

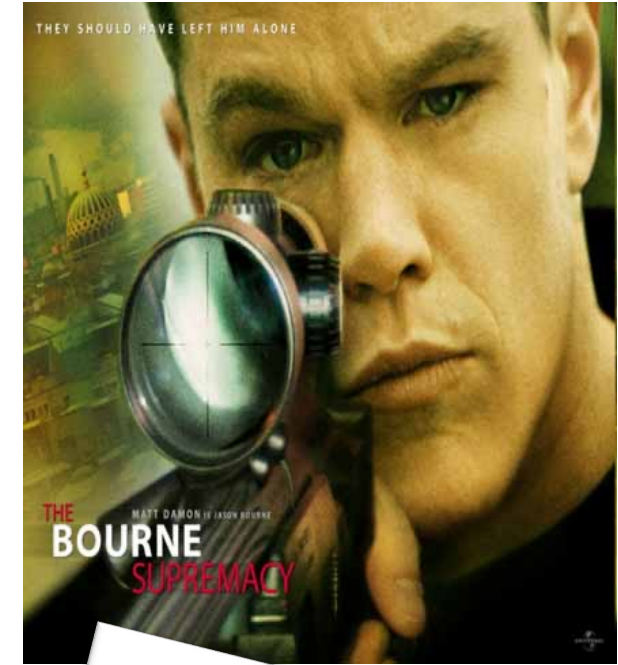
# Lesson 22 – Basic immunology: The third line of defense



# Acquired (specific) immunity – the third line of defense (TLD)

The body's ability to recognize and defend itself against **distinct invaders**

- Is a “smart” system
  - Also called **specific** and/or **adaptive** immunity
  - “Memory” allows it to respond rapidly to additional encounters with a pathogen
  - If nonspecific immune system has *warriors*, then acquired immunity has more sophisticated *special agents* and *assassins*
- Two types of specific immunity
  - **Naturally acquired** = immune response against **antigens** encountered in daily life
  - **Artificially acquired** = response to antigens introduced via vaccines

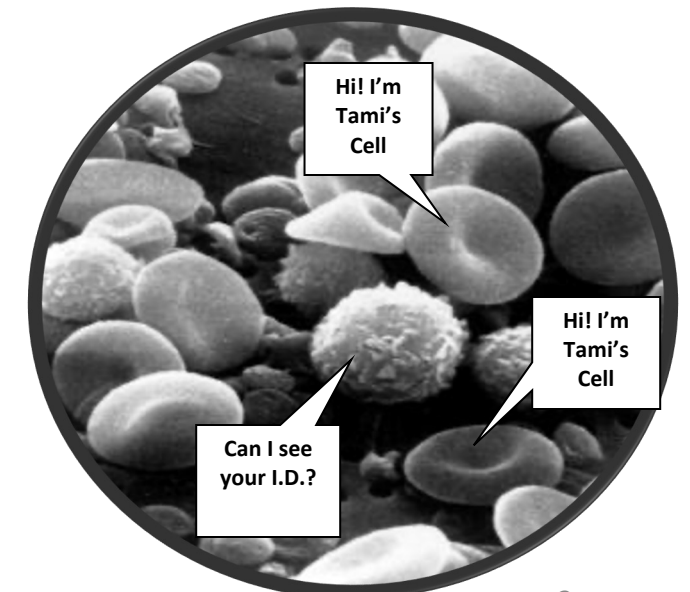


# Antigens

- Body does not direct immune response against whole bacteria, fungi, protozoa or viruses
- **Foreign molecules (antigens) trigger a specific immune response**
  - Include components of bacterial cell walls, capsules, pili, and flagella, as well as proteins of viruses, fungi and protozoa
- Food and dust can also contain antigenic particles
- Enter the body by various methods
  - Through breaks in skin and mucous membranes
  - Direct injection, as with a bite or needle
  - Through organ transplants and skin grafts

