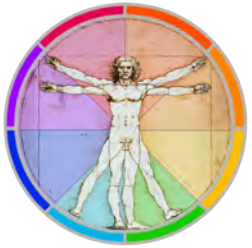
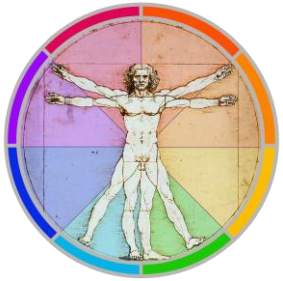
HUBS191 Lecture Material

This pre-lecture material is to help you prepare for the lecture and to assist your note-taking within the lecture, it is NOT a substitute for the lecture !



Please note that although every effort is made to ensure this pre-lecture material corresponds to the live-lecture there may be differences / additions.



HUBS191
Lecture 35
T cells

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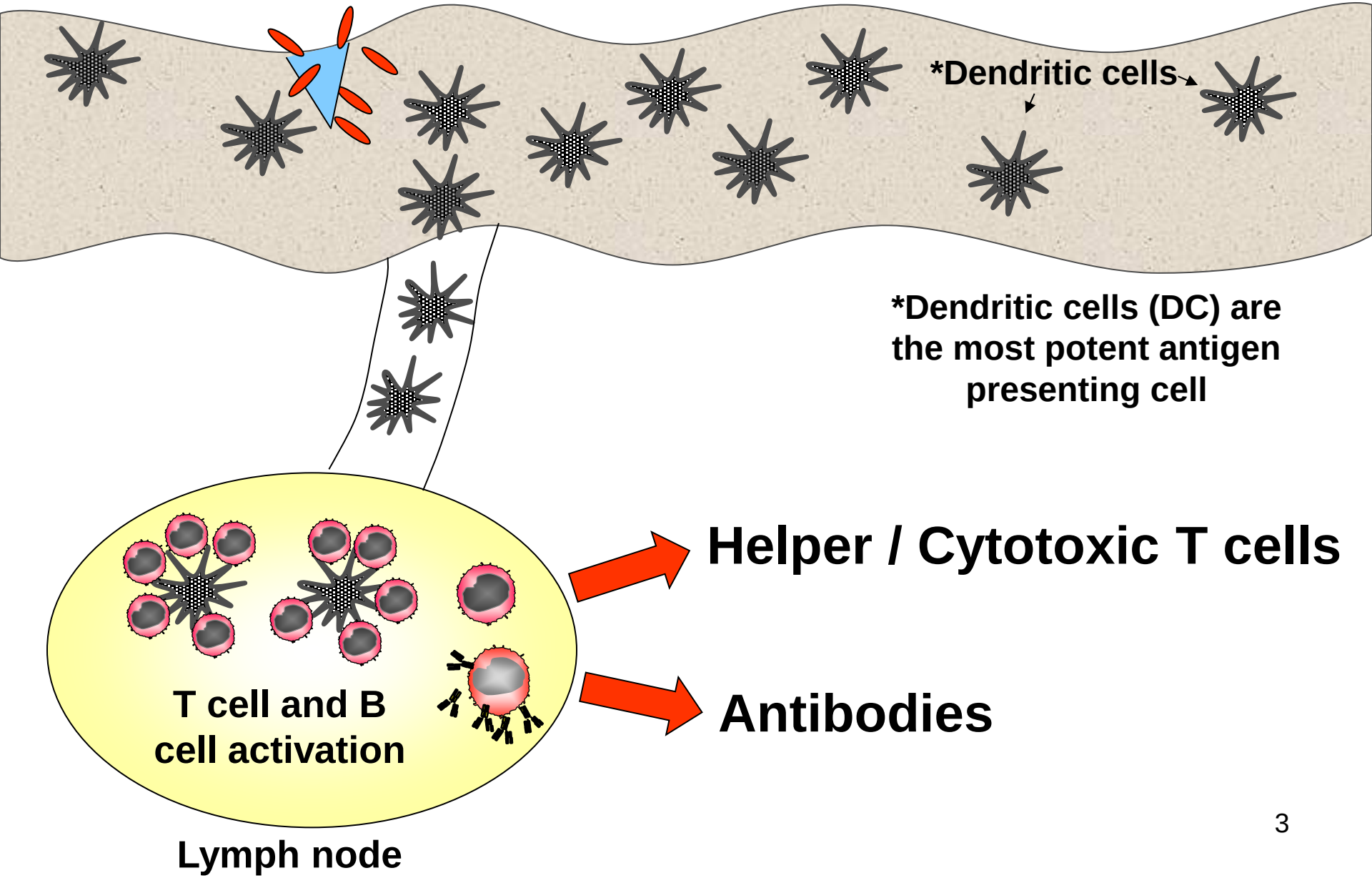
NEW ZEALAND

MICROBIOLOGY & IMMUNOLOGY
Te Tari Moromoroiti me te Ārai Mate

Objectives

- Know that DC take up antigen and stimulate T cells in lymph node or spleen.
- Understand how DC use MHC-I & MHC-II to stimulate CD8 and CD4 T cells.
- Know how T cells develop (born in bone marrow → TCR rearrangement in the thymus) and form effector and memory cells.
- Understand that CD4 helper cells help both CD8 T cells and B cells (next lecture) responses.
- Pre-reading: Marieb; p802-806, 811-819

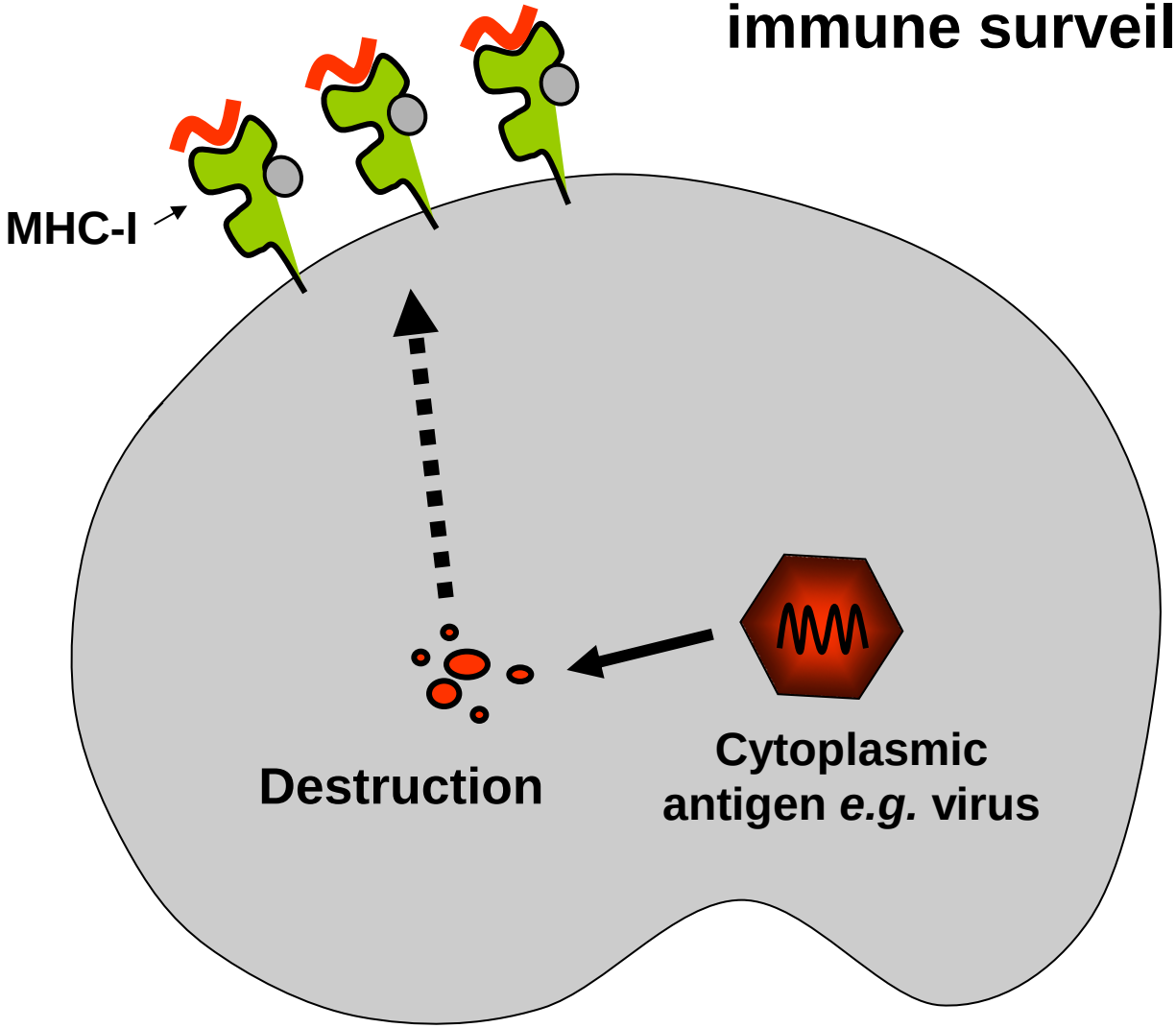
Infection and inflammation of tissue e.g. skin



