



**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

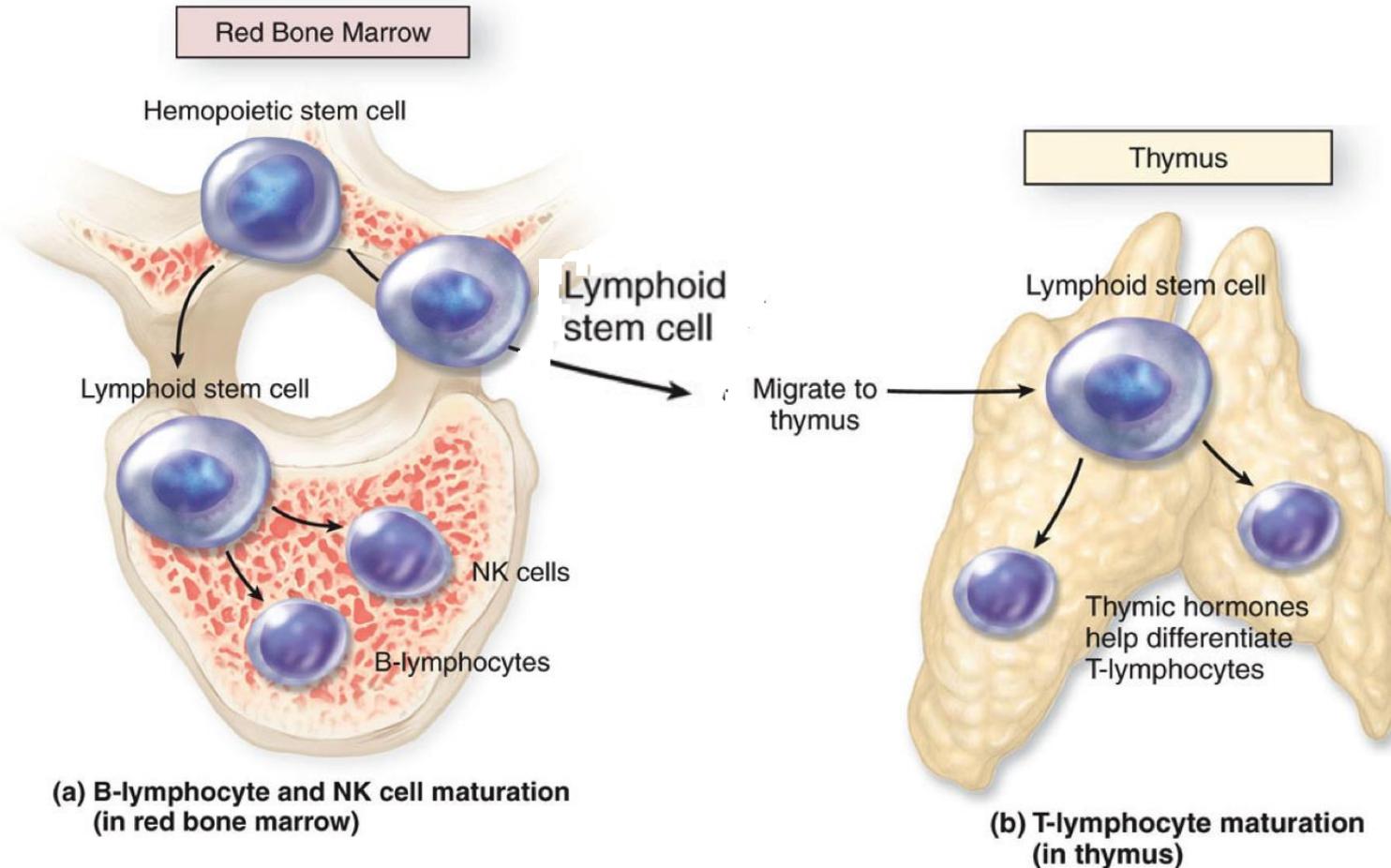
Describe the sequence of B and T lymphocytes maturation

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?

Why do we have millions of different versions of TCRs?

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?

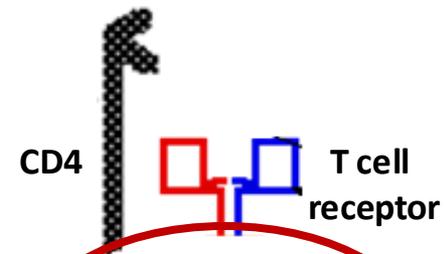
T helper lymphocyte

T cytotoxic lymphocyte

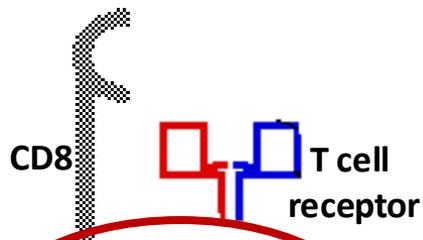
B cell

Natural killer cell

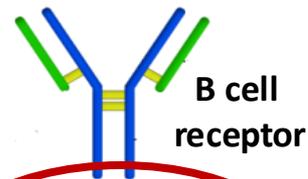
What are the types of receptors on these lymphocytes?



