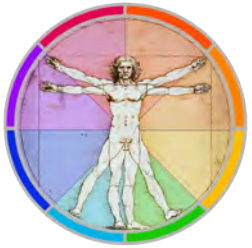
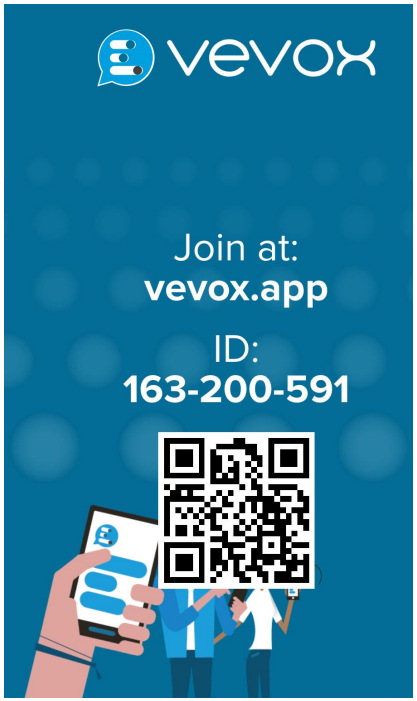
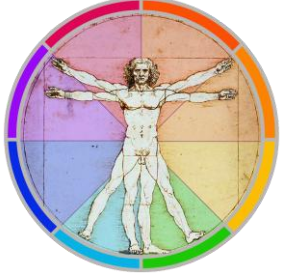
HUBS191 Lecture Material

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 34

Adaptive Immunity

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Microbiology & Immunology
Te Tari Moromoroiti me te Ārai Mate

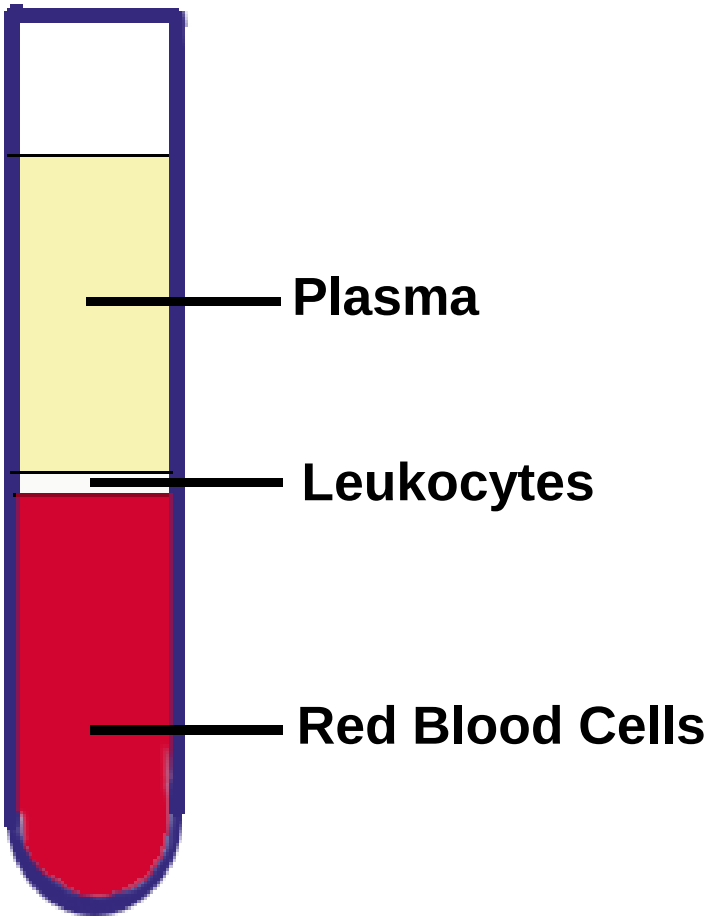
Objectives

- Know that adaptive immunity evolved in vertebrates.
- Understand how antigen is sampled by immune cells and how it is presented on MHC
- Know the expression patterns of MHC-I & MHC-II on cells

