



The production of antibodies and vaccination technology



By:Reham Alahmadi NOV 2018

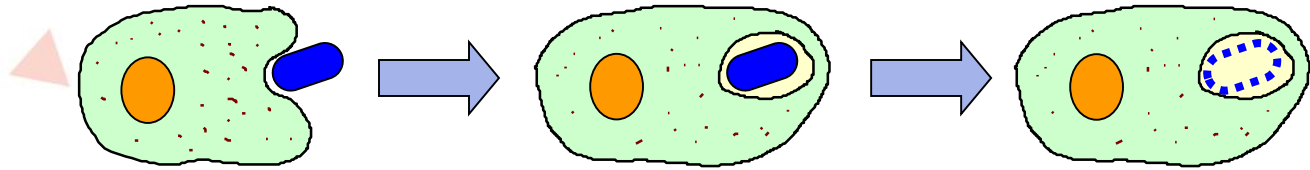


Antibody Production

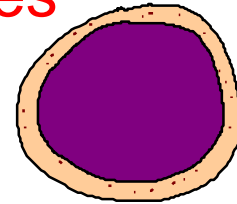


The blood contains two types of white blood cell or leukocyte

Phagocytes ingest bacteria by **endocytosis**



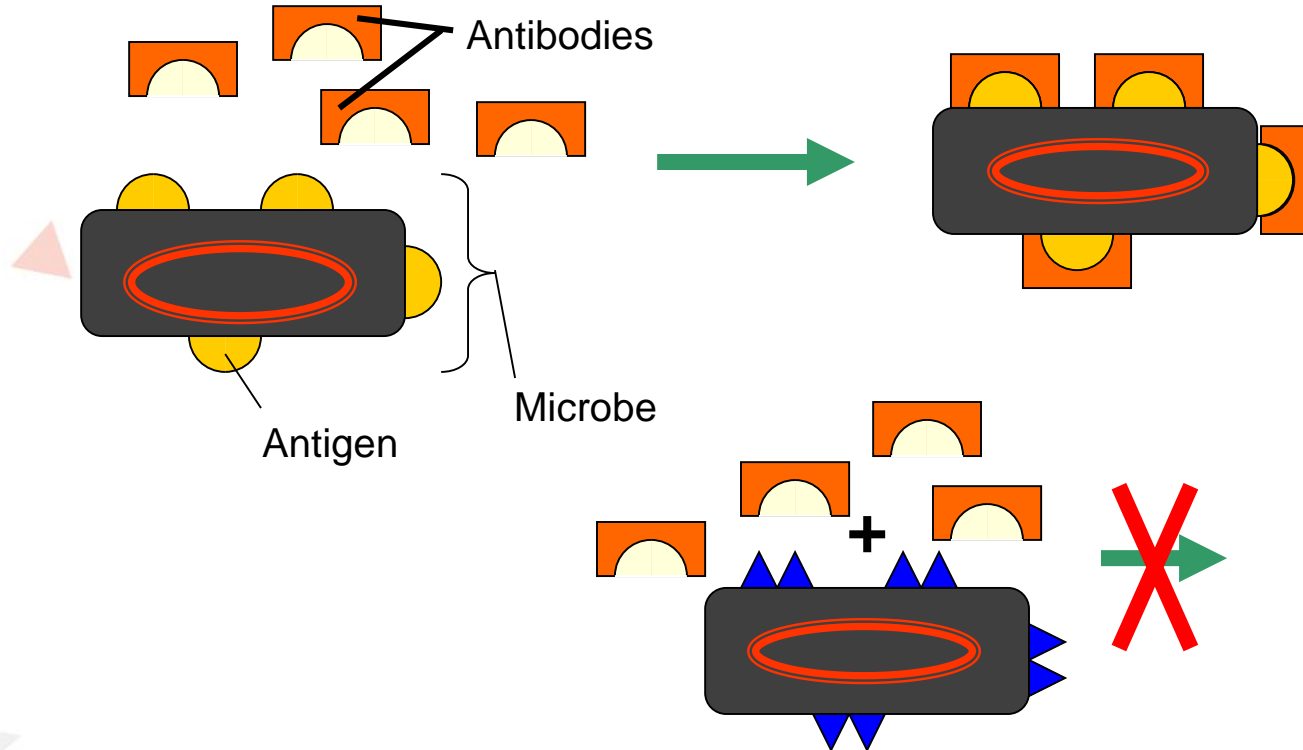
Lymphocytes produce **antibodies**



Antibodies

- Antibodies are **proteins** that recognise and bind to specific **antigens**
- Antigens are **foreign substances** that **stimulate** the production of antibodies
- Many of the molecules on the surface of viruses and bacteria are antigens

Antibodies are **specific** – they usually bind to only **one specific antigen**.

