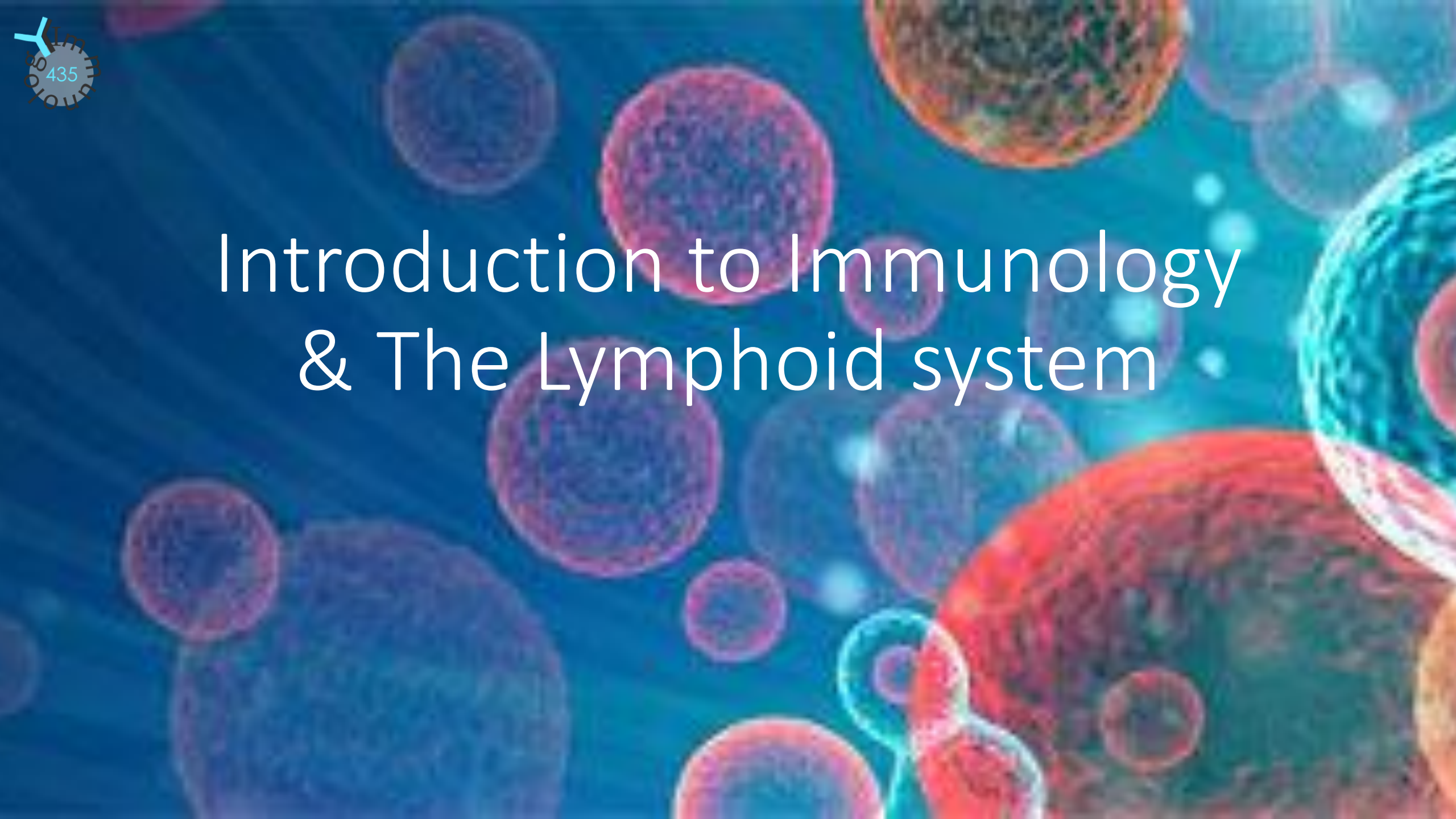


Introduction to Immunology & The Lymphoid system





Objectives:

- To know the historical perspective of immunology
- To be familiar with the basic terminology and definitions of immunology
- Cells of immune response
- To understand types of immune responses
- To know about the lymphoid system
- To understand T and B cell functions



**Immunology -
introduction**

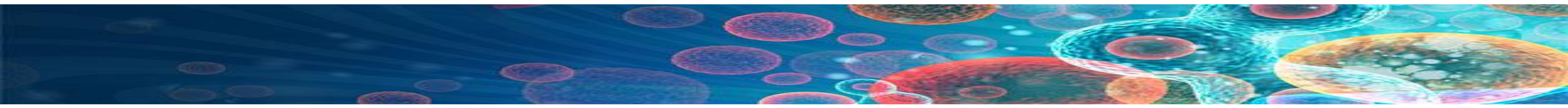


Immune System: "Body
Defenses Against Disease"
2nd Ed 1978 Encyclopaedia
Britannica Films



Your Immune System:
Natural Born Killer - Crash
Course Biology #32

Videos to get you warmed up (^ ^)