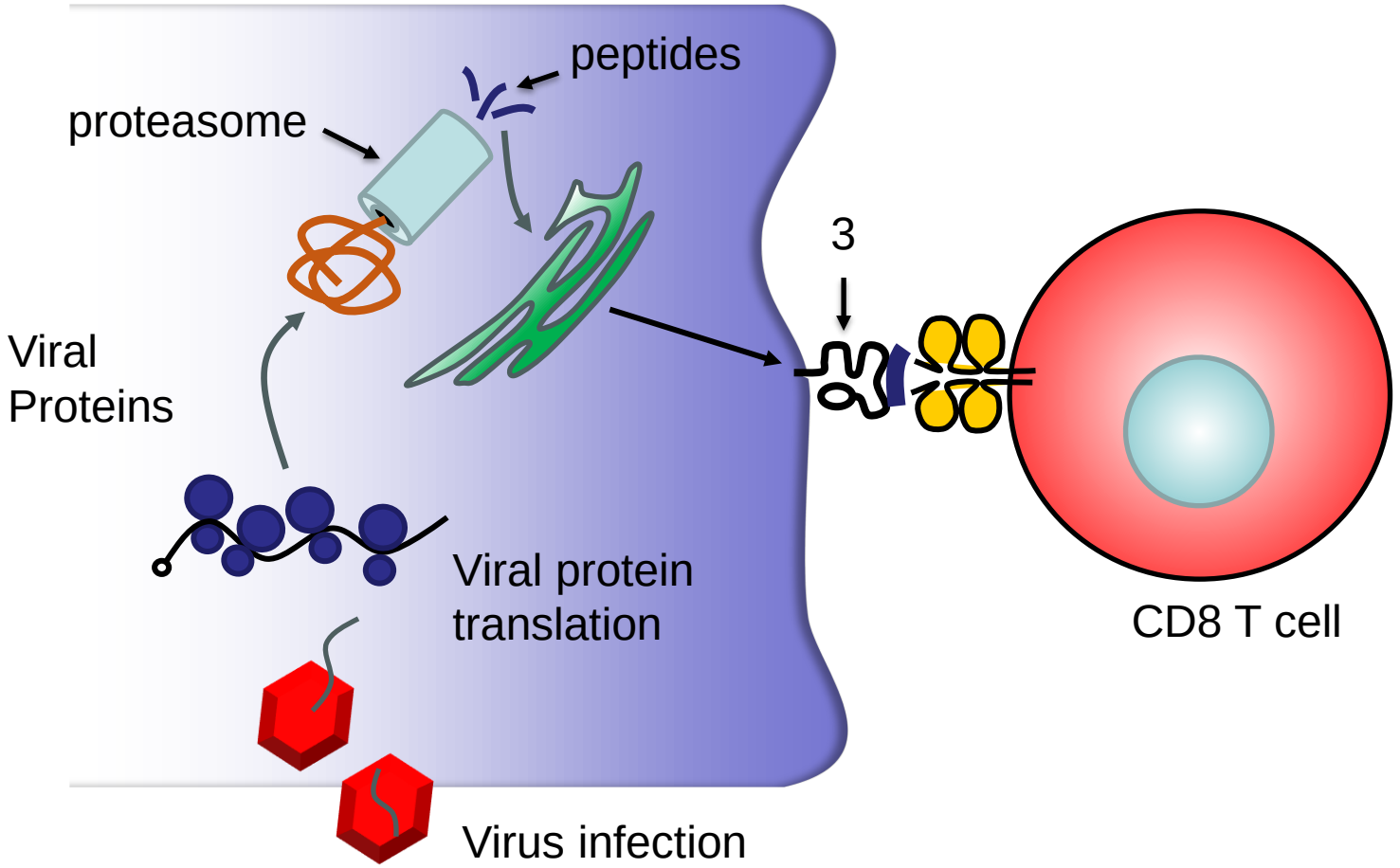
*Dendritic cells (DC) are the most potent antigen presenting cell

Endogenous antigens

Peptides: loaded onto MHC class I molecules for immune surveillance



The ‘proteasome’ degrades proteins to peptides.