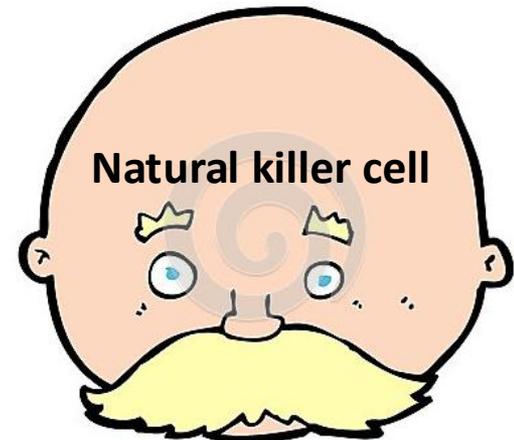
T helper lymphocyte



T cytotoxic lymphocyte

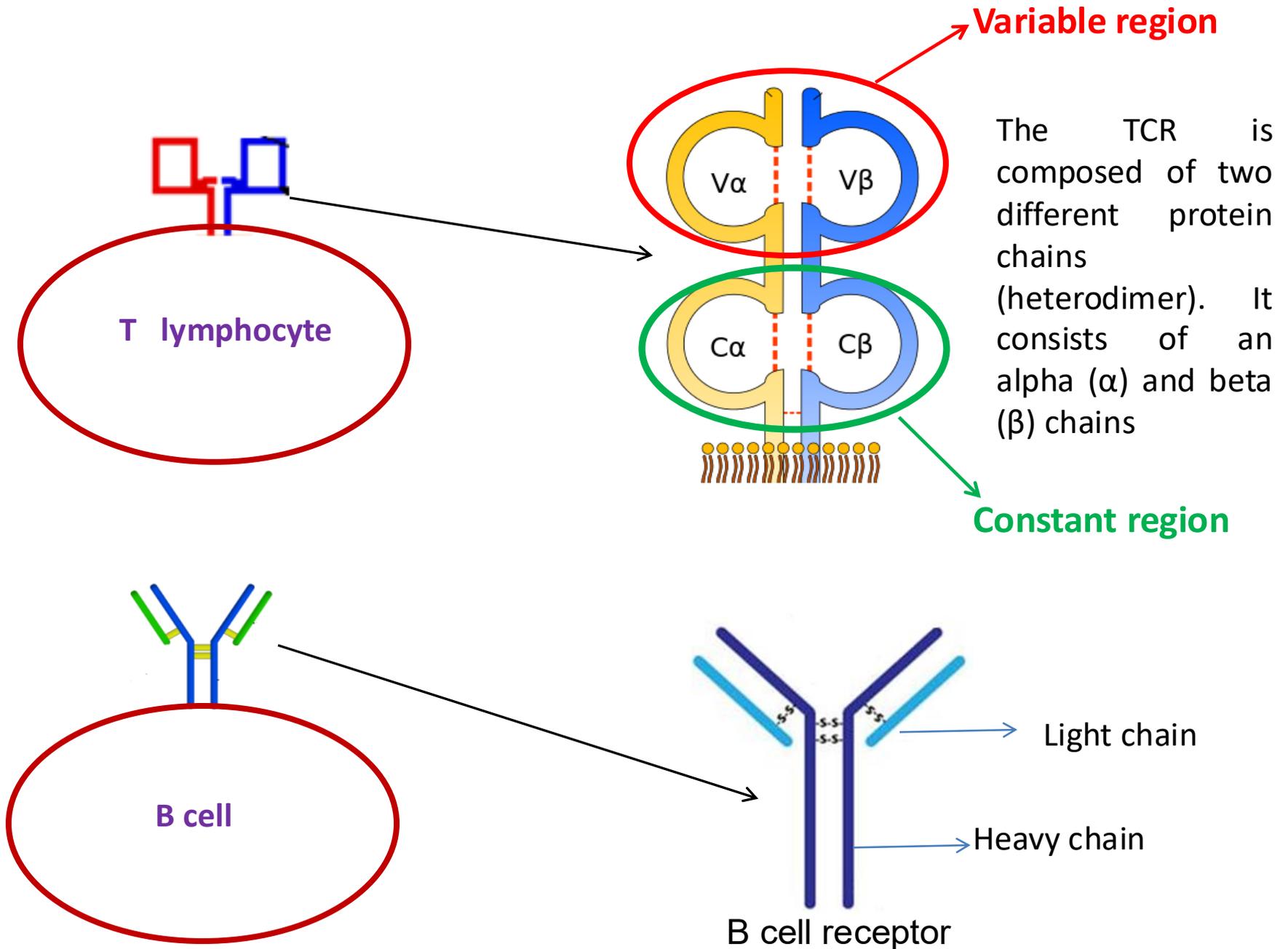


B cell

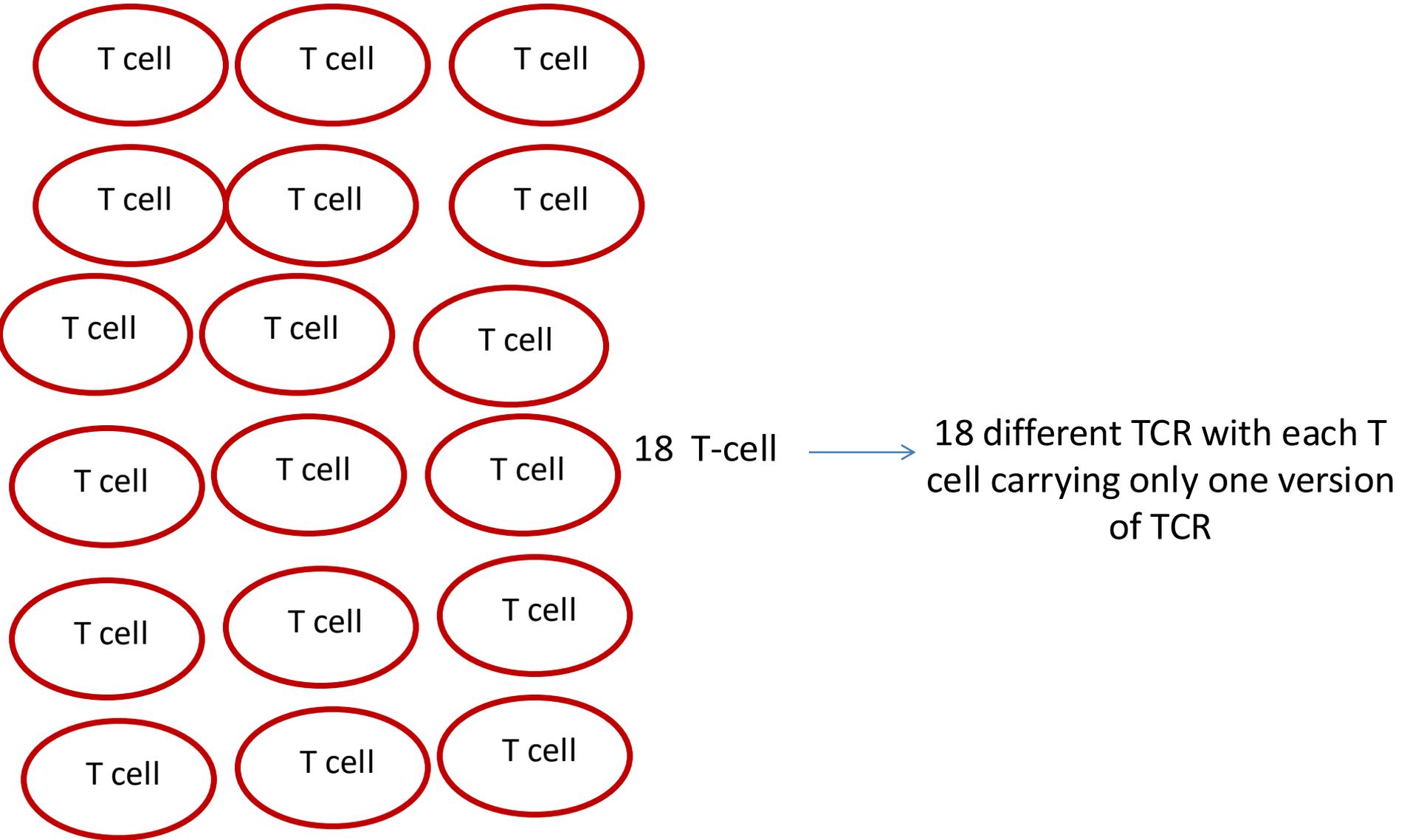


Natural killer cell

# What is the structure of TCRs & BCRs?



Why do we have millions of different versions of TCRs?



Why do we have millions of different versions of TCRs?



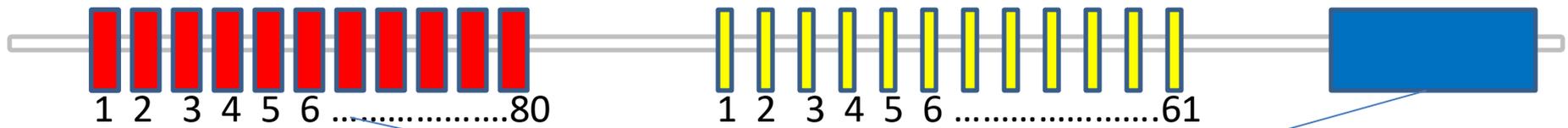
# Why do we have millions of different versions of TCRs?

Chromosome 14

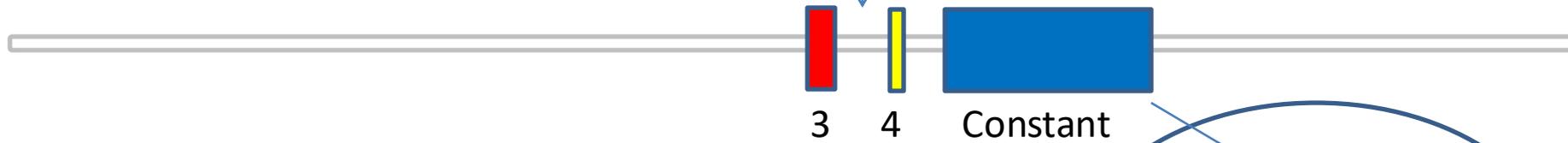
V  $\alpha$ -genes (70-80)

J  $\alpha$ -genes (61)

