DISEASE CAUSES AND TRANSMISSION

DISEASE - any condition that prevents an organism from functioning effectively in its surroundings

INFECTIOUS DISEASES	NON-INFECTIOUS DISEASES
♦ caused by pathogen (e.g. bacterium, fungus, protozoan, worm, insect or virus	♦ can be genetic, nutritional, environmental or caused by physiological malfunction
♦ can be transmitted	♦ cannot be transmitted

INFECTIOUS DISEASES

- Koch's Postulates establish whether a specific micro-organism is the cause of a disease.
  1. The micro-organisms must be observed in the blood or tissues of the infected animal or plant, and must have a reasonable relationship to the disease symptoms.
  2. The organisms must be isolated from the diseased host and grown outside of the body in a pure culture.
  3. A portion of this culture must be injected into a second, previously uninfected animal or plant, and symptoms similar to those in the first host must appear.
  4. The micro-organisms must be observed in and recovered from the experimentally-diseased animal or plant in pure culture.
- Causative Organism - the pathogen that causes the disease (e.g. virus, bacterium, fungus, protozoan, worm, insect or arachnid)
- Mode of Transmission - the means by which the pathogen is spread (e.g. droplets in sneezing and coughing, direct contact, sexual contact, food and water contaminated by either faeces or bacterial toxin, soil contamination, vector such as mosquito or rat)
- Signs and Symptoms - e.g. fever, headache, nausea, vomiting, diarrhoea
- Pyrogens – Pyrogens cause fever by changing the set-point temperature of the brain's 'thermostat' from the normal 37^{o}C up to higher temperatures such as 40^{o}C. A person with a fever will sweat more to try to reduce body temperature. The sick person may also become thirsty as water is lost by sweating. If too much body heat is lost in a short time, the person may experience 'chills'.
- Carrier - a person who is infected with pathogenic micro-organisms in the body but shows no signs of the disease
- Antibiotic - the chemical treatment used to treat all infections except viral ones

COMMON INFECTIOUS DISEASES	CAUSATIVE ORGANISM	MODE OF TRANS-MISSION	SIGNS AND SYMPTOMS
Influenza	virus	droplet	inflammation of respiratory tract, fever, headache

Cold sores (*Herpes simplex)*	virus	direct contact	blisters on lips and gums
Genital Herpes	virus	sexual contact	burning sensation on genitals, blisters and painful ulcers, may cause cervical cancer in women
Tetanus	bacterium	deep wound contaminated with infected soil	muscle paralysis, death in severe cases
Cholera	bacterium	having food or drink contaminated with infected faeces	severe diarrhoea, high fever, some intestinal damage
Botulism (food poisoning)	bacterium	eating food containing a bacterial toxin	muscle paralysis, death in some cases
Tinea (Athlete's Foot)	fungus	contact with contaminated wet floors towels or shoes	cracks in the skin between toes, itching
Malaria	protozoan	vector of Anopheles mosquito	muscular pains, chills, fever, sweating, death in some cases
Tapeworm infection	tapeworm	having food or drink contaminated with infected faeces	malnutrition, weight loss

- Viruses - Viruses are not classified as living organisms and they are not cells. They consist of a nucleic acid core (either DNA or RNA) surrounded by a protein coat. They are all parasitic. Viruses cannot reproduce on their own, but instead they must invade other cells, multiplying within the host cells using the host cell's materials and metabolic processes. The name given to viruses that invade bacteria is bacteriophages. All viruses are unaffected by antibiotics.
- Bacteria – Bacterial colonies grown on agar plates are easily identifiable. They appear as flat shiny white or yellow colonies. (*For more information on bacteria, refer to the study notes of Kingdom Monera in Classification section.)*
- Fungi – Fungal colonies grown on agar plates are easily identified as fuzzy raised colonies of various colours. *(For more information on fungi, refer to the study notes of Kingdom Fungi in Classification section.)*
- Life Cycle of a Parasite - Parasites may be endoparasites (live inside the host) or ectoparasites (live on the outside of the host).
  Some parasitic organisms (e.g. *Ascaris* a nemotode) require one host. Other organisms (e.g. *Plasmodium* the protozoan that causes malaria, *Echinococcus* the tapeworm which causes hydatids) require more than one host to complete the life cycle.

The primary host is the host that is infected by the adult parasite which reproduces inside that host.
The secondary or intermediate host is infected by the larval stage of the parasite.
A vector (e.g. the *Anopheles* mosquito that transports the malaria protozoan *Plasmodium*) is an organism that transports a parasite from one organism to another without being infected itself.
Many parasites are hermaphrodites having both male and female reproductive organs, and these organisms can self-fertilise in the absence of a mate. This is of advantage if the parasite is inside the body tissues of the host.