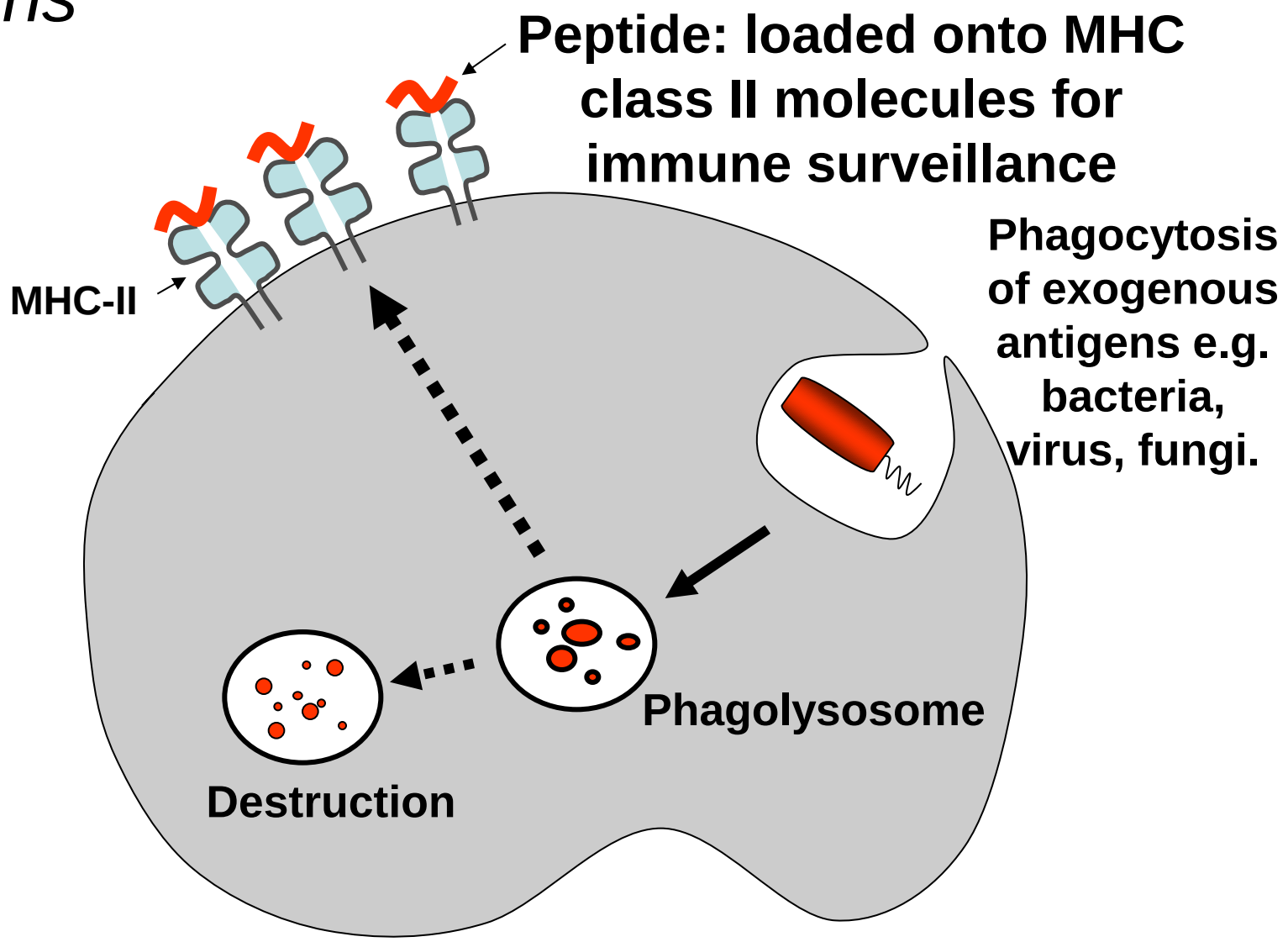


MHC-I antigen processing

- Antigenic proteins are degraded to peptides (in the cytoplasm) by the proteasome.

- Peptide loading of MHC-I takes place in the endoplasmic reticulum (ER).