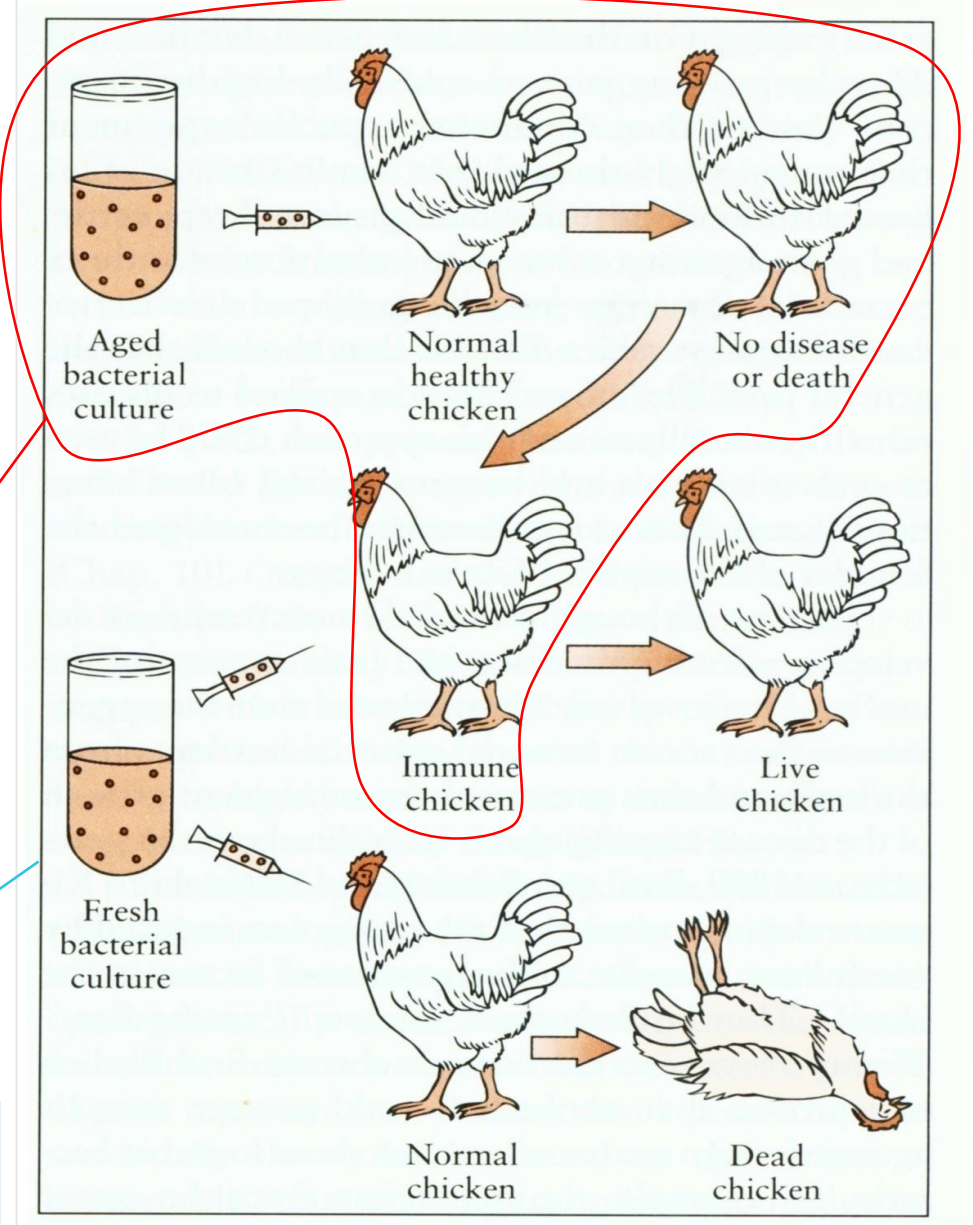
Edward Jenner


- In 1798 Edward Jenner began the science of Immunology. After he noticed that Milkmaids who contracted cowpox (a mild disease) were subsequently immune to small pox.
- Louis Pasteur Introduced Weakened Virulence (attenuated: weakened, non-virulent strain whose exposure can confer resistance to disease.)


Louis Pasteur


Bacterial culture > Normal healthy chicken > No disease or death > produce IMMUNE chicken.

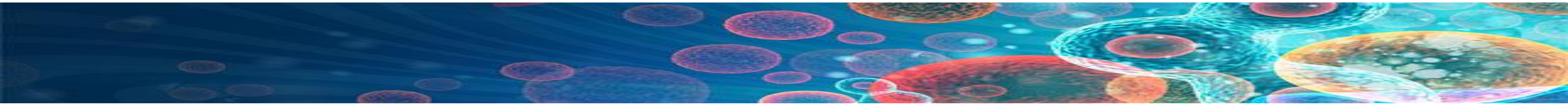
Fresh Bacterial 'No culture' > **IN** IMMUNE chicken > Live chicken.
Or > **IN** NORMAL chicken > Dead chicken.



 **Edward Jenner Story**

 **How we conquered the deadly smallpox virus - Simona Zompi**

 **Louis Pasteur - Mini Biography**



Basic terminology & Definitions of immunology

Immunoglobulin (Ig) or Antibodies

- Secreted from plasma cell.
- Consist of a heavy or light polypeptide chain.

Allergen

Noninfectious antigens that induce hypersensitivity reactions, most commonly IgE-mediated type 1 reactions.

Antigen (Ag)

Any substance that binds specifically to a component of adaptive immunity.

Immune

People survived ravages of epidemic diseases when faced with the same disease again.

Immunology

The study of mechanisms that humans and other animals use to defend their bodies from invading organisms such as bacteria, viruses, fungi, parasites or toxins

Immunity

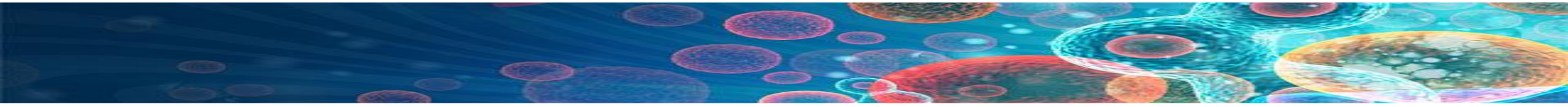
Refers to protection against infection.

Immune system

Is the collection of cells, tissues and molecules that function to defend us against infectious microbes (bacteria, Virus , parasite Fungus).

Immune response

The reaction of the immune system against foreign substances.



Where & what are antigens?

- **Microorganisms (bacteria, viruses and parasites) & their related products (proteins, polysaccharides, lipids)**
- **Environmental substances.**
- **Drugs.**
- **Organs (kidney transplant) , tissues, cells.**

Immune system abnormalities

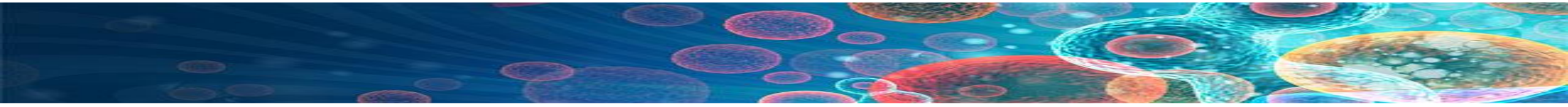
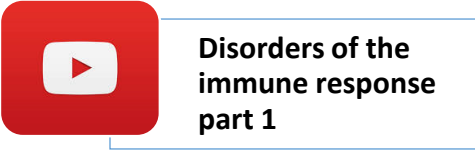
Susceptible to infections by Antigen like virus, bacteria, fungi and parasite.

Hypersensitivity due to exposure to Allergen. Allergen :non-infectious antigens that induce hypersensitivity reactions, most commonly IgE-mediated type I reactions

