



**Immunology Course**  
**Lymphopoiesis, T and B cells maturation**  
**Lecture 6**  
**2025-2026**

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# Objectives

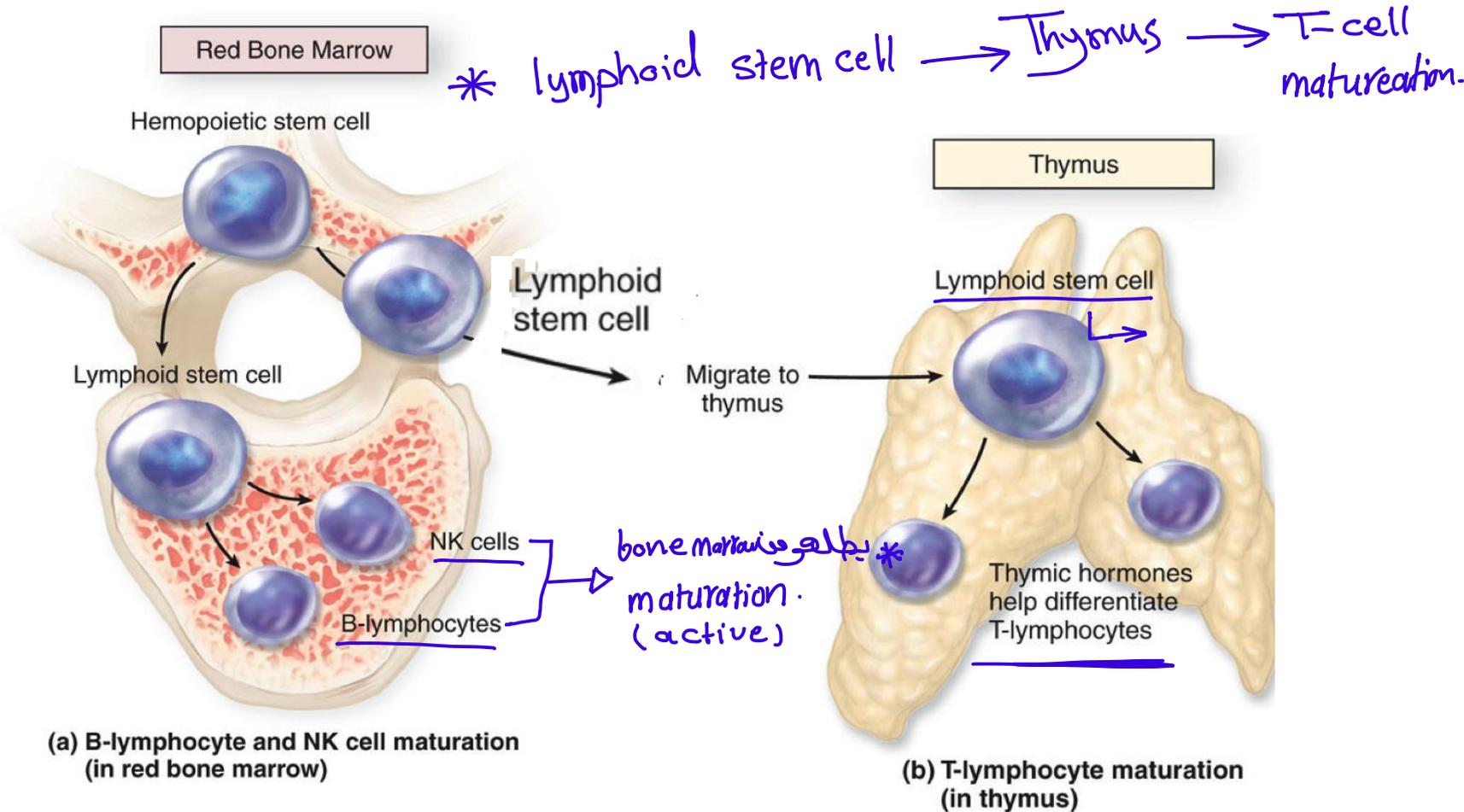
## You should be able to:

- \* Identify the sites of B and T lymphocytes production and maturation
- \* Describe the structure B and T lymphocytes antigen receptors
- \* Understand the process of T cell receptor rearrangement
- \* Describe the sequence of B and T lymphocytes maturation
- \* Types and functions of different lymphocytes

# T & B lymphocytes

## Lymphopoiesis

Lymphopoiesis is the generation of mature lymphocytes



What are the different types of lymphocytes?

What are the types of receptors on different lymphocytes?

What is the structure of TCRs & BCRs?

↓  
T-cell, B-cell

Why do we have millions of different versions of TCRs?

↳ as B-cell antibody.

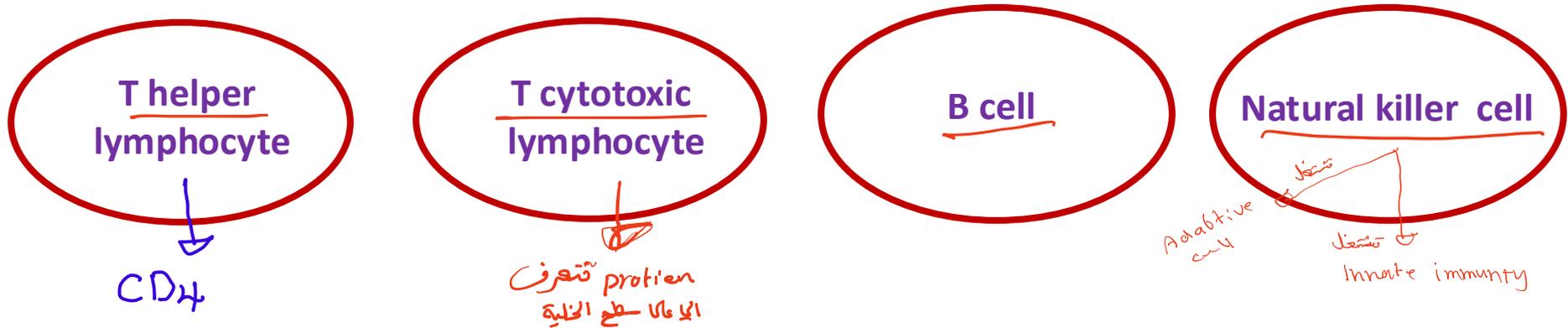
Why do we have millions of different versions of BCRs?

What are requirements for T lymphocytes activation?

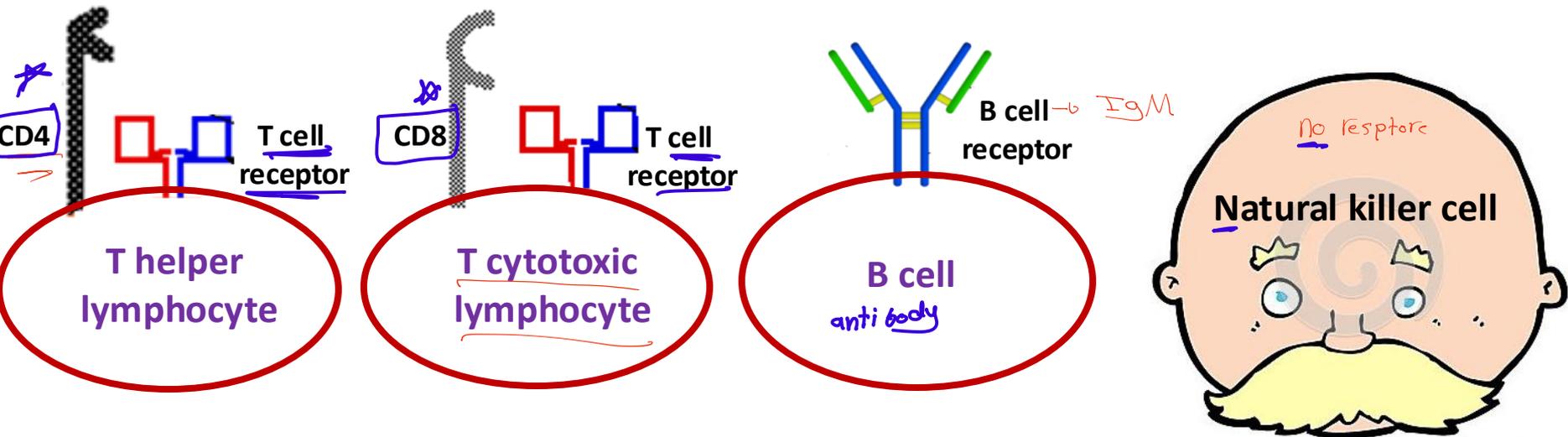
What are requirements for B lymphocytes activation?

What are the steps of T & B maturation in bone and thymus?