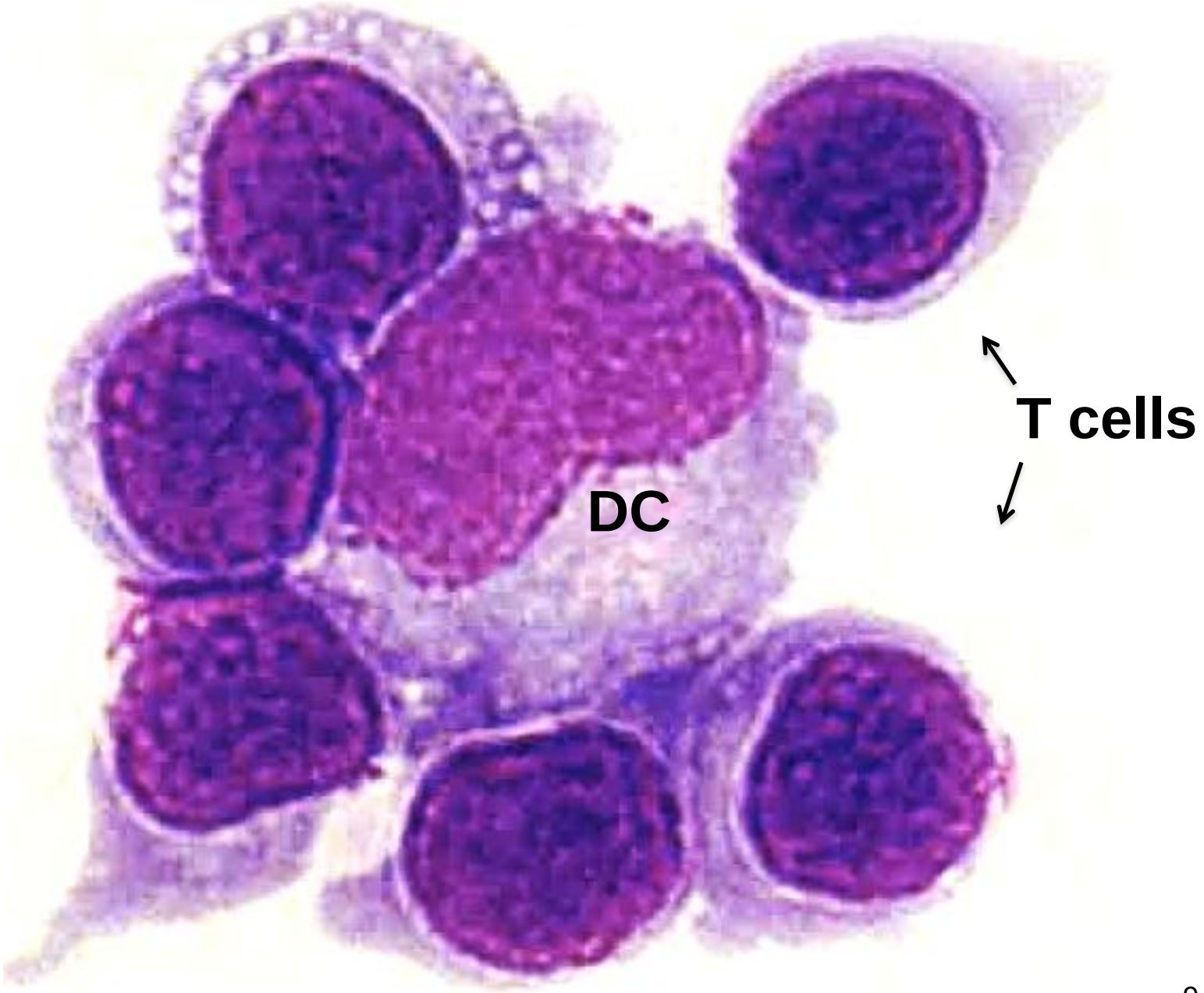
Exogenous antigens

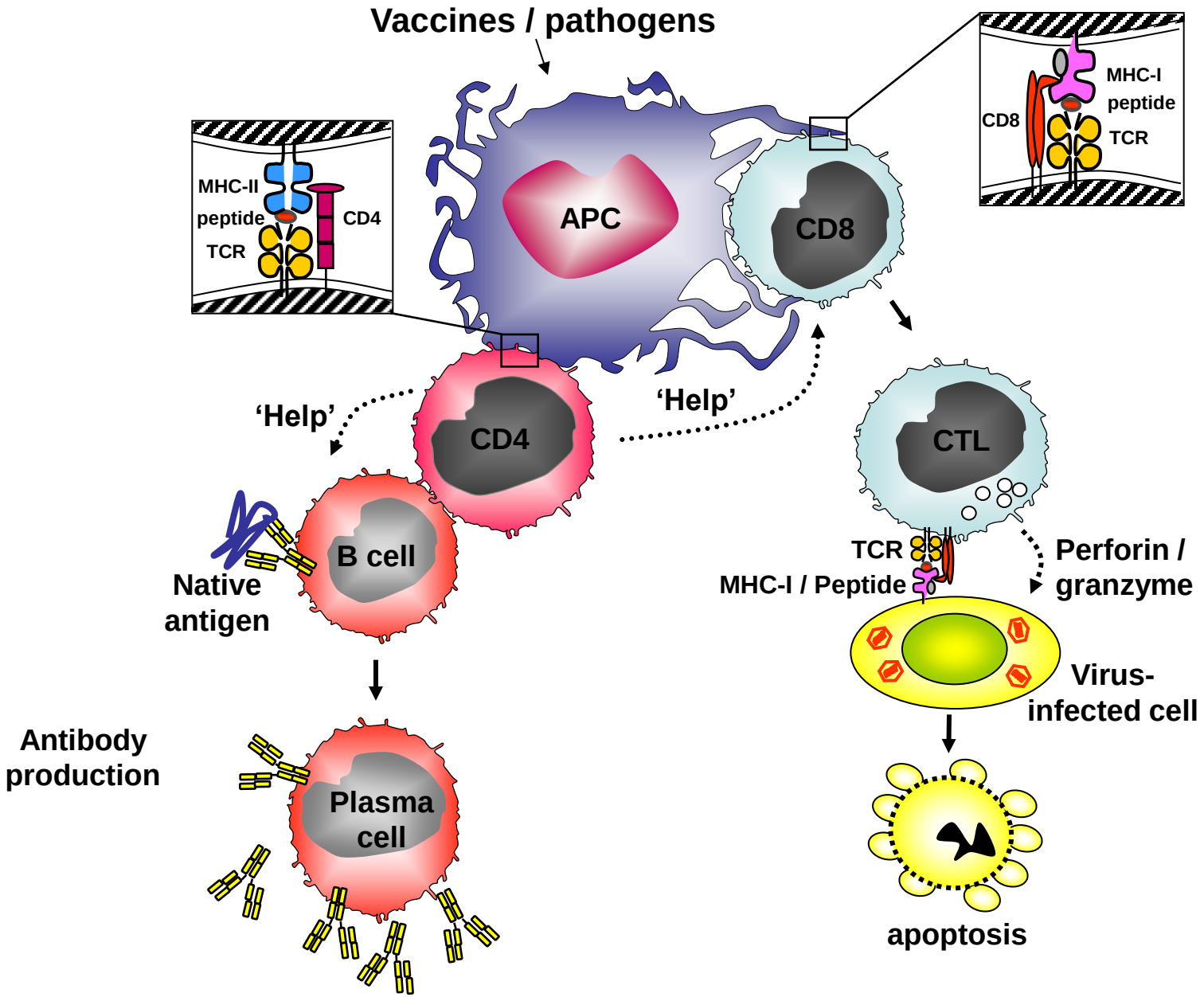


MHC-II antigen processing

- Antigenic proteins are degraded in acidic phagolysosome.

- Peptide loading of MHC-II takes place in phagolysosome.

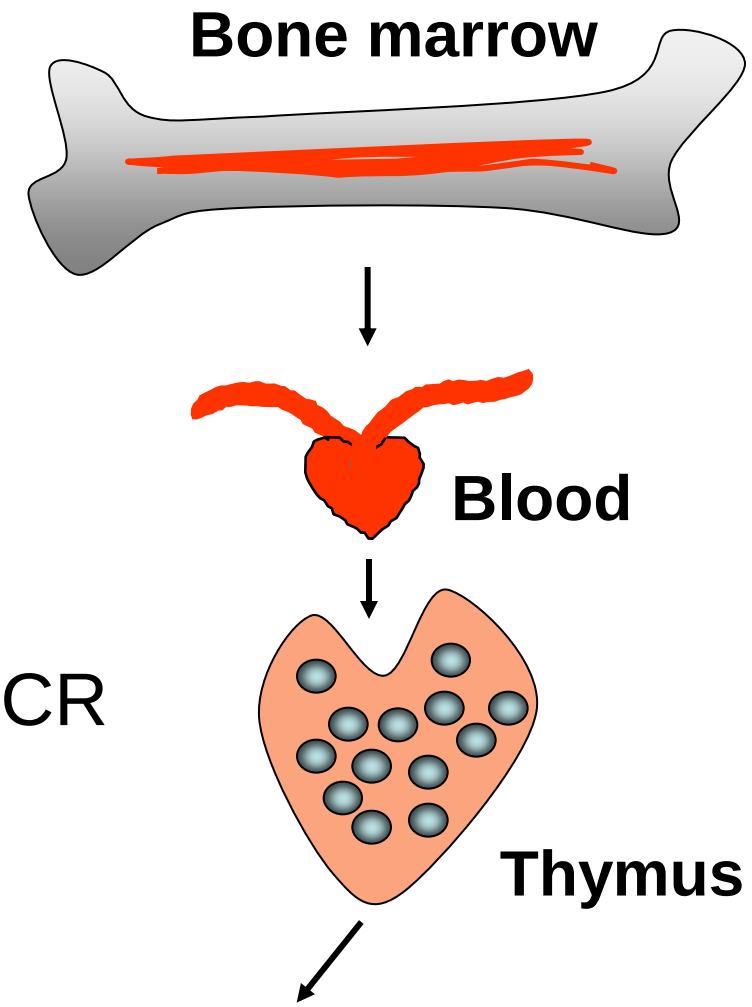

T cells
DC


Vaccines / pathogens
MHC-II
peptide
TCR
CD4
APC
CD8
MHC-I
peptide
TCR
CD8
'Help'
'Help'
CD4
CTL
B cell
Native
antigen
TCR
MHC-I / Peptide
Perforin /
granzyme
Virus-
infected cell
Antibody
production
Plasma
cell
apoptosis

T cells

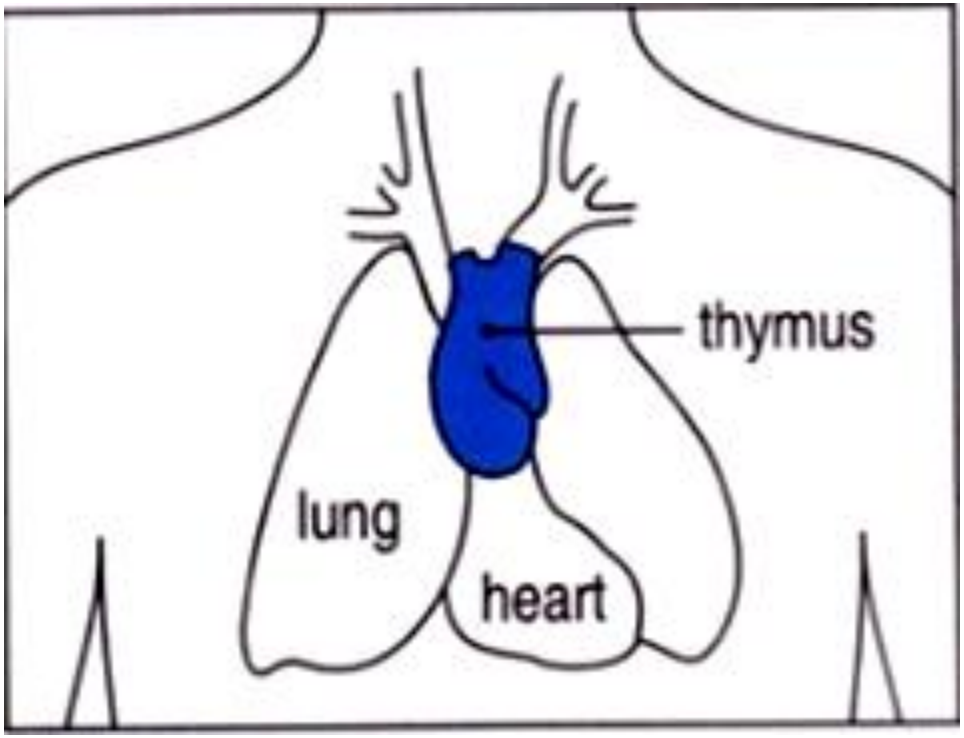
- Are lymphocytes that arise in the bone marrow and fully develop in thymus
- T cells express T cell receptor (TCR) with co-receptors (either CD4 or CD8).
- Recognise MHC / peptide complexes.