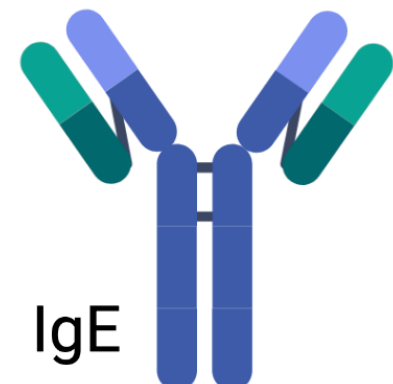
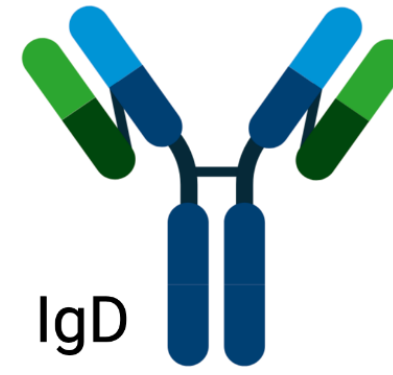
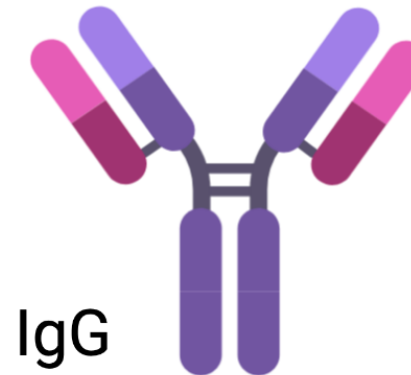
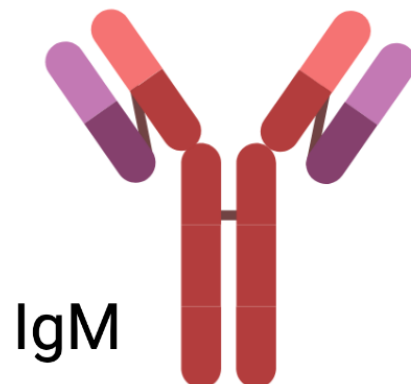
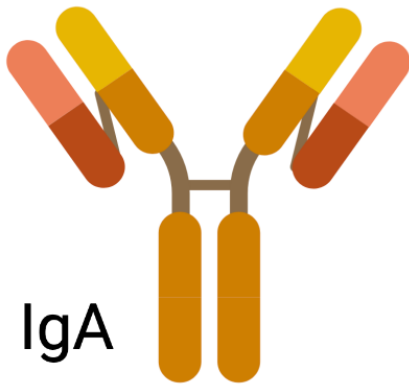
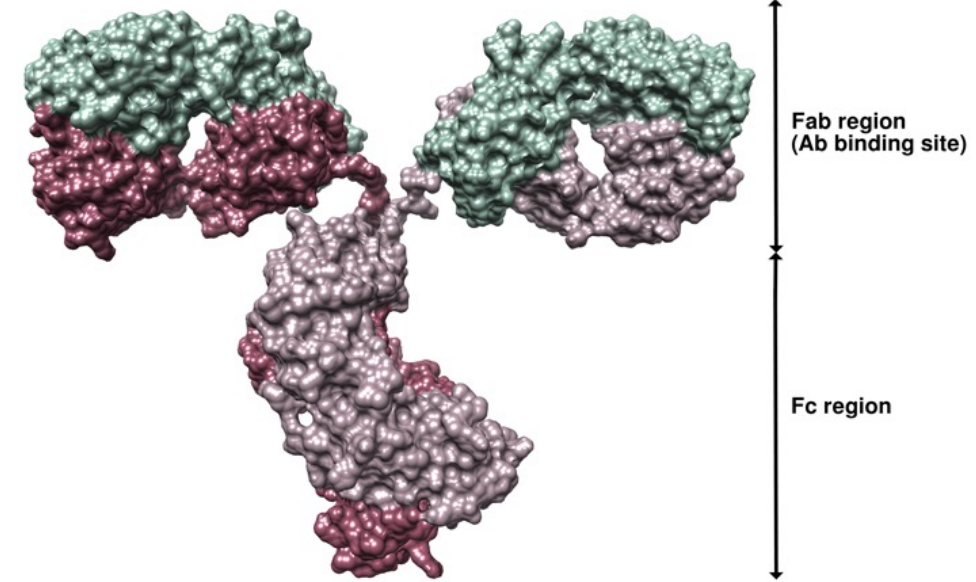
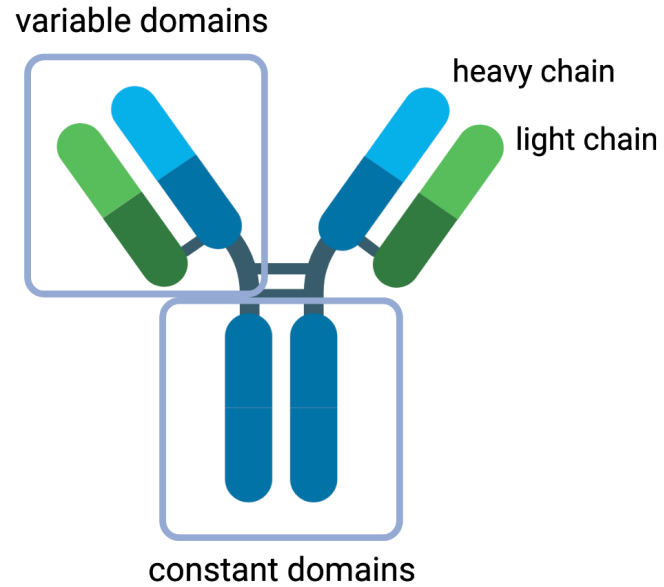
**HELLO**  
my name is

**Antigens Are Like Name Tags**  
Antigenic particles are often associated with a specific characteristic of an organism, so are detected as foreign when they get inside another organism that doesn't have that characteristic



# Antibodies

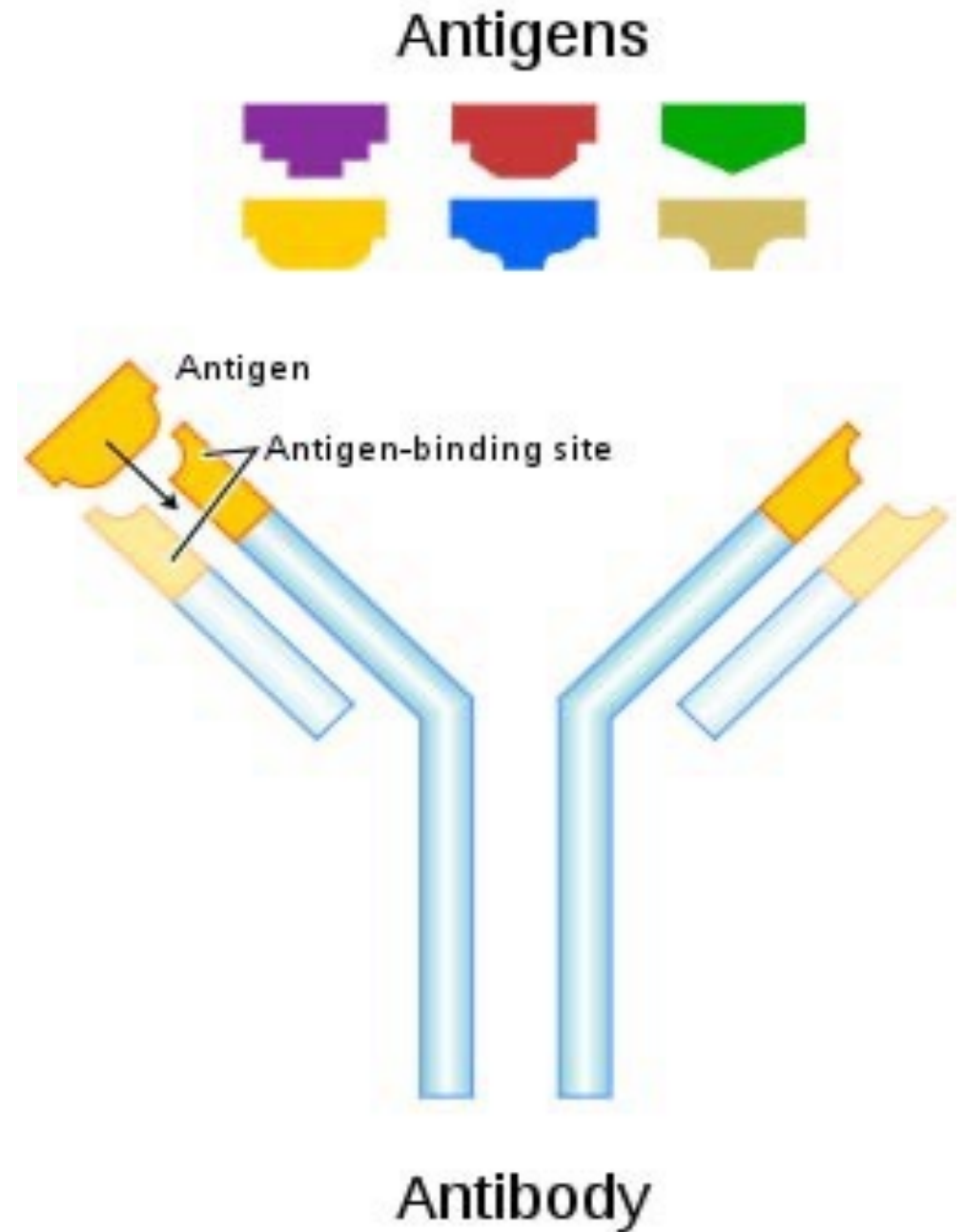
- Also called immunoglobulins (Igs)