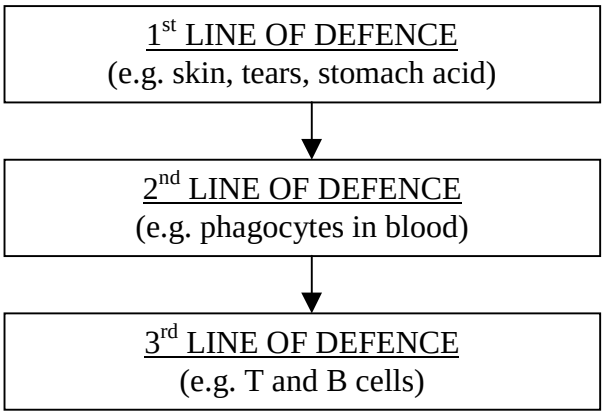
Refer to diagrams showing the life cycles of parasites in your textbook.

NON-INFECTIOUS DISEASES

- Genetic Diseases - hereditary diseases (e.g. short-sightedness, cystic fibrosis)
- Diet and Deficiency Diseases – caused by too much or too little of certain nutrients in our food (e.g. anorexia, scurvy, rickets)
- Cancers – caused by rapid and uncontrolled growth of cells into tumours (e.g. lung cancer, skin cancer or melanoma)
- Occupational Diseases – acquired during incidents in the working environment (e.g. pesticide poisoning on a farm)
- Heart Diseases – caused by a malfunctioning of the heart and blood vessels due to smoking, stress and poor diet (e.g. angina)

Did You Know…? In 1770, Captain Cook was the first ship's captain to have an entire ship's crew free of scurvy. He fed his sailors pickled cabbage containing Vitamin C, and if they refused to eat it, they were flogged.

DEFENCE AND THE IMMUNE SYSTEM



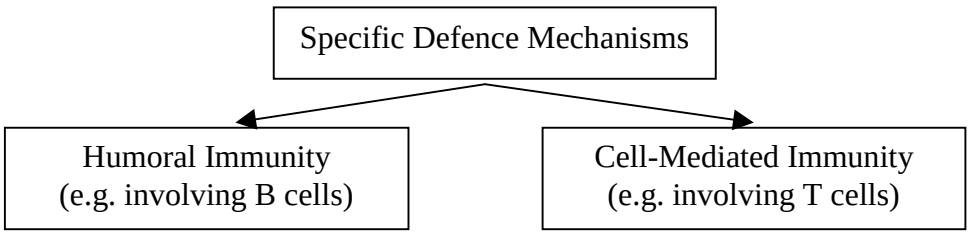
NON-SPECIFIC RESPONSE MECHANISMS

- Non-specific defence mechanisms are those which operate against a range of pathogens and foreign particles such as dust and smoke.
- There are 7 non-specific defence mechanisms:
  1. Intact skin - The intact skin provides a barrier to invading pathogens. Also damaged blood vessels rapidly contract to reduce blood loss, and platelets accumulate to create a clot to prevent further blood loss and invasion of foreign particles.

2. Mucus-secreting membranes - Mucus of the nose traps dust and smoke.
3. Ciliated membranes - Hairs of the respiratory tract also trap dust and smoke.
4. Tears containing lysosyme enzymes and lactic acid - These chemicals are very effective in destroying bacterial cell walls.
5. Phagocytes - The inflammatory response involves an increase in blood flow to the area, and white blood cells called phagocytes engulf and digest foreign particles that enter the body tissues.
6. Complement system - The inflammatory response also involves transporting large blood proteins that break open or lyse the bacterial cell walls, and attracts phagocytes to the area.
7. Interferon - Viral-infected body cells secrete interferon against viruses.

SPECIFIC DEFENCE MECHANISMS

- The specific defence mechanisms involve 2 factors:
  1. the ability to 'recognise' and respond specifically against an antigen (a molecule on the wall of an invading bacteria, a toxin produced by the bacteria, or a foreign particle)
  2. the ability to 'remember' the chemical structure of the antigen so the immune response is more rapid at the next encounter



- HUMORAL IMMUNITY

  B-lymphocytes (B cells) produce specific antibodies that can bind to 2 antigen molecules. Most antibodies are large globular proteins called immunoglobulins that are released into blood plasma. Antibodies also coat foreign particles so that they are recognised and engulfed by macrophages.
  B cells are formed in bone marrow and the spleen, and when they become active, they form 2 types of daughter cells - plasma cells (which make antibodies) and memory cells (which remain in lymphatic tissue for some time and provide a long-term immunity after a person has encountered a disease).

