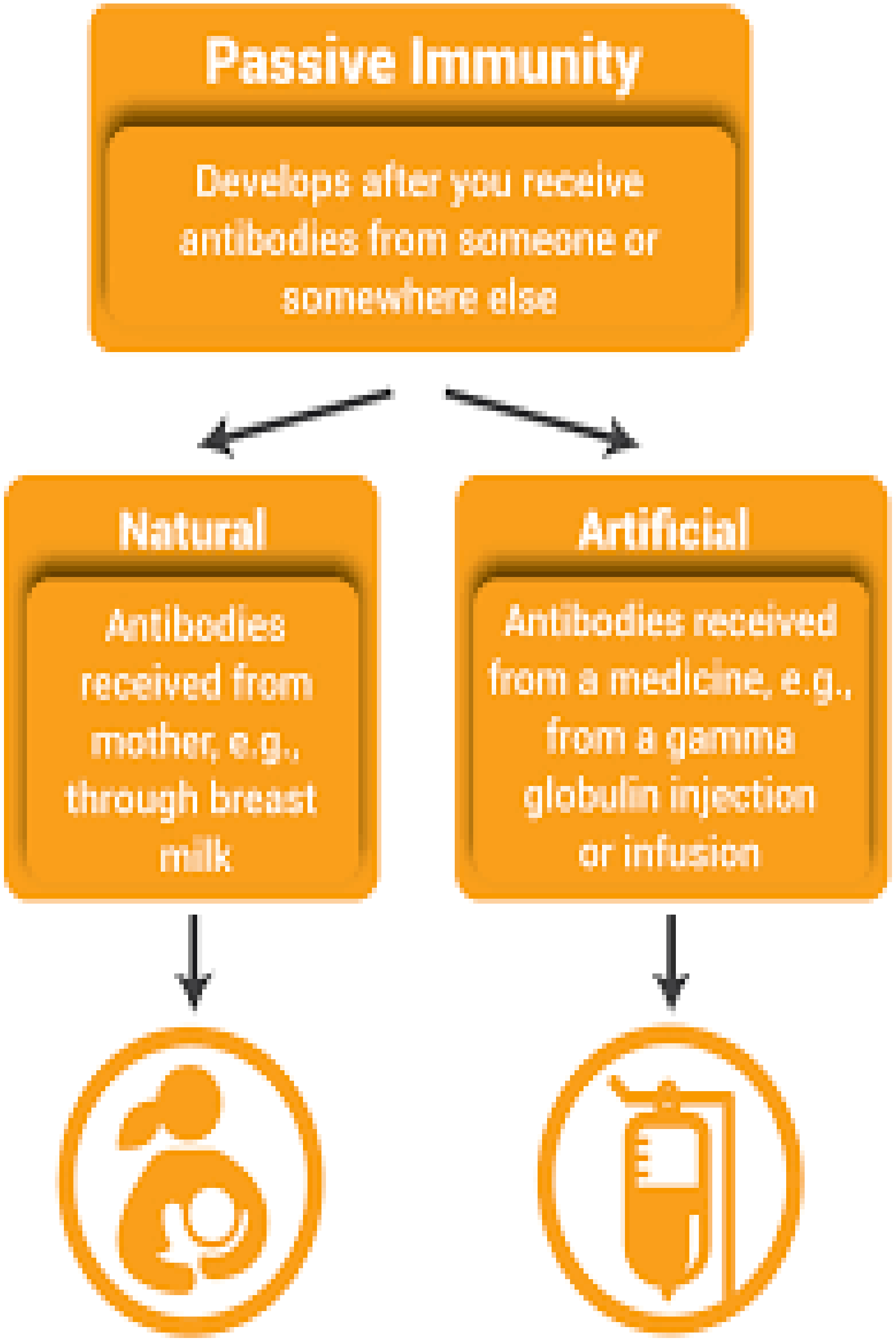


Active immunity **results when exposure to a disease organism triggers the immune system to produce antibodies to that disease. Exposure to the disease organism can occur through infection with the actual disease (resulting in natural immunity), or introduction of a killed or weakened form of the disease organism through vaccination (vaccine-induced immunity). Either way, if an immune person comes into contact with that disease in the future, their immune system will recognize it and immediately produce the antibodies needed to fight it.**

Active immunity is long-lasting, and sometimes life-long.

