

# Immunology

teamwork 437

Lecture (1): Introduction to  
Immunology & Lymphoid System

Color index :

**IMPORTANT**

Definition

Explanations +  
notes

extra

# Objectives

- ▶ To know the historical perspective of immunology
  - ▶ To be familiar with the basic terminology and definitions of immunology
  - ▶ To recognize immune response cells
  - ▶ To understand types of immune responses
  - ▶ To know about the **lymphoid system**
  - ▶ To understand **T and B cell functions**
- 
- Reference: kuby Immunology 7<sup>th</sup> Edition (chapter 1 pages 1-22 & chapter 2 pages 27-57)

# 1798 Edward Jenner



Smallpox



A child infected with smallpox in Bangladesh, 1973. Patients with ordinary-type smallpox usually had bumps filled with a thick and opaque fluid, often with a depression or dimple in the center. This is a major distinguishing characteristic of the disease.

- **Observation:** Milkmaids who contracted cowpox (a mild disease) were subsequently **immune to small pox**

Symptoms of small pox: SCARRING BUMPS, BLINDNESS, LIMB DEFORMITIES

- Profound results:

- 1- Jenner's technique of **inoculating** with **cowpox** to protect against **small pox** spread quickly throughout Europe
- 2- **Began the science of Immunology**, the study of the **body's response to foreign substances**.

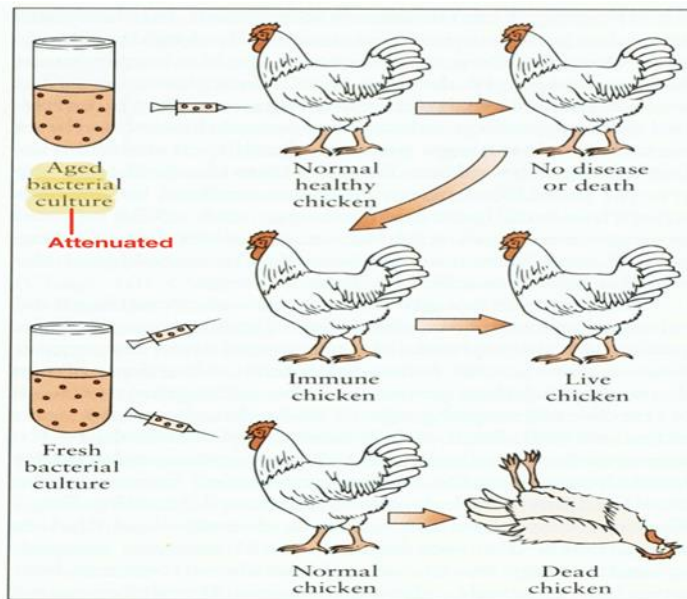
## Louis Pasteur's Contributions

Determined through studies of **cholera in chickens** that the virulence of a pathogen **weakens with age** (chickens inoculated with old strains not only survive but become **resistant**)

**Attenuated** - weakened, non-virulent strain whose exposure can confer resistance to disease

Classical experiment > Heat attenuated anthrax bacillus and subsequent challenge with virulent Bacillus anthracis in sheep

Observation :  
Cholera



# Definitions

## Immune (Latin- "immunus")

- To be free, exempt
- People survived ravages of epidemic diseases when faced with the same disease again
- **Immunity**: The state of protection from infectious disease

Also it's :The study of mechanisms that humans and other animals use to defend their bodies from invading organisms such as **bacteria, viruses, fungi, parasites and toxins**

**(CD) Cluster of Differentiation/Marker**: molecule with a CD designation has a characteristic **cell surface protein are often associated with the cells function.**

### CD(NUMBER)

"THEY ARE SURFACE MOLECULES , THEY CAN BE RECEPTORS OR PROTEINS TO IDENTIFY THE CELLS"

**CELLULAR MARKER** :EACH ONE OF THESE CELLS HAVE A SPECIAL MARKER

**Antigen (Ag)**: any substance (**usually foreign**) that binds specifically to a component of **the adaptive immunity.**

**Allergen**: noninfectious antigens that induce hypersensitivity reactions, **most commonly IgE-mediated type I reactions.**