Autoimmune disease

Transplant rejection

Immune deficiency

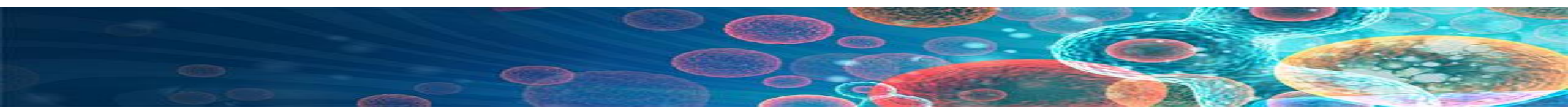
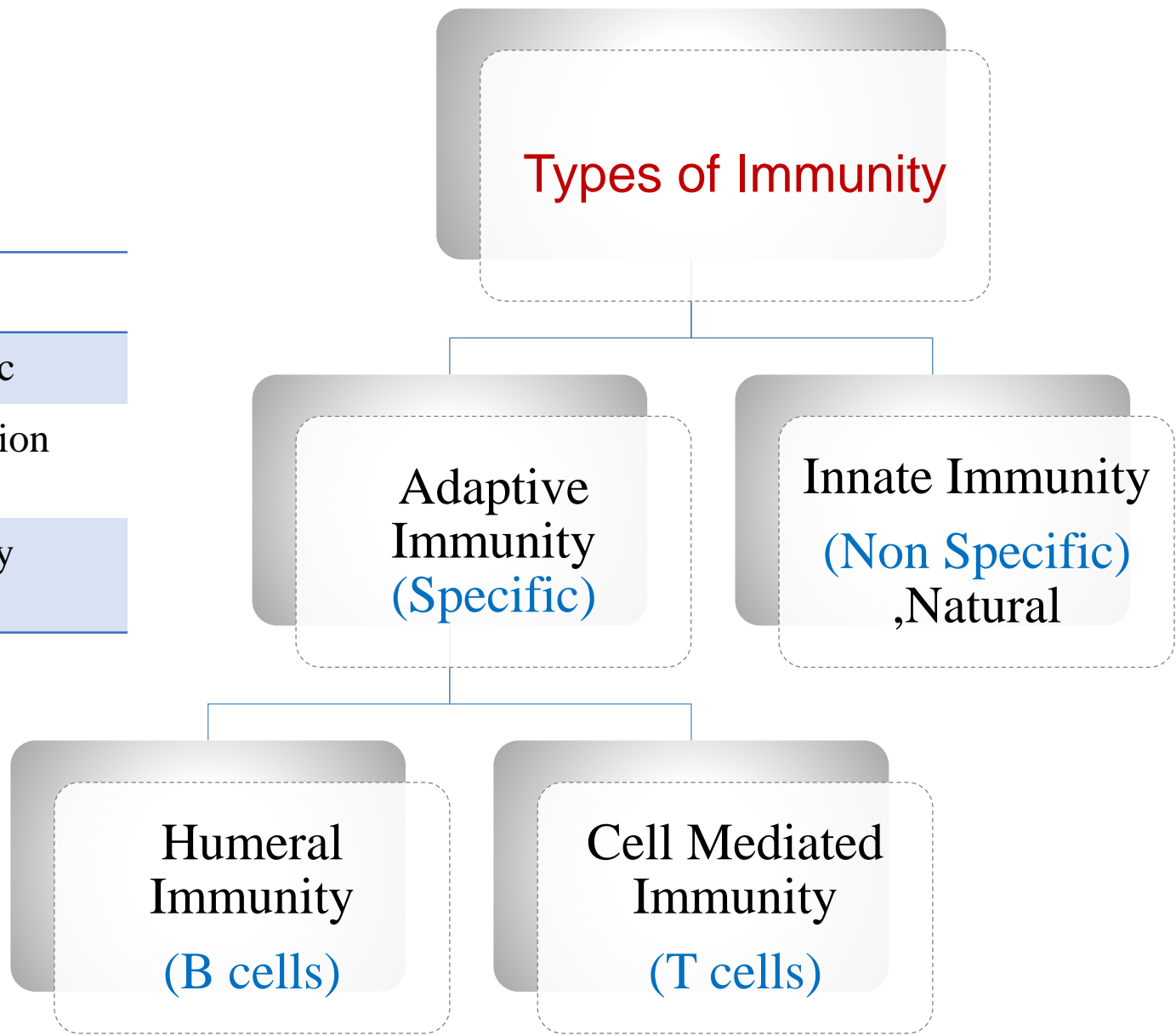




Types of immune responses: Innate and Adaptive. Humoral vs. Cell-Mediated

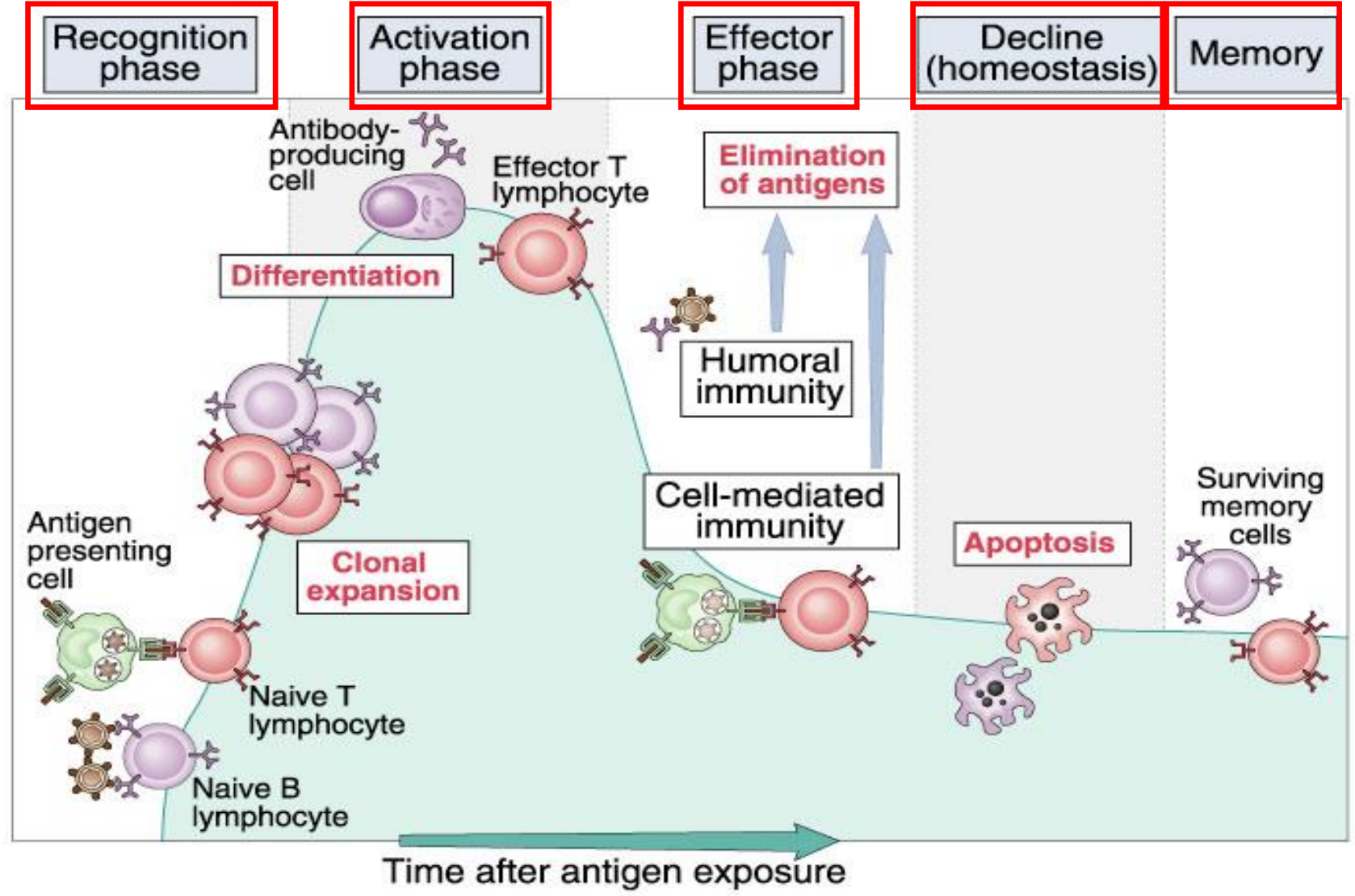
Adaptive	Innate
Specific	Nonspecific
Response of an antigen specific B and T lymphocytes to an antigen	Shorter duration
Immunological memory “recognition”	No memory

The cells of innate and adaptive immunity are recruited to sites of infection and injury, and activated to get rid of the infectious agents and dead tissues.
This process is called inflammation



Phases of adaptive immune responses.