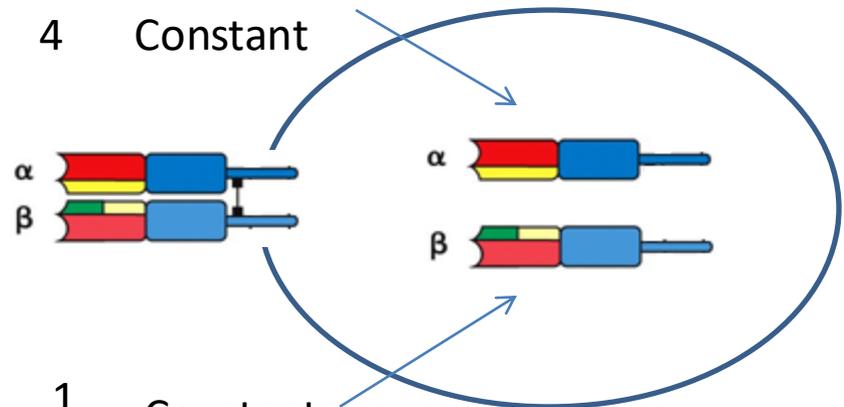
C  $\alpha$ -gene



Recombinases



V: **V**ariable  
J: **J**oining  
C: **C**onstant  
D: **D**iverse



7 1 Constant

Recombinases

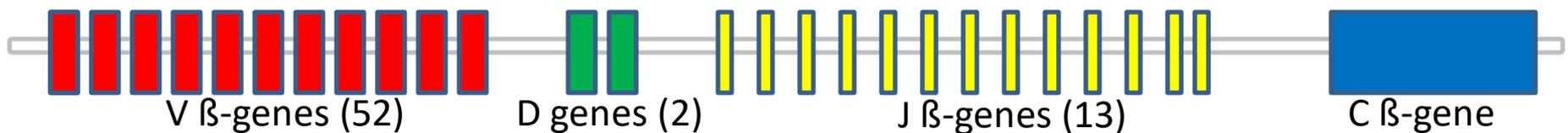
Chromosome 7

V  $\beta$ -genes (52)

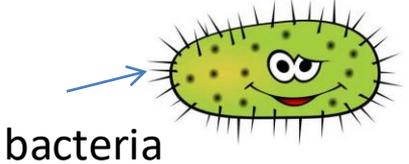
D genes (2)

J  $\beta$ -genes (13)

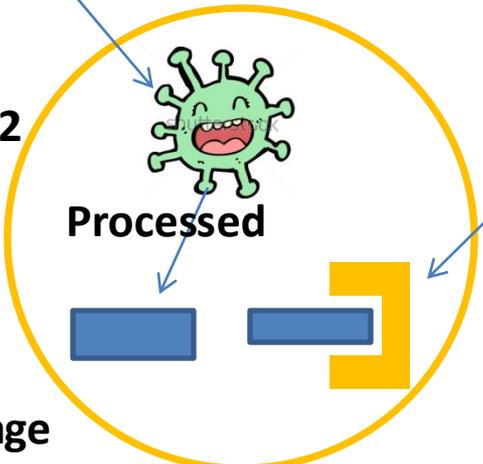
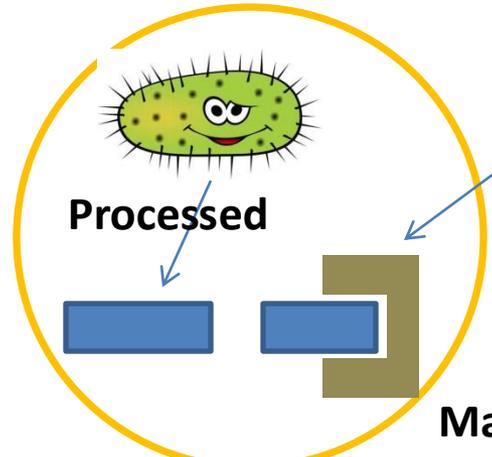
C  $\beta$ -gene



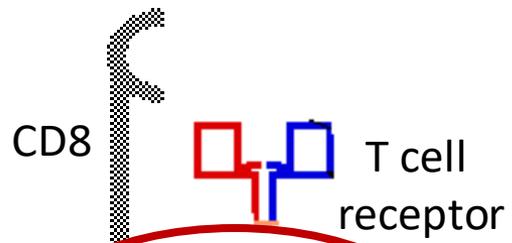
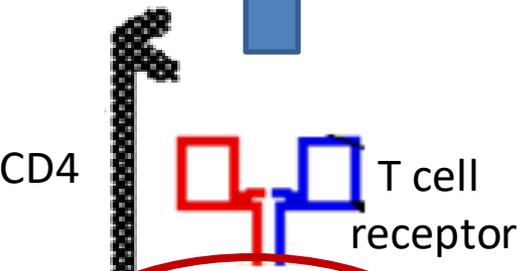
# Activation of T Lymphocytes



Virus



Macrophage



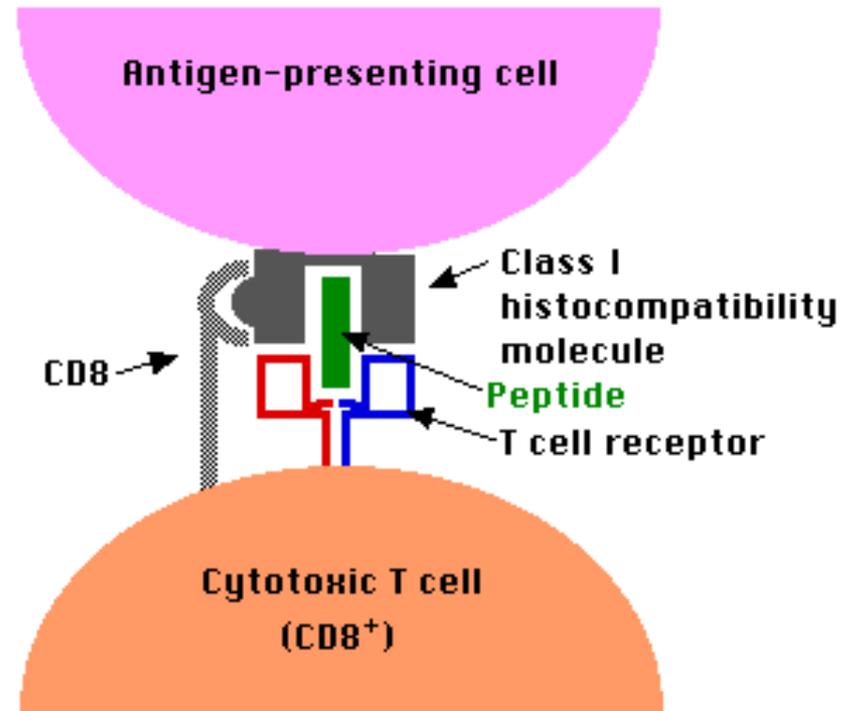
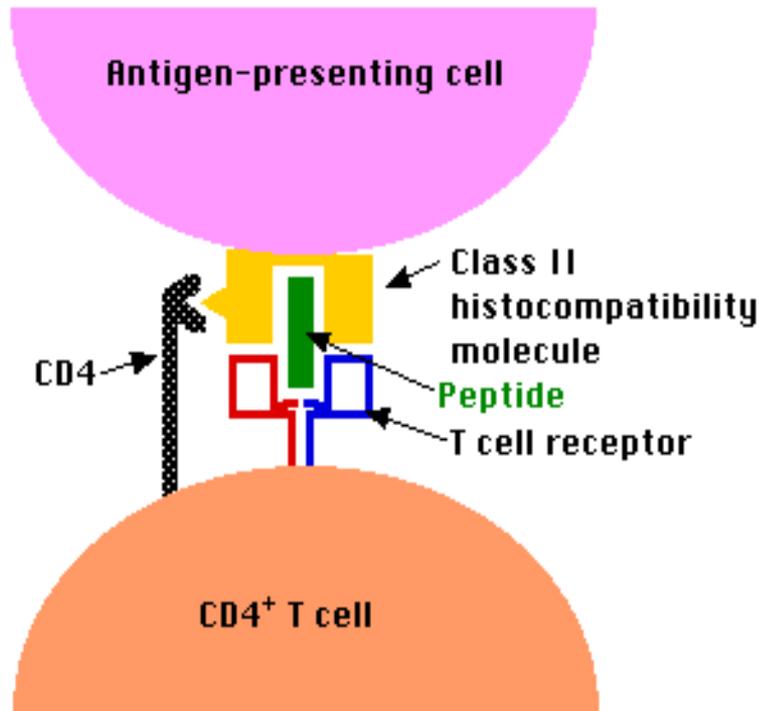
**TH2**  
**2X4=8**