### Immunoglobulin (Ig) or Antibodies:

- Secreted from **plasma cell (B cell)**
- Consists of **a heavy and light polypeptide chains** linked to each other **via disulfide bonds.**

**Adaptive Immunity**: **Specific** host defenses that **are mediated by T & B cells following exposure to Ag.**

**Innate immunity**: **Nonspecific** host defenses that **exist prior to exposure to Ag.**

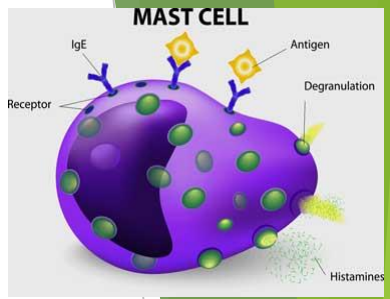
**Pathogen**: a disease causing organism.

**Vaccination**: deliberate induction of protective immunity to a pathogen.

## Where & what are antigens?

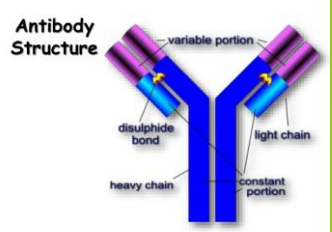
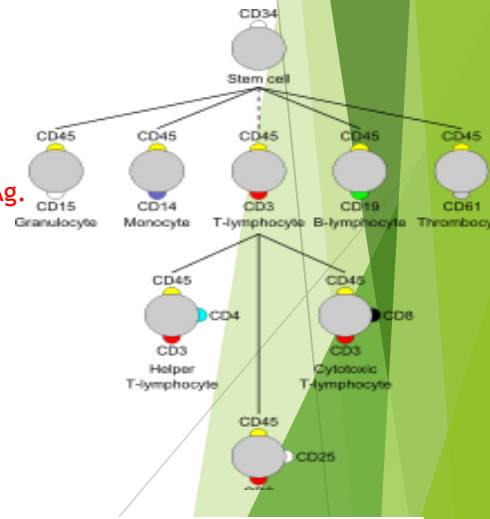
- Microorganisms & their related products (proteins, polysaccharides, lipids)
- Environmental substances
- Drugs
- Organs, tissues, cells ( transplantation)

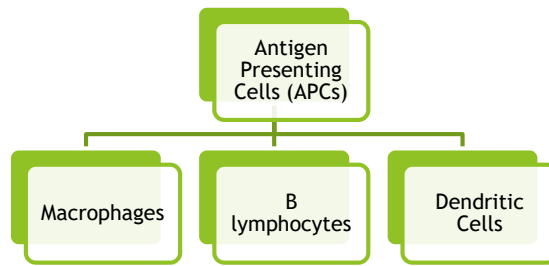
**Antigen Presenting Cells (APCs)**: Cells that process the antigen "breaking it down" into 13 - 15 amino acids and then present it on the surface **to be contacted with T&B lymphocytes.**



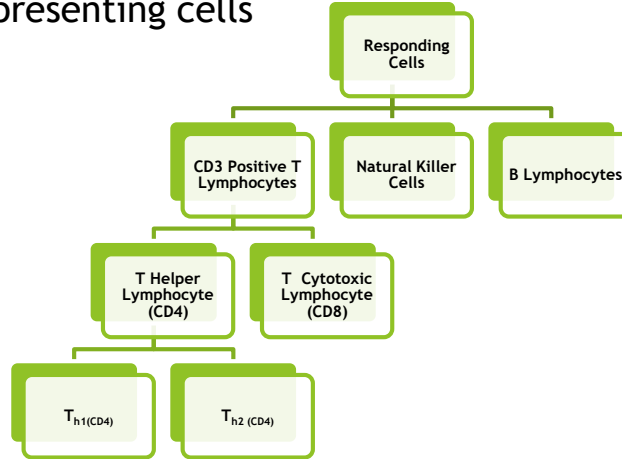
CD:-  
 هذا بروتين موجود ع سطح الخلية عن طريق ذا البروتين راح نقدر نعرف على الخلية وعلى وظيفتها كمان ري مثلا  
 هم متمائلين جدا تحت T and B lymphocytes  
 المايكروسكوب ومانقدر نعرفهم فصار العلماء يفرقونهم بذي البروتينات اللي موجوده في surface  
 وطبعاً عددها كثير جدا يوصل ل 300 ولكن ال قليل common