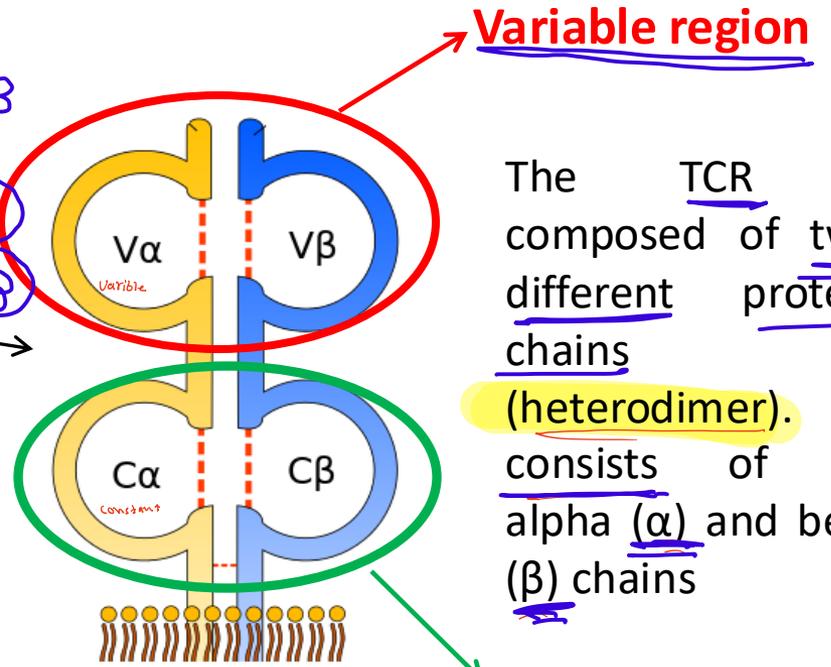
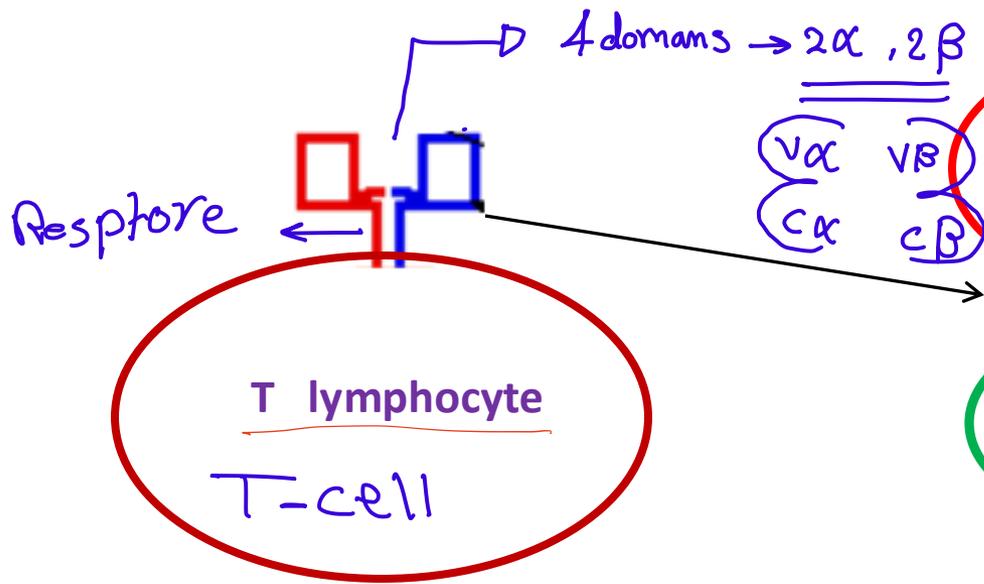
What are the different types of lymphocytes?



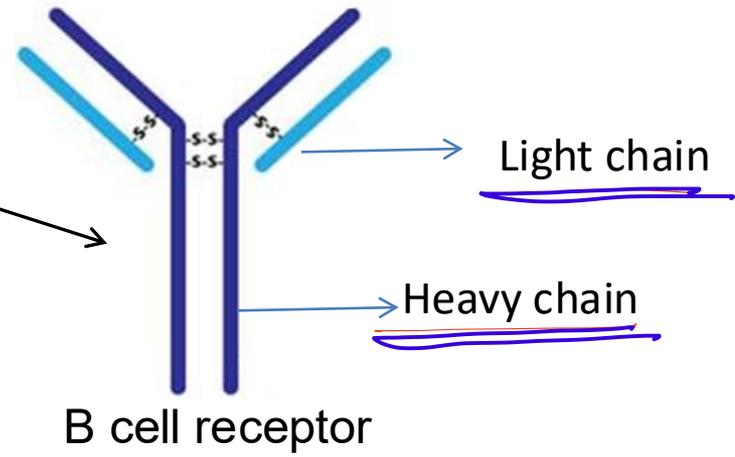
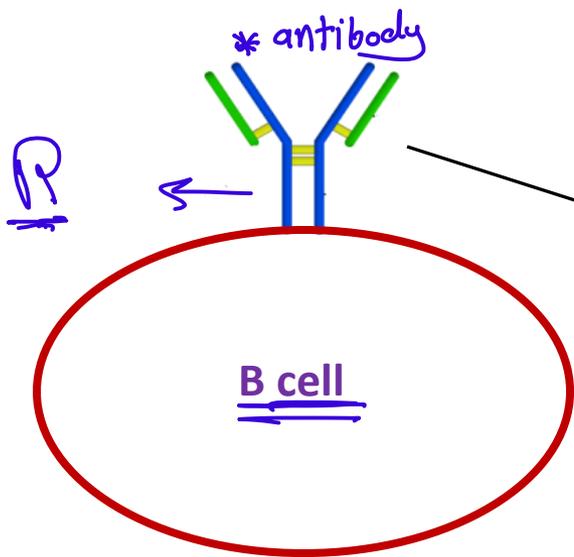
What are the types of receptors on these lymphocytes?



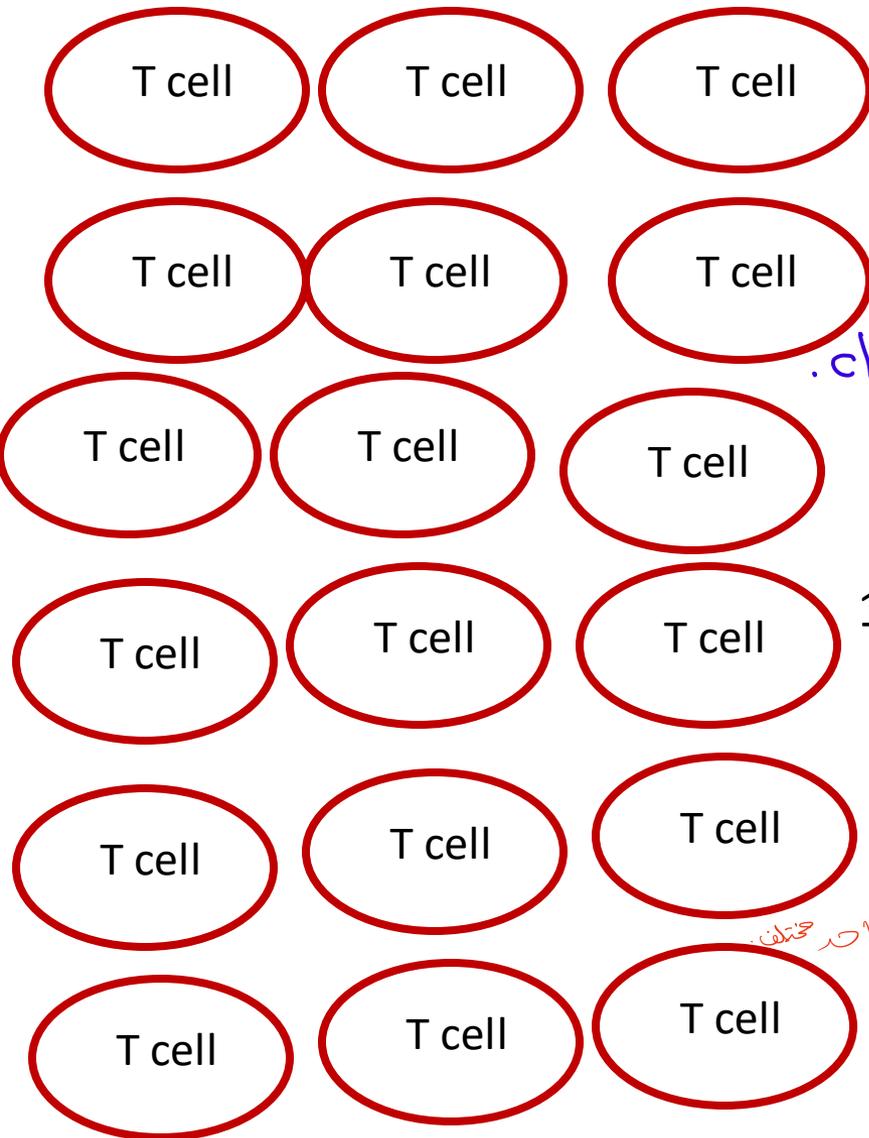
# What is the structure of TCRs & BCRs?