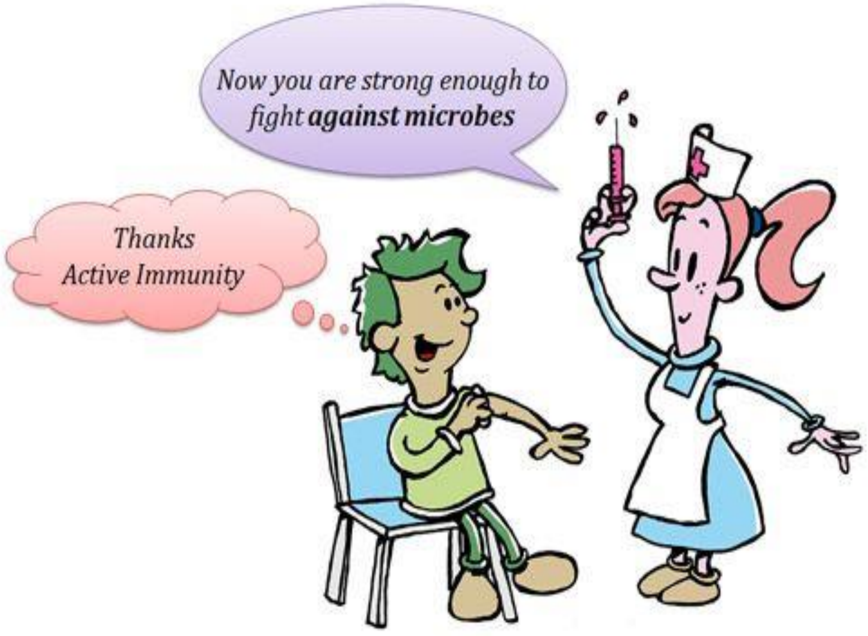


Passive immunity **is provided when a person is *given* antibodies to a disease rather than producing them through his or her own immune system.**
A newborn baby acquires passive immunity from its mother through the placenta.
A person can also get passive immunity through antibody-containing blood products such as immune globulin, which may be given when immediate protection from a specific disease is needed. This is the major advantage to passive immunity; protection is immediate, whereas active immunity takes time (usually several weeks) to develop.
However, passive immunity lasts only for a few weeks or months. Only active immunity is long-lasting.