For example you have a mast cell on the surface of the cell (IgE) and if there is an allergen(antigen) associated with it , it will become hypersensitivity reaction  
 mast cell يعني لو عندك وعلى سطح ذي الخلية موجود (IgE)  
 وكان هناك Allergen(antigen) ربط فيها راح يصير hypersensitivity reaction





T-lymphocytes are **unable** to recognize antigen they need to be presented by antigen presenting cells



## Types of Immunity

### ❖ Innate immunity

- Shorter duration
- No memory
- **Non specific**

### ❖ Adaptive immunity

- Response of a B and T lymphocytes to an antigen
- Exhibit immunological memory
- **Specificity**
- \* Self / non-self recognition

N.B the innate and adaptive immunities are not working separately, they are overlapped and work in harmony

\*Self = part of the body      Non-self = foreign

## Adaptive immunity

Divided into:

### ❖ Humoral immunity

- Immunity that is mediated by antibodies (**B cells**)

### ❖ Cell mediated immunity

- Immune response in which antigen specific **T Cells** dominate.

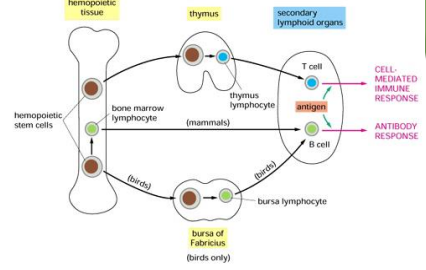
# Lymphoid system

Consist of lymphatic vessels and lymphoid organs.

## Primary lymphoid organs

- Bone marrow
- Thymus

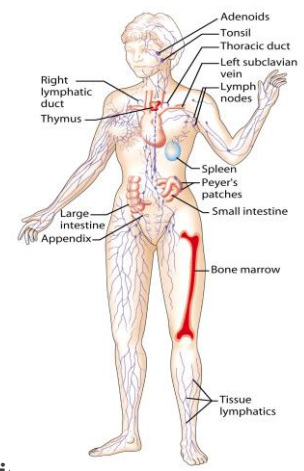
responsible for **development and differentiation** of immune cells



## Secondary lymphoid organs

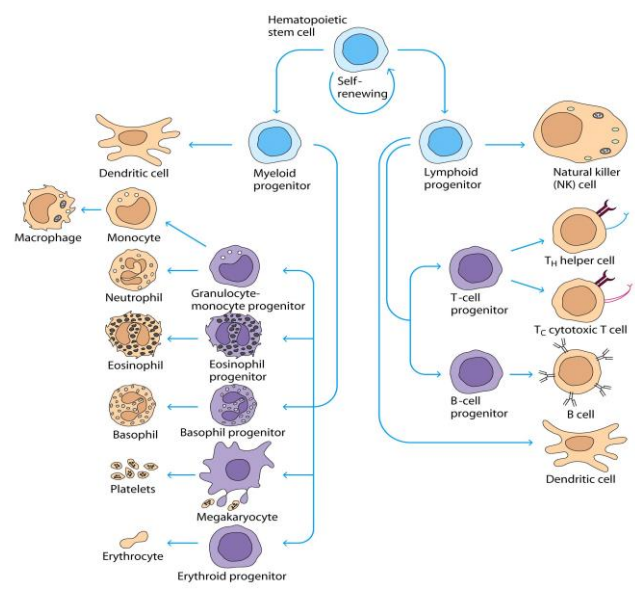
“where the immune response occurs”

- ▶ Spleen
- ▶ Lymph nodes
- ▶ Tonsils
- ▶ MALT ( Mucosa Associated Lymphoid Tissue )
- ▶ Peyer’s patches
- ▶ Appendix



## Lymphoid Series Comprise of Two main lymphocyte populations:

- T cells
- B cells

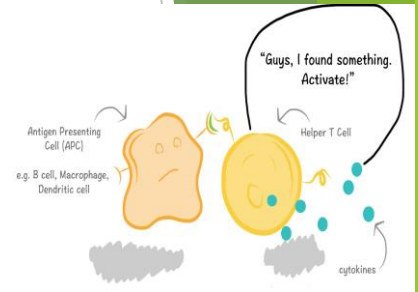


# T-Lymphocyte Differentiation

- T cells originate in Bone Marrow then migrate to Thymus for development.
- T cell precursors differentiate into mature T cells **in thymus**
- Stem cells lack antigen receptors and CD3, CD4, CD8 surface markers
- During their passage through thymus they differentiate into T cells expressing either markers (CD4 or CD8)