**1X8=8**

**Activation**

**Activation**

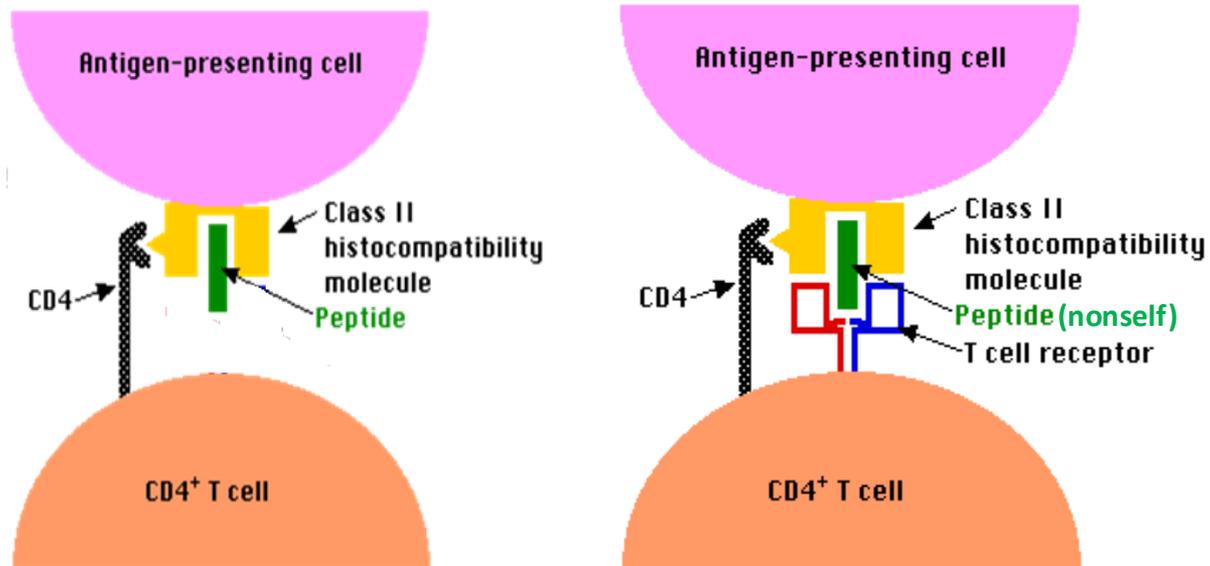
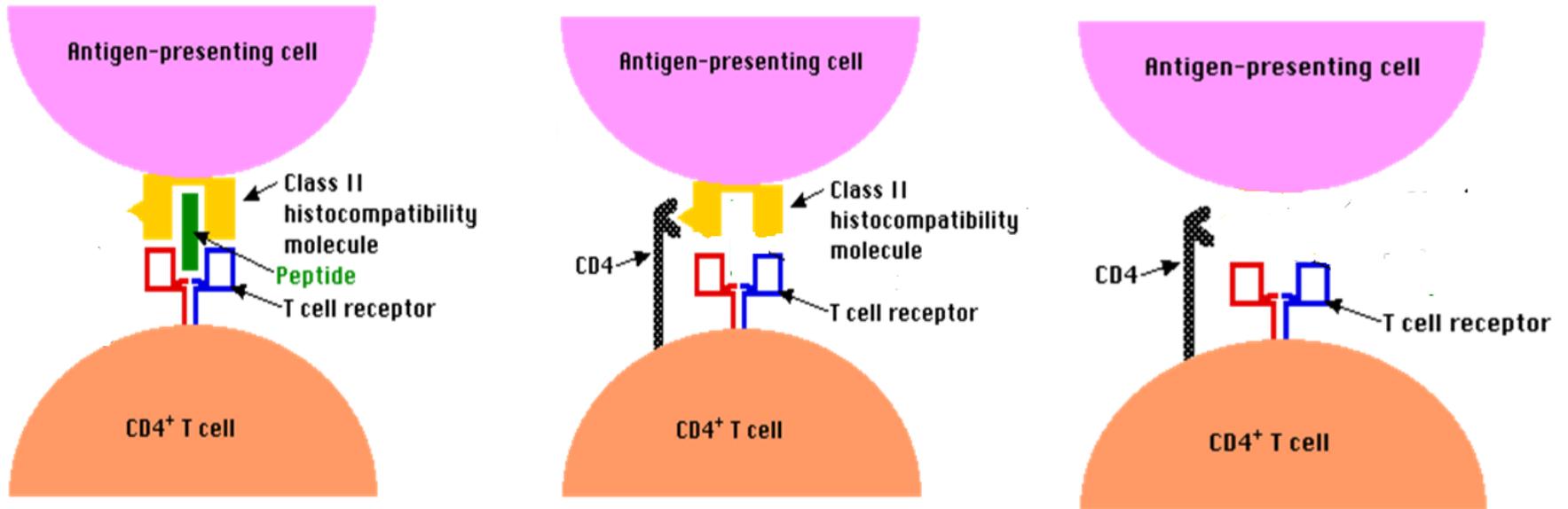
## What are requirements for T cells activation?



### Prerequisites for Lymphocytes activation

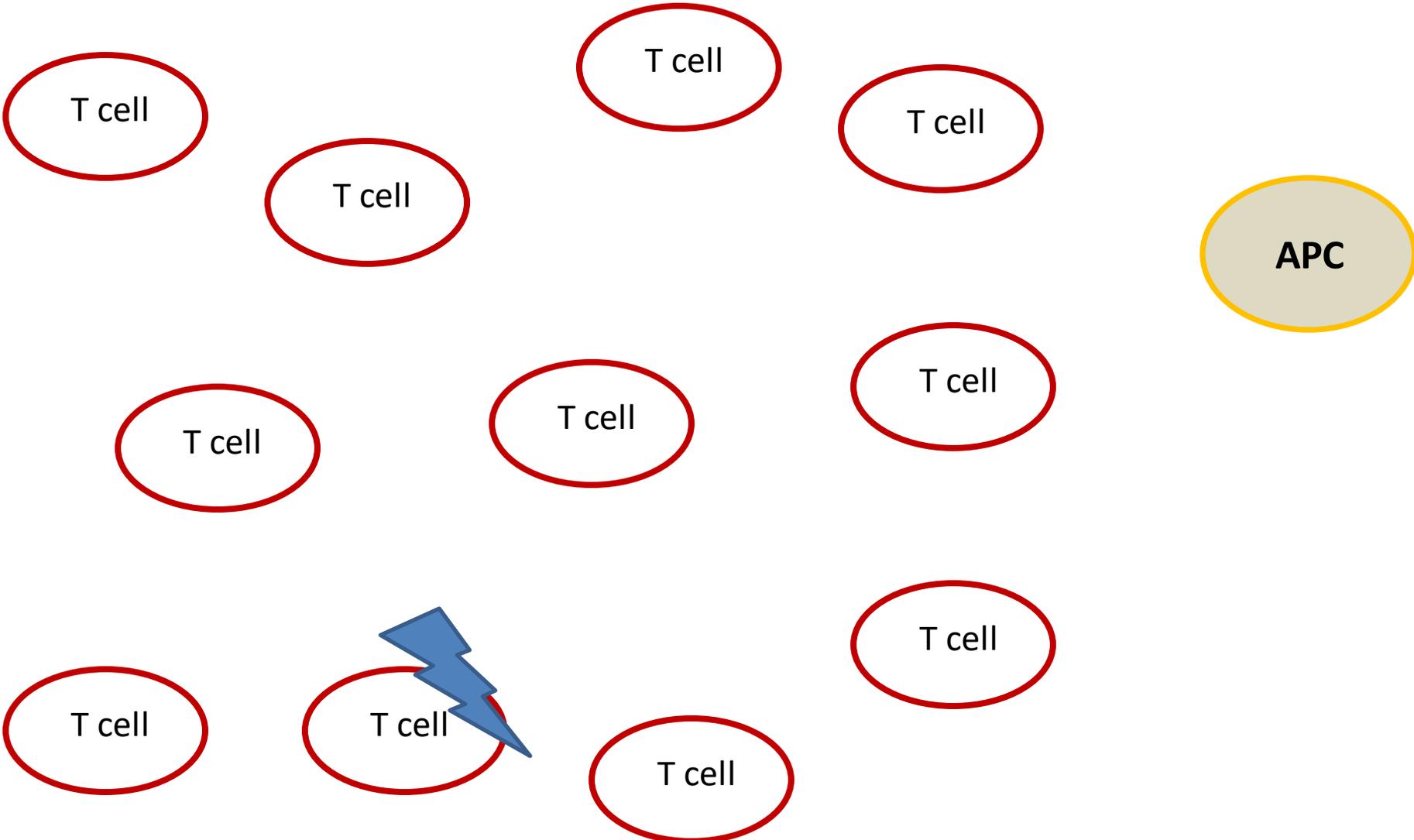
1. CD 4 and CD8 recognizing and binding to MHC class 2 and class 1 respectively
2. TCR should recognize foreign (nonself) antigen complexed with MHC molecules
3. having TCR specific for that antigen