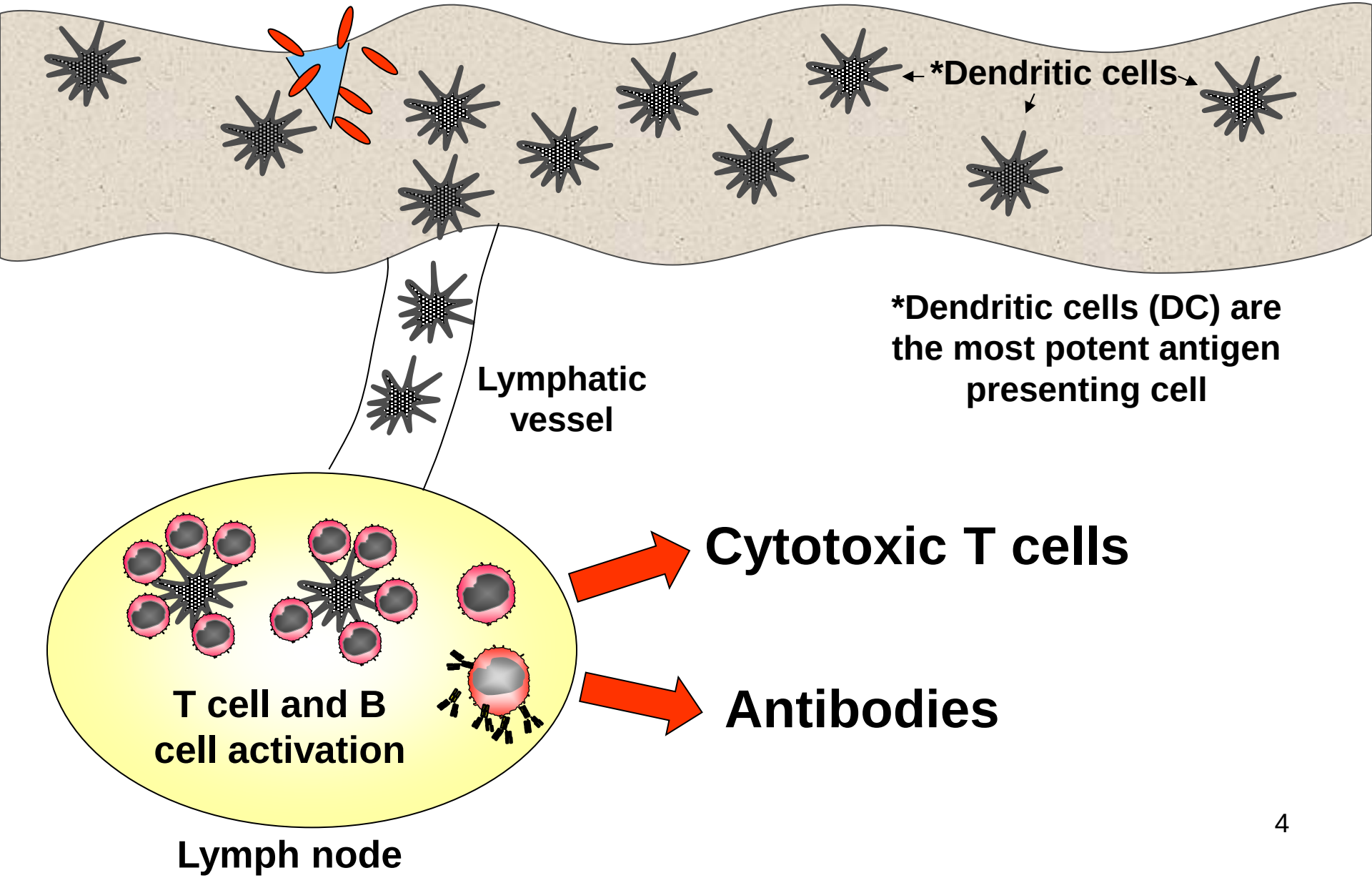
Pre-reading: Marieb; Adaptive Defences: p800-804

White blood cells (leukocytes) are a minor constituent of blood.

But they are the main cells involved in immunity.