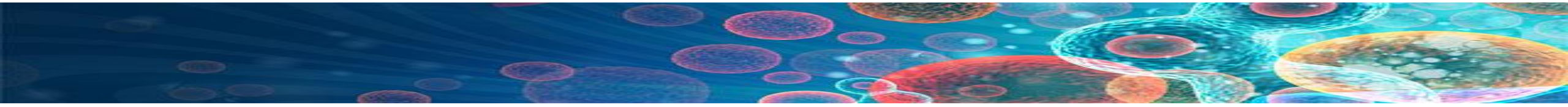
Phases of adaptive immune responses.

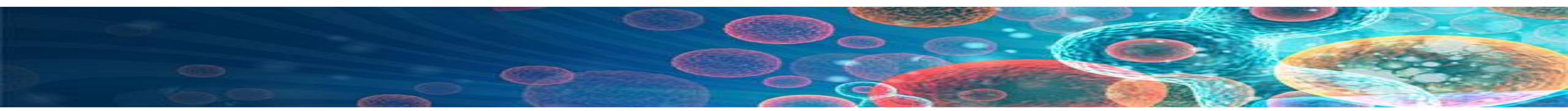
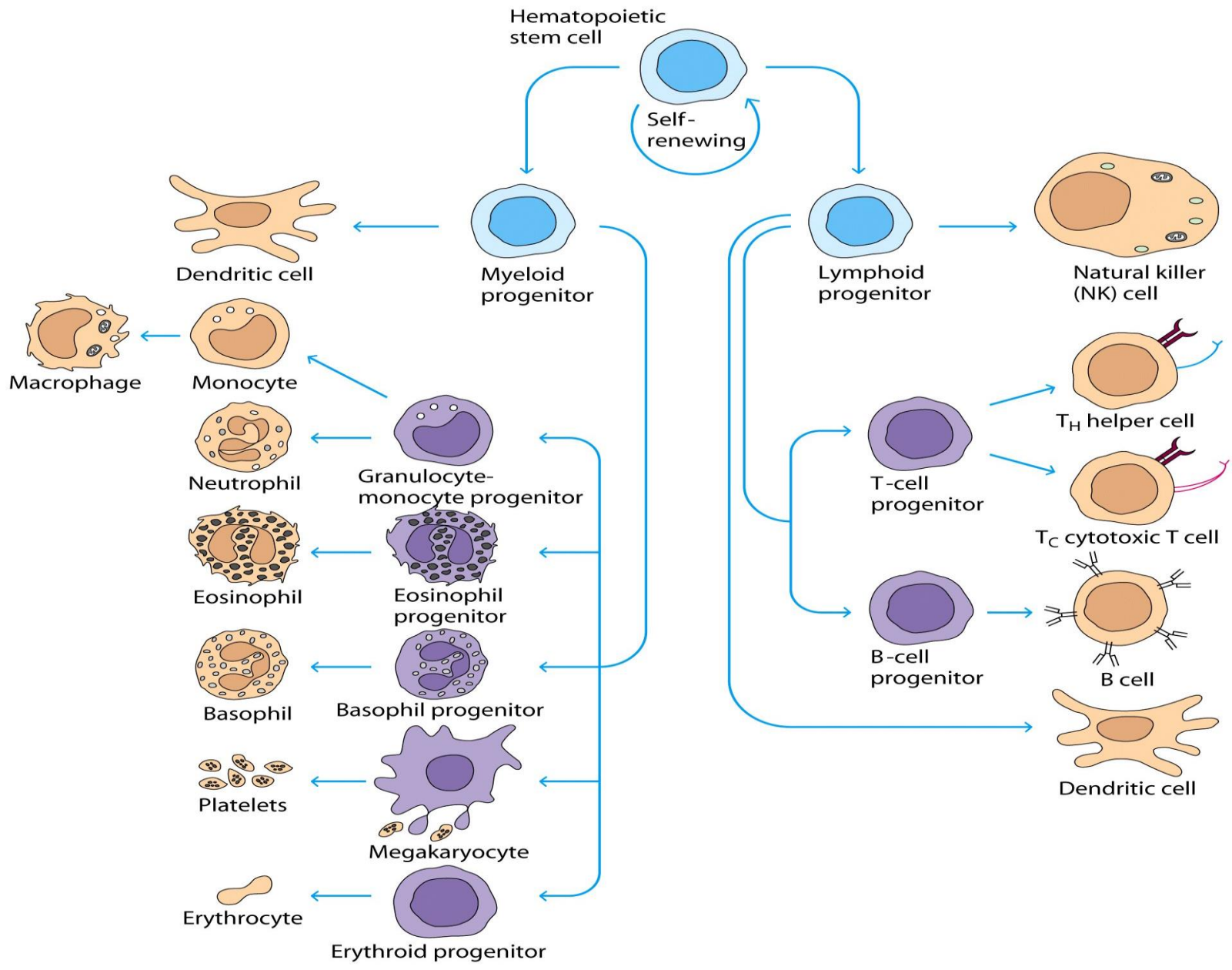