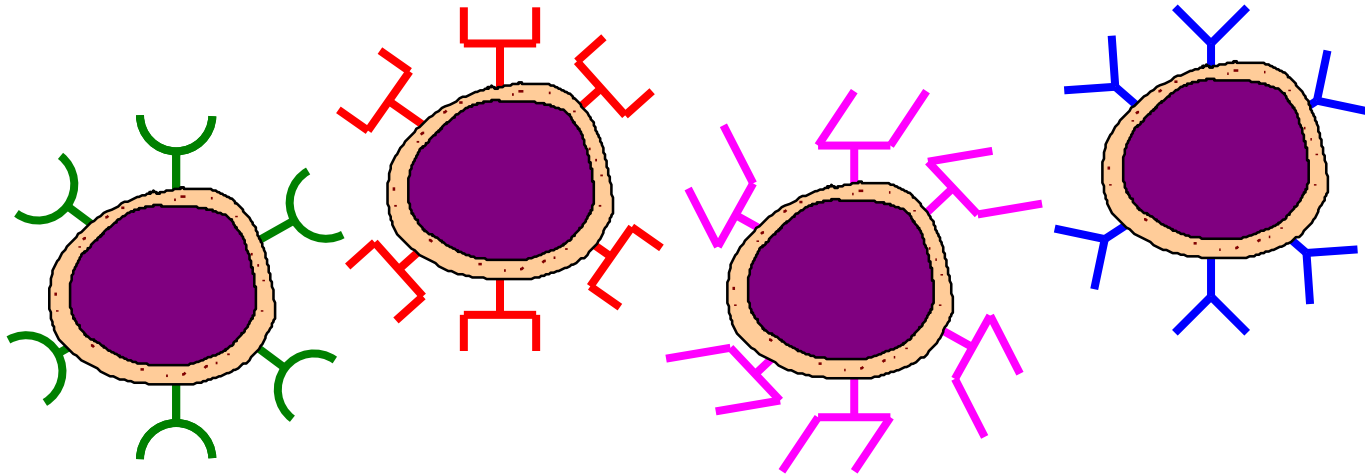


Production of Antibodies by Lymphocytes

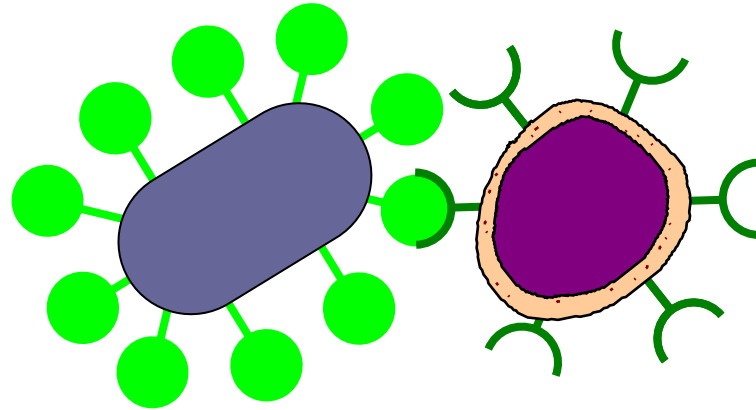
A lymphocyte can produce only one type of antibody so a huge number of different types are needed