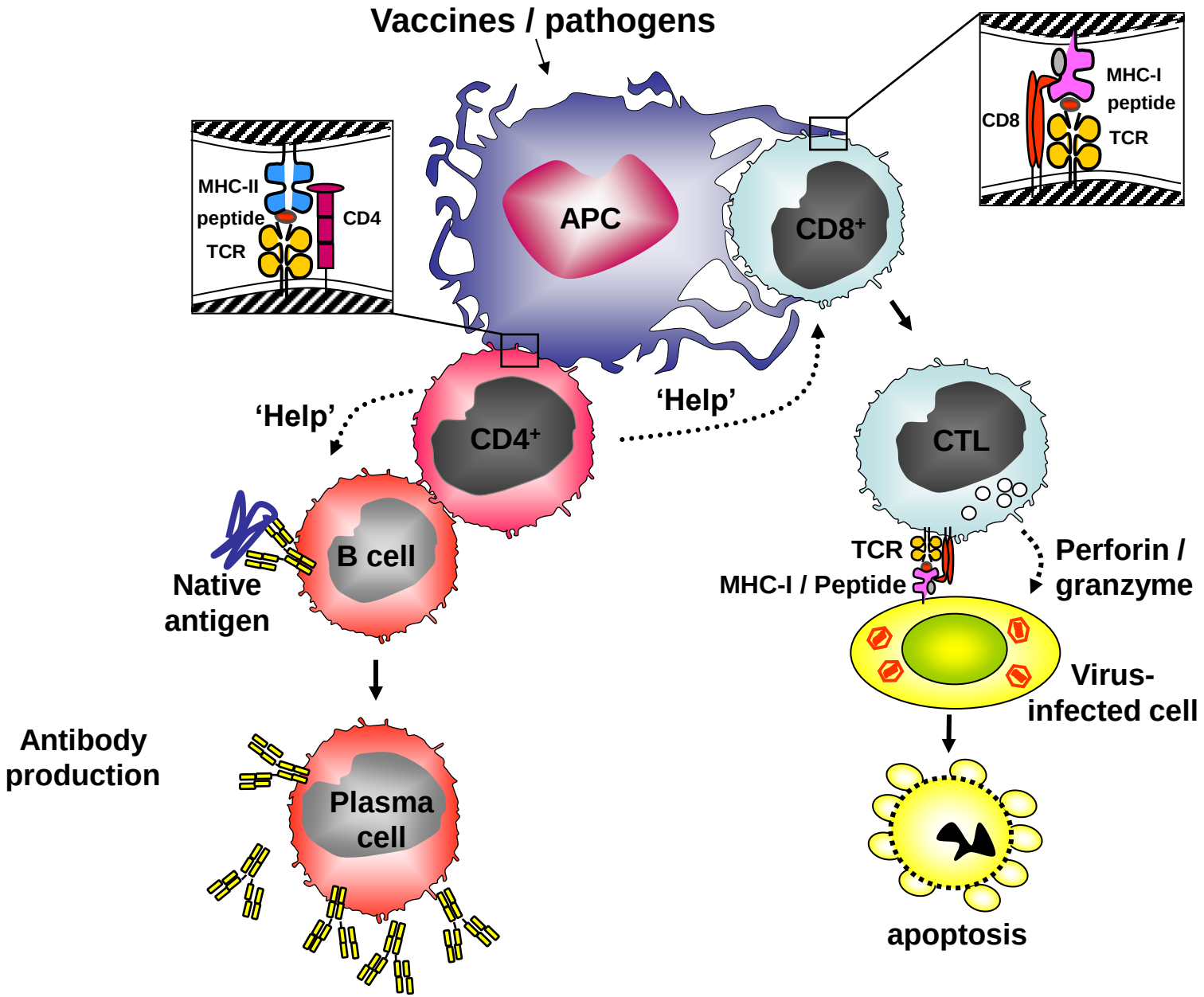
Infection and inflammation of tissue e.g. skin



Antigen sampling and presentation

- Dendritic cells (DC) are present in major organs.
- They phagocytose (gobble up) antigen and process it down to peptides.
- DC migrate from organs (e.g. skin) to draining lymph node.
- They present peptides on MHC to other white blood cells (called T cells).