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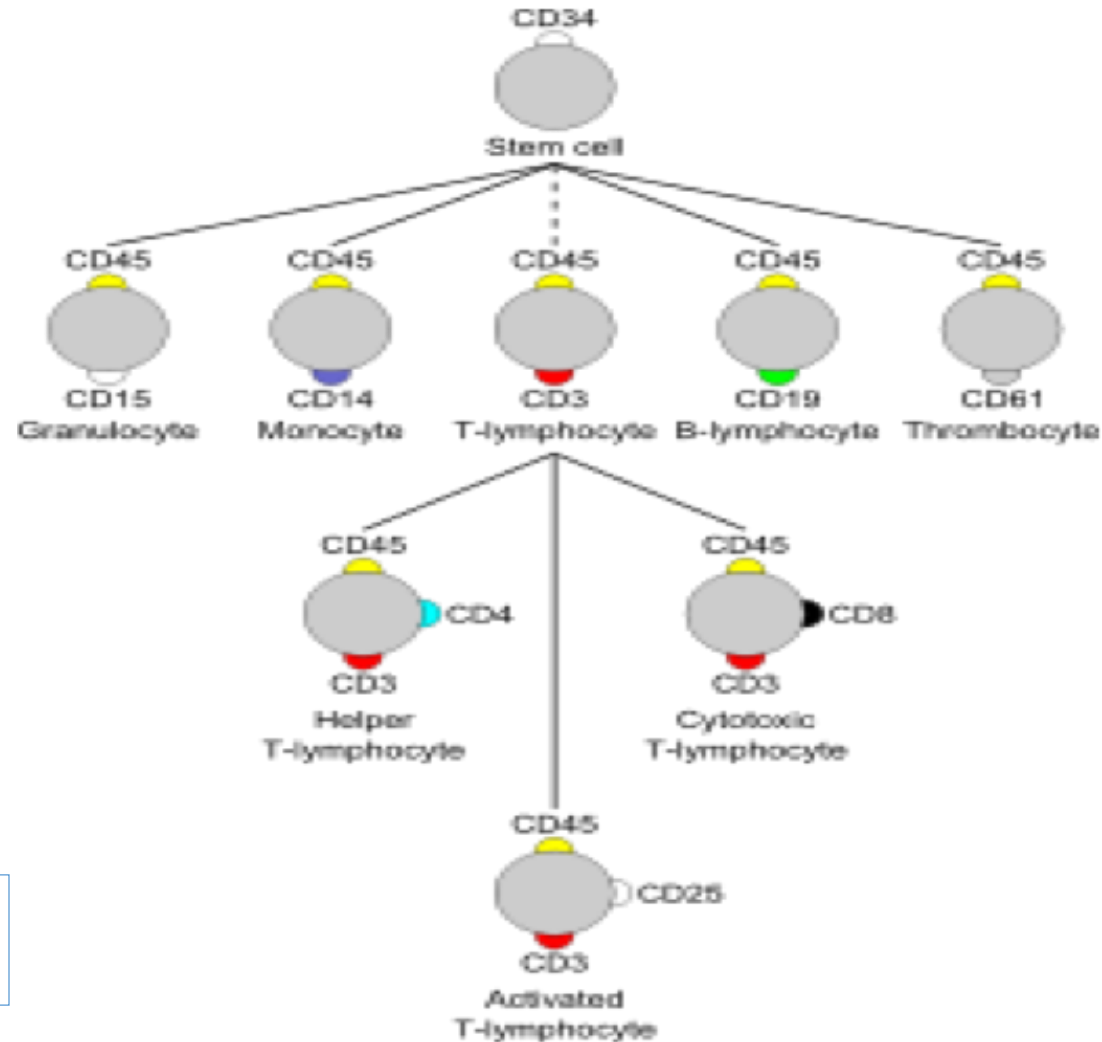


Overview of the Immune System





Clusters of differentiation (CD): A molecule with a CD designation has characteristic cell surface protein are often associated with cell's function. (They are the Cellular markers for the cells)



Cell surface markers: CD3, CD4, CD8, CD19, CD28, CD16, CD56



Innate Immunity (Natural Immunity)

Mediated by cells and proteins that fight against microbes.
It has 4 major components:



Epithelial barriers of the skin, GI tract and respiratory tract:

Prevent microbe entry.
(Have to be breached for a microbe to establish function.. E.g. by cuts and burns)

Phagocytic leukocytes (neutrophils and macrophages)

~Neutrophils respond rapidly to foreign stimuli and injury. Their reaction is part of acute inflammation.
~Macrophages are monocytes after entering the tissue and are present under epithelia, CT & in all organs. This reaction is chronic inflammation.
Macrophages also help to repair damaged tissue

Natural Killer (NK) cell:

~Specialised in identifying cells that are infected by a virus or that have become tumor cell.
~They do this by looking for changes in cell surfaces. If natural killer cells find cells with a changed surface, they dissolve them using cytotoxins.

Complement System:

~The complement systems consists of about **20 proteins** in normal human serum.
~Synthesised mainly in the liver.
~Heat labile i.e. it's inactivated in 56C for 30 minutes.



Immunology - Innate Immunity (Complement System Overview)



Note: Antigen+Antibody= complex, We add the complement in order to remove the complex



Complement Functions

1-Chemotaxis:

Attracts other immune cells from the blood, such as: macrophages and neutrophils

2-Opsonization:

Enhancing phagocytosis of antigens

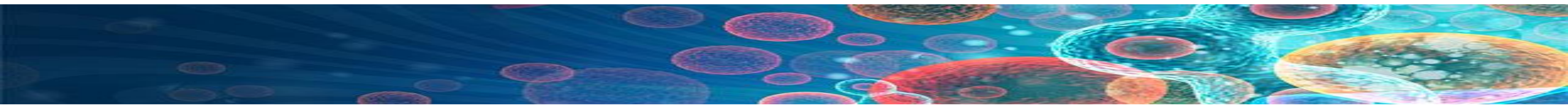
3-Agglutination:

Clustering & binding of pathogens together.

4-Cell Lysis:

Dissolve the cell walls of **bacteria** which leads to loss of fluids & minerals and then death.

Fight **viruses directly** by destroying the virus's envelopes or **indirectly** by destroying cells infected by viruses.





Adaptive Immunity

(acquired immunity after exposure to antigens)

-Consists of highly specialized cells which have the ability to destroy invading pathogen & toxic molecule.

-Includes both:

1-Humoral Immunity

2-Cellular Immunity

-Highly specific to a specific pathogen

-Antigen is any substance that elicits the adaptive immune response.

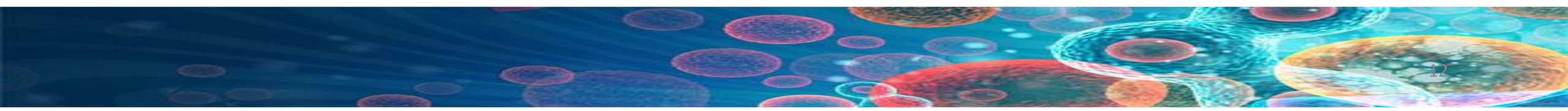
-Mediated by T and B lymphocytes following exposure to specific antigen & characterised by immunological memory

-B-Lymphocytes secretes antibodies

-T-Lymphocytes secretes cytokines



Immunology - Adaptive Immune System





1- Humoral Immunity:

(antibodies)

1-The Humoral immune response begins with the recognition of antigens by **naive B cells**



2-These cells then undergo a process of clonal expansion and differentiation.



3- B cells mature into plasma cells that secrete antibodies

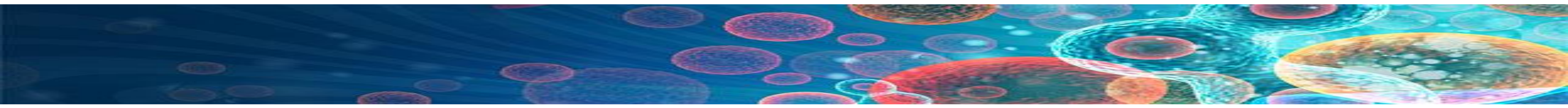


4--As this response declines, a pool of memory cells remain behind.