The TCR is composed of two different protein chains (heterodimer). It consists of an alpha (α) and beta (β) chains



# Why do we have millions of different versions of TCRs?



\* كل T-cell عليه ملايين Resptore لكن

ياخذ الاليل واحد → Recombinaze

فيصبح one version of TCR .  
والباقي يعدل الو switch of أغلاق close.

18 T-cell → 18 different TCR with each T cell carrying only one version of TCR

رج تعرف على 18 antigen.  
deffernt antigen  
كل واحد يتعرف على واحد مختلف

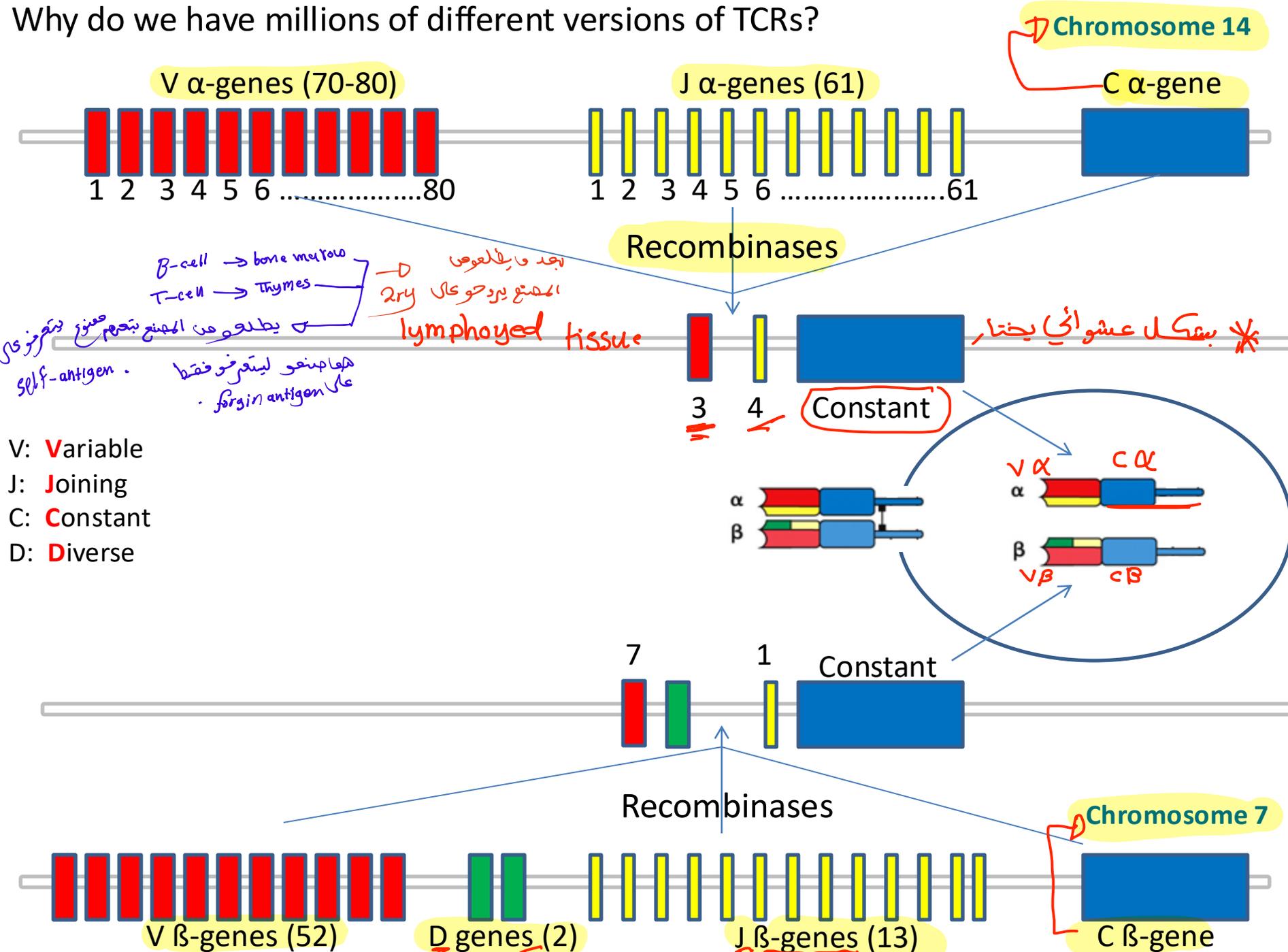
\* each cell recognize one sepcatic antigen.

