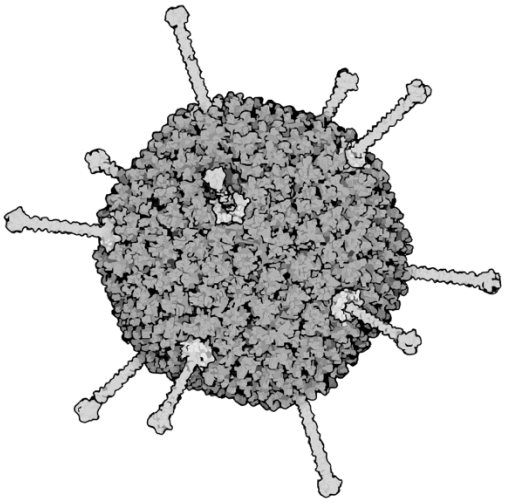
Antigens and allergy

- Al organisms have proteins and ither substances in the plasma membranes on the surface of their cells, mostly proteins. Some organisms have a cell wall outside their plasma membrane made of polysaccharides or other substances.
- Viruses are not considered as living organisms. Nevertheless, they also have unique molecules on their surfaces. The surface of most viruses is a protein coat or a 'capsid'.
- The protein coat or the capsid of some viruses is 'enveloped' in a membrane taken from the plasma membrane of the host cell. The image on the right is an example of the capsid of an adenovirus.



What are surface molecules used for?

- Viruses recognize and bind to their host using molecules on the surface of the host's cells
- Living organisms recognize their own cells and cell types using surface molecules
- Living organisms also recognize foreign cells or viruses by the surface molecules that aren't present or a part in that organism.

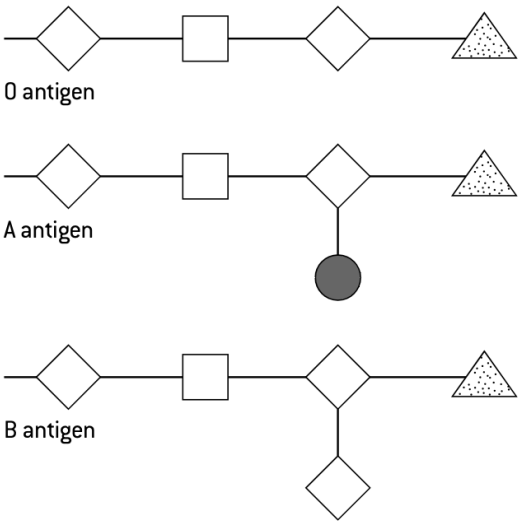
***The detection of foreign molecules results in an immune response and trigger the production of antibodies, so they are antigens.**

<u>Host specificity of pathogens</u>

- Some pathogens such as polio, measles and syphilis only affect humans, these types of pathogens are called **species-specific** as they target only one infect members of a single species e.g., humans
- On the other hand, some pathogens could transmit from one infected member of one species to an uninfected member of another species such as rabies, where the virus is transmitted from an infected dog to a human OR tuberculosis which transmits through the milk of an infected cattle to humans

***A disease that can pass to humans from other animals is called a zoonosis**

<u>Antigens on red blood cells (blood groups)</u>



Blood group	Antigens present	Antigens that cause antibody production
O	O	A or B (A, B or AB blood)
A	O and A	B (B or AB blood)
B	O and B	A (A or AB blood)
AB	O, A and B	None

How does the ABO blood group system work?

- The system is based on the presence or absence of a group of glycoproteins in the membranes of red blood cells.

What do glycoproteins do?

- Glycoproteins In the groups cause antibody production If a person does not have them naturally so they are antigens.

O, A and B antigens are the here different versions of the glycoprotein.

The O antigen is like a base, it is always present.

The A antigen is made by adding N-acetyl-galactosamine to the O antigen.

The B antigen is made by adding Galactose to the O antigen

Histamine and allergies

What are the two types of cells that secrete histamine?

- **Basophils-** types of white blood cell
- **Mast cells-** similar to basophils but are found in connective tissue

What is Histamine?