# Requirements of T lymphocytes activation



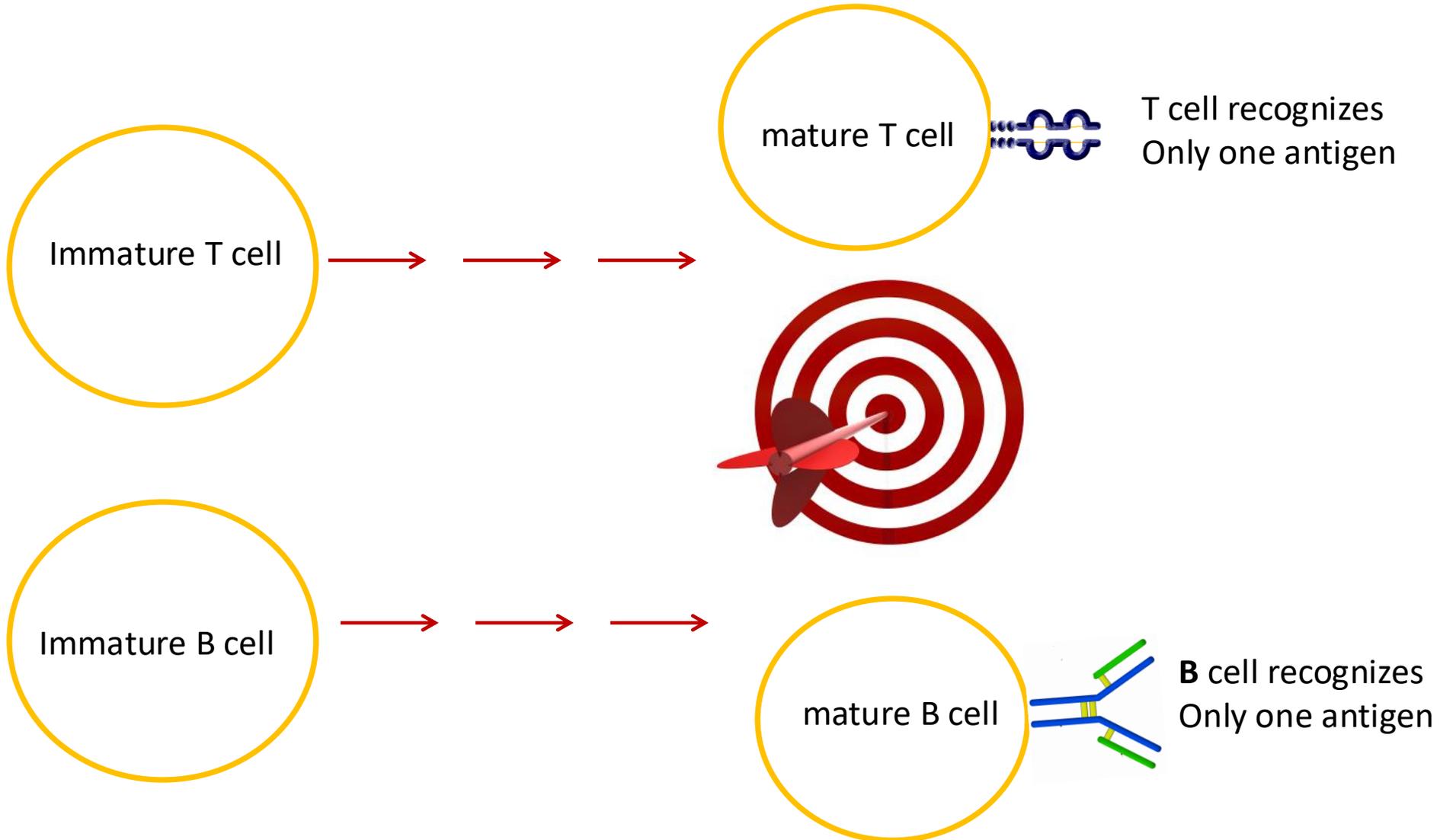
**Activation**

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



# Maturation of B & T lymphocytes

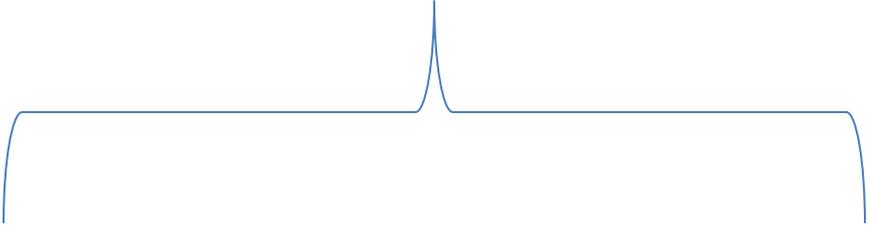
The ultimate goal of maturation is to have B and T cells with receptors monospecific for a specific antigen