5-If the body is re-exposed to the antigen, these memory B-cells will recognise the antigen and respond much more quickly and effectively.

*Antibodies are the effector products of humoral immunity.



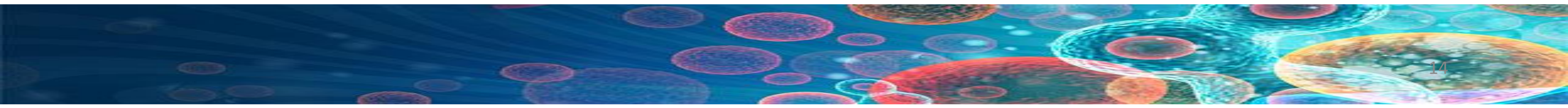


2- Cellular Immunity

(T and B lymphocytes)

- Naive T cell and their effector products make up the second branch of the adaptive immune system
- T cells type: T-helper **CD4**
T-cytotoxic **CD8**
- is called into action against pathogens that overcome innate immune defences

Components of the adaptive immune system are normally silent; however, when activated, these components “adapt” to the presence of infectious agents by activating, proliferating, and creating potent mechanisms for neutralizing or eliminating the microbes.



	Innate immunity	Adaptive Immunity
Components	<ol style="list-style-type: none"> 1. Physical and chemical barriers 2. Phagocytic leukocytes 3. Dendritic cells 4. Natural Killer cells 5. Plasma proteins (complement) 	<ol style="list-style-type: none"> 1. Humoral immunity (B cells, which mature into antibody secreting plasma cells) 2. Cell-mediated immunity (T cells, which mature into effector helper and cytotoxic T cells)
Activity	Always present	Normally silent
Response and potency	Immediate response, but has a limited and lower potency	Slower response (over 1-2 weeks, but is much more potent)
Specificity	General: can recognize general classes of pathogens (i.e. bacteria, viruses, fungi, parasites) but cannot make fine distinctions	Recognizes highly specific antigens
Course	Attempts to immediately destroy the pathogen, and if it can't, it contains the infection until the more powerful adaptive immune system acts.	Slower to respond; effector cells are generally produced in 1 week and the entire response occurs over 1-2 weeks. However, this course can vary somewhat during different responses in an individual.
Memory?	No--reacts with equal potency upon repeated exposure to the same pathogen.	Yes--memory cells "remember" specific pathogens; upon re-exposure to a pathogen, these cells mount a much faster and more potent second response

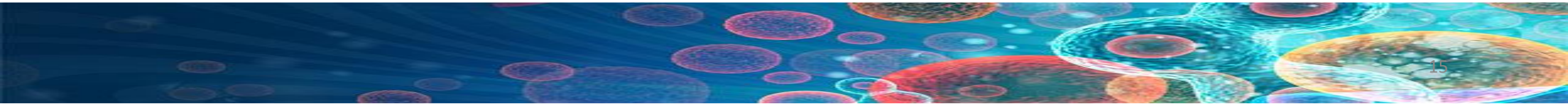


Innate and Adaptive Immune Systems



Innate vs Adaptive Immunity

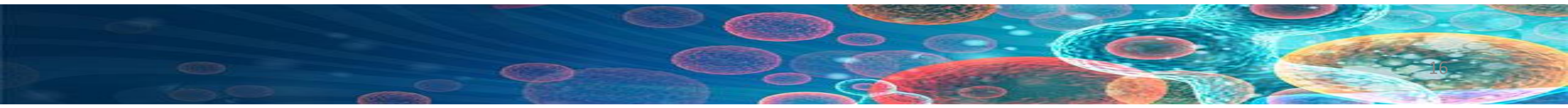
You can use this table to revise from once you finish studying both types of immunity.





Cells of immune response are organized into 3 functional groups:

- Lymphocytes: come from distinct lineage of stem cells and are responsible for the adaptive response
- Antigen presenting cells: are capable of **bringing antigens** to lymphocytes to **initiate the adaptive response**
- Effector cells: actually **do the killing of microbes** once an adaptive response is underway





Lymphatic System

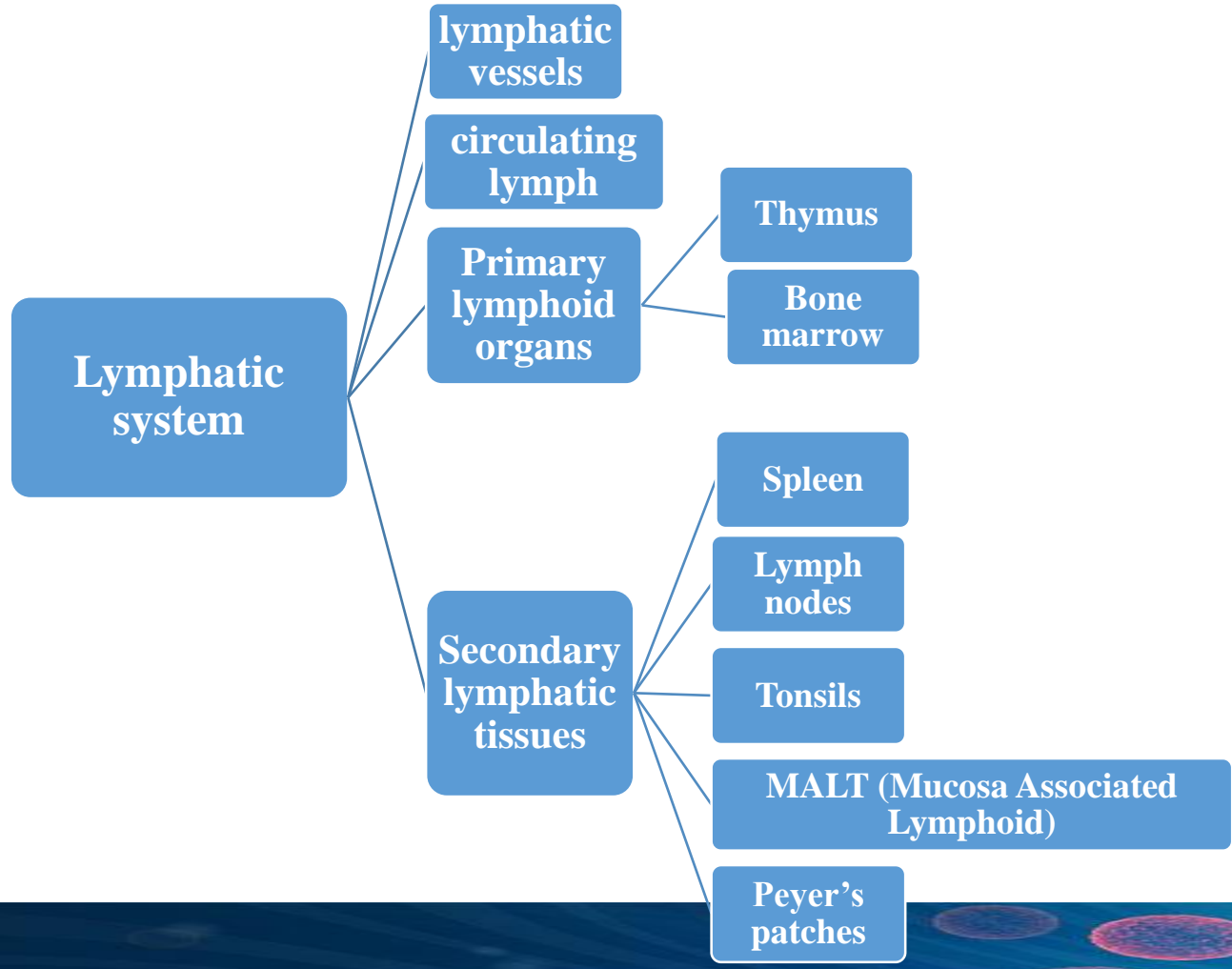
Lymphoid system provides suitable environment for development, maturation and proper functioning of cells of immune system