1. Histamine is secreted in response to a local infection
2. Histamine secretion causes small blood vessels to dilate in the infected area in order for the vessels to become leaky.
3. To increase the flow of fluids that contain immune components to the infected area, allowing the immune components to leave the blood vessel which therefore results in both a specific or non-specific immune response.

What are allergies?

Allergies are reactions of the immune system to allergens such as bee stings, pollen or peanuts where the substances in the allergens cause the over-activation of basophils and therefore the excessive excretion of histamine which causes rashes, inflammation, sneezing or even in extreme cases swelling.

How to prevent excessive histamine?

The use of anti-histamine drugs can be used to lessen the effects of allergic responses.

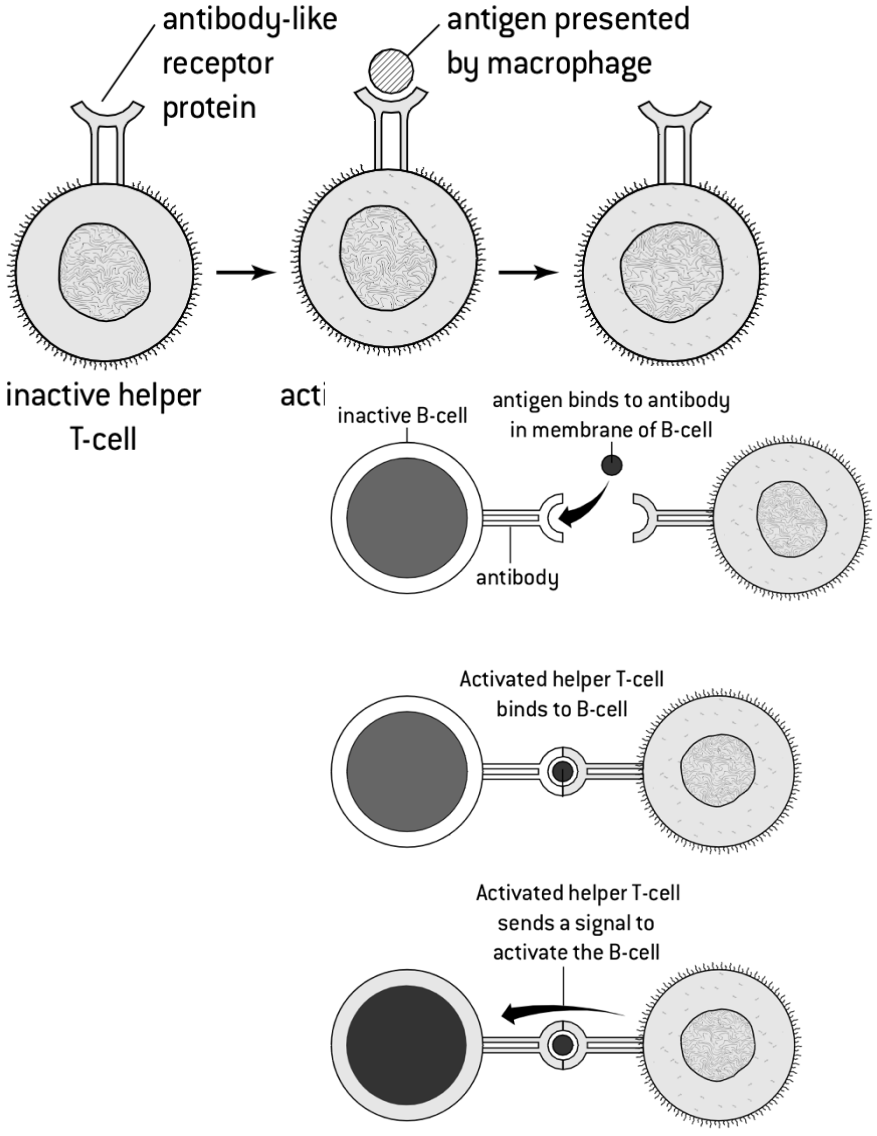
Antibody production

Stages in antibody production

When a pathogen enters the body, the immune system produces large amounts of the specific antibodies need to combat the pathogen.

