

## Understandings:

### 1. Explain our primary defence against pathogens that cause infectious disease.

- Most pathogens are stopped by skin and mucous!

Skin – It is the first line of defence in our body. The skin is tough and about 20-30 cells thick, and the outmost skin cells are dead.

It protects us from harmful pathogens getting direct contact with our blood.

The skin also secretes sweat that contains uric acid to prevent pathogens growing on the skin surface. More precisely said, sebaceous glands secrete sebum.

Mucous – It is found in cavities and tubes, mucous are always present. Sticky mucous catches the pathogens and enzymes in the mucous digest them as well. Mucous may also contain glycoproteins (usually referring to antibodies).

Mucous leads to sneezing and coughing out the trapped pathogens.

Also, hair-like structure called cilia on the cells help the mucous to move up along the tube (e.g. trachea).

### Extra notes

- What are pathogens?

A pathogen is anything unwanted in your body. It is an organism that can cause diseases + virus.

A list of pathogens would therefore be:

1. Bacteria (not all of them).
2. Viruses.
3. Fungi.
4. Parasites.
5. Other unwanted unicellular organisms as well.

### 2. Explain the importance of blood clotting.

- When we get a cut, blood clotting clogs the wound, prevents further blood loss, and prevents pressure loss and infections by pathogens.

### 3. Explain the role of platelets.

- Platelets are cells without a nucleus and only fragments of cytoplasm. When there is a wound, these form a temporary plug and then signal the blood clotting.

Blood clotting is an extremely fast process because during the chain of reactions, each reaction produces enzyme for the next reaction.

#### 4. Explain the role of thrombin.

- So what exactly is the end product of this chain reaction? Well, it converts prothrombin into the enzyme thrombin and this thrombin makes a soluble protein fibrinogen, into an insoluble protein fibrin.

Thus prothrombin → thrombin → fibrinogen → fibrin

A way to remember which one thrombin acts on is by looking at the letter “o”. Only fibrinogen has “o” common with thrombin.

This fibrin will form a gel in the cuts that captures additional platelets (and some blood cells). Eventually, the outside will get dry and form a scab.

#### 5. Explain what phagocytes are.

- Welcome to our second line of defence. Phagocytes are a type of leukocytes (WBC) and sometimes, they are called phagocytic leukocytes. Why? Well, phagocytic, means any cell that ingests and destroys foreign particles, and leukocytes, means white blood cell. Thus phagocytic leukocytes just mean eating white blood cells!

The phagocytic leukocytes uses phagocytosis (quite obvious) to engulf them. Remember! Phagocytosis was a type of an endocytosis and is also called cell eating. The pathogen is digested by the lysosome’s lysozyme inside the cells.

Lysosome breaks into the pathogens shell and explodes it. Woah... (.\_.)

Phagocytic leukocytes respond to infected cells that emit chemical, such as histamine. When wounds get infected, phagocytes will accumulate, forming what we call “pus”.

They move by amoebic movement.

#### Extra note

If phagocytic WBC fails to eliminate the infection or something very severe, then lymphocyte (also a WBC) will produce antibodies to inactivate the pathogen. Immune system is the defence system using antibodies! Not the first (skin and mucous) and second (phagocytes) defence.

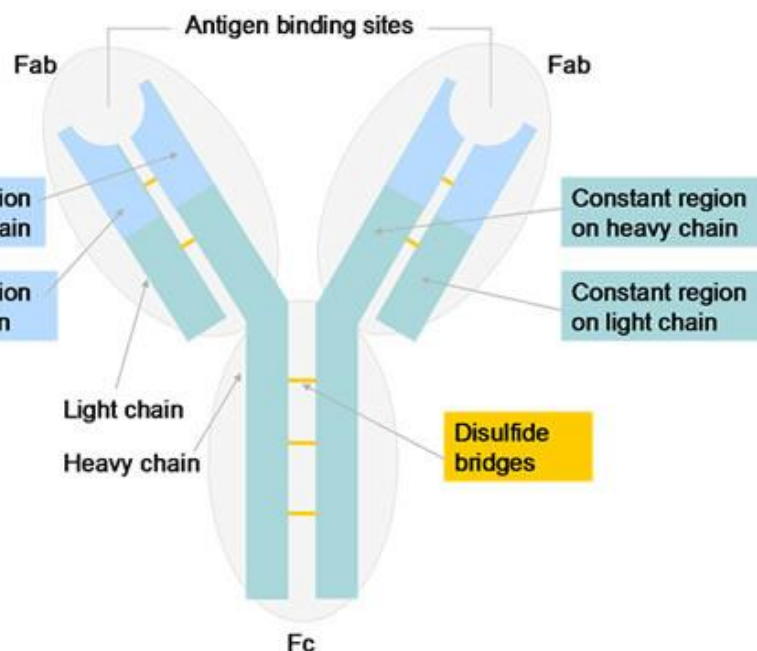
## 6. Explain antibody production.

- Now we have reached our third line of defence. Things are about to get serious and this is the point we call “the immune system”.