Production of T cell precursors



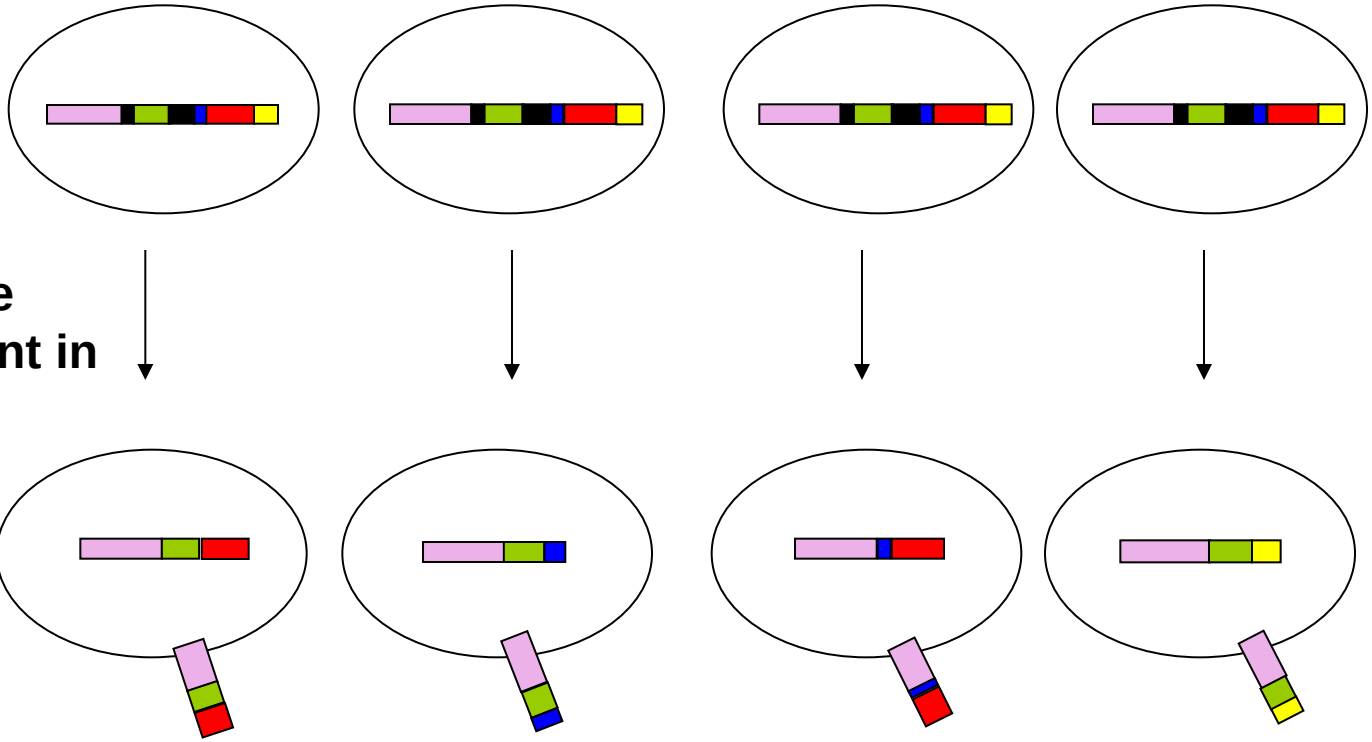
T cell development / TCR gene rearrangement

T cells develop in the thymus



T cells express a unique T cell receptor

Immature T cells (TCR genes in germline state) in bone marrow



TCR gene rearrangement in thymus

Mature (naïve) T cells expressing unique antigen receptors (TCR)

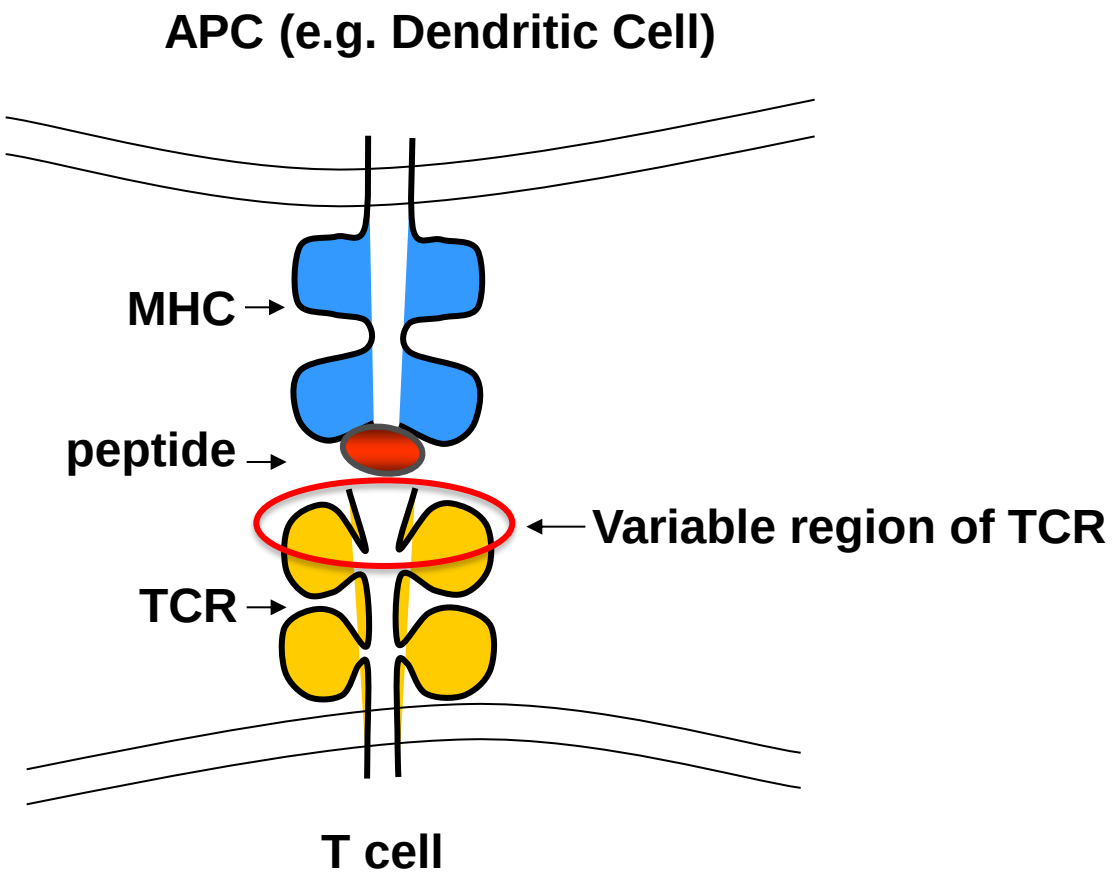
Thymic gene rearrangement

- Immature T cells (thymocytes) rearrange the ‘variable’ parts of their TCR genes in the thymus