Each lymphocyte has some of its antibody on its surface

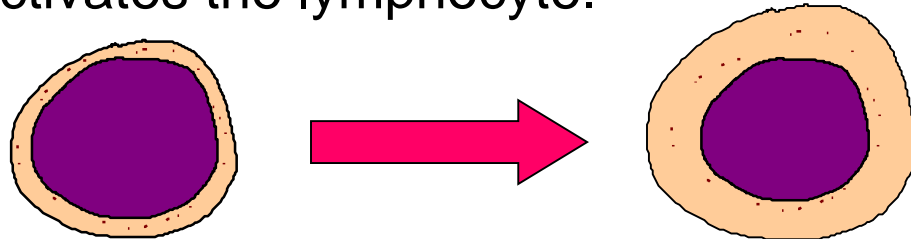
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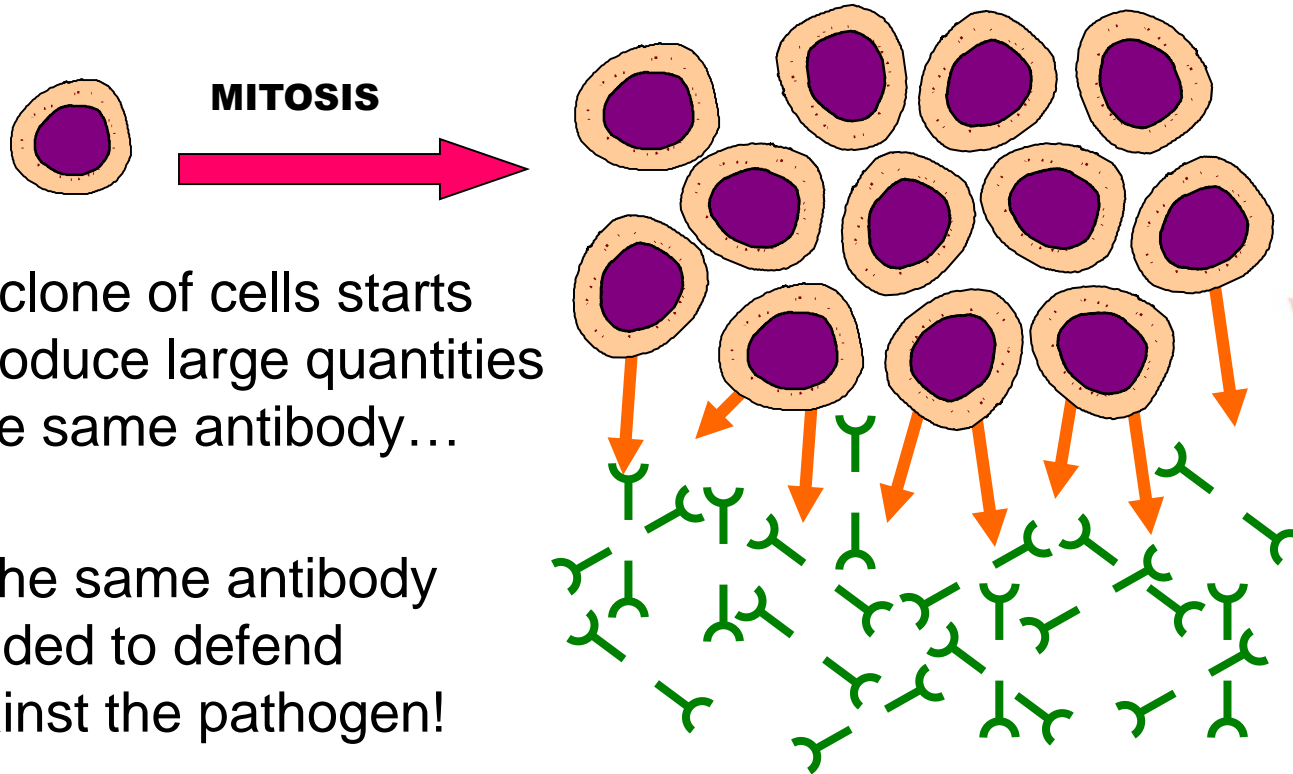
The antigens of a pathogen bind to the antibodies in the surface membrane of a lymphocyte...



...This activates the lymphocyte.



The active lymphocyte divides by **mitosis** to produce a **clone** of many **identical** cells



The clone of cells starts to produce large quantities of the same antibody...

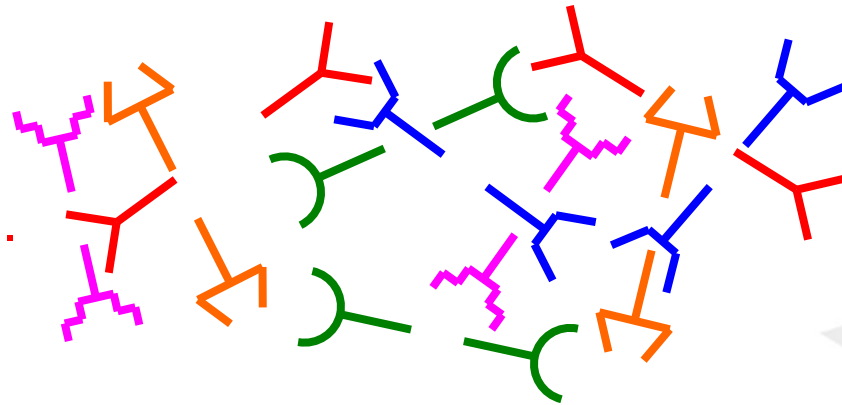
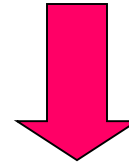
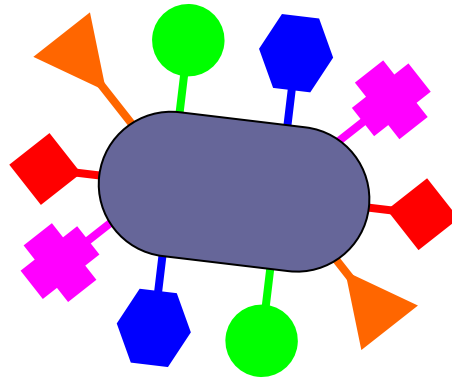
... the same antibody needed to defend against the pathogen!