# Antibodies

- Also called immunoglobulins (Igs)
- Proteins that bind **antigens** at the antigen-binding site



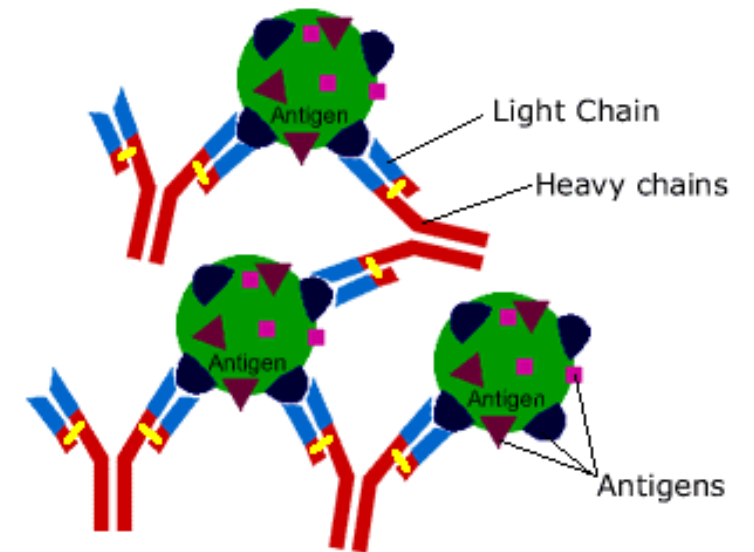
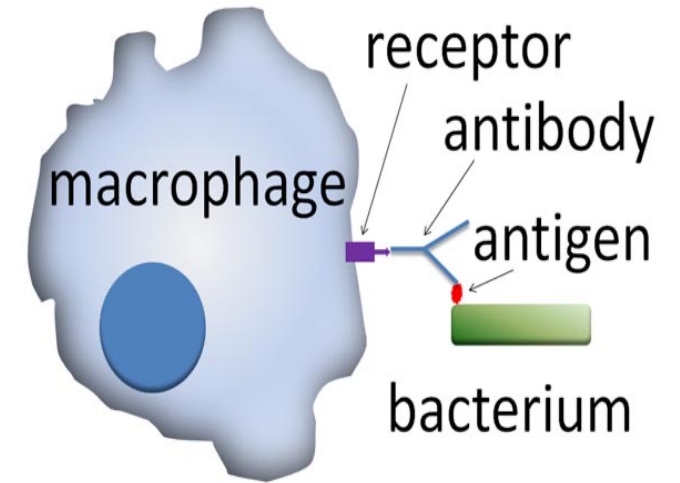
# Antibodies

Some act as **opsonins**, markers to identify antigens for phagocytes and stimulate phagocytosis

Some work as **antitoxins** (*i.e.*, they neutralize toxins *e.g.* those causing diphtheria and tetanus)

Some attach to bacterial flagella making them less active and easier for phagocytes to engulf

