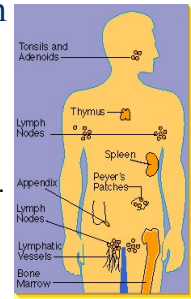


## Defense against Invaders – The Immune System



## The Immune System

- the system which protects the body from foreign invaders such as bacteria and viruses.
- Many of these are pathogens (disease-causing organisms)



## 1<sup>st</sup> line of defense: Physical and Chemical Barriers



- The skin, mucous lining of respiratory and digestive tracts, chemicals in tears and sweat (eg. Lysozyme)
- These help to prevent the entry of pathogens

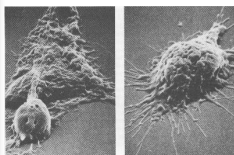


## Second Line of Defense – the Inflammatory Response

- occurs when invaders get past first line of defense (eg. a splinter in your finger)
- damaged cells release chemicals (histamines) which cause surrounding tissue to become red, swollen, and sore (inflammation)

## Inflammatory Response

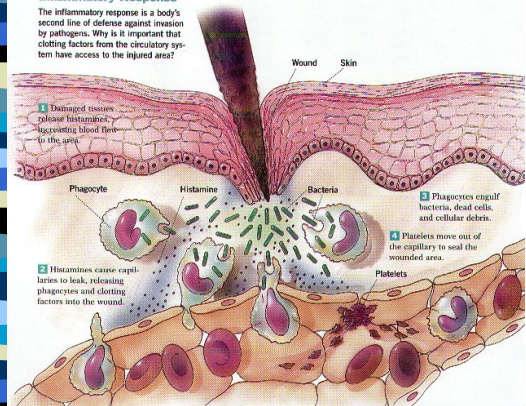
- macrophages engulf foreign cells by phagocytosis (may form pus)
- lymph nodes swell at site of infection as they filter out bacteria
- body temperature rises (fever)



phagocytosis is the process where a leucocyte recognizes a foreign body and engulfs it.

### Steps of the Inflammatory Response

The inflammatory response is a body's second line of defense against invasion by pathogens. Why is it important that clotting factors from the circulatory system have access to the injured area?



### Third Line of Defense – Specific immune response

- Involves special kinds of white blood cells called Lymphocytes
- Lymphocytes (T-cells and B-cells) help neutralize and destroy the pathogen

### **B-cells – Antibody immunity**

- - mature in the bone marrow
- - associated with production of antibodies
- - when these cells come into contact with a pathogen they undergo cell division to produce :
  - Plasma cells and
  - Memory Cells

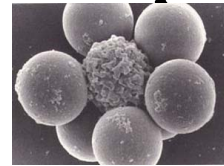
- i) **Plasma cells:** Produce antibodies which bind to the antigen (antigen-antibody complex).
- This complex is then eaten by phagocytes

### 3<sup>rd</sup> line of defense: **ANTIBODIES!**



Antibodies are globular 'Y' shaped proteins.

- 1. The body makes antibodies to fight antigens.
- 2. Specific antibodies bond to specific antigens.



- ii) **Memory cells:** Remember the antigen.
- When the same antigen enters the body for a second time, the memory cells divide to produce antibodies rapidly.
- The infection can be fought off before a person even gets sick. (e.g. Chicken pox)

### **T-cells - cellular immunity**

- - mature in the thymus (by heart)
- - recognize viral infections and tumour cells
- - they divide into:
  - i) **Cytotoxic T-cells:** Bind to the antigen and causes the infected cell to burst (lysis)
  - ii) **Memory T-cells:** Remember the original antigen.

## Other T-cells:

- suppressor T-cells: shut down killer T-cells
- helper T-cells: organizers of the immune response
  - Helper T-cells are the cells affected by the AIDS virus (HIV)

## The Immune Response

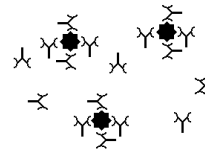
1. Macrophages engulf foreign cells (pathogens).
2. They display the genetic markers or antigens of the pathogen on their cell membrane.
3. Helper T-cells bind to the antigen displayed on macrophages and then multiply.
4. Some of these become cytotoxic T-cells which destroy infected body cells.

## The Immune Response

5. Helper T-cells also stimulate the production of plasma cells and memory cells from B-cells
6. Plasma cells produce thousands of antibodies and release them into bloodstream
7. Memory cells – retain information about the pathogen so the immune response can be activated quickly in future

## Antigen-Antibody

- Note: An antibody is specific and will bind to only one specific kind of antigen.
- This is the antigen-antibody reaction.



- The 'Y' Shaped antibodies attach to an antigen and make a clump. The clump gets filtered out at the lymph nodes.

## Immunity

- when the body has built up antibodies and memory cells
- it can respond quickly in the future if the pathogen invades the body.

## Natural Immunity

- – acquired from an infection (**active** natural immunity)
- or **passively** when a person receives antibodies from another person
- (eg. Through breast-feeding)




## Artificial immunity

- induced through vaccines.
- These contain weakened or dead pathogens, or antigens of a particular pathogen.
- The body builds up antibodies in response (**active** acquired immunity).
- Some vaccines may contain antibodies against the antigen (**passive** acquired immunity)



## Other Issues related to the Immune System


- **Auto-Immune Disorders** (eg rheumatoid arthritis) - when the immune system attacks its own tissues
- **Allergies**
  - exaggerated immune response to a harmless substance (dust, pollen, etc)
  - can be delayed or immediate (acute)
  - cells release histamines



## Other Issues related to the Immune System

### **AIDS:**

some T-cells (called Helper T Cells) are directly attacked by the HIV virus essentially disables the immune system.



## Other Issues related to the Immune System

**Organ Transplants** – foreign organs are considered antigens by the body's immune system.

The immune response is activated. This is called **rejection**.

**Immuno-suppressant drugs** may be given, but this increases the risk of infection.