Most microbes have more than one antigen on their surface, so...

...they stimulate more than one type of lymphocyte...

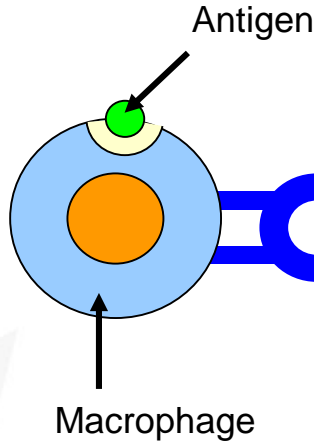
...resulting in the production of **many different** antibodies.

These are called **polyclonal antibodies**.



Antibody Production: The Primary Response

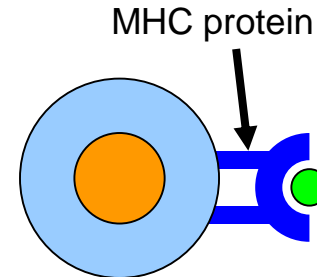
Step 1: Antigen Presentation



Macrophages take in antigen by **endocytosis**

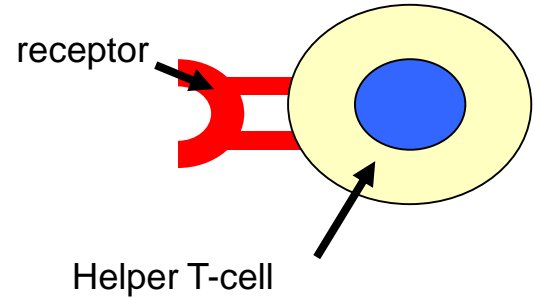
The macrophage processes the antigen and attaches it to a membrane protein called a **MHC** protein

The MHC protein is moved cell surface membrane by **exocytosis** so that the antigen is displayed on its surface.

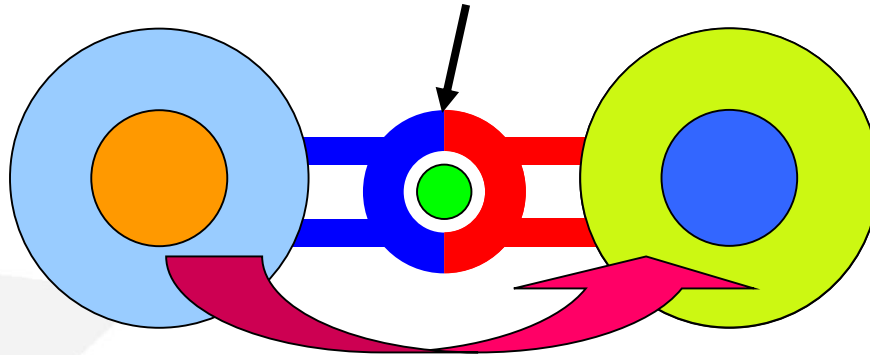


Step 2: Activation of Helper T-cell

Helper T-cells have receptors on their cell surface membranes which can bind to antigens presented by macrophages.



Helper T-cell binds to macrophage presenting the antigen



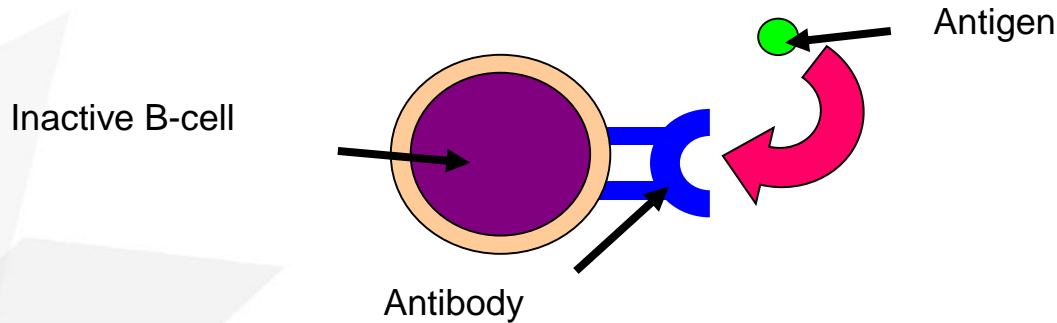
Macrophage sends a signal to activate the helper T-cell