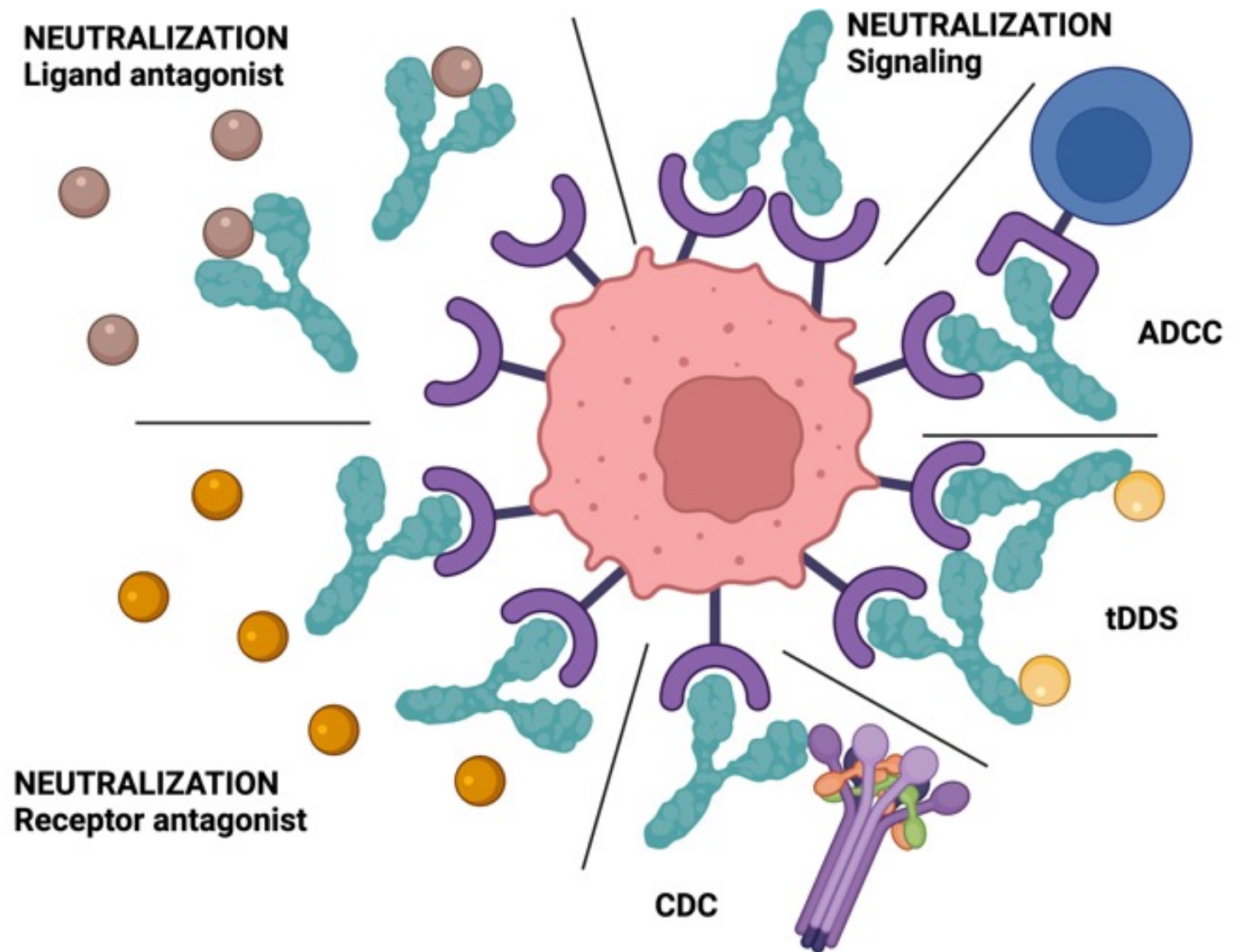
Some cause **agglutination** (clumping together) of bacteria making them less likely to spread



# Antibodies

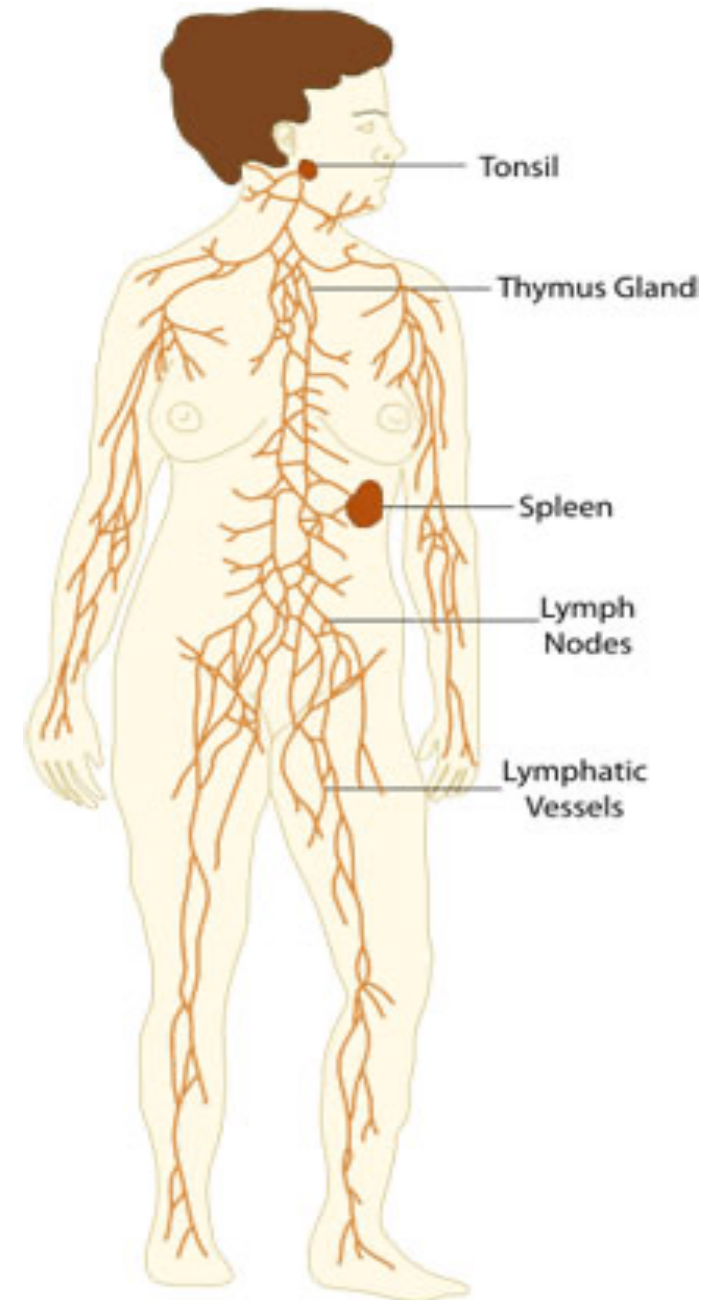
## And much more...