1. **Activation of helper T-cells**

Helper T-cells have antibody like receptor proteins in the plasma membrane to which a specific antigen can bind to. Once the antigen binds, the helper T-cell is activated. The antigen is brought to the helper T-cell by a macrophage which is a type of phagocytic white blood.

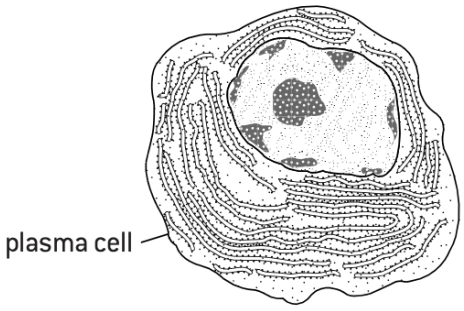


2. **Activation of B-cells**

- Inactive B-cells have antibodies in their plasma membrane.
- If these antibodies match an antigen the antigen binds to the antibody.
- Afterwards the helper T cell with receptors for the same antigen can bind to the B -cell.
- Then the activated helper T-cell sends a signal to the B-cell to activate it.

3. **Production of plasma cells**

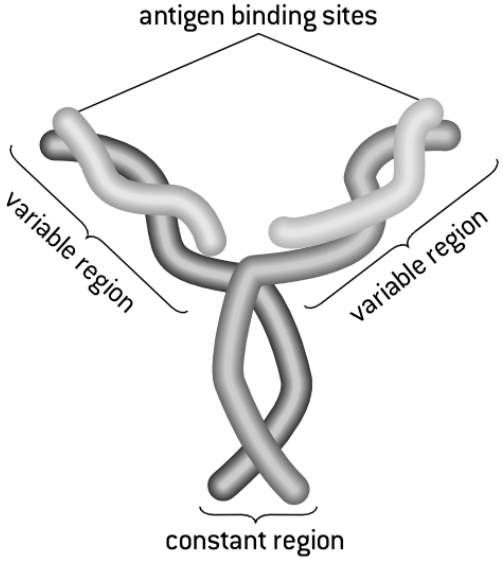
- Activated B-cells start to divide by mitosis to form a clone of cells.
- The cells then become active with a much greater volume of cytoplasm; they are called **plasma cells.**



- They have a very extensive network of rough endoplasmic reticulum. This is used for the synthesis of large amounts of antibody, which is then secreted by exocytosis.

4. **Production of memory cells**

- Memory cells are B-cells and T-cells that are formed at the same time as activated helper T-cells and B-cells when a disease challenges the immune system.
- After the activated cells and the antibodies produced to fight the disease disappear the memory cells persist
- They allow a rapid response if the disease is encountered again. Memory cells give long-term immunity to a disease.



The role of antibodies

-The diagram shows the structure of

an antibody molecule or an immunoglobin.

-The tips of the variable regions are the antigen binding sites.

-The constant region aids the destruction of the pathogen.

What are the ways the different versions of the constant region use to destroy pathogens?

- Make pathogens more recognizable to phagocytes so they are easily engulfed
- Prevents viruses from attaching to host cells
- Neutralizing toxins produced by pathogens
- Binding to the surface of pathogen cell and bursting it by forming pores
- Sticks pathogens together (agglutination) so that they cannot enter host cells and phagocytes can ingest them easier

Vaccination and monoclonal antibodies

Vaccination

- Vaccines contain antigens that trigger immunity to a disease without actually causing the disease in the person who is vaccinated.
- Most vaccines contain the weakened form or the killed forms of the pathogens OR a chemical that acts as the antigen.

What is the principle of vaccination?

The principle of vaccination is that the antigens in the vaccine cause the production of the antibodies needed to control the disease. Sometimes two shots of the vaccination are required.

1. First vaccination cause little antibody production and some memory cells

2. Second vaccination/booster shot causes a response from the previously produced memory cells and therefore a more rapid production of antibodies.