# Why do we have millions of different versions of TCRs?

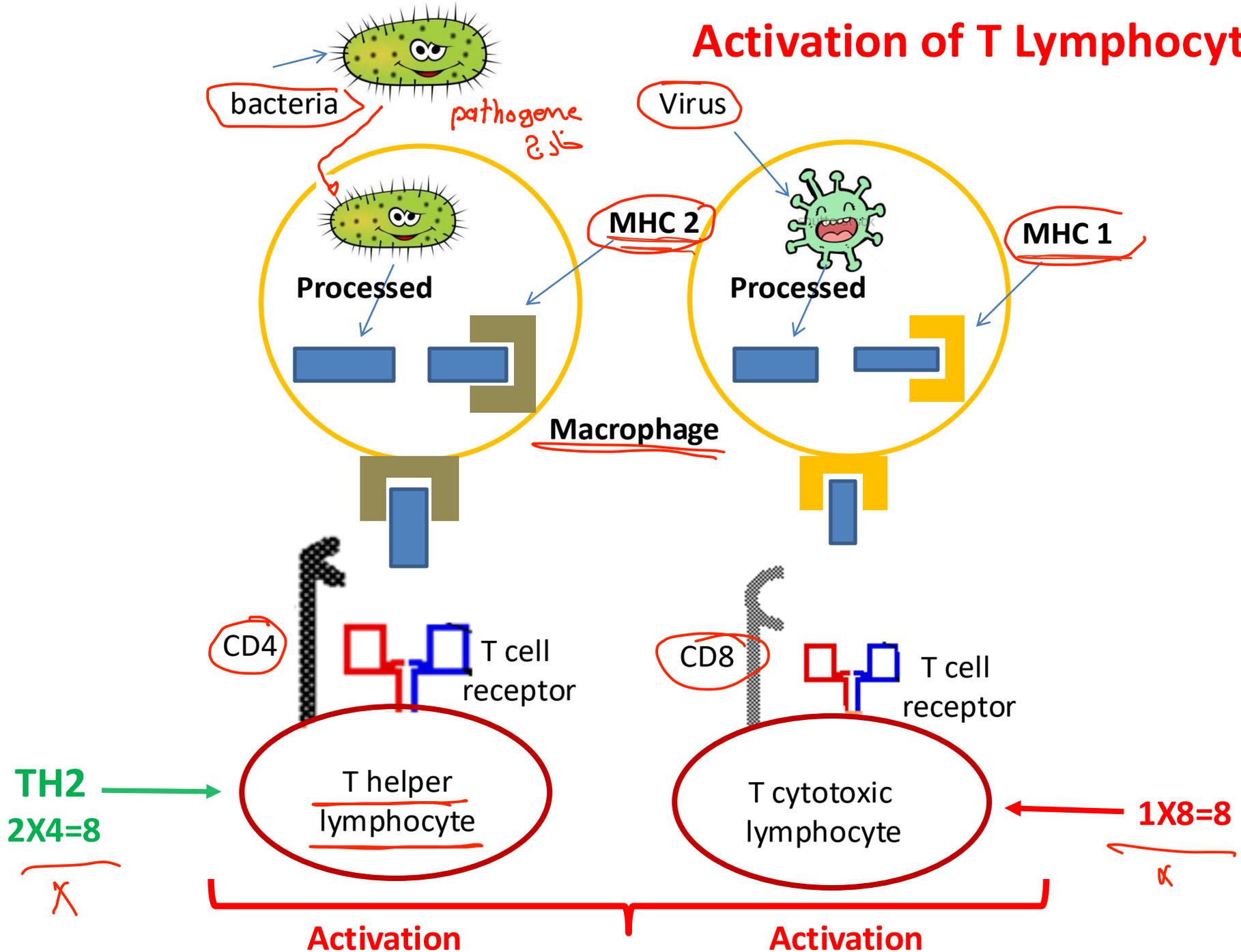
Recombination  
shuffling



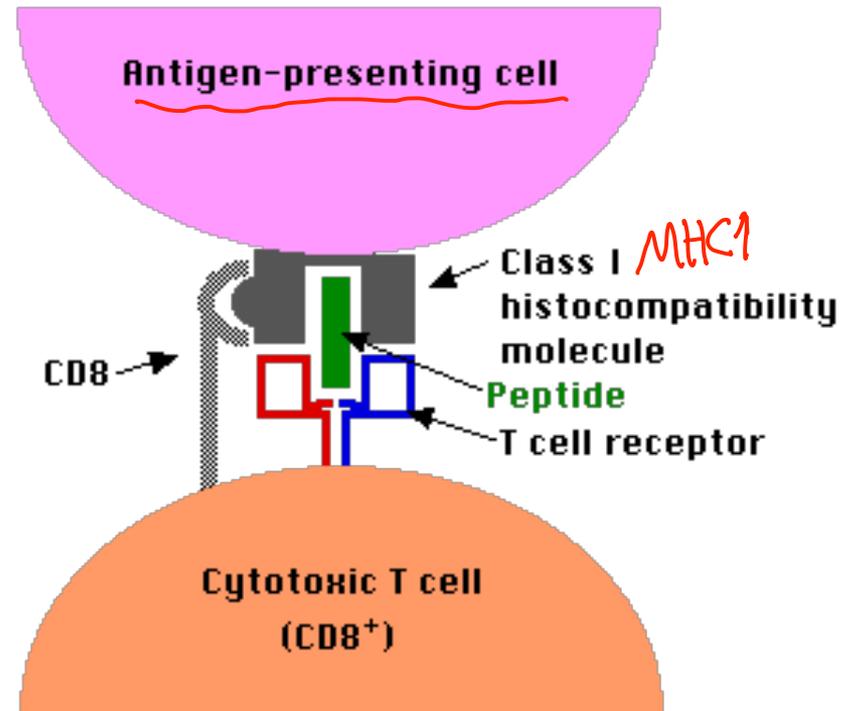
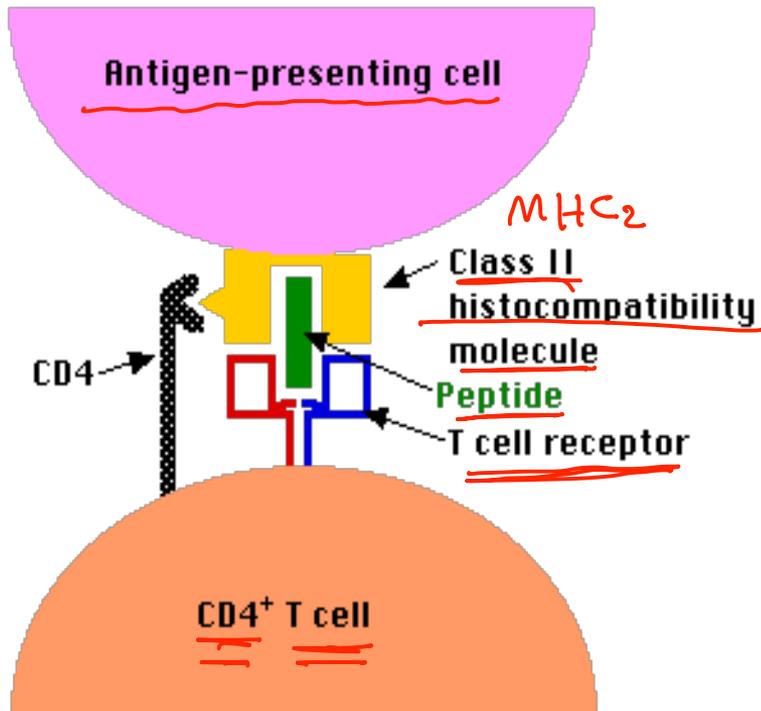
# Why do we have millions of different versions of TCRs?



# Activation of T Lymphocytes



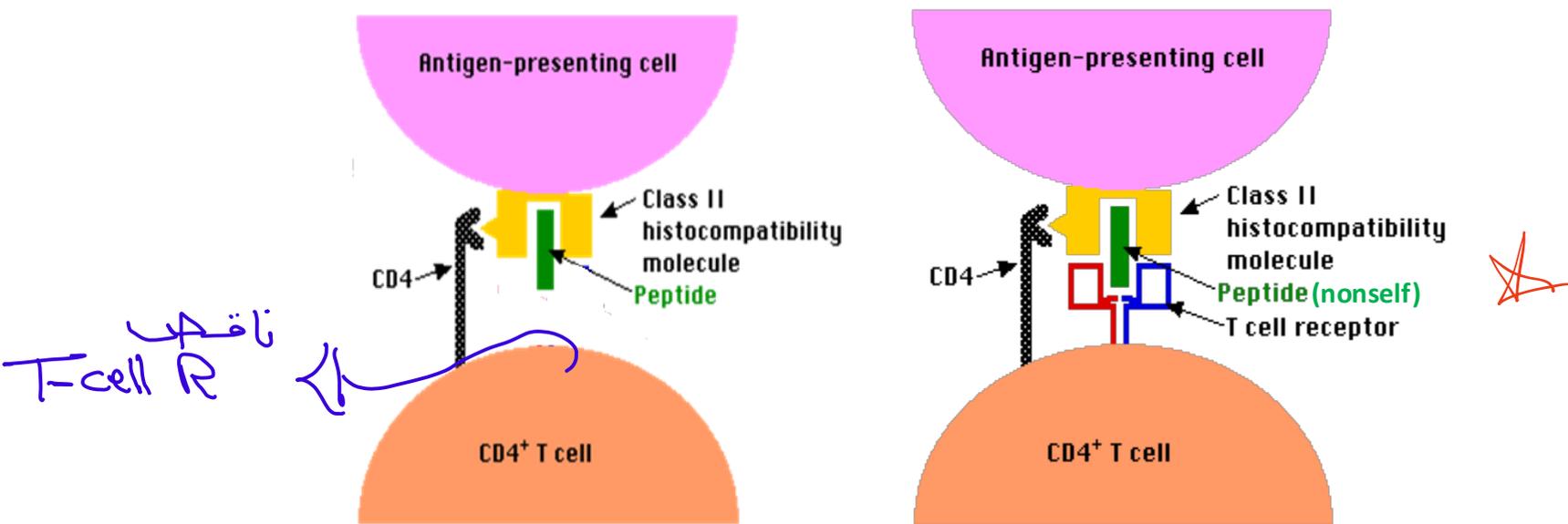
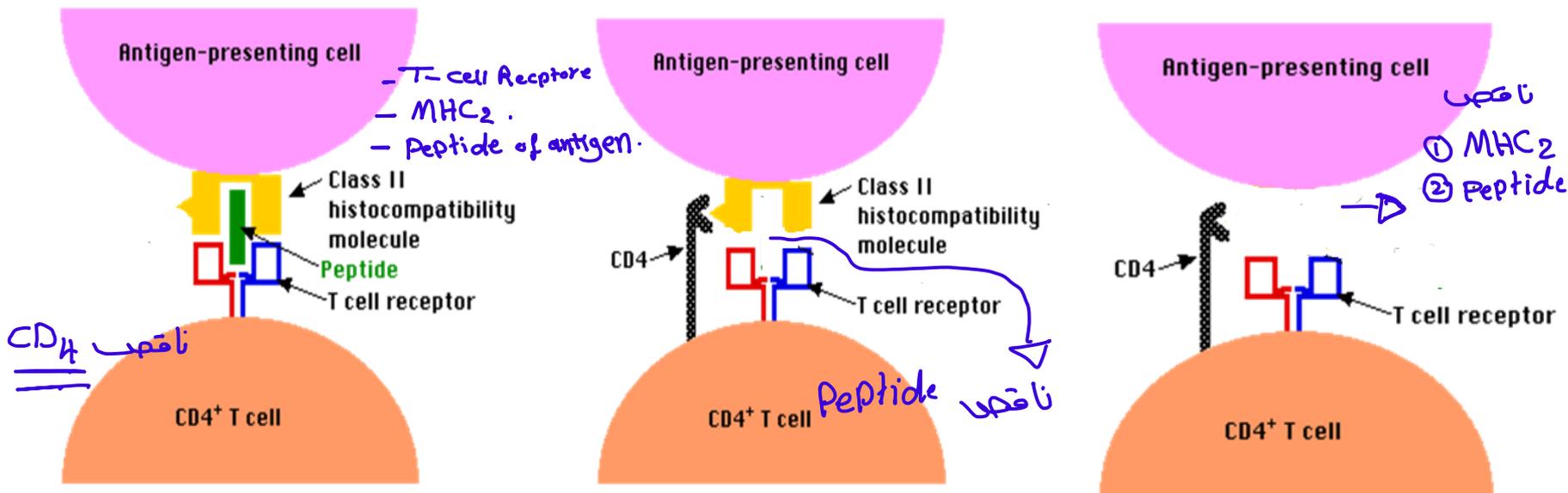
# What are requirements for T cells activation?