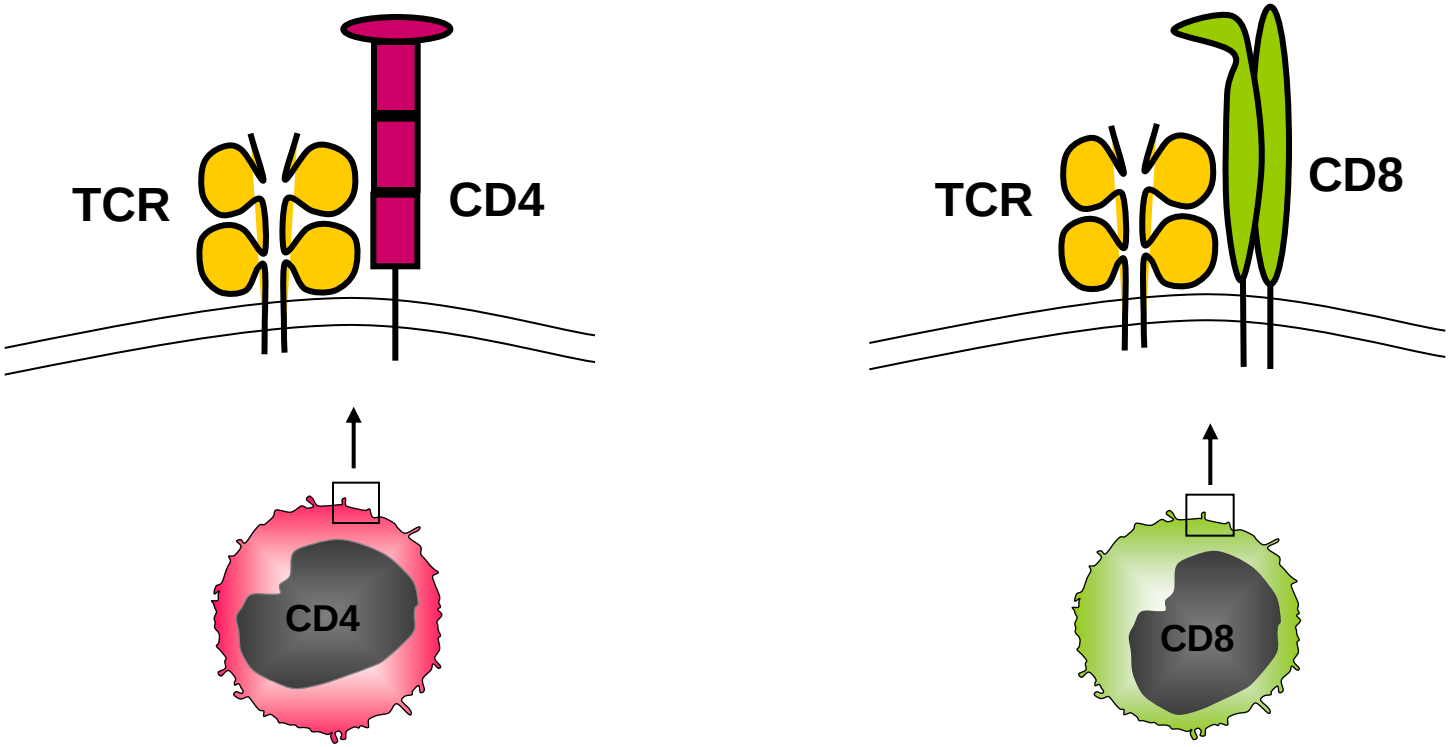
- The rearrangement process is essentially random.

- This ensures that individual T cells are unique in terms of their TCR. Creates ‘diversity’ in T cell repertoire.

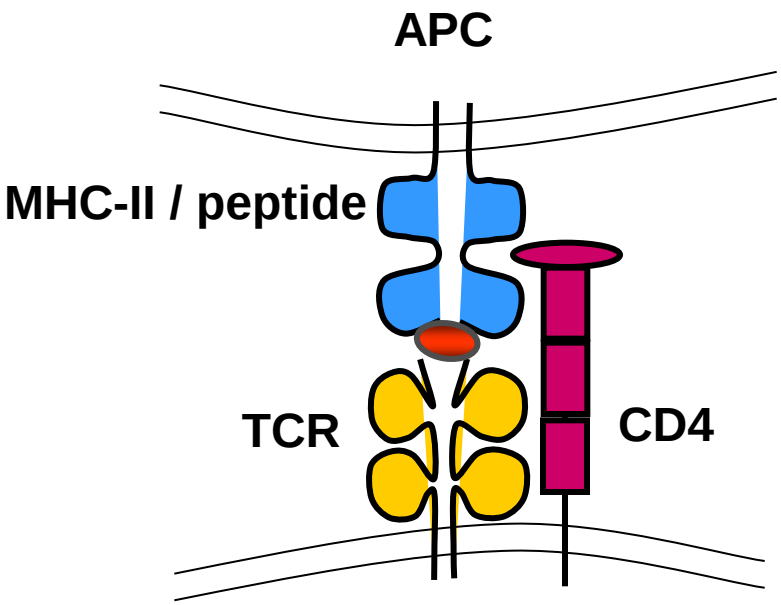
T cells express a T cell receptor (TCR) that recognises peptide + MHC

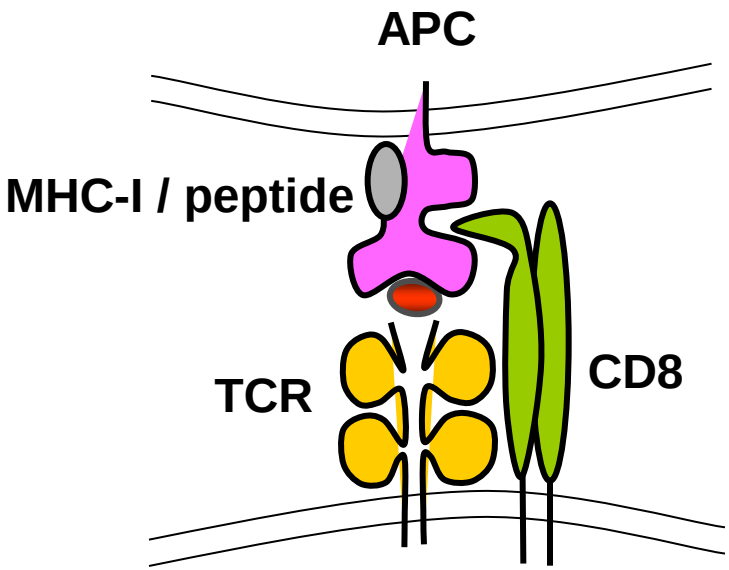


CD4 and CD8 ‘co-receptors’ on T cells



CD4 and CD8 expression on T cells





CD4 and CD8 molecules assist with the docking of the TCR onto MHC-II or MHC-I respectively

T cell differentiation

- T cells that have not been activated by MHC / peptide are ‘naïve’.

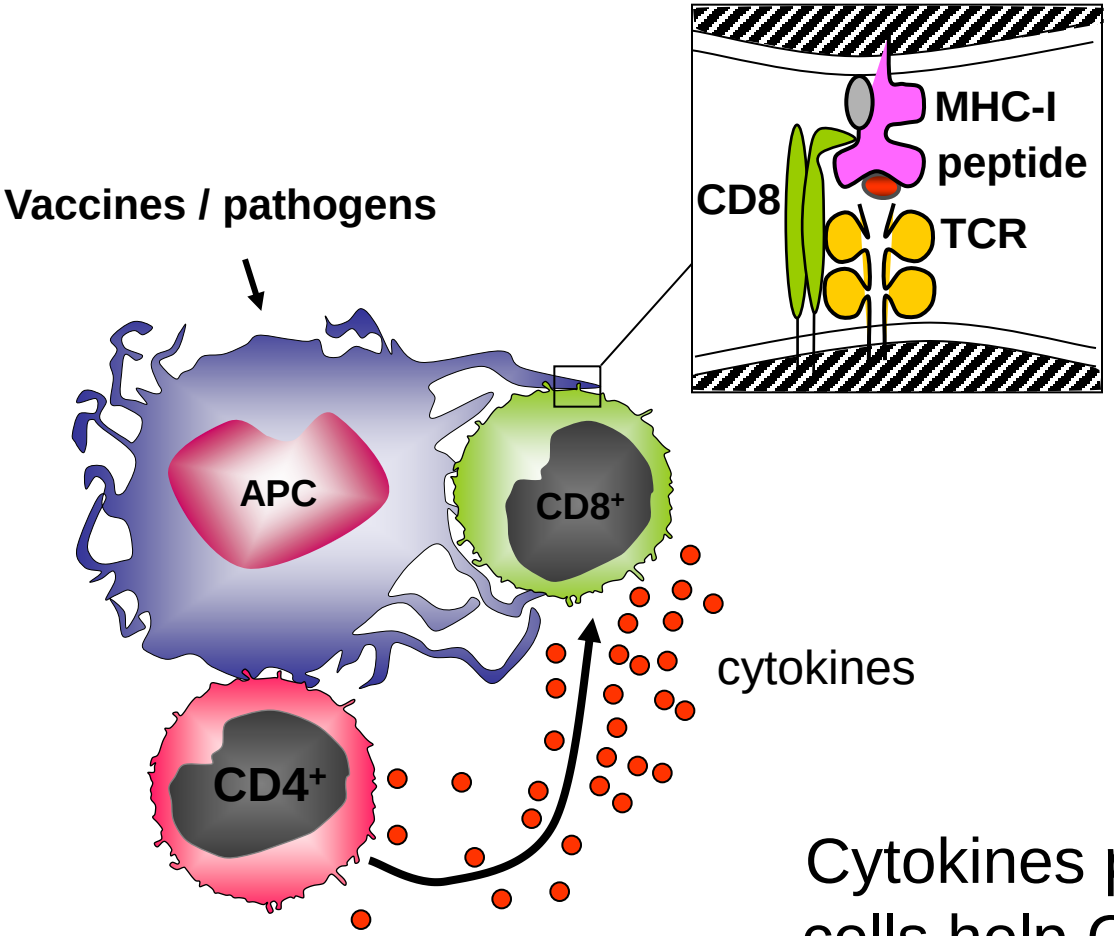
- Activated T cells are also known as ‘effector T cells’.