Step 3: Activation of B-lymphocytes

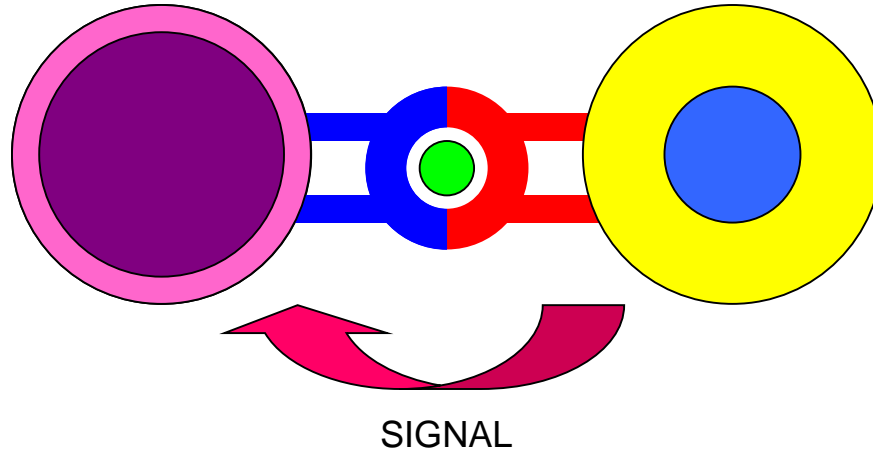


B-cells have antibodies in their cell surface membranes

Antigens bind to the antibodies in the surface membranes of B-cells



An activated helper T-cell with receptors for the same antigen binds to the B-cell



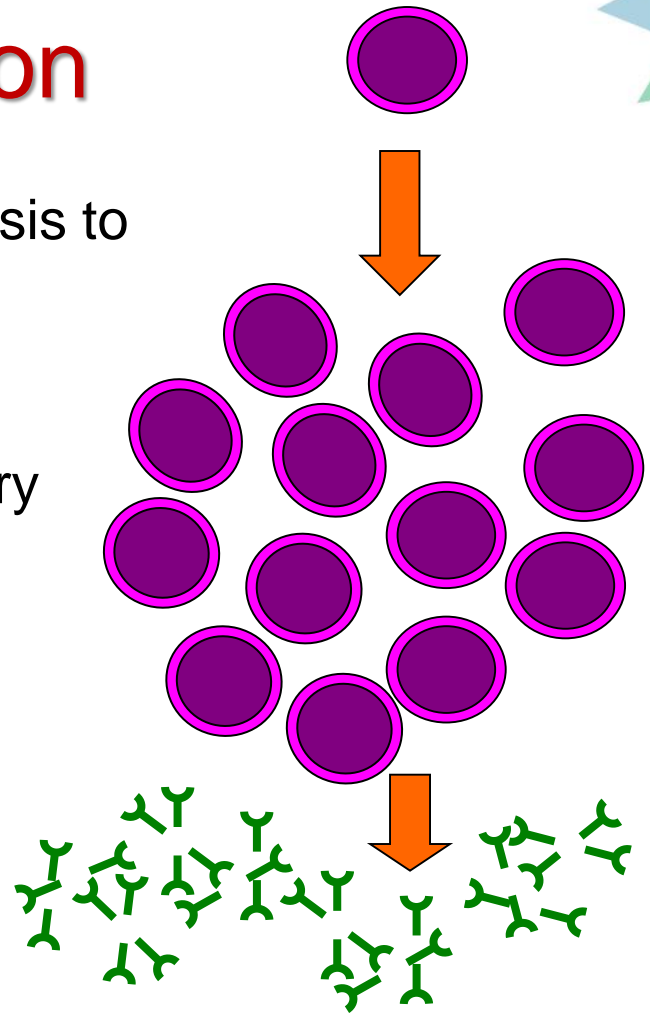
The helper T-cell sends a signal to the B-cell, activating the B-cell.

Step 4: Proliferation

The activated B-cell starts to divide by mitosis to form a clone of plasma cells.

Plasma cells are activated B-cells with a very extensive network of **rough endoplasmic reticulum**.