## Prerequisites for Lymphocytes activation

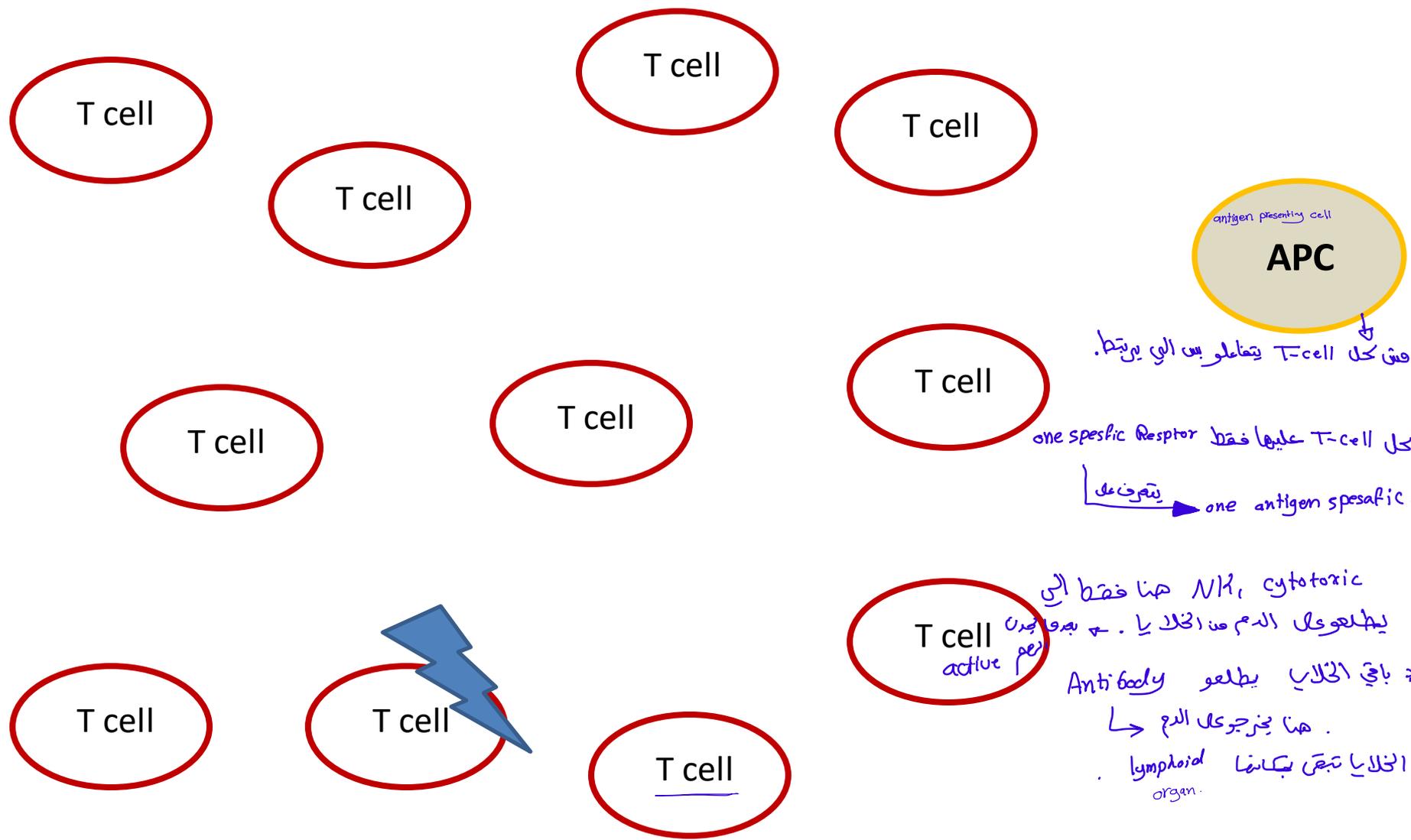
1. CD 4 and CD8 recognizing and binding to MHC class 2 and class 1 respectively
2. TCR should recognize foreign (nonself) antigen complexed with MHC molecules
3. having TCR specific for that antigen

# Requirements of T lymphocytes activation



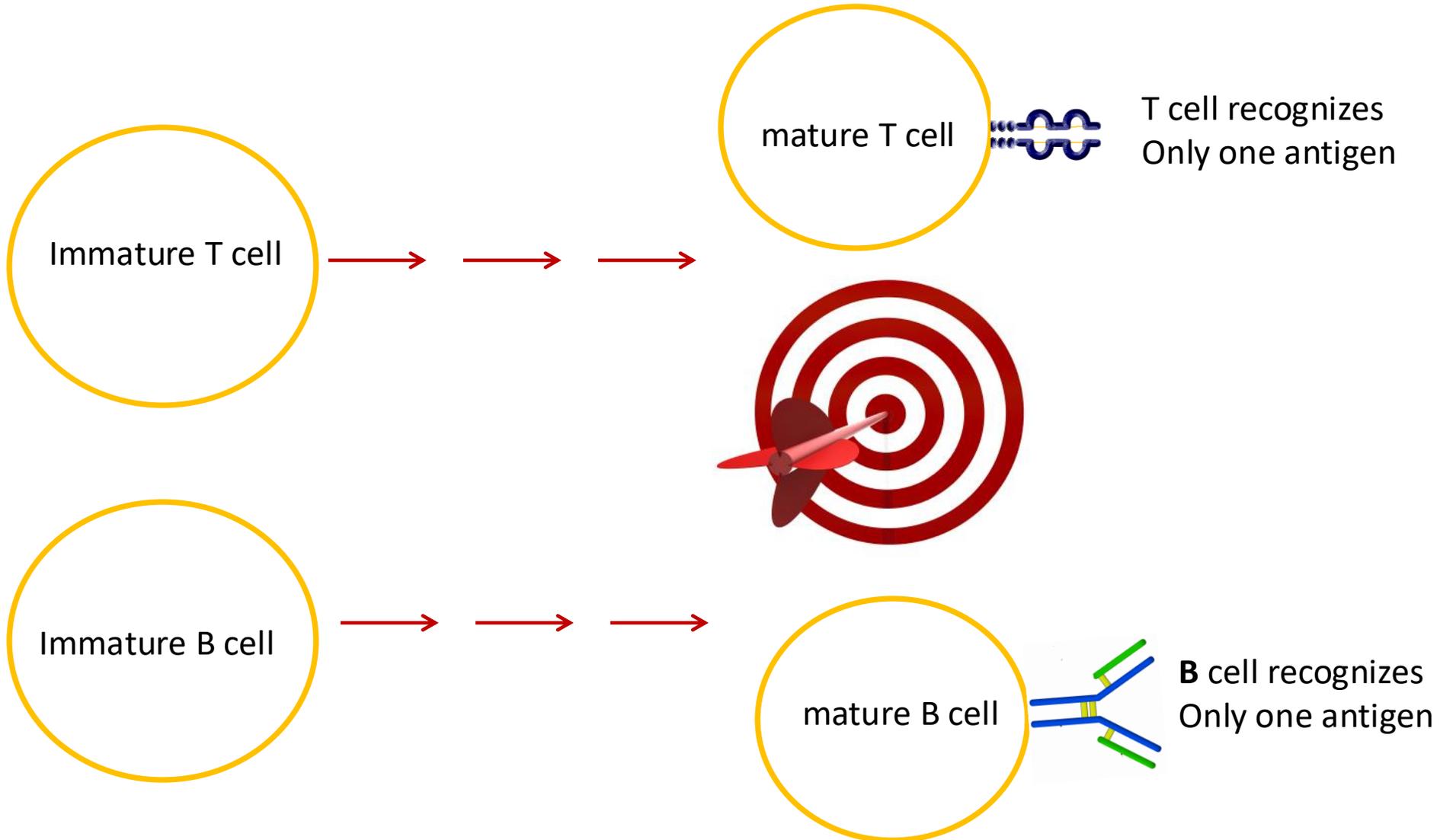
**Activation**

Therefore, each lymphocyte recognizes only one specific antigen presented by APC



# Maturation of B & T lymphocytes

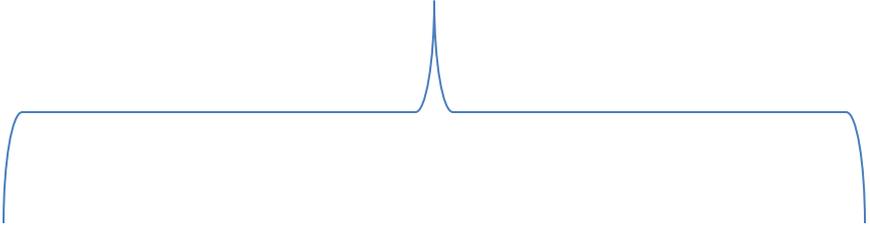
The ultimate goal of maturation is to have B and T cells with receptors monospecific for a specific antigen