CD4 T helper cell

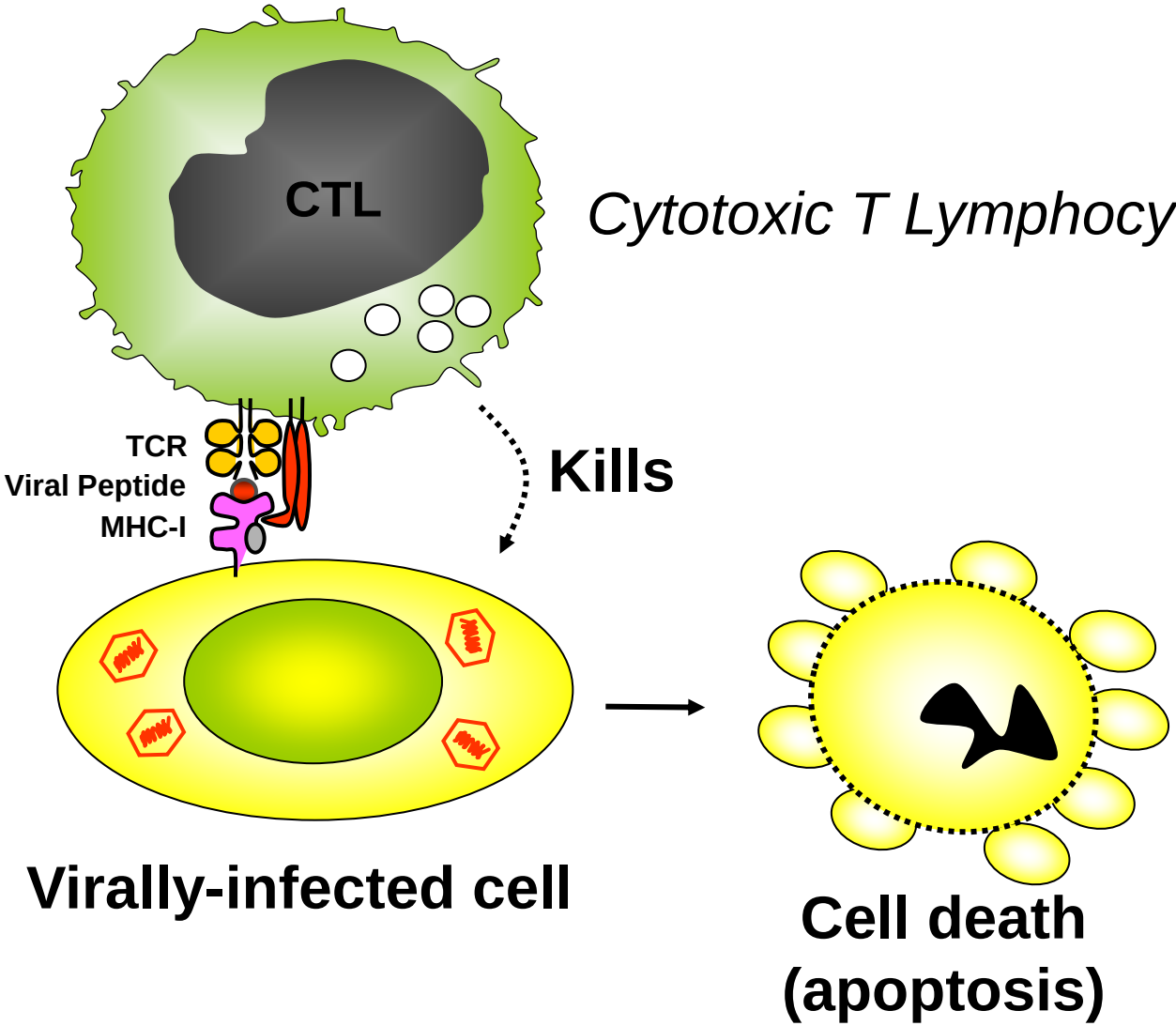
- Recognises MHC-II / peptide
- Helps CD8 T cell become cytotoxic
- Helps B cell make antibody

CD8 T cell

- Recognise MHC-I / peptide
- Develops into ‘cytotoxic T lymphocyte’ (CTL) aka ‘cytotoxic T cell’.

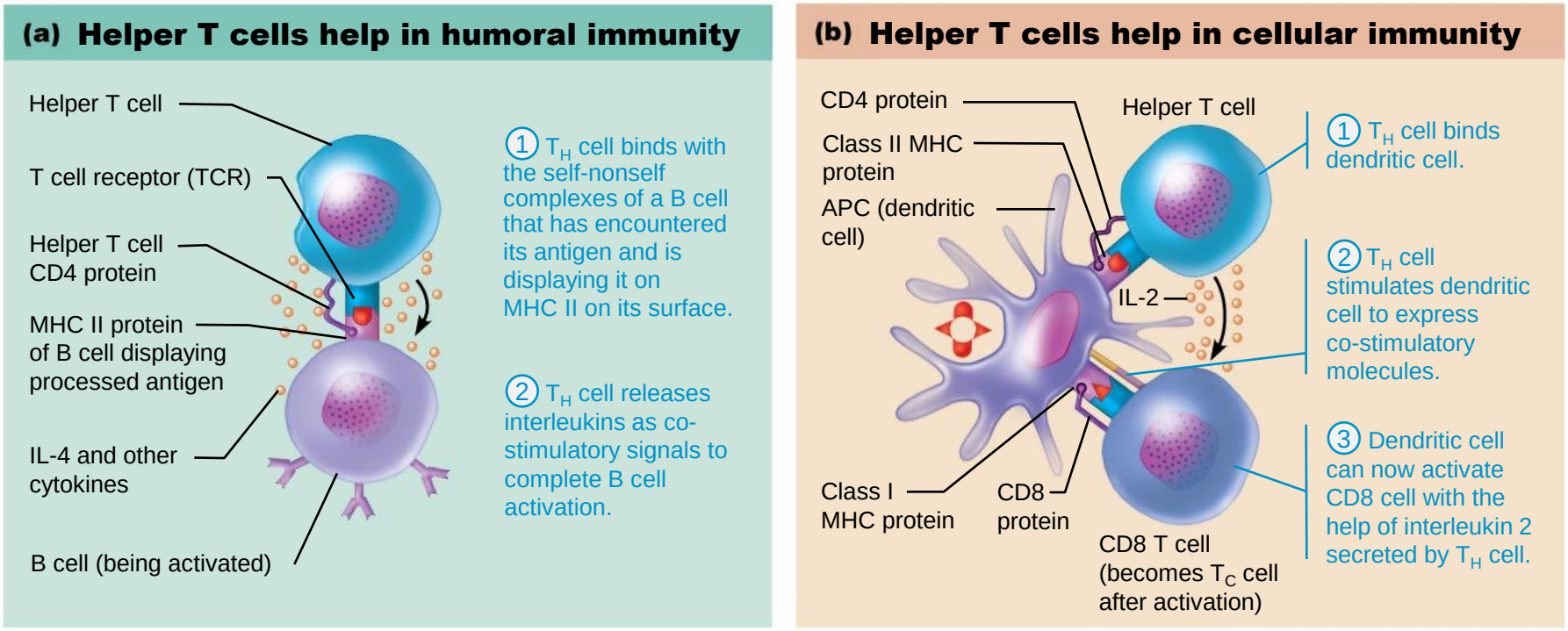


Cytokines produced by CD4 T cells help CD8 T cells become activated


CTL
Cytotoxic T Lymphocytes
TCR
Viral Peptide
MHC-I
Kills
Virally-infected cell
Cell death
(apoptosis)

Marieb p816

Adaptive defenses → Humoral immunity
Cellular immunity



Memory T cells

In addition to the formation of ‘effector’ cells, T cell activation results in the formation of memory T cells

Memory CD4 or CD8 T cells reside in the body for long periods of time.