# Maturation of B lymphocytes

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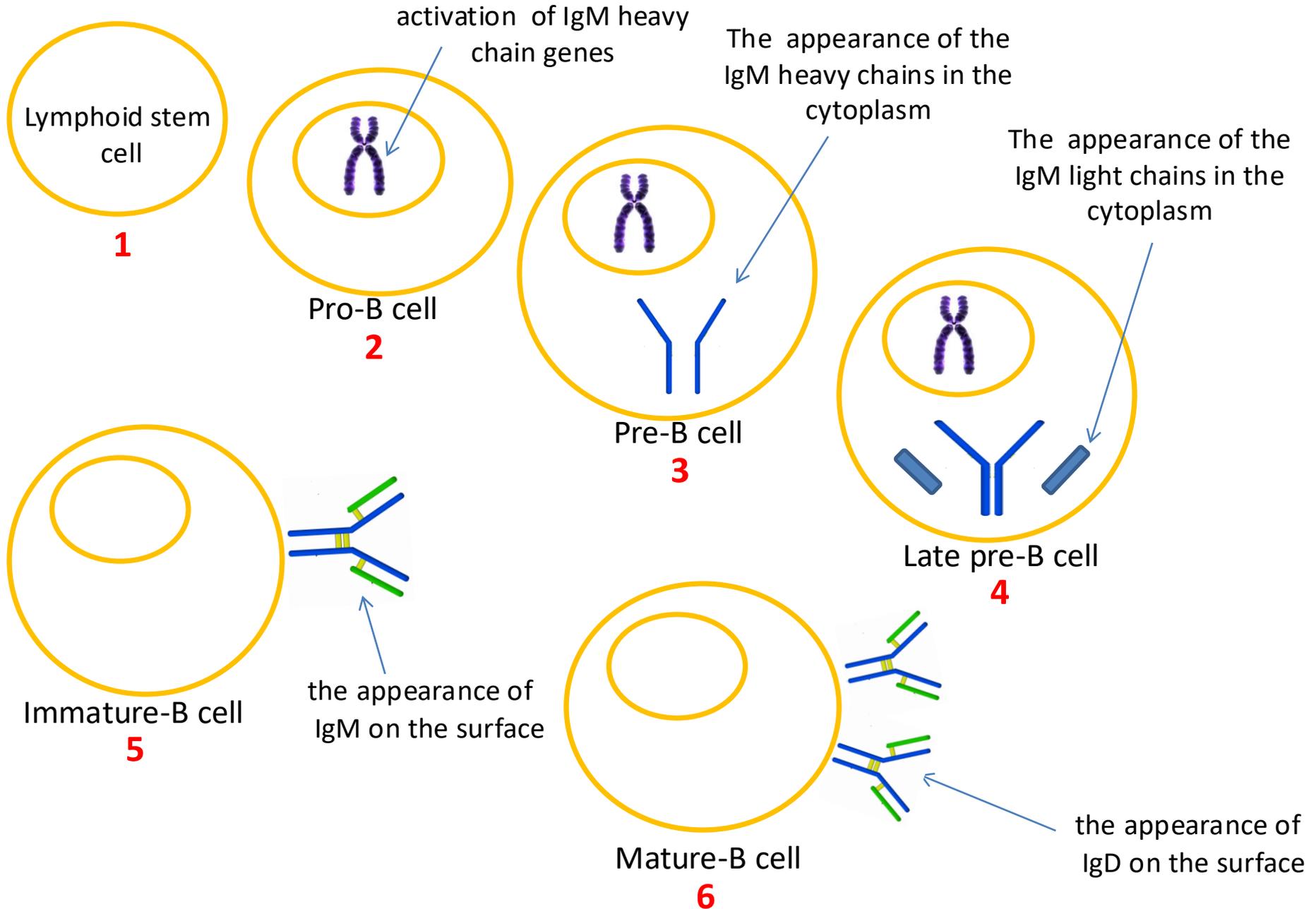
## Maturation of B lymphocytes



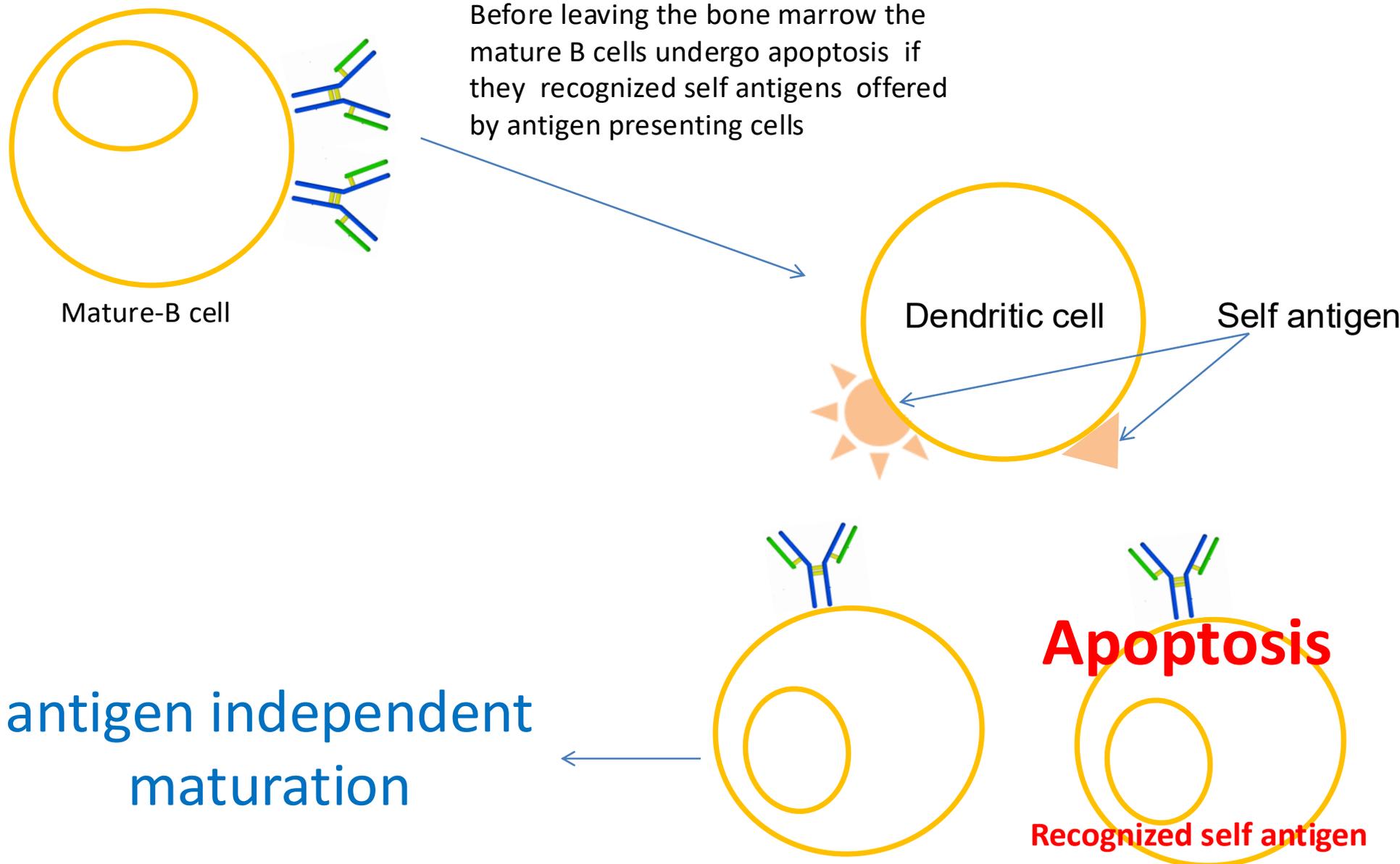
Antigen independent which  
takes place in bone marrow

Antigen dependent which  
takes place in the secondary  
lymphoid organs

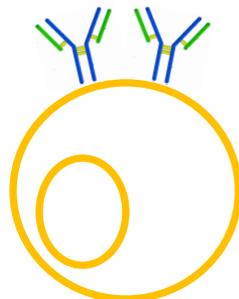
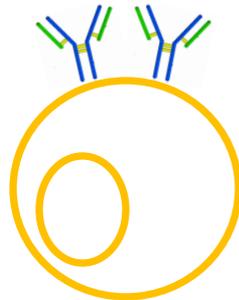
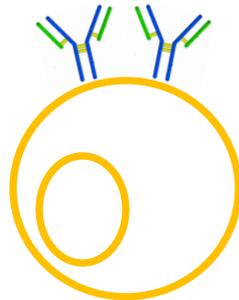
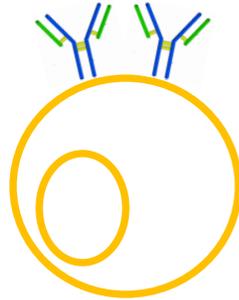
# Maturation of B lymphocytes (Antigen independent)