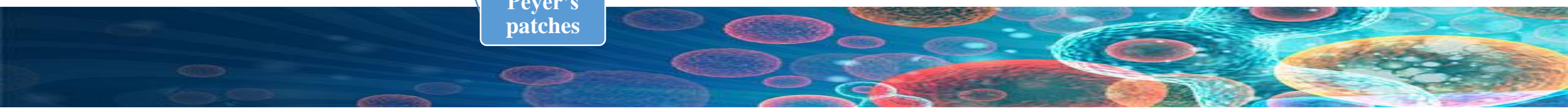
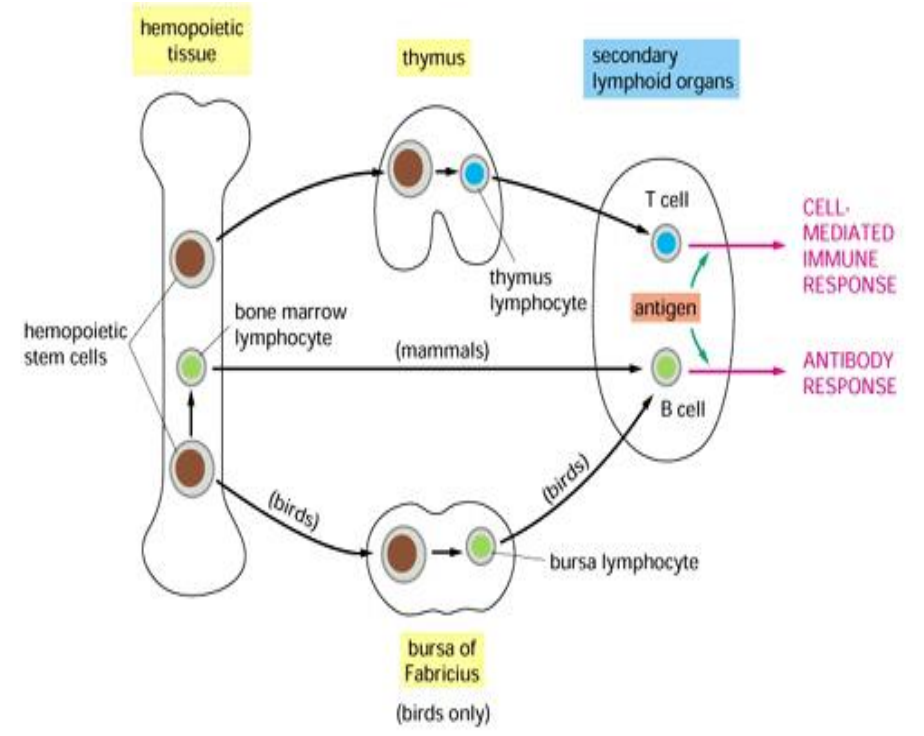
The Lymphatic System, Part 1



Cells and organs of immune System



Primary Lymphoid Organs



Lymphoid cells



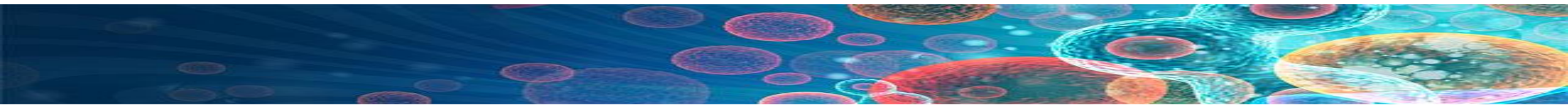
Lymphoid series comprise of two main lymphocyte populations

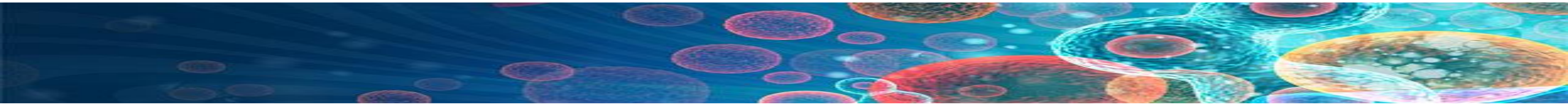
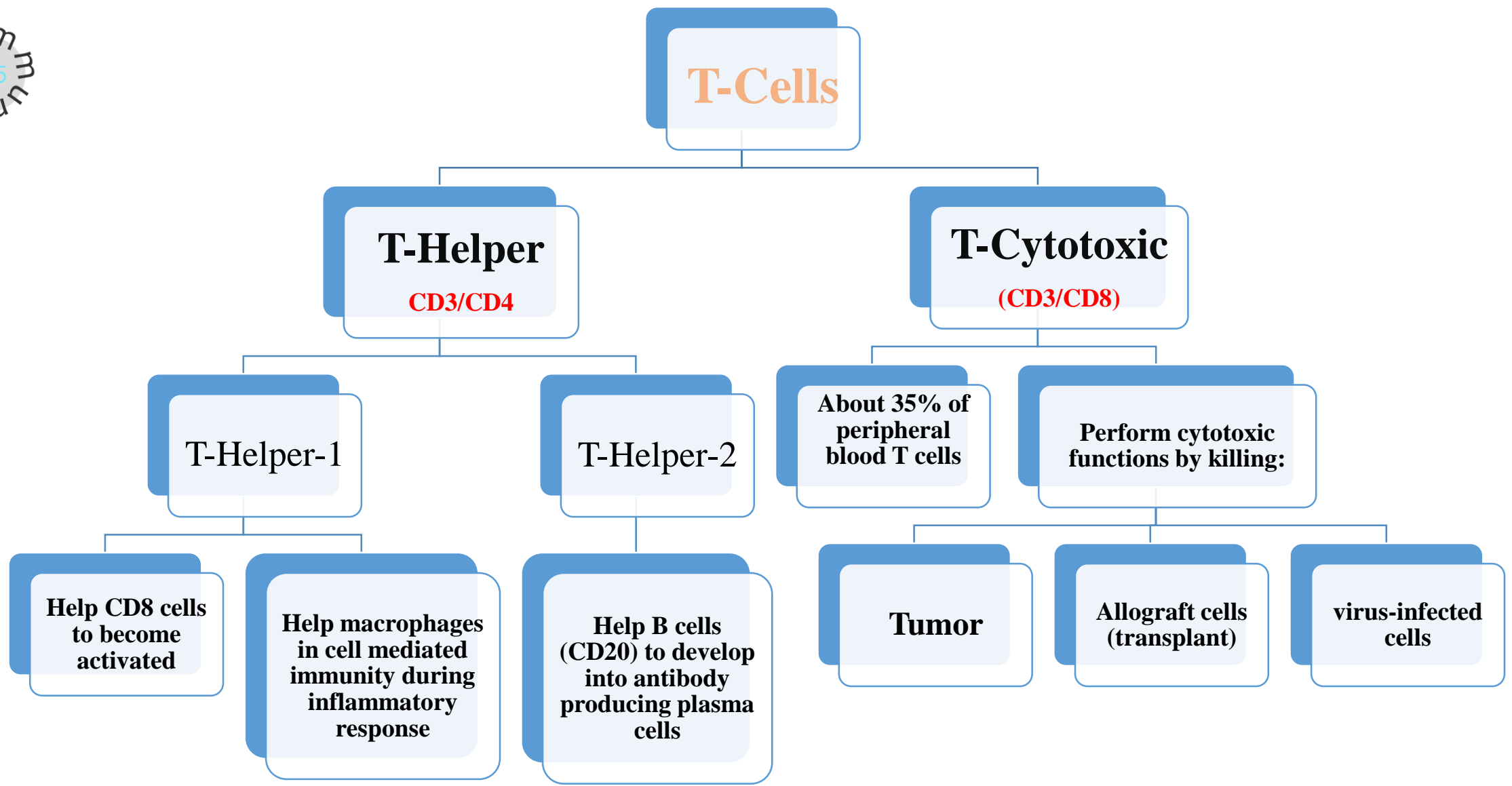