# Maturation of B lymphocytes

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## Maturation of B lymphocytes



Antigen independent which takes place in **bone marrow**

\* لا يرتبط مع Antigen

Antigen dependent which takes place in the secondary **lymphoid organs**

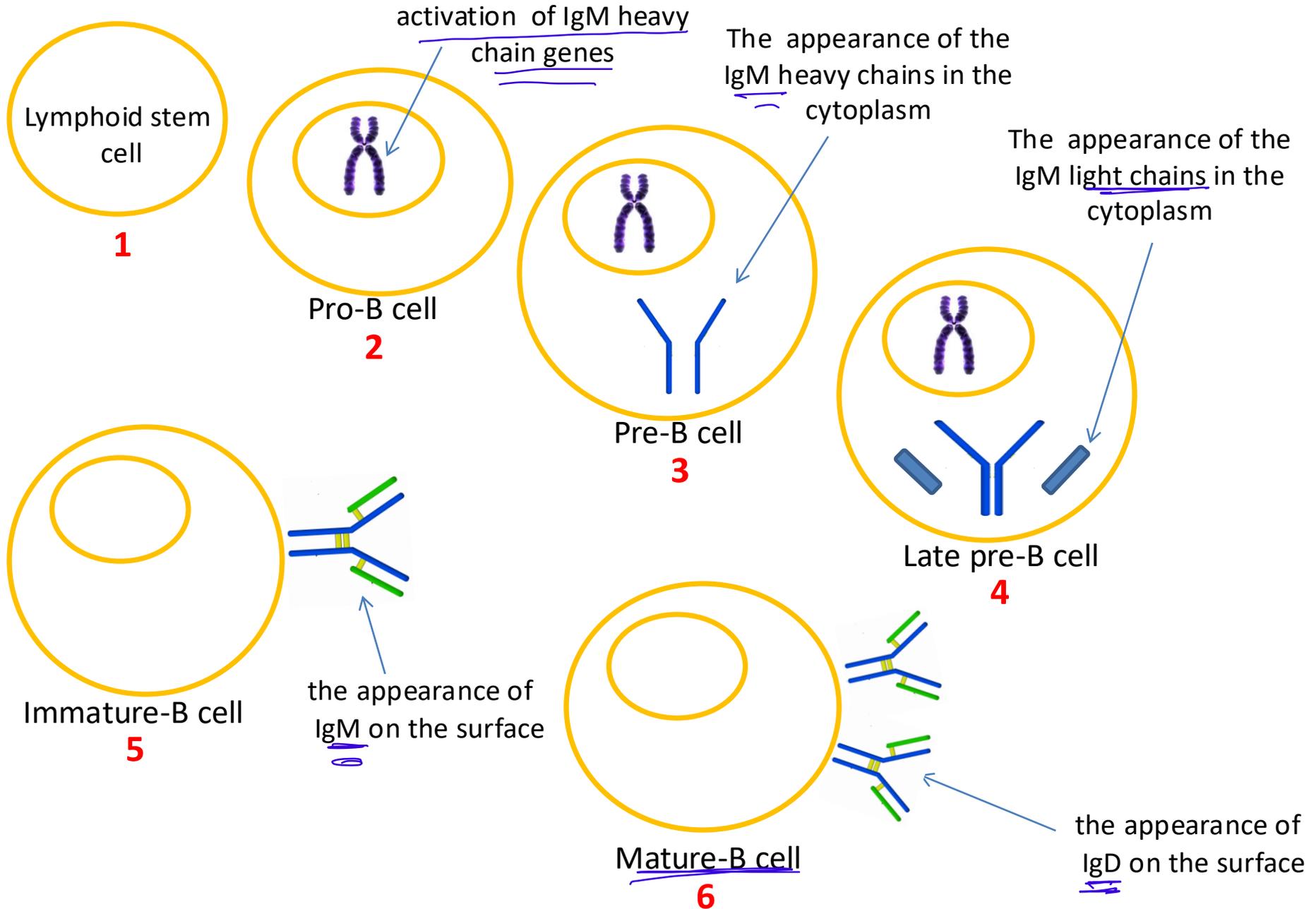
$\beta$ -cell %

↳ low maturation:

↳ ① bone marrow.

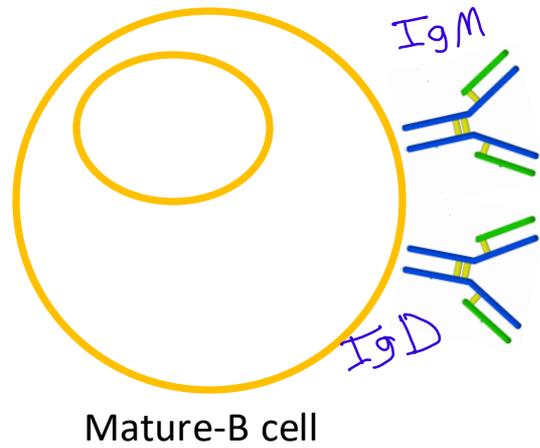
↳ ② Antigen لا يرتبط مع

# Maturation of B lymphocytes (Antigen independent)

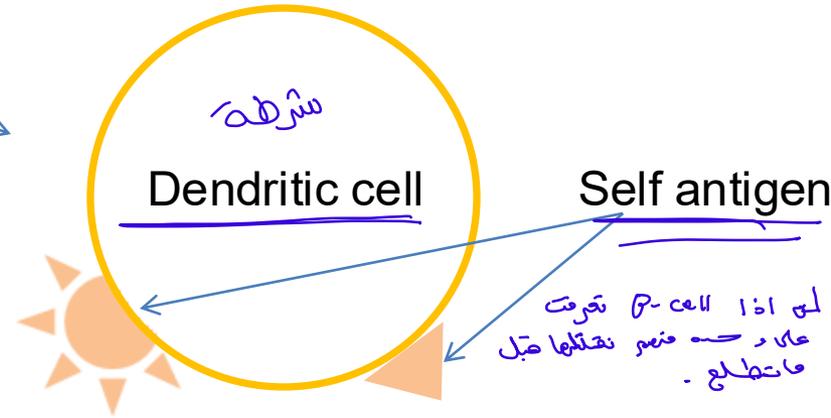


# Maturation of B lymphocytes (Antigen independent)

\* First step of maturation.

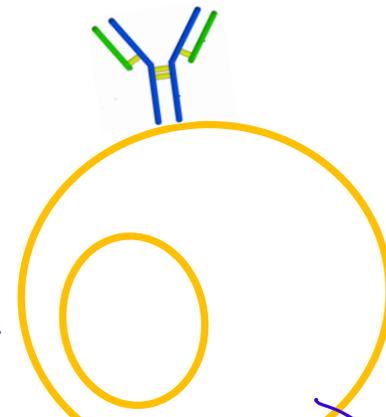


Before leaving the bone marrow the mature B cells undergo apoptosis if they recognized self antigens offered by antigen presenting cells



2ry lymphoid organ. انتج على

antigen independent maturation

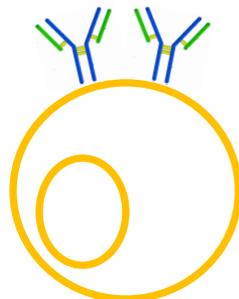
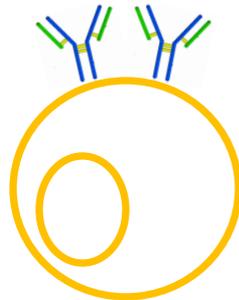
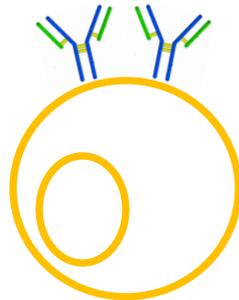
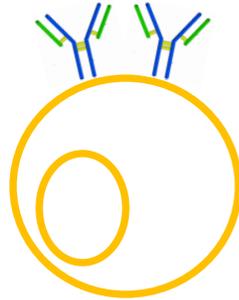