Pre-reading: Marieb; Antigen presenting cells: p804-805


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

Adaptive immunity

- Dendritic cells (DC) present peptides on MHC to T cells
- CD4 T cells help B cells make antibody (L36)
- CD8 T cells become cytotoxic and kill virus infected cells and cancer cells (L35)

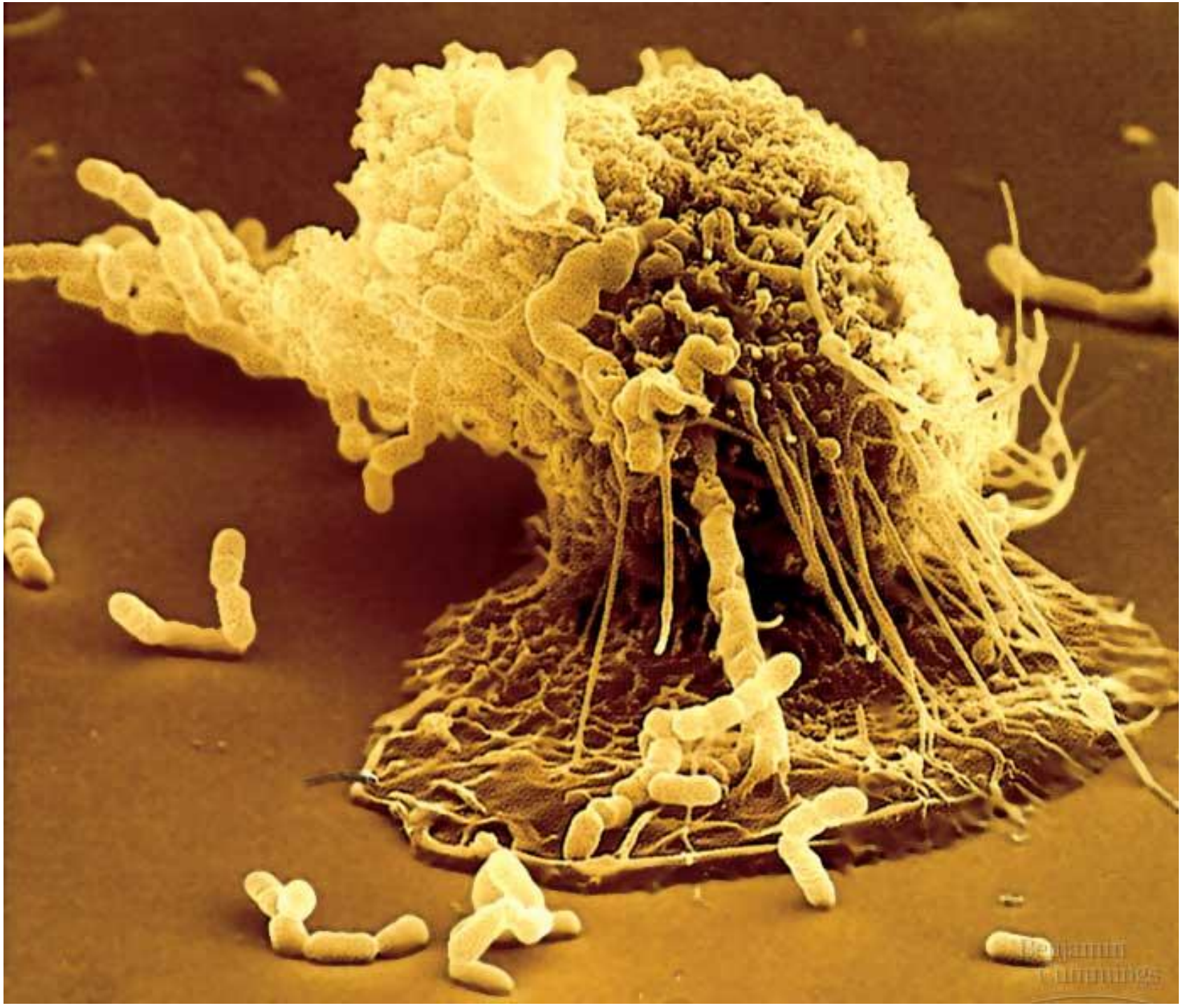
Pre-reading: Marieb; Antigen presenting cells: p804-805

What is ‘antigen’?

- Anything that has the potential to be recognised by the immune system.
- Foreign antigen (transplants, pathogens, some chemicals). Anything from ‘outside’.
- Auto (self)-antigen: Immune system normally tolerant of self-antigen. Self-antigen may be recognised in autoimmune disorders (e.g. Rheumatoid Arthritis or Diabetes Type I).