❖ T-Lymphocyte Differentiation

- Originate in Bone Marrow → migrate to Thymus for development
- T cell precursors differentiate into mature T cells in thymus
- Stem cells lack antigen receptors.
- All T- Cells have CD3 as a cell marker.
- T cell passage take place in thymus and differentiate into T cells expressing either markers (CD4 or CD8).
- T-Helper cell CD3/CD4
- T-Cytotoxic Cell CD3/CD8

Lymphoid system provides suitable environment for development, maturation and proper functioning of cells of immune system





B Lymphocyte

(CD20 or CD19)



Immunology - Adaptive Immunity (B cell Activation, Hypermutation and Class Switching Overview)

Originate

- During embryogenesis:
fetal liver
- final destination:
Migrate to
Bone Marrow

* They do not require thymus for maturation

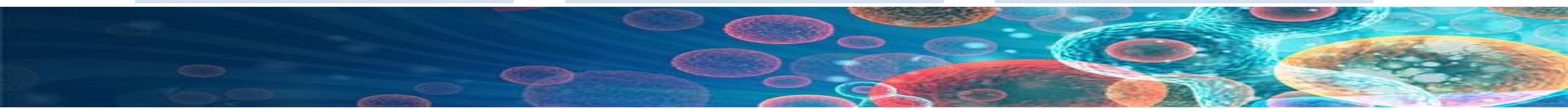
Display

- They display Surface:
 - **IgM**
 - **IgD**

They both serve as an antigen receptor

Found

- Pre B cells:
found in Bone Marrow
- Mature B cells:
found circulating bloodstream

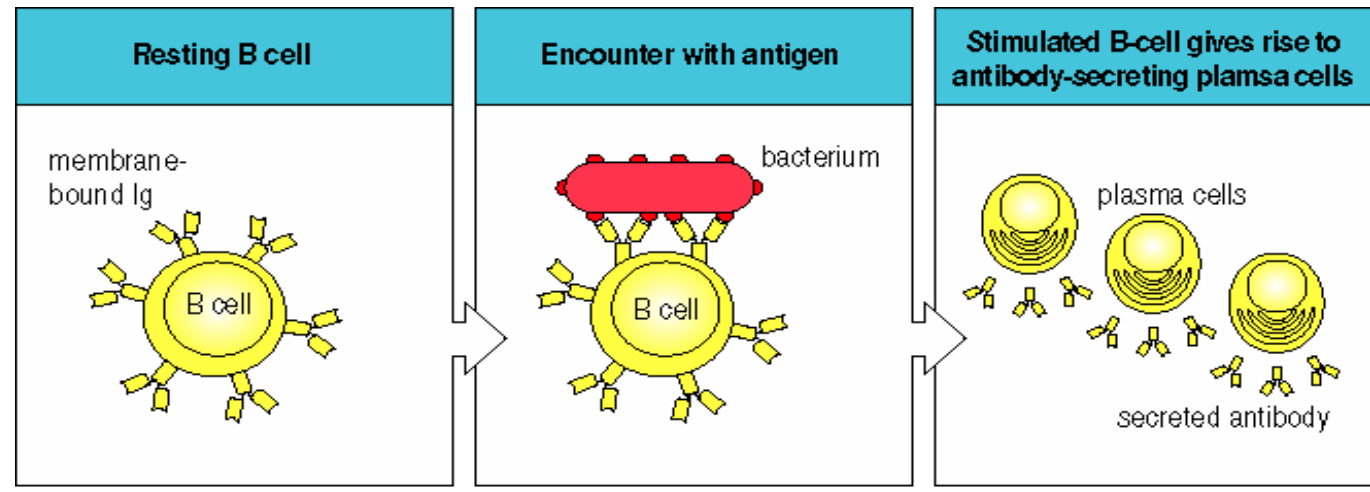


Antibodies

One way to memorize them: A person named Ig
G.A.M.E.D a lot

Immunoglobulins (Ig) are grouped into **5** classes:

- Ig**G**
- Ig**M**
- Ig**A**
- Ig**D**
- Ig**E**



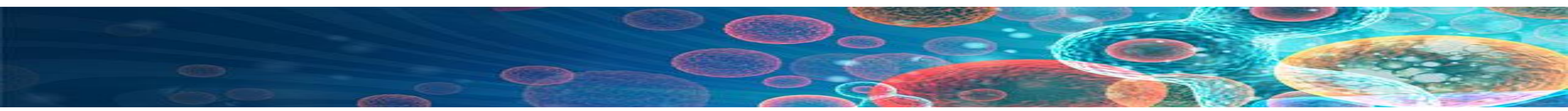
- Ig are **glycoproteins**
- They differ in size, amount of CHO and biologic functions after binding to specific **antigens**

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Immunology - Antibodies (Function)

Video 15 Ig Antibodies and Immunoglobulin Function

Video 16 Antibody Immunoglobulin Immune Function





Thank you!

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