- CELL-MEDIATED IMMUNITY

  T-lymphocytes (T cells) are produced in the thymus gland and act against eukaryotic cells such as infected or cancerous cells.
  There are 2 types of T cells - Cytotoxic T cells (directly kill infected or foreign cells) and Helper T cells (assist in regulating the B cells and the cytotoxic T cells).

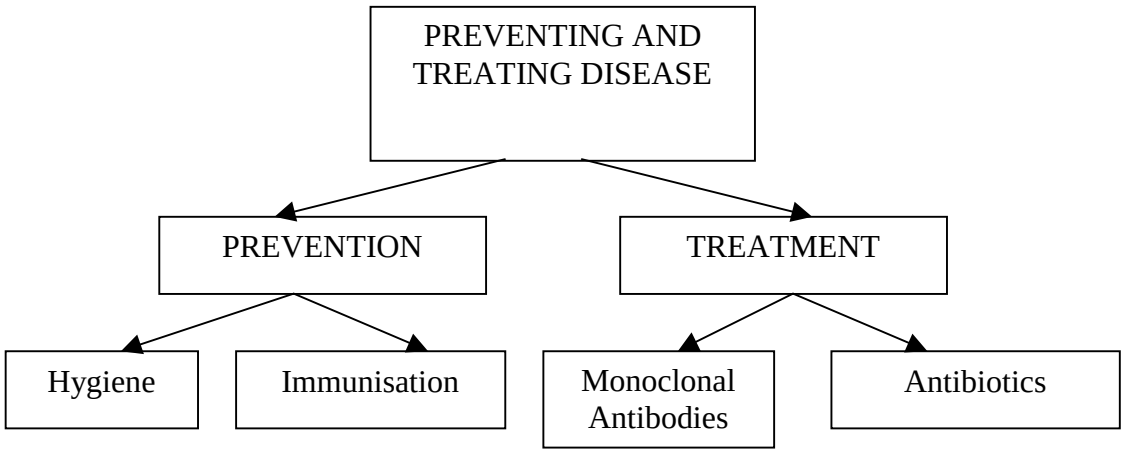
REJECTION OF TRANSPLANTED ORGANS

- All body cells have a group of antigens on their surface that distinguish them as unique ('self' recognising cells). Identical twins have identical antigens. These antigens are the result of linked genes called the major histocompatibility complex (MHC).
- After an organ such as a heart or kidney is transplanted from one person to another person who is not an identical twin, the immune system is triggered. The

recipient's immune system identifies the 'non-self' cells of the donor organ. The organ may be rejected by the body's immune system

- To prevent this from happening, immuno-suppressant drugs (e.g. cyclosporin) are given for the rest of the transplant recipient's life. Because these drugs reduce the effectiveness of the immune system, the transplant recipient is in danger of contracting other diseases.

PREVENTING AND TREATING DISEASE



HYGIENE

- Hygiene involves purification of drinking water, sanitation of sewage and personal hygiene practices (e.g. regular bathing, thorough hand-washing after going to the toilet).

IMMUNISATION

- Immunity may be natural (where a person has suffered and recovered from the disease and sufficient memory B cells to remember the antigenic molecule and rapidly set up a specific defence against the antigen) or artificial (following the injection of a specific vaccine, made of altered weakened or killed bacteria, or inactivated forms of the toxin released by some bacteria).
- Active Immunity occurs when an individual's own immune system 'recognises, fights and remembers' the invading antigen. This is more long-lasting. For example, the triple antigen injections given to young children provide long-term protection against diphtheria, tetanus and whooping cough.
- Passive Immunity occurs when an injection contains the actual antibodies or when a baby receives antibodies via the umbilical cord blood or breast milk. It is short-term only and requires booster injections. For example, the tetanus injection given immediately following a deep wound contains antibodies for immediate treatment.

MONOCLONAL ANTIBODIES

- These are antibodies produced by cloning plasma B cells, and can be produced in large quantities for immunisation. They are also used in pregnancy tests.

ANTIBIOTICS

- An antibiotic is any chemical used to kill or inhibit the growth of a living micro-organism. They are more toxic to the invading pathogen that they are to the host.
- Antibiotics are ineffective against viruses.

Did You Know That…?

- Leonardo da Vinci was famous for painting the 'Mona Lisa', inventing the first helicopter and various weapons of warfare. Also as far back as 1500, he proposed that bombs containing a liquid extracted from the saliva of a mad pig or dog should be dropped on the enemy. That was the first example of biological warfare.