Q. Where are antibodies produced?.. Stay tuned..



# The lymphatic system

- Screens tissues of the body for foreign antigens
- Composed of lymphatic vessels and lymphatic cells
- One-way system that conducts lymph from local tissues and returns it to the circulatory system
- Lymph is a liquid with similar composition to blood plasma
- Lymph nodes house **lymphocytes** that recognize and attack foreign antigens present in lymph





# The lymphocytes

- WBCs of specific immunity (Lesson 21, slide #6)
- Smallest leukocytes
  - Have huge nucleus surrounded by thin rim of cytoplasm
  - Produced from blood stem cells in the red bone marrow

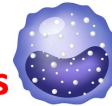
## Leukocytes - agranulocytes



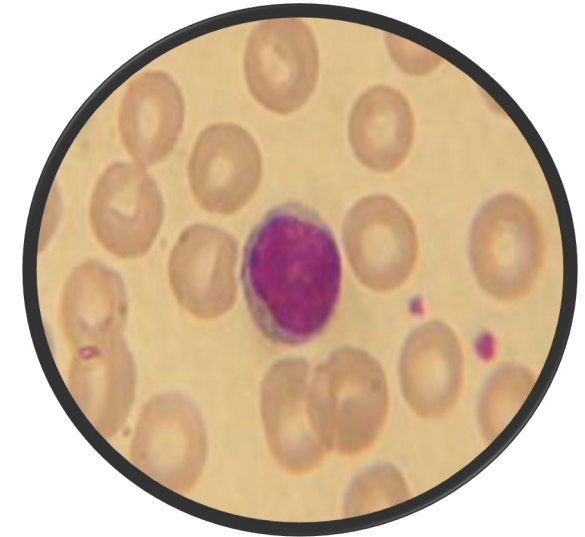
• Category of **WBCs** characterized by the **absence of granules** in their cytoplasm

• 2 types:

- **Lymphocytes**



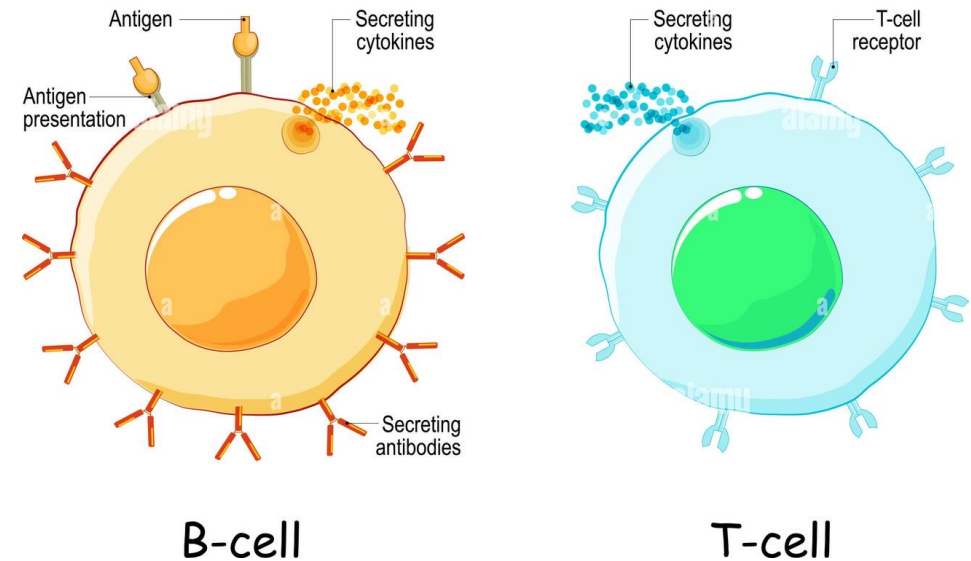
- most involved in the **SPECIFIC IMMUNITY** (3<sup>rd</sup> line of immune defense - TLD)