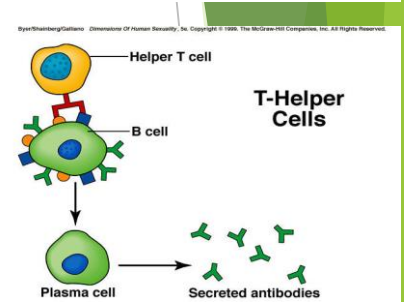
## T-Lymphocytes

- All T cells have CD3 proteins on their cell surface
- Mature T cells have either CD4 or CD8 proteins but not both



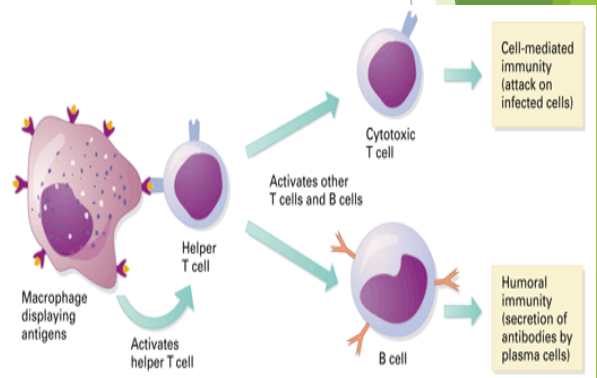
## Functions of T Helper Lymphocytes

- ▶ CD4 Lymphocytes (T helper 1 and 2: Th1 and Th2)
- ▶ Functions
- ▶ Help B cells to develop into antibody producing plasma cells (Th2)
- ▶ Help CD8 cells to become activated cytotoxic T cells (Th1)
- ▶ Help macrophages in cell mediated immunity (Th1) during inflammatory response.



## CD8 positive cells (Cytotoxic T cells)

- About 35% of peripheral blood T cells
- Perform cytotoxic functions
- They mediate the killing of:
  - ▶ Virus-infected cells
  - ▶ Tumors
  - ▶ Allograft cells (transplant)



## B cells

### Origin

During embryogenesis - **fetal liver**

Migrate to **bone marrow** - final destination

They **do not** require thymus for maturation

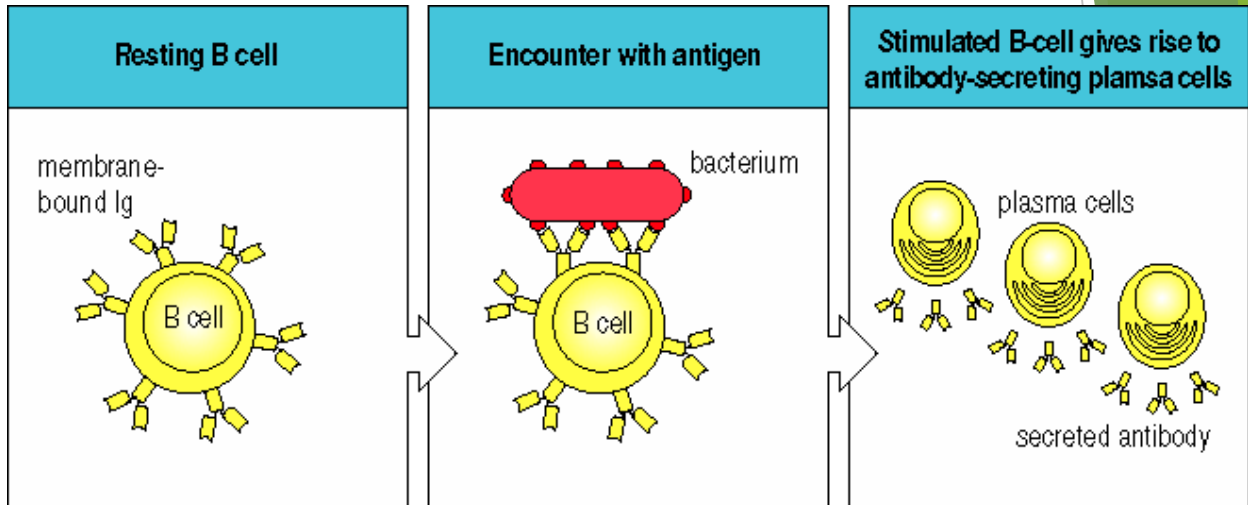
**B cell progenitors** like **Pro-B cells**, **Pre-B cells** and **immature B cells** are normally found **in bone marrow** and