Purpose of antigen uptake

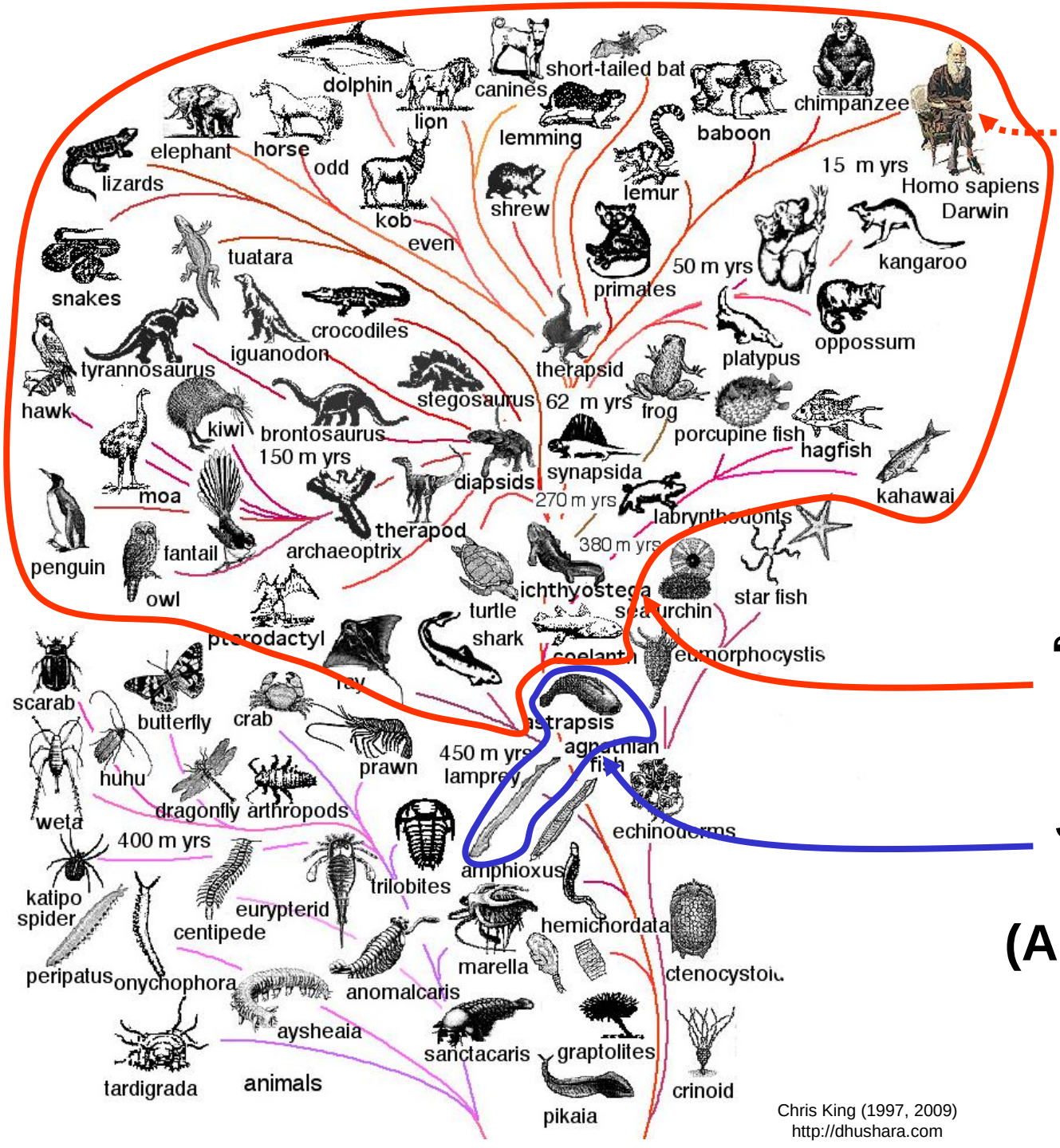
- Clearance of pathogens (innate response)
- For presentation to T cells (adaptive response; L35)



500 million years ago…

Phagocytes evolved to keep remnants of pathogens and display these to other cells of the immune system.

This was the beginning of the adaptive immune response.