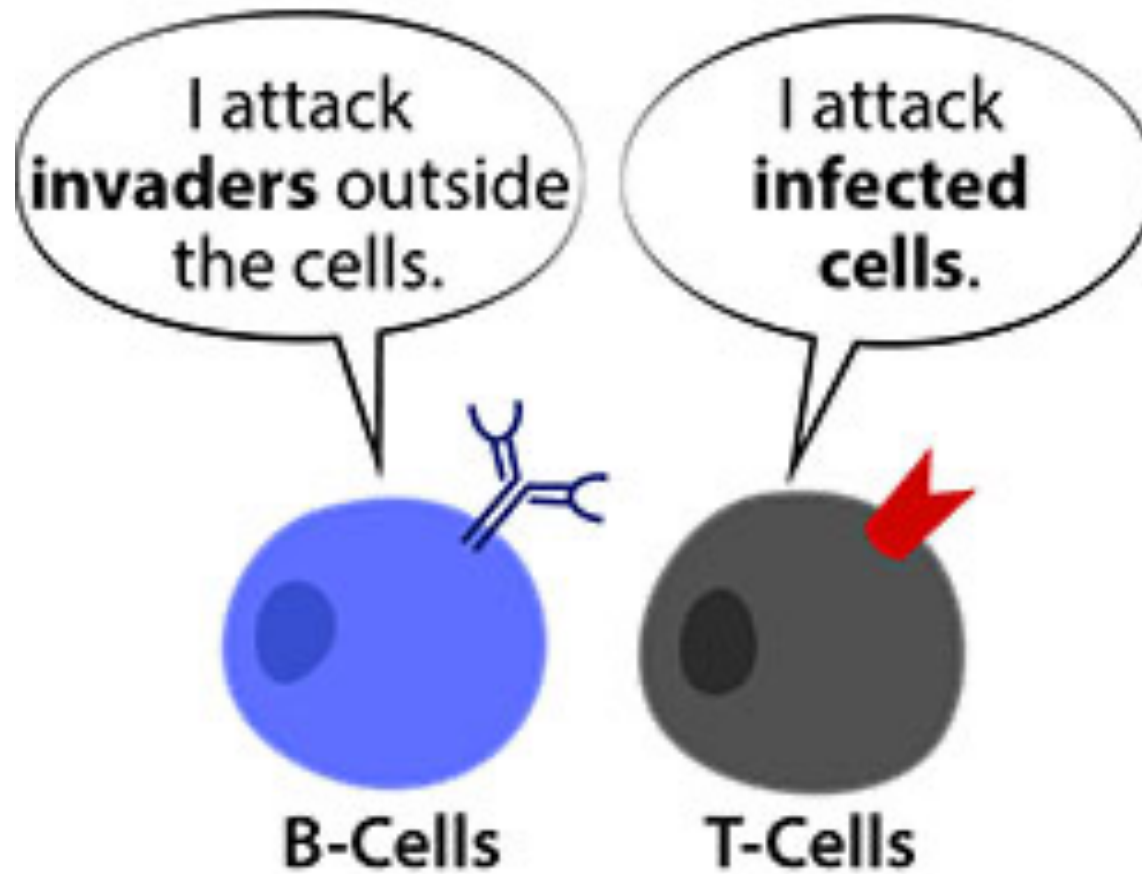
# The lymphocytes

- WBCs of specific immunity
- Smallest leukocytes
  - Have huge nucleus surrounded by thin rim of cytoplasm
  - Produced from blood stem cells in the red bone marrow
- Two main types
- **B-cells**
  - mature in bone marrow, then concentrate in lymph nodes and spleen
- **T-cells**
  - mature in thymus
- B and T cells mature then circulate in the blood and lymph
- Circulation ensures they come into contact with pathogens and each other

## Cells of the adaptive immune system

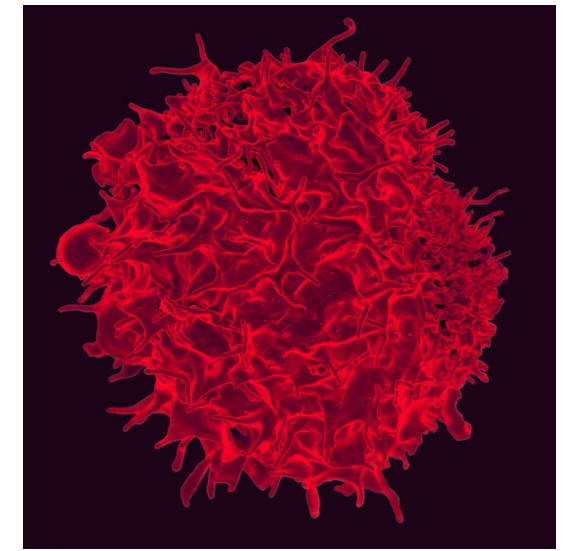


# B- vs. T-lymphocytes



# T-cells (or T-lymphocytes)

- Produced in red bone marrow and mature in thymus
- Circulate in the lymph and blood and migrate to the lymph nodes (and other areas of the lymph system)
- Part of the **cellular immune response** (aka cell-mediated immune response) because **these cells act directly against various antigens**
  - Intracellular pathogens (inside the body's cells)
  - **Abnormal body cells such as cancer cells**





# T-cells (or T-lymphocytes)

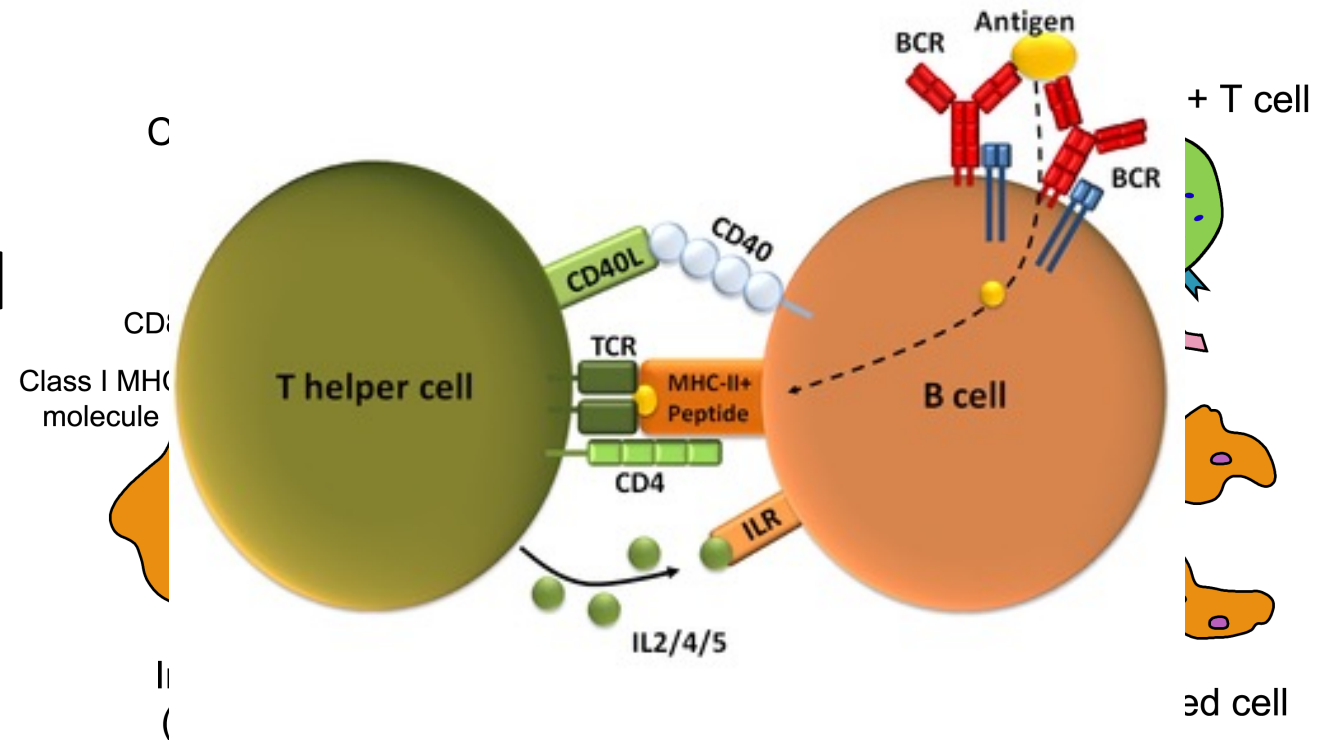
2 main types

- **cytotoxic or killer T cells** ( $T_C$ )