Memory T cells become effector cells much quicker than naïve T cells.

Summary

- Dendritic cells (DC) stimulate T cells using MHC-peptide. Occurs in lymph node and spleen
- T cells express unique T cell receptors (TCR) and develop into mature T cells in the thymus
- CD4 T cells are helper cells that respond to MHC-II-peptide.
- CD8 T cells respond to MHC-I-peptide and become cytotoxic T lymphocytes (CTL).
- T cells form memory cells.

The T cell receptor of CD4 T cells recognises:

A) The CD8 co-receptor on CD8 T cells.

B) MHC-I / peptide complexes on antigen presenting cells.

C) MHC-II / peptide complexes on antigen presenting cells.

D) Native antigen on MHC-II

The T cell receptor of CD8 T cells recognises:

A) MHC-I / peptide complexes on antigen presenting cells (e.g. dendritic cells, macrophages, B cells).

B) MHC-I / peptide complexes on virus-infected or cancer cells.

C) MHC-II / peptide complexes on antigen presenting cells.

D) Both (A) and (B) are correct.

The following is true for presentation of viral antigens:

A) Viral antigens are exclusively presented on MHC-I

B) Viral antigens are mostly presented on MHC-I, but can also be presented on MHC-II by APC (e.g. DC)

C) Viral antigens are mostly presented on MHC-II

D) Viral antigens are mostly presented on MHC-II, but can be presented on MHC-I by DC

T cells express a diverse range of T cell receptors (TCR) due to:

A) Somatic hypermutation

B) Expression of germline sequences from both chromosomes

C) Expression of rearranged TCR genes

D) Clonal selection

E) Thymic selection

The site of T cell germline TCR gene rearrangement is the:

A) Thyroid gland

B) Pancreas

C) Thymus

D) Spleen

E) Bone marrow

Immature T cell-precursors (‘baby T cells’) arise in the:

A) Thyroid gland

B) Pancreas

C) Thymus

D) Spleen

E) Bone marrow

Antigen presenting cells include:

A) neutrophils, mast cells, eosinophils & basophils

B) T cells and B cells

C) Natural killer cells, monocytes & macrophages

D) B cells, macrophages, monocytes and dendritic cells

Lymphocytes that have not seen antigen are termed:

A) guileless

B) jejune

C) provincial

D) callow

E) naïve

Following stimulation via MHC-I, CD8 T cells become:

A) natural killer cells

B) apoptotic cells

C) plasma cells

D) Cytotoxic T lymphocytes (aka cytotoxic T cells)

Long-lived T cells (or B cells) that respond vigorously to a second encounter of antigen are:

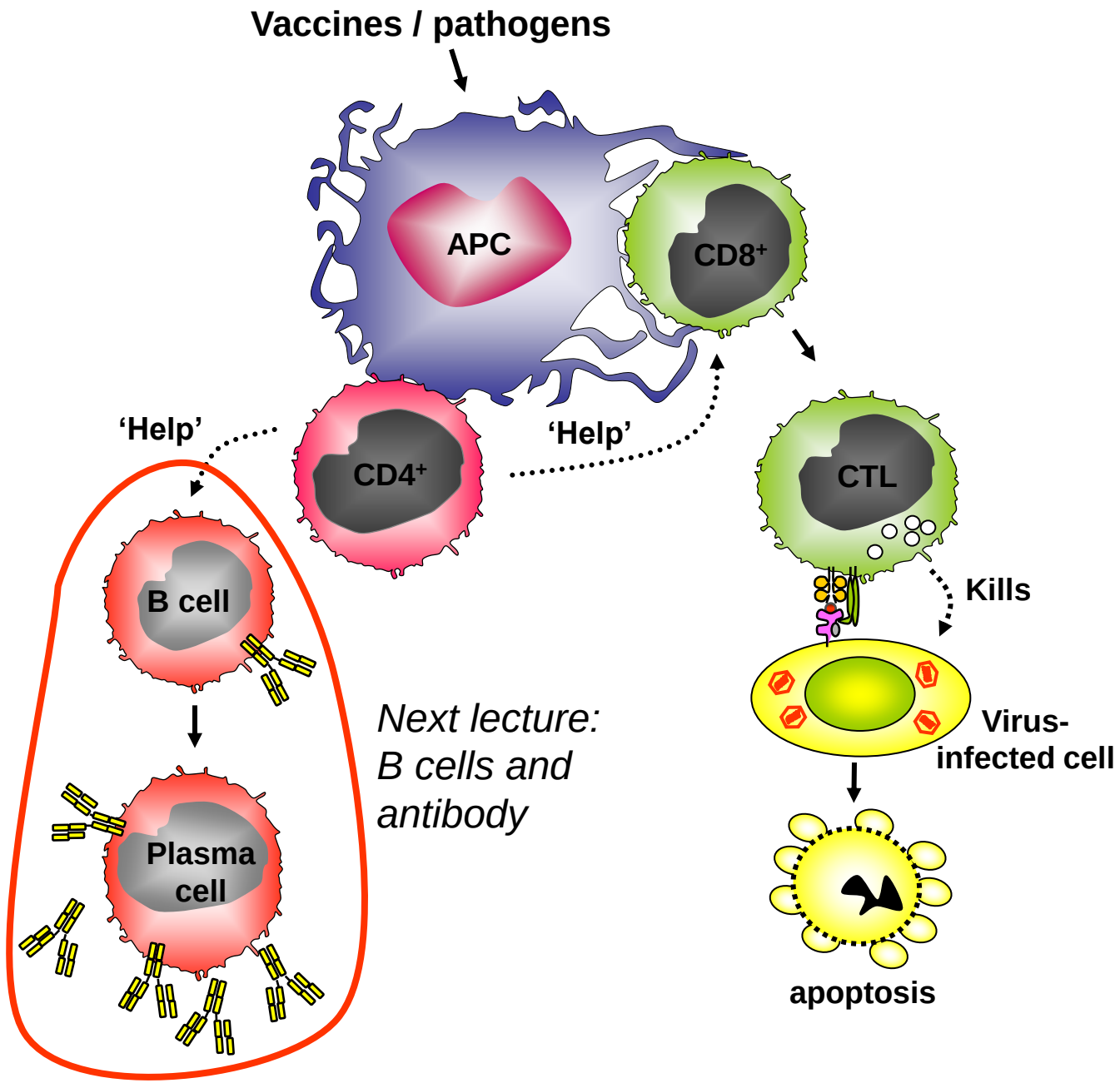
A)Recollection cells

B) Effector cells

C) Memory cells

D) Thymocytes

E) Medullary cells


Vaccines / pathogens
APC
CD8+
CD4+
'Help'
'Help'
CTL
Kills
B cell
Plasma cell
Virus-infected cell
apoptosis
Next lecture:
B cells and
antibody

HUBS191