# Maturation of B lymphocytes (Antigen independent )



# Maturation of B lymphocytes (Antigen independent )

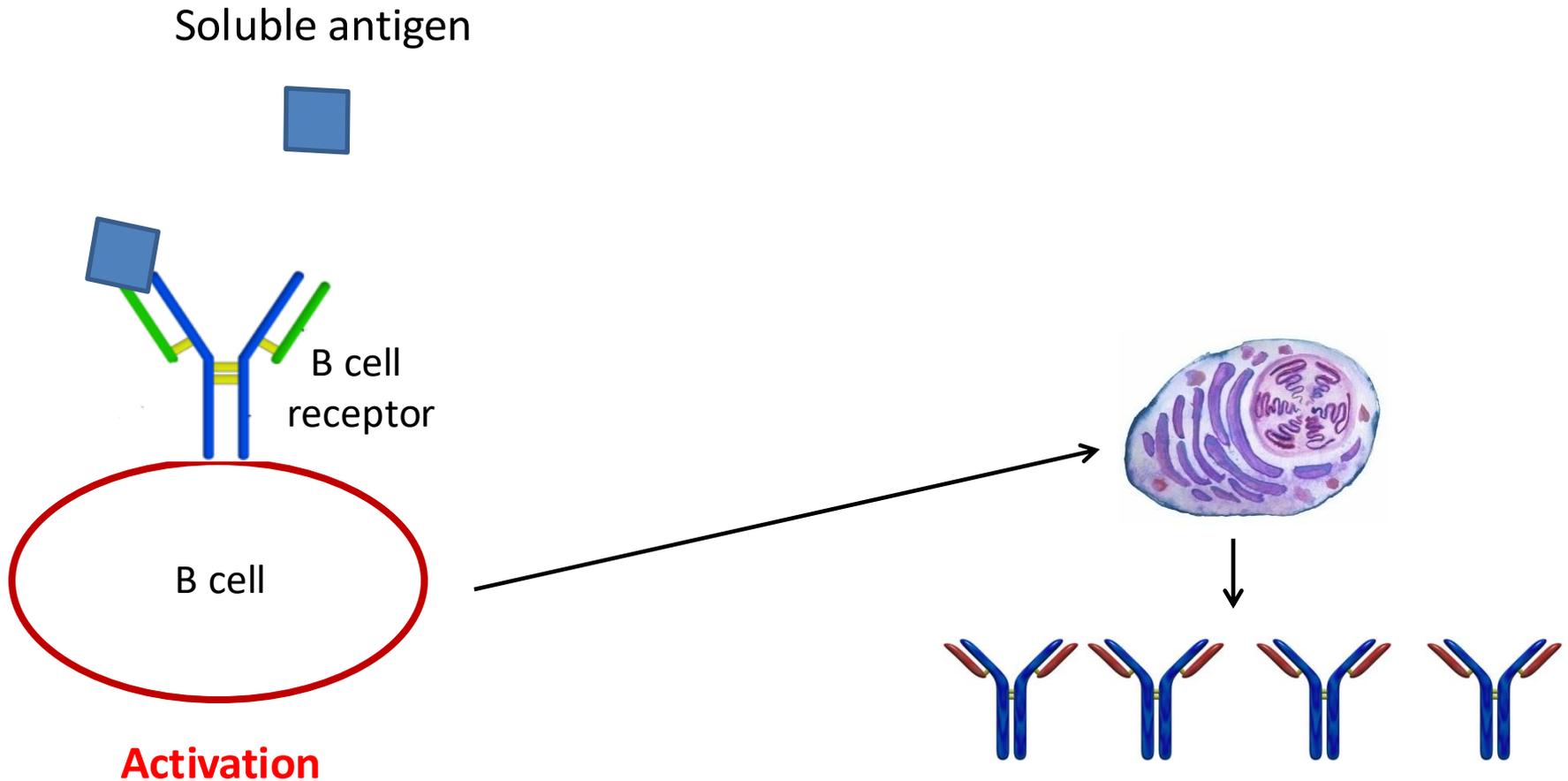


Each B cell leaving bone marrow to the secondary lymphoid organs displaying specific IgM (BCR) for a specific antigen

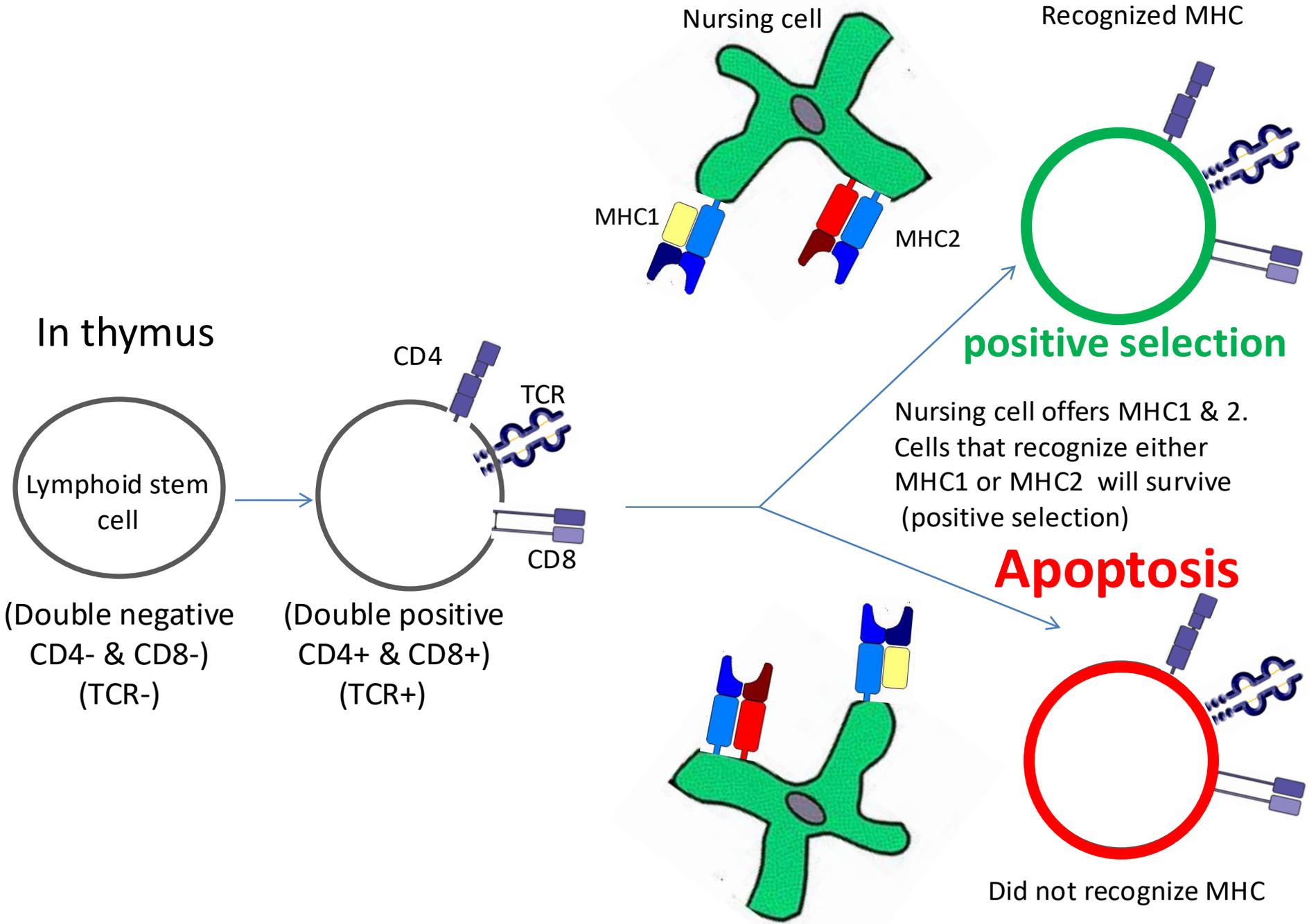
Mature B cells leave bone marrow to the secondary lymphoid organs