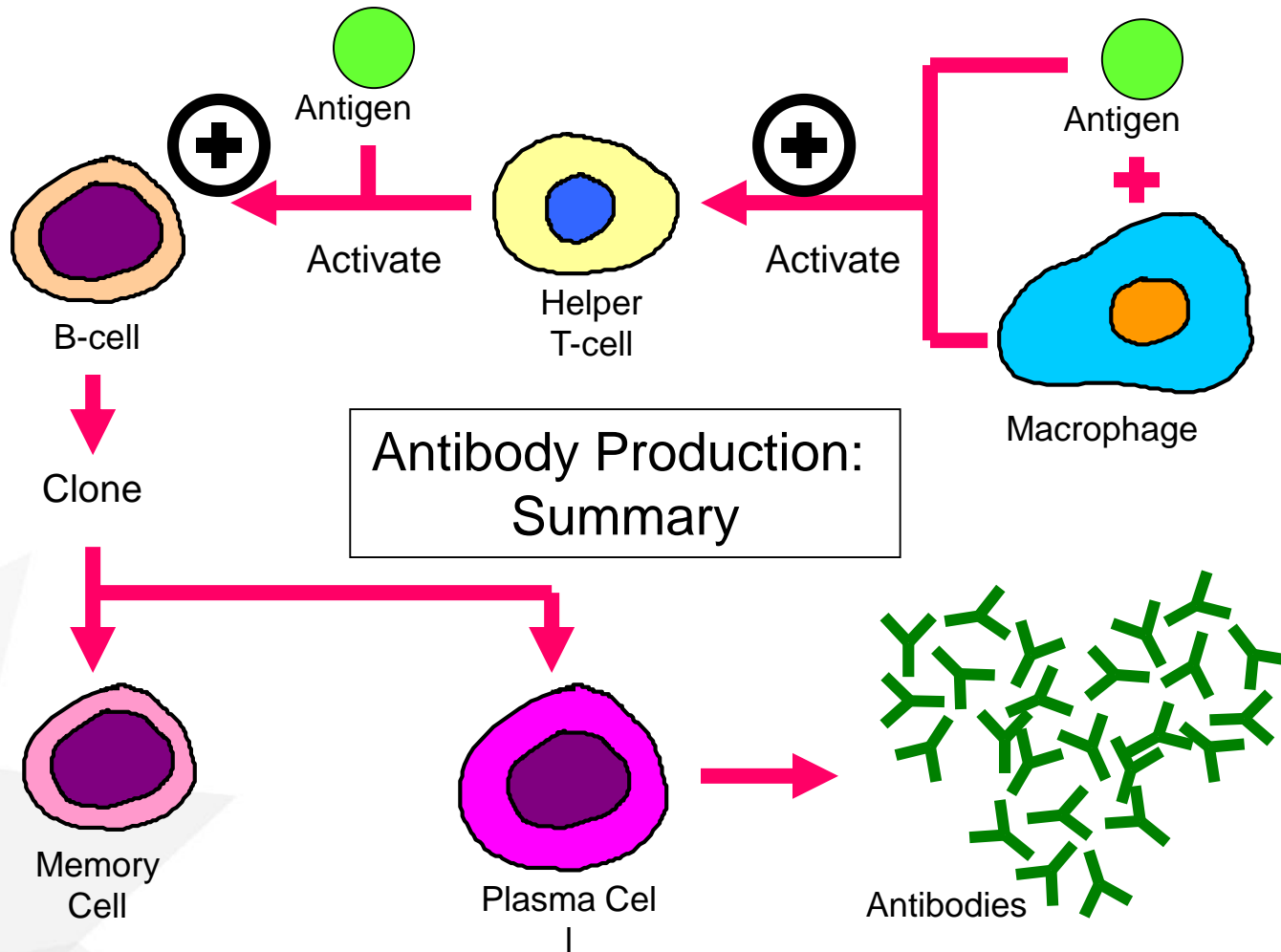
Plasma cells synthesis large amounts of antibody, which they excrete by exocytosis.

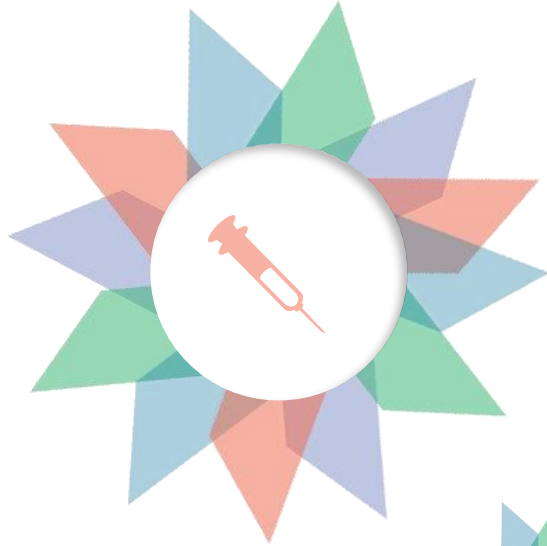


The Secondary Response: Memory Cells



- If an antigen invades your body a second time, a much faster response occurs which produces much larger quantity of the required antibody.
- When activated B-cells are dividing during the **primary** response , some cells stop dividing and secreting antibody and become **memory cells**.
- Large numbers of memory cells remain in the body for a long time...
- ...they are capable of producing large amounts of antibody very quickly when stimulated.