**Apoptosis**

Recognized self antigen

\* اذا ما تعرفت على Self-Antigen ← تخرج على lymphoid

# Maturation of B lymphocytes (Antigen independent )



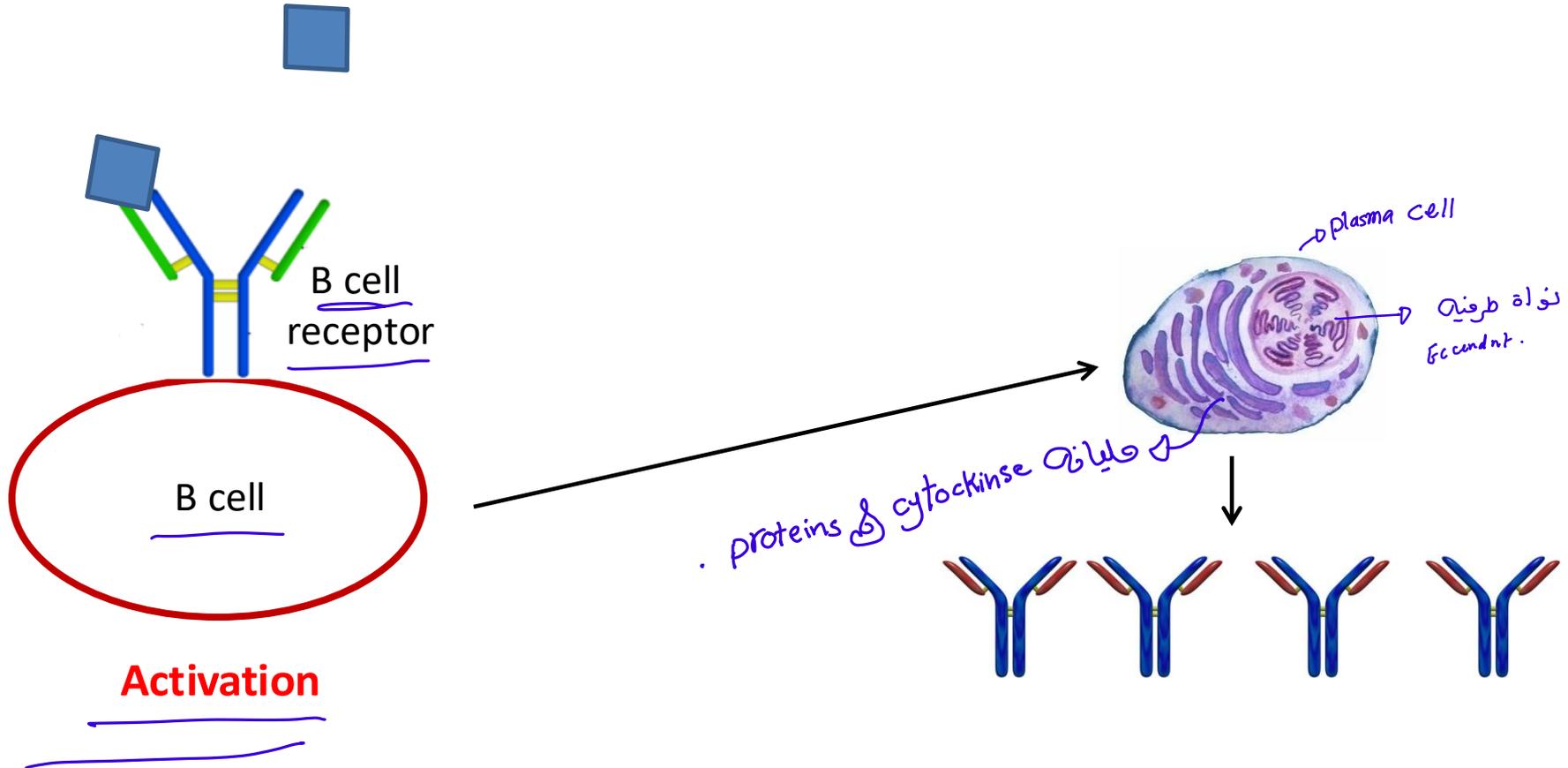
Each B cell leaving bone marrow to the secondary lymphoid organs <sup>عرض</sup> displaying specific IgM (BCR) for a specific antigen

→  
Mature B cells leave bone marrow to the secondary lymphoid organs

# Maturation of B lymphocytes (Antigen dependent )

Antigen dependent B cell maturation:  
occurs in the secondary lymphoid organs

Soluble antigen



# Maturation of T lymphocytes

عظمة الخلق  
سبحان الله

\* الخلايا الخادعة  
Nursing cell

1, 2  
Recognized MHC

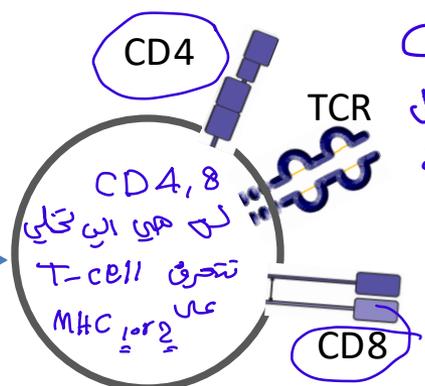
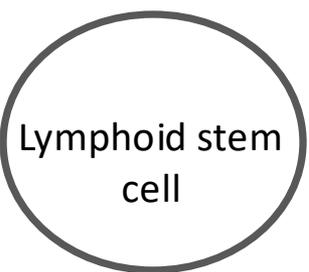
لازم T-cell  
تتحرك على  
وتتربط مع  
تترشح على  
خطوة الثانية

MHC1

MHC2

التي قدرت تتعرف على  
أحدها  
والتي تعرفت عليها

In thymus



CD<sub>4</sub> or CD<sub>8</sub>  
الي بيست اول يعمل  
Switch off → الأخر

Nursing cell offers MHC1 & 2.  
Cells that recognize either  
MHC1 or MHC2 will survive  
(positive selection)

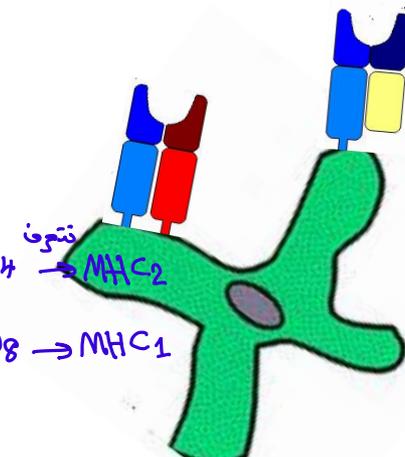
positive selection

(Double negative  
CD4- & CD8-)  
(TCR-)

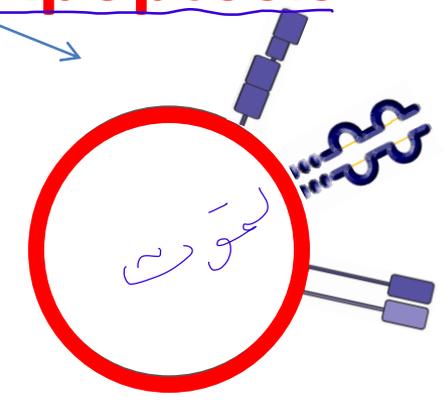
(Double positive  
CD4+ & CD8+)  
(TCR+)