The foreign cells will have proteins and other molecules that our cells do not recognize. This will trigger an immune response, and any molecules that trigger an immune response are called an antigen.

What will happen from this point on is the production of antibodies. It is time for another leukocyte, called lymphocyte. Depending on the type of antigen, the lymphocyte that have corresponding antibody will divide. Within few days, enough antibodies will have been secreted to fight off the pathogen.

But what about the structure of the antibody?



Antibodies are shaped like “Y”.

We see that we have 2 light chains and 2 heavy chains.

However, the left side and right side is not identical. The left part, called variable region, is the place where the specific antigen binds.

The other part is for fighting the antigen. Their method includes making the pathogen with the antigen more recognizable for phagocytes and immobilizing pathogens (effect against viruses).

Once the pathogens are killed, the concentration of antibody decreases. However, there are memory cells (more on this on chapter 11).

## **7. Explain what antibiotics do.**

- Antibiotics inhibit the metabolism in bacteria.

It was first discovered by observing saprotrophic fungi. These digest externally and then ingest. However, in order to do so, they are competing with other bacteria that feed on the detritus (dead material). Thus, they produce antibacterial antibiotics, example penicillin.

## **8. Explain why viruses cannot be treated with antibiotics.**

- Viruses do not have their own metabolic pathways. They use host cells to reproduce, thus antibiotics are not effective against viruses. Using antibiotics against viruses might cause human cells to die as well.

There are on the other hand, few enzymes that can control viruses without harming the host cell. These are called antivirals and not antibiotics.

## **9. Explain how antibiotics might accelerate the evolution of bacteria in terms of resistance.**

- As we use antibiotics, we are essentially exposing them into the natural selection process. Only those who have resistance may survive and breed.

This is particular more problematic when not only one type of resistance builds up, but multiple resistance as well, such as multidrug-resistant tuberculosis (MDR-TB).

Resistance could be prevented through cautious prescription, patients completing the use of antibiotics, hygiene in hospital, farmers not using antibiotics to promote growth, continuous supply of new antibiotics (most recent one was developed during 1980s... if I am correct).

## **Applications and skills:**

### **1. Explain the causes and consequences of blood clot formation in coronary arteries.**

- Blood clot = mesh of platelets and fibrin = thrombus. Coronary thrombosis = blood clot in coronary arteries.

When a person develops coronary thrombosis the cardiac muscle contracts irregularly.

Atherosclerosis (we know what these are now) may give rise to blood clots. These blood clots can then travel to the coronary arteries and cause coronary thrombosis.

Smoking, excess of cholesterol, high blood pressure, diabetes, obesity and lack of exercise increase the risk of coronary thrombosis. You may ask how diabetes, high blood pressure and smoking cause atherosclerosis that in turn may cause coronary thrombosis. I looked in the internet, and it is beyond my level of understanding...sorry...

## 2. Explain Florey and Chain's experiments to test penicillin on bacterial infections in mice.

- Due to these people at Oxford in 1930s, the use of penicillin has been verified as antibiotics.

## 3. Effects of HIV on the immune system and methods of transmission.

- HIV stands for (human immunodeficiency virus, meaning weakening the human immune system). HIV is a kind of retrovirus (retro, meaning reverse), i.e. it reverse engineers from RNA to DNA! Usually, and according to the central dogma of biology, it should go from DNA – transcription – RNA. But the retrovirus adds a step between host cell's metabolism to duplicate itself and disables the target host cell. Horrible!

What it does:

1. It targets the helper T lymphocytes and reverse engineers from its RNA to DNA inside the host cell.
2. It is inactive for some years. Then suddenly it activates and replicates until it has got billions of its duplicate.
3. Helper T lymphocytes reduce in number hence making the production of antibodies much slower and harder.
4. Thus they will get all sorts of viruses much easily.
5. This disorder is called AIDS, acquired immune deficiency syndrome.

T cells can be usually found in mucous, genetic seed in both genders and especially rectum.

Cause	Transmission	Social implications
A syndrome is a group of symptoms found together. Thus in this case, there are many symptoms due to the weakened immune system. Hence we call it AIDS.	HIV is transmitted through body fluid, except for salivary mucous (very low possibility). It's because it is short-lived.	By having HIV in a society leads to an immense chain reaction.
HIV lowers the immune system, and AIDS is the final stage where all the symptoms can be seen.	Thus: <ul style="list-style-type: none"> <li>- Through intercourse or any type of sex.</li> <li>- Blood transfusions (must be very unlucky to get this).</li> <li>- Through placenta from mother.</li> <li>- Injuries from child and via milk in breast feeding.</li> </ul>	Thus: <ul style="list-style-type: none"> <li>- Short working period</li> <li>- Poor family</li> <li>- No education, no job</li> <li>- Less confidence, reduced sexual activity</li> <li>- Hard to find partner</li> <li>- Lowered population</li> <li>- No skilled employee</li> <li>- Expensive for state</li> <li>- State cannot develop</li> <li>- Increase debt for development</li> </ul>