Vaccination Technology



Vaccination

- ❖ Vaccination is a method of giving antigen to stimulate the immune response through active immunization.
- ❖ A vaccine is an immuno-biological substance designed to produce specific protection against a given disease.
- ❖ A vaccine is “antigenic” but not “pathogenic” .

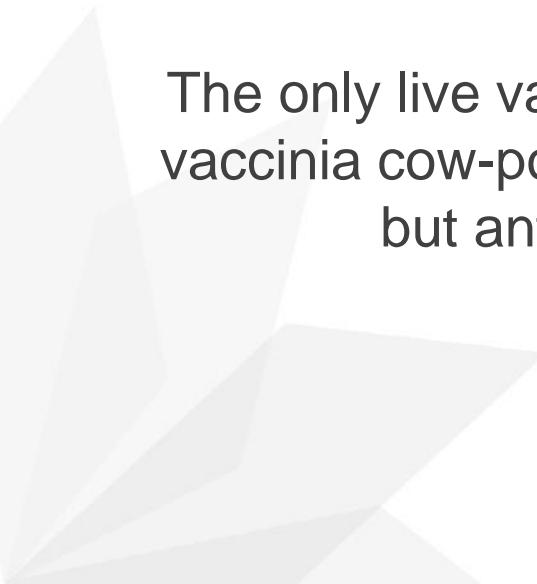
Types of vaccines

- ❖ Live vaccines
- ❖ Attenuated live vaccines
- ❖ Inactivated (killed vaccines)
- ❖ Toxoids
- ❖ Polysaccharide and polypeptide (cellular fraction) vaccines
- ❖ Surface antigen (recombinant) vaccines.



Live vaccines

Live vaccines are made from live infectious agents without any amendment.



The only live vaccine is “Variola” small pox vaccine, made of live vaccinia cow-pox virus (not variola virus) which is not pathogenic but antigenic, giving cross immunity for variola.

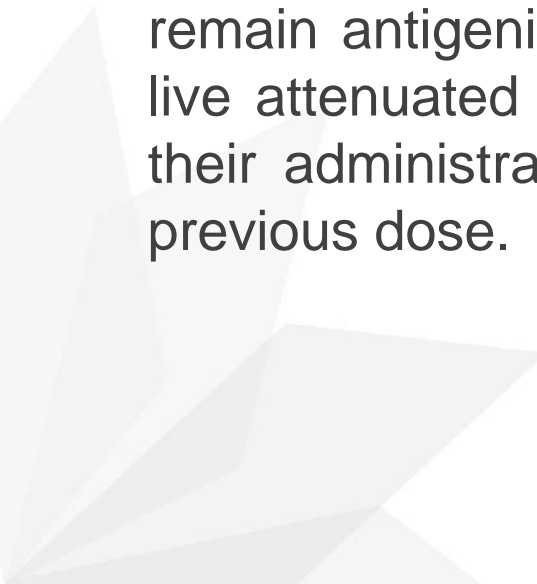
Live attenuated (avirulent) vaccine

- ❑ Virulent pathogenic organisms are treated to become attenuated and avirulent but antigenic. They have lost their capacity to Induce full-blown disease but retain their immunogenicity.

- ❑ Live attenuated vaccines should not be administered to persons with suppressed immune response due to:
 - Leukemia and lymphoma
 - Other malignancies
 - Receiving corticosteroids and anti-metabolic agents
 - Radiation
 - pregnancy



(killed) vaccines



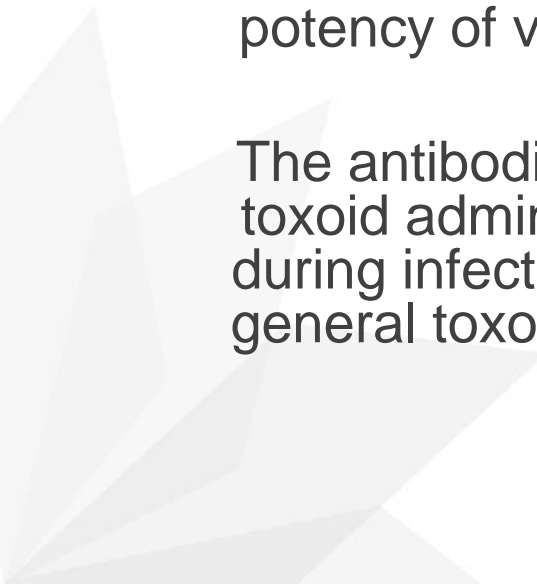
Organisms are killed or inactivated by heat or chemicals but remain antigenic. They are usually safe but less effective than live attenuated vaccines. The only absolute contraindication to their administration is a severe local or general reaction to a previous dose.