Darwin

‘Adaptive’ immunity

Jawless fishes (Agnathans)

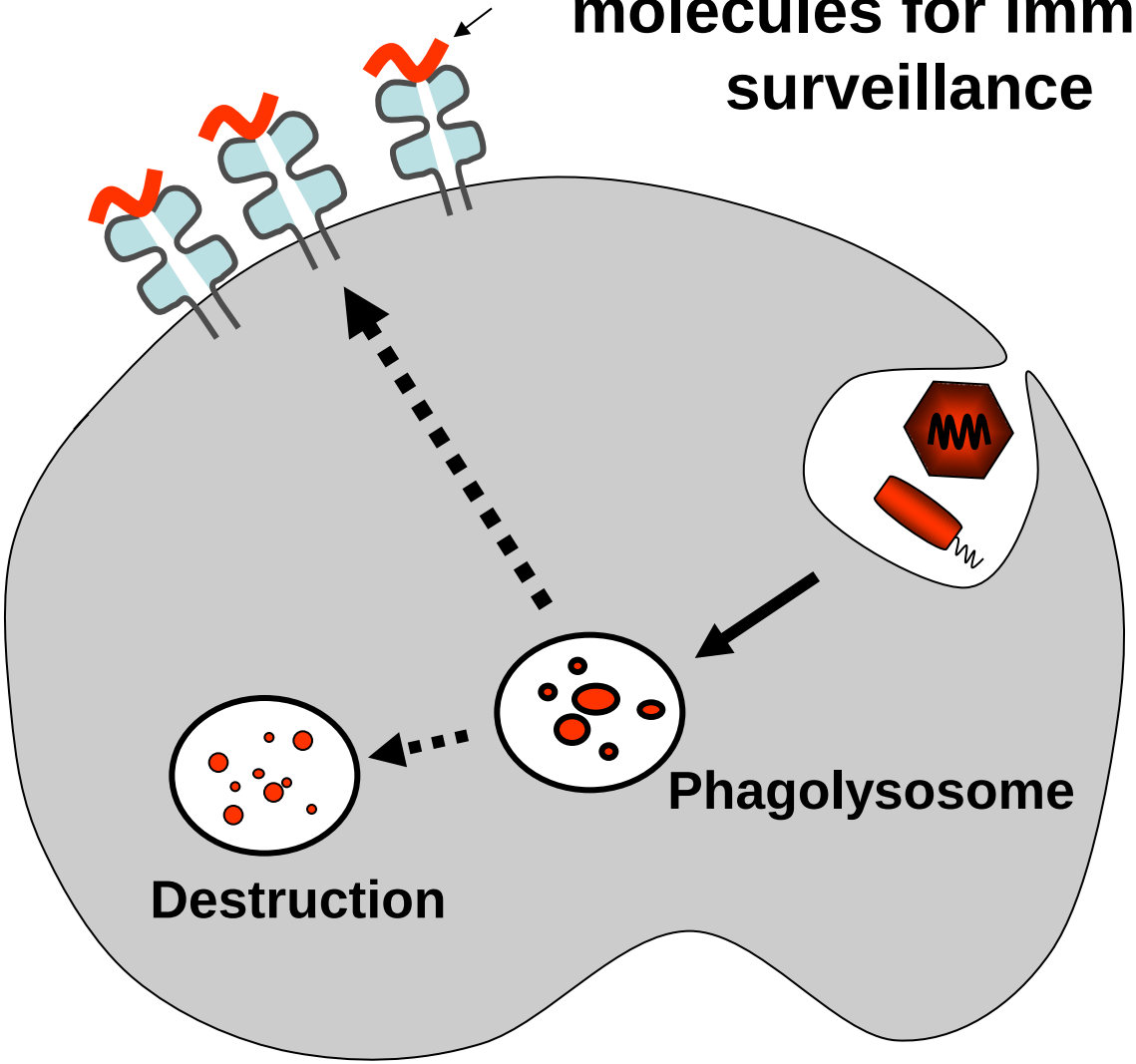
Chris King (1997, 2009)
http://dhushara.com

Vertebrates possess both innate and adaptive immune systems

Evolution of Immunity

- Invertebrates (e.g. insects, spiders, jellyfish) have innate immunity only.
- Vertebrates have both innate and adaptive systems.
- Note: Jawless fish (Agnathans: hagfish & lamprey) are vertebrates with both innate and adaptive systems. But their adaptive system is based on different structures cf. other vertebrates.