Immunizations

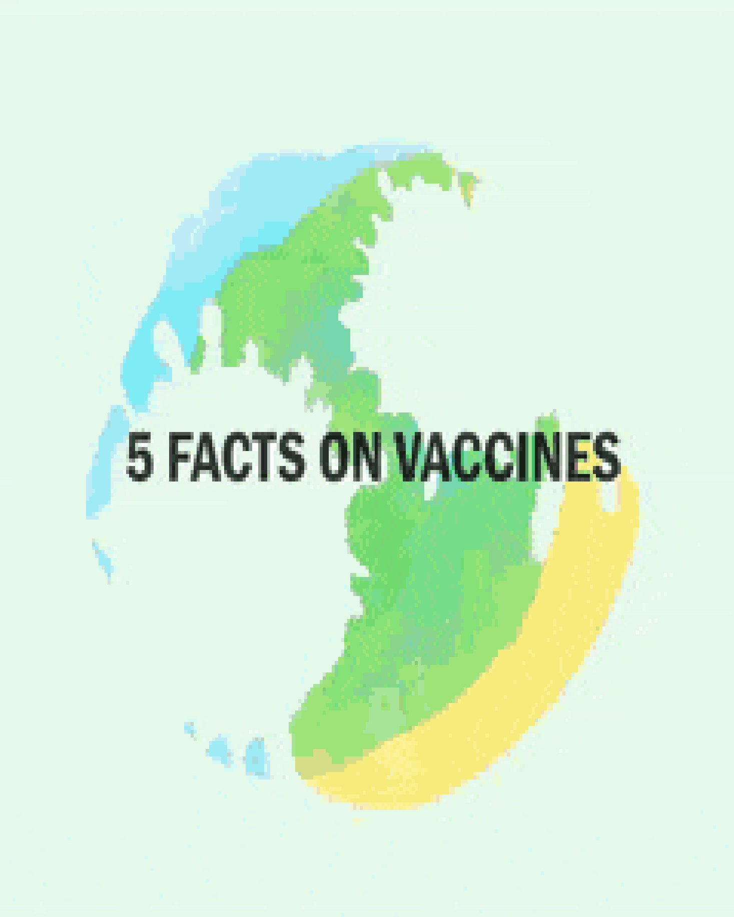
Immunization introduces antigens or weakened pathogens to a person in such a way that the individual does not become sick but still produces antibodies. Because the body saves copies of the antibodies, it is protected if the threat should reappear later in life.
Artificially acquired active immunity can be induced by a vaccine, a substance that contains antigen. A vaccine stimulates a primary response against the antigen without causing symptoms of the disease.



Active Immunity by Vaccination

- **Immunization is a global health and development success story, saving millions of lives every year. Vaccines reduce risks of getting a disease by working with your body's natural defences to build protection. When we get a vaccine, our immune system responds.**

- **We now have vaccines to prevent more than 20 life-threatening diseases, helping people of all ages live longer, healthier lives. Immunization currently prevents 2-3 million deaths every year from diseases like diphtheria, tetanus, pertussis, influenza and measles.**



- **Immunization is a key component of primary health care and an indisputable human right. Vaccines are also critical to the prevention and control of infectious-disease outbreaks. They underpin global health security and will be a vital tool in the battle against antimicrobial resistance.**

- **Yet despite tremendous progress, for too many people around the world – including nearly 20 million infants each year – have insufficient access to vaccines. In some countries, progress has stalled or even reversed, and there is a real risk that complacency will undermine past achievements.**

There are four types of traditional vaccines:

- **Inactivated vaccines** are composed of micro-organisms that have been killed with chemicals and/or heat and are no longer infectious. Examples are vaccines against flu, cholera, plague, and hepatitis A. Most vaccines of this type are likely to require booster shots.
- **Live, attenuated vaccines** are composed of micro-organisms that have been cultivated under conditions which disable their ability to induce disease. These responses are more durable, however, they may require booster shots. Examples include yellow fever, measles, rubella, and mumps.
- **Toxoids** are inactivated toxic compounds from micro-organisms in cases where these (rather than the micro-organism itself) cause illness, used prior to an encounter with the toxin of the micro-organism. Examples of toxoid-based vaccines include tetanus and diphtheria.
- **Subunit vaccines**, recombinant, polysaccharide, and conjugate vaccines are composed of small fragments or pieces from a pathogenic (disease-causing) organism. A characteristic example is the subunit vaccine against Hepatitis B virus.

Two future vaccinations

DNA vaccines: **DNA vaccines are composed of DNA encoding protein antigens from the pathogen. These vaccines are inexpensive, relatively easy to make and generate a strong, long-term immunity.**

Recombinant vector vaccines (platform-based vaccines): **These vaccines are harmless live viruses that encode a one/or a few antigens from a pathogenic organism. They are used widely in veterinary medicine.**

Most vaccines are given by hypodermic or intramuscular injection as they are not absorbed reliably through the gut. Live attenuated polio and some typhoid and cholera vaccines are given orally in order to produce immunity based in the bowel.