Toxoids

They are prepared by detoxifying the exotoxins of some bacteria rendering them antigenic but not pathogenic. Adjuvant (e.g. alum precipitation) is used to increase the potency of vaccine.

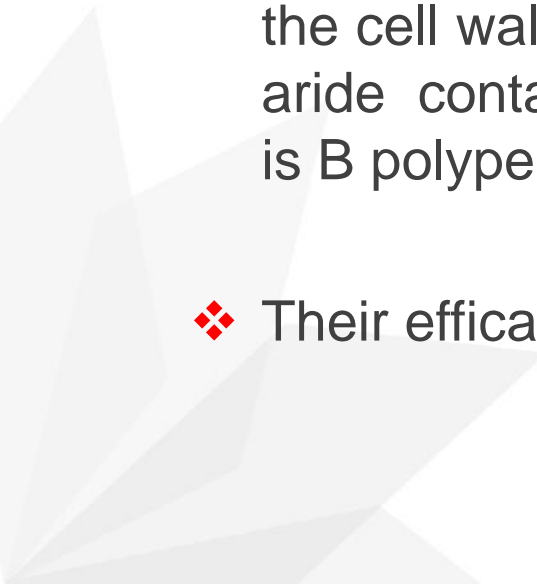
The antibodies produced in the body as a consequence of toxoid administration neutralize the toxic moiety produced during infection rather than act upon the organism itself. In general toxoids are highly efficacious and safe immunizing agents.



Polysaccharide and polypeptide (cellular fraction) vaccines

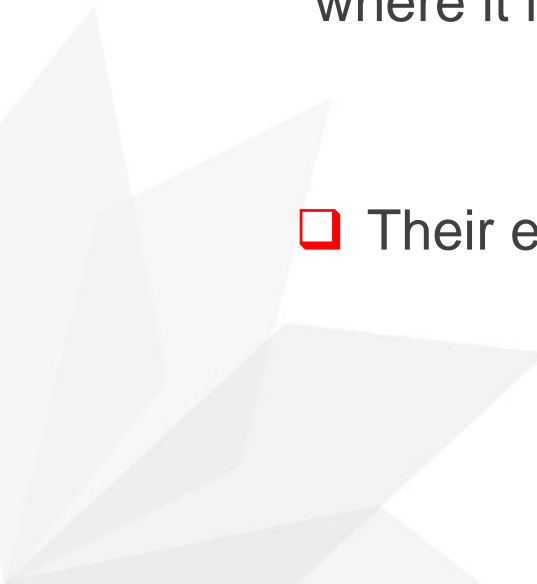


- ❖ They are prepared from extracted cellular fractions e.g. meningococcal vaccine from the polysaccharide antigen of the cell wall, the pneumococcal vaccine from the polysaccharide contained in the capsule of the organism, and hepatitis B polypeptide vaccine.
- ❖ Their efficacy and safety appear to be high.





Surface antigen (recombinant) vaccines

- ❑ It is prepared by cloning HBsAg gene in yeast cells where it is expressed. HBsAg produced is then used for vaccine preparations.
 - ❑ Their efficacy and safety also appear to be high.
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Types of vaccines

Live vaccines	Live Attenuated vaccines	Killed Inactivated vaccines	Toxoids	Cellular fraction vaccines	Recombinant vaccines
<ul style="list-style-type: none">•Small pox variola vaccine	<ul style="list-style-type: none">•BCG•Typhoid oral•Plague•Oral polio•Yellow fever•Measles•Mumps•Rubella•Intranasal Influenza•Typhus	<ul style="list-style-type: none">•Typhoid•Cholera•Pertussis•Plague•Rabies•Salk polio•Intra-muscular influenza•Japanise encephalitis	<ul style="list-style-type: none">•Diphtheria•Tetanus	<ul style="list-style-type: none">•Meningococcal polysaccharide vaccine•Pneumococcal polysaccharide vaccine•Hepatitis B polypeptide vaccine	<ul style="list-style-type: none">•Hepatitis B vaccine



Thank you

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