**Mature B cells** are found circulating in **body fluids and lymphoid organs.**

**Mature B cells display surface IgM and IgD** which serves as antigen receptor

طبعا ال  
B cells  
غير موجودة  
في الدم  
نفسه , فإن  
كانت موجودة  
فيعتبر  
lukemia

# The Antibodies



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Antibodies are also called Immunoglobulins

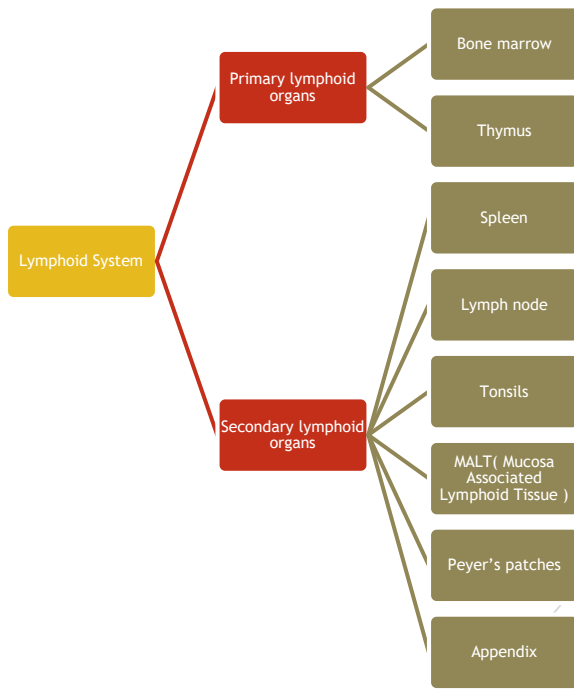
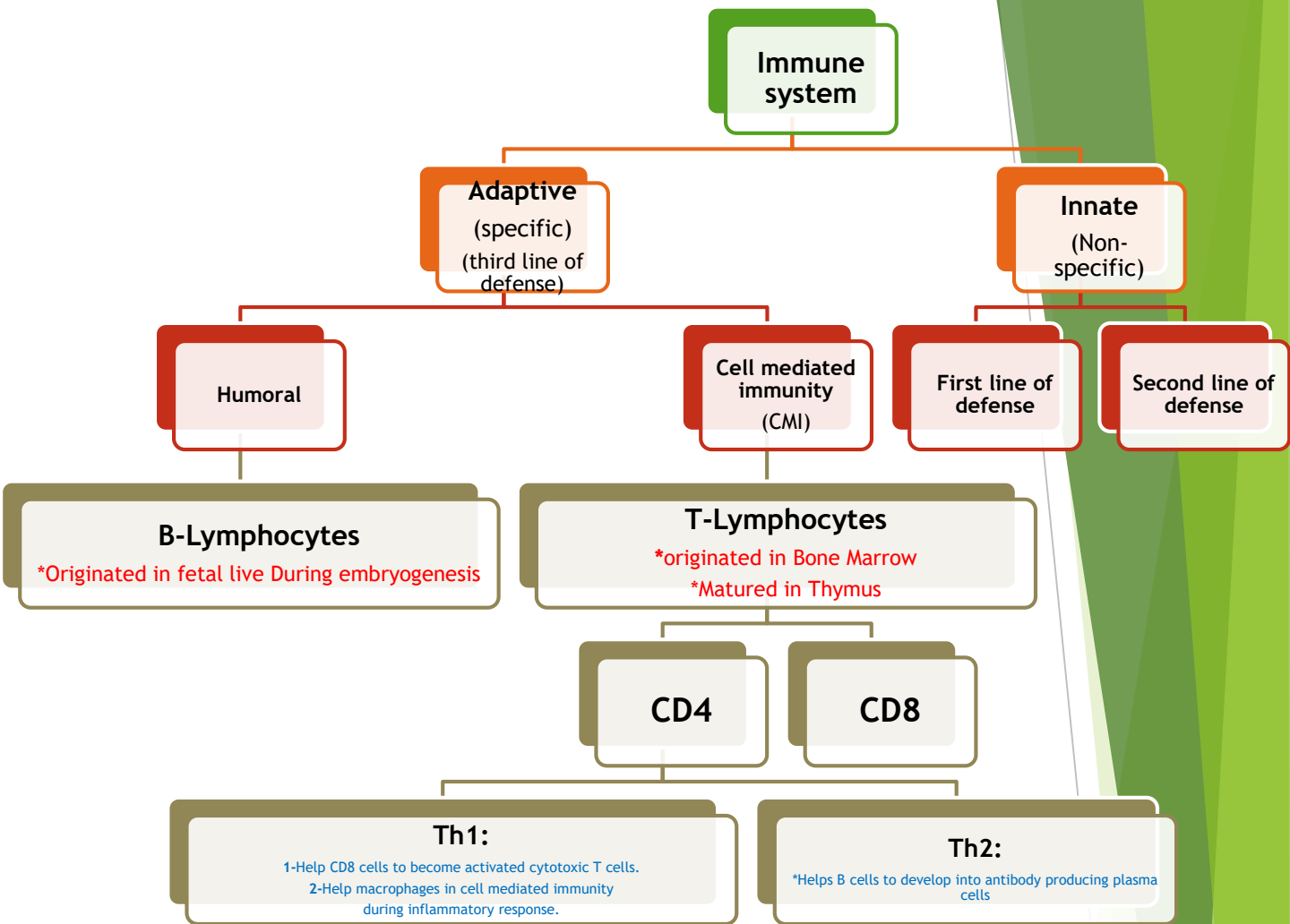
Immunoglobulins (Ig) are grouped into 5 classes:

- ❖ IgG
- ❖ IgM
- ❖ IgA
- ❖ IgD
- ❖ IgE

Ig are **glycoproteins**

They differ in size, amount of CHO and biologic functions after binding to specific **antigens**





# Quiz

**1-the state of protection from infectious disease is**

A. Immunity B. Immunology C. pathology D. microbiology

**2-antigen binds specifically to a component of the :**

A. complementary system B. adaptive immunity C. innate immunity D. allergen

**3- the light and heavy chains in the antibody are linked by**

A. Hydrophobic interaction B. disulfide bond C. covalent bond D. hydrogen bond

**4- Natural Killer cell originate from**

A. Lymphoid progenitor B. myeloid progenitor C. A&B D. non

**5-Humoral immunity is mediated by**

A. Macrophages B. T lymphocytes C. B lymphocytes D. NK cells

**6-all T cells have**

A. CD18 B. CD4 C. CD8 D. CD3

**7- origin of the B cells embryogenesis is**

A. fetal spleen B. fetal liver C. bone marrow D. thymus

**8- the immune response occur in the**

A. bone marrow B. thymus C. -secondary lymphoid organ D. A&B

**9-which Ig can be found in the surface of the B mature cells**

A. IgG B. IgE C. IgM D. IgA

**10- Ig are**

A. Polypeptides B. proteoglycans C. glycoproteins D. CHO

10-C  
9-C  
8-C  
7-B  
6-D  
5-C  
4-A  
3-B  
2-B  
1-A

<https://www.youtube.com/watch?v=-wUhYRHstps> what are antibodies?

[https://www.youtube.com/watch?v=Nw27\\_jMWw10](https://www.youtube.com/watch?v=Nw27_jMWw10) شرح بطريقة ممتازة لو ما فهمت

<https://www.youtube.com/watch?v=RPIzIznmAO0> هذا الفيديو فيه الخلايا تحت المايكروسكوب أثناء حربها على المكروبز تأمل فيه خلق الله سبحانه وتعالى.

Introduction to Immunology

<https://youtu.be/NYicBnqwSOE>

Review of B cells, CD4+ T cells and CD8+ T cells

<https://youtu.be/xaz5ftvZCyl>

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