- Destroy compromised body cells

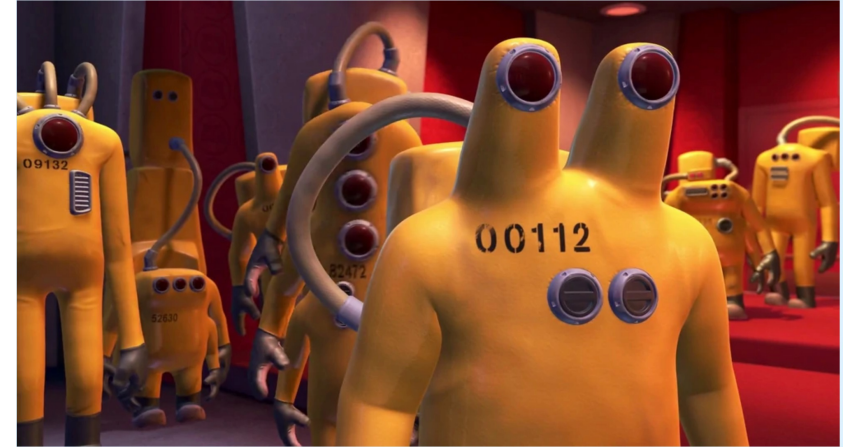
- **helper T cells** ( $T_H$ )

- Activate B-cells



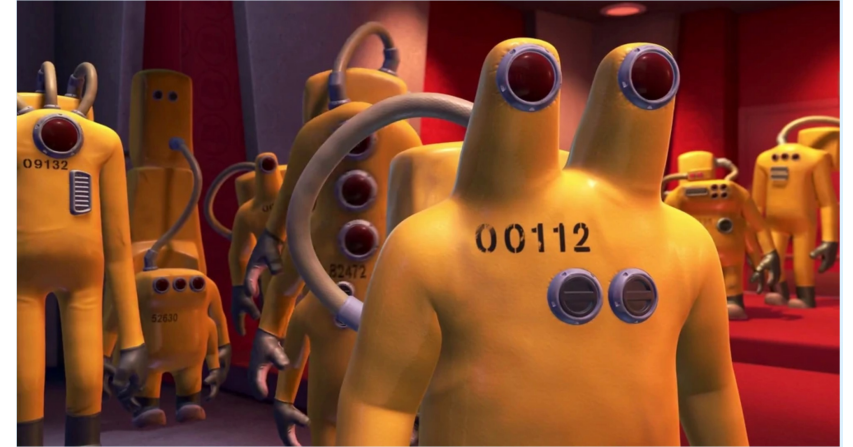
# B-cells (or B-lymphocytes) – the APCs

- Consider your WBCs a **security patrol** for your body and
- any non-self antigens as **the bad guys**



# The antigen presenting cells (APCs)

- Consider your WBCs a **security patrol** for your body and
- any non-self antigens as **the bad guys**
- The larger the patrol, the more likely one of the officers will run into a bad guy and help the body apprehend it
- **Any WBC that can grab and present an antigen to another immune cell, is called an antigen presenting cell (APC)**



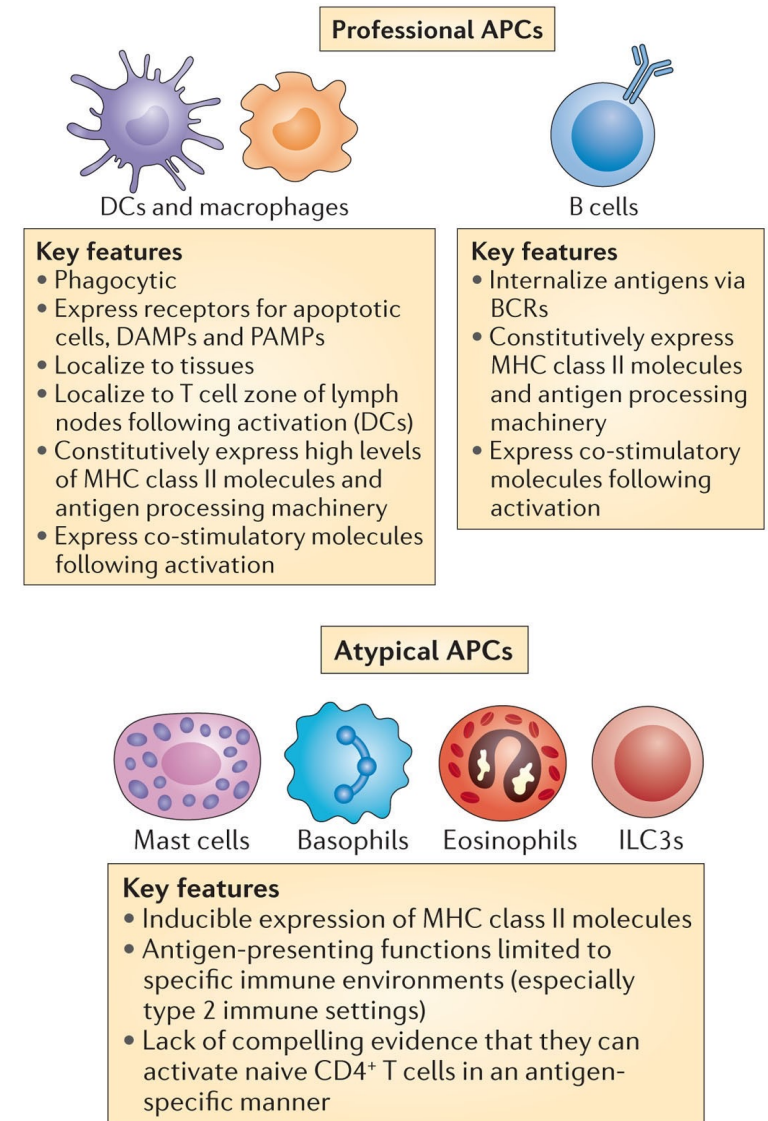
# The APCs

- Antigen-presenting cells (APCs) are **a heterogeneous group of immune cells that mediate the cellular immune response by processing and presenting antigens for recognition by certain lymphocytes such as T cells**