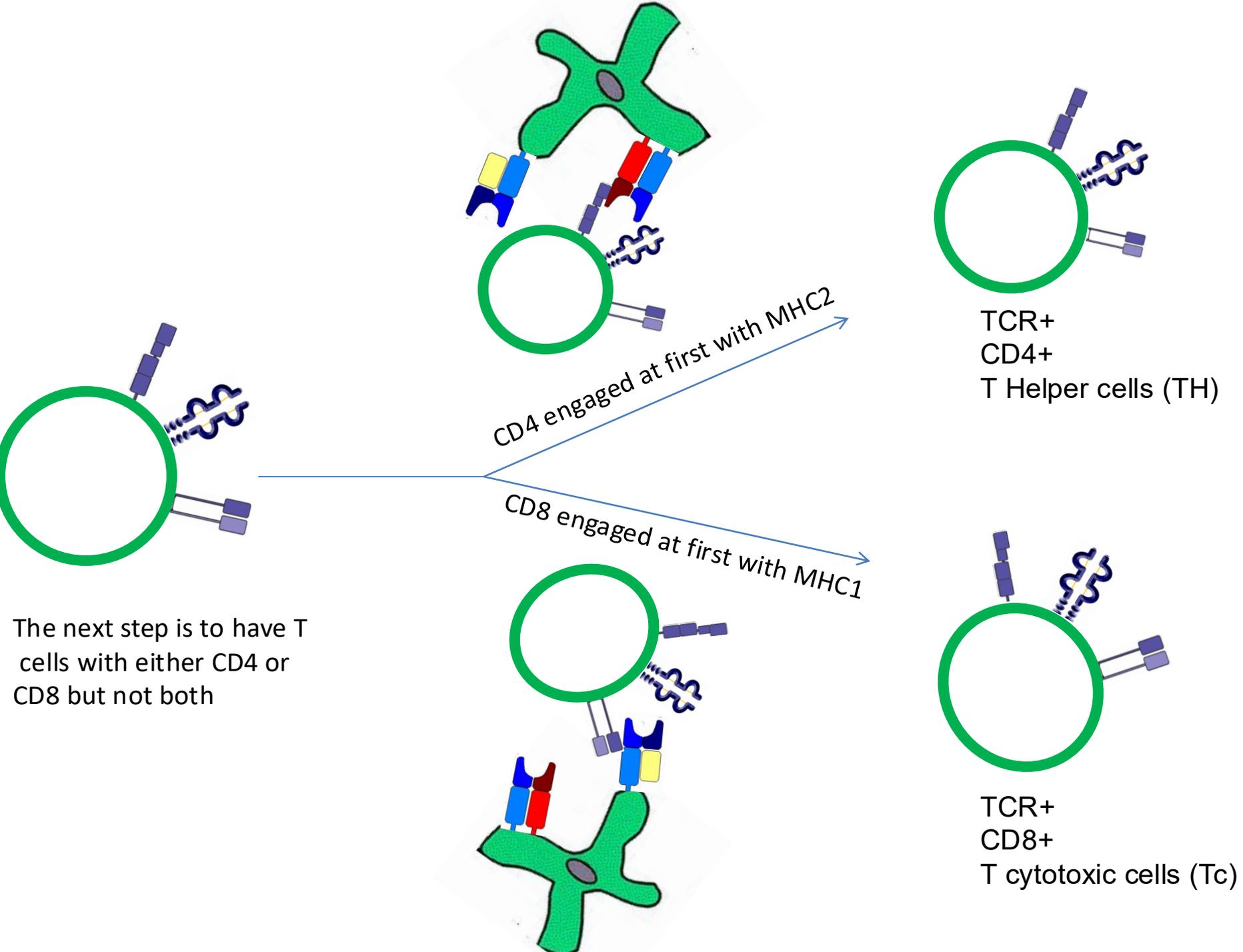
# Maturation of B lymphocytes (Antigen dependent )

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



# Maturation of T lymphocytes





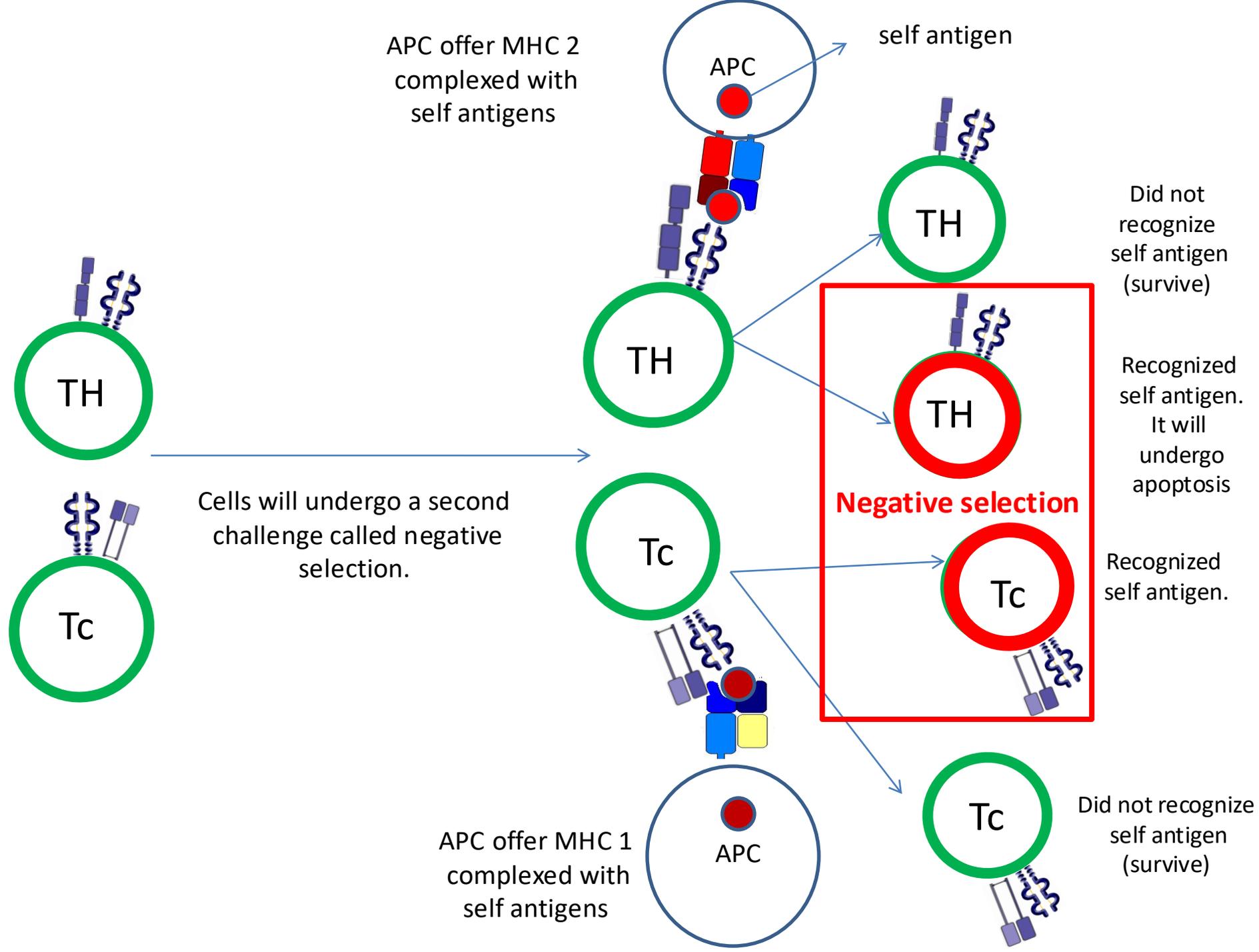
The next step is to have T cells with either CD4 or CD8 but not both

CD4 engaged at first with MHC2

CD8 engaged at first with MHC1

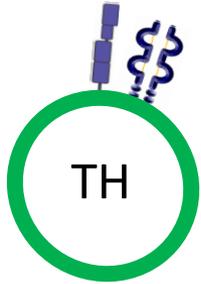
TCR+  
CD4+  
T Helper cells (TH)

TCR+  
CD8+  
T cytotoxic cells (Tc)



# Maturation of B lymphocytes

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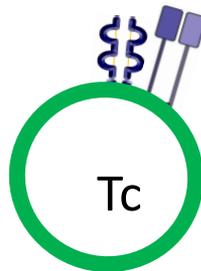
TCR+

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

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## **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
- 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 has a slight 3D effect with a gradient from a darker blue at the top to a lighter blue at the bottom. Below the text is a soft, semi-transparent reflection of the same words, creating a sense of depth and balance. The entire composition is centered on a plain white background.