\* لساما أختصت

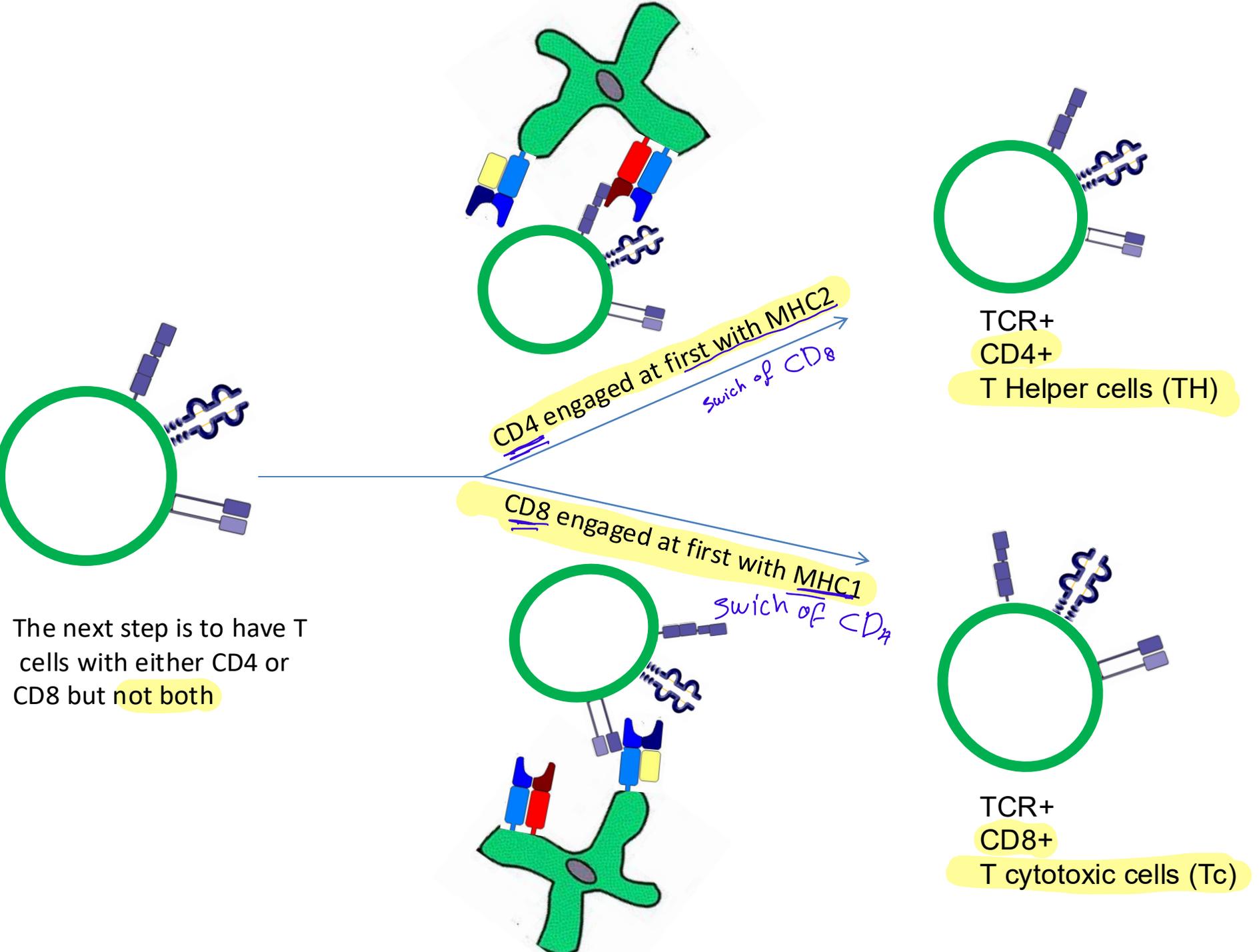
\* عندما تختص T-cell  
→ T-cell helper → CD4 → MHC2  
→ T-cell cytotoxic → CD8 → MHC1



Apoptosis



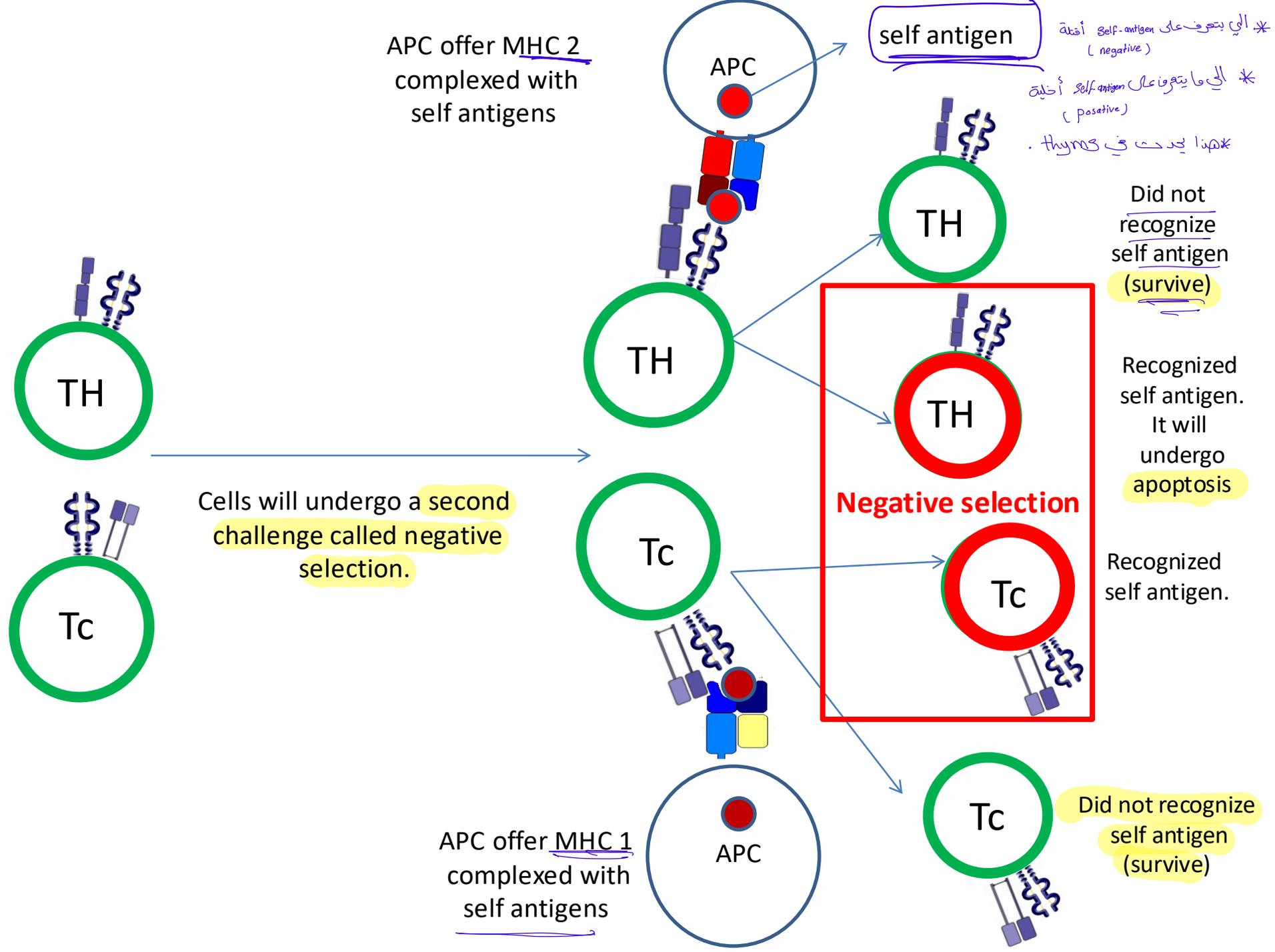
Did not recognize MHC



The next step is to have T cells with either CD4 or CD8 but **not both**

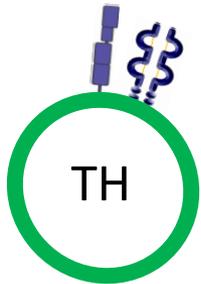
TCR+  
CD4+  
T Helper cells (TH)

TCR+  
CD8+  
T cytotoxic cells (Tc)



# Maturation of B lymphocytes

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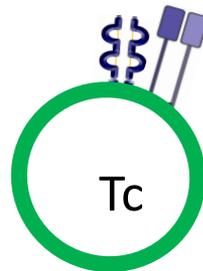
TCR+

CD4+

T Helper cells (TH)

Recognized MHC2 (positive selection)

Did not recognize self antigens (negative selection)



TCR+

CD8+

T cytotoxic cells (Tc)

Recognized MHC1 (positive selection)

Did not recognize self antigens (negative selection)

# Lymphocytes

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Typically, lymphocyte is small, round, cell with diameter of 5-10 $\mu$ m, spherical nucleus, and scanty cytoplasm

Resting lymphocytes are known as naïve cells

Different lymphocytes are identified by certain protein markers on their surface called "cluster of differentiation" or "CD" system.

There are three major types of lymphocyte, B lymphocyte, T lymphocyte and NK cells.

# Lymphocytes

## B Lymphocytes

➤ In humans the development and maturation of these cells occur in bone marrow

➤ B cells differentiate into antibody producing plasma cells

## Plasma cells:

➤ Plasma cells are oval or egg shaped, have eccentrically placed nuclei من طرفية

➤ These are the effector cells of the B-cells and are specialized in secreting immunoglobulins

➤ When activated B cells divide, some of its progeny become memory cells (survive 20 years or more) and the reminders become immunoglobulin-secreting plasma cells.

➤ They have a short life span of few days to few weeks.

**THANK YOU**

The image features the words "THANK YOU" in a bold, blue, sans-serif font. The text is rendered with a 3D effect, showing a slight gradient and a shadow on the bottom surface. Below the text is a clear, semi-transparent reflection of the words, creating a mirror-like effect on a white background.