Peptides loaded onto MHC molecules for immune surveillance



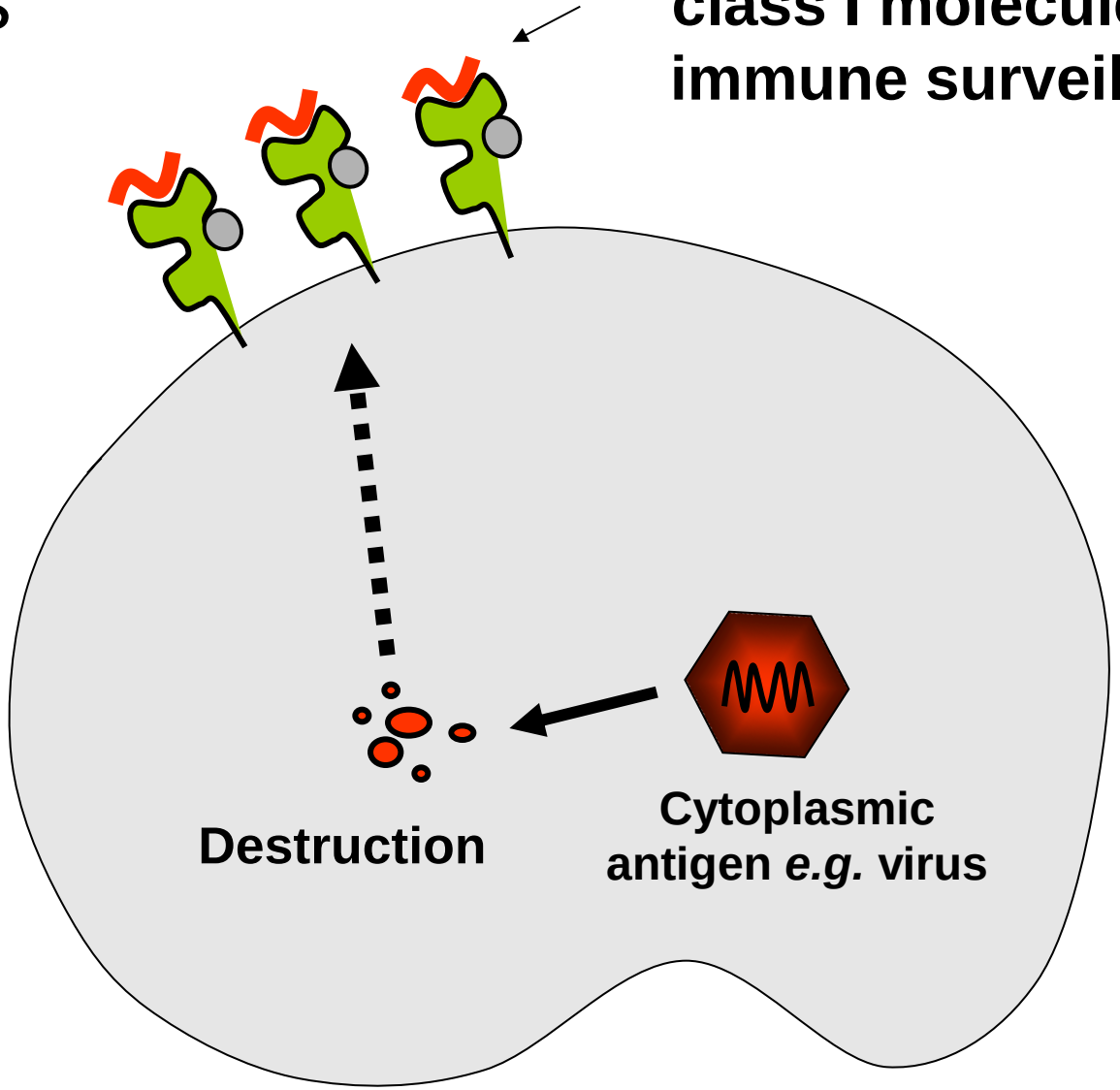
MHC expression

- MHC-I presents endogenous (intracellular) antigen. Expressed on all nucleated cells.