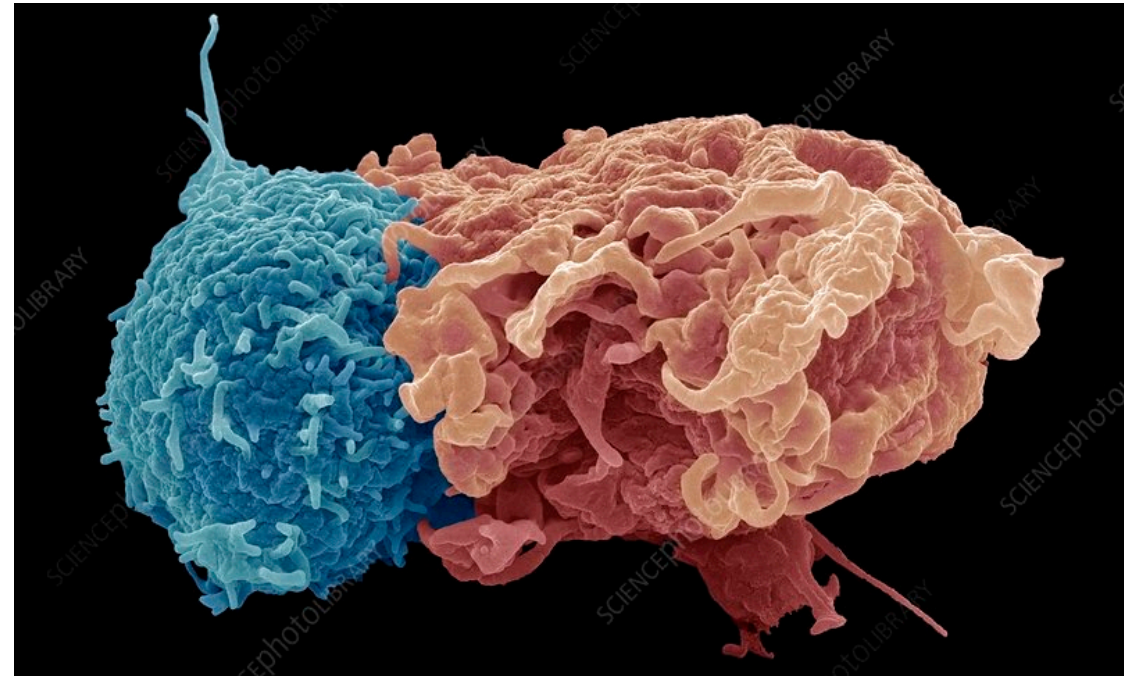
# The APCs

- Antigen-presenting cells (APCs) are a heterogeneous group of immune cells that mediate the cellular immune response by processing and presenting antigens for recognition by certain lymphocytes such as T cells
- **APCs are classified as**
  - **Professional APCs**
    - include **dendritic cells, macrophages, Langerhans cells and B- cells**
  - **Atypical APCs**
    - Include basophils, eosinophils, some skin cells (like fibroblasts and some epithelial and endothelial cells) and glial cells (brain) among others



# Antigen presentation

- Macrophages (red) are antigen-presenting cells (APCs)
- They present antigens (fragments on the surface of pathogens or foreign objects) to T-helper-lymphocytes (Th, blue), activating them
- Each Th lymphocyte recognizes and binds to a specific antigen
- Binding of the Th cell to the antigen presented by the macrophage activates the Th cell
- This leads to its proliferation and the activation of other immune cells that eliminate the antigen



# B-cells (or B-lymphocytes) – special APCs

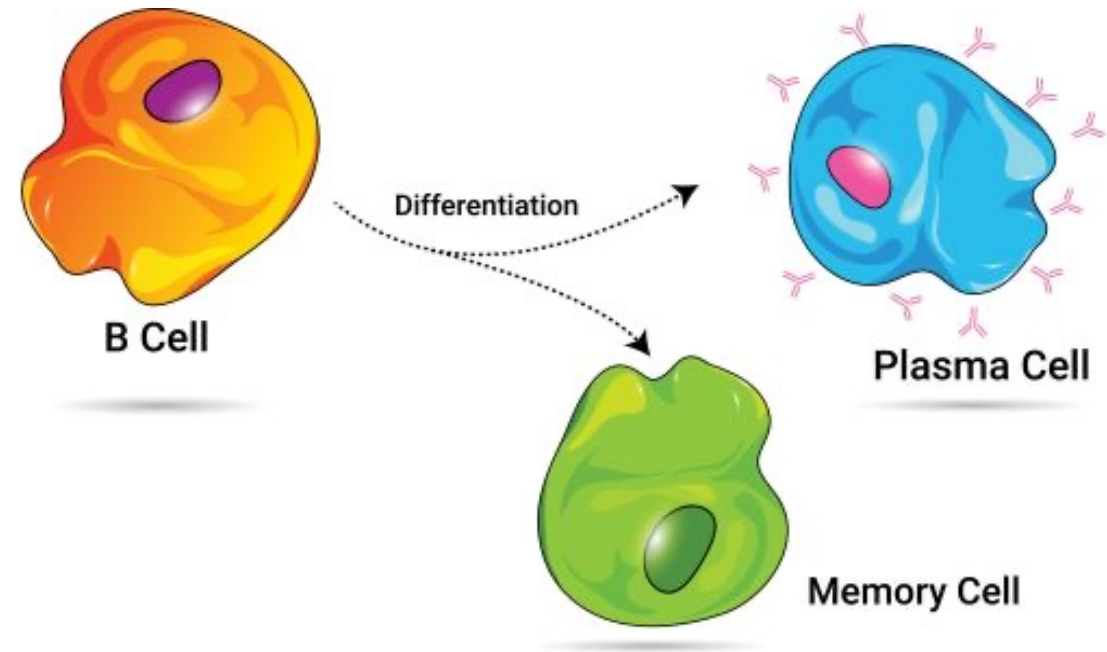
Activated B-lymphocytes produce either:

- **Plasma cells**

- make antibodies to a pathogen

- **Memory cells**

- remember the same pathogen for faster antibody production in future infections



B Cell Differentiation

Answer to question in slide 7