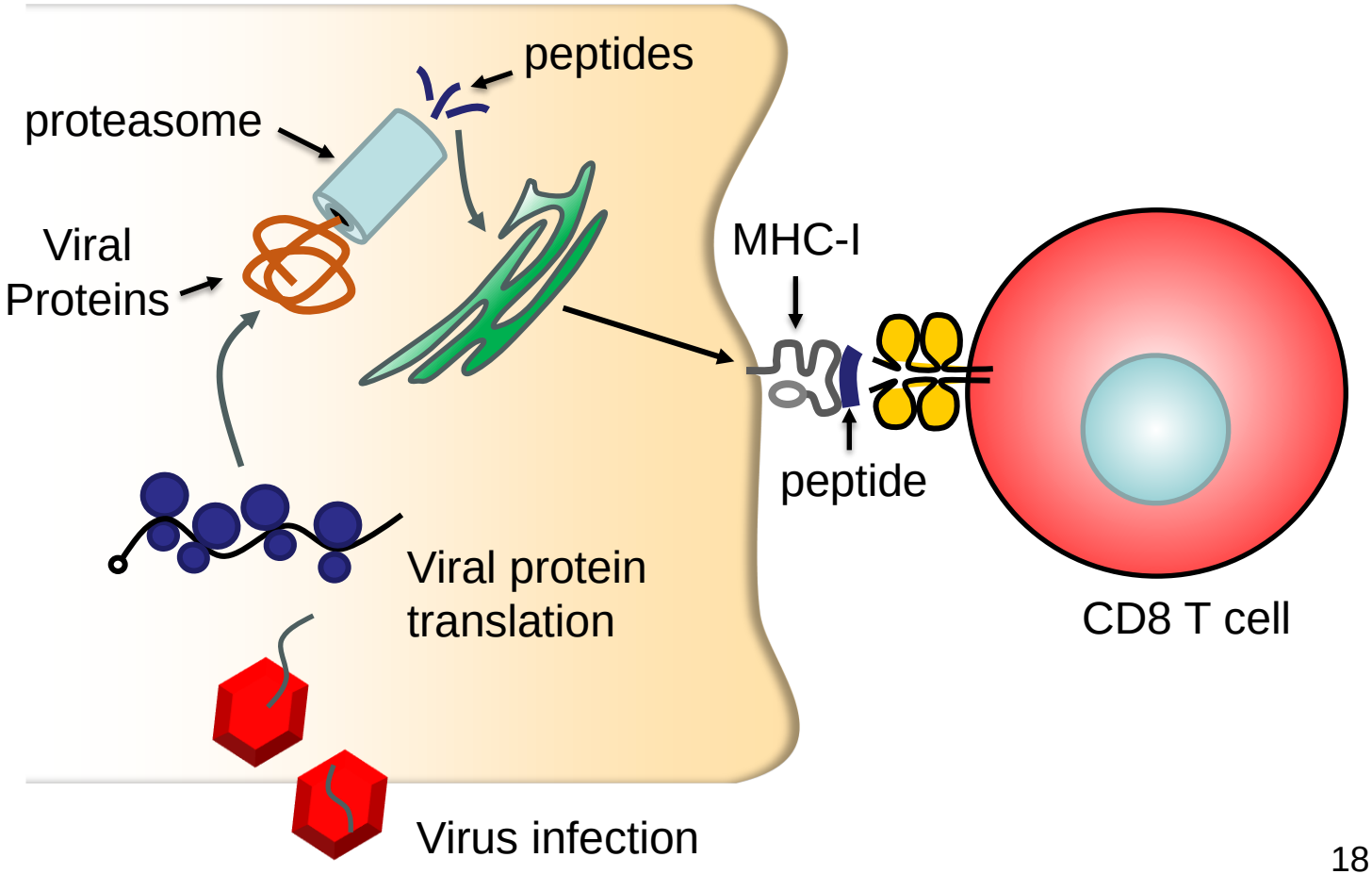
- MHC-II presents exogenous (extracellular) antigen. Expressed only on antigen presenting cells.

Endogenous antigens

Peptides loaded onto MHC class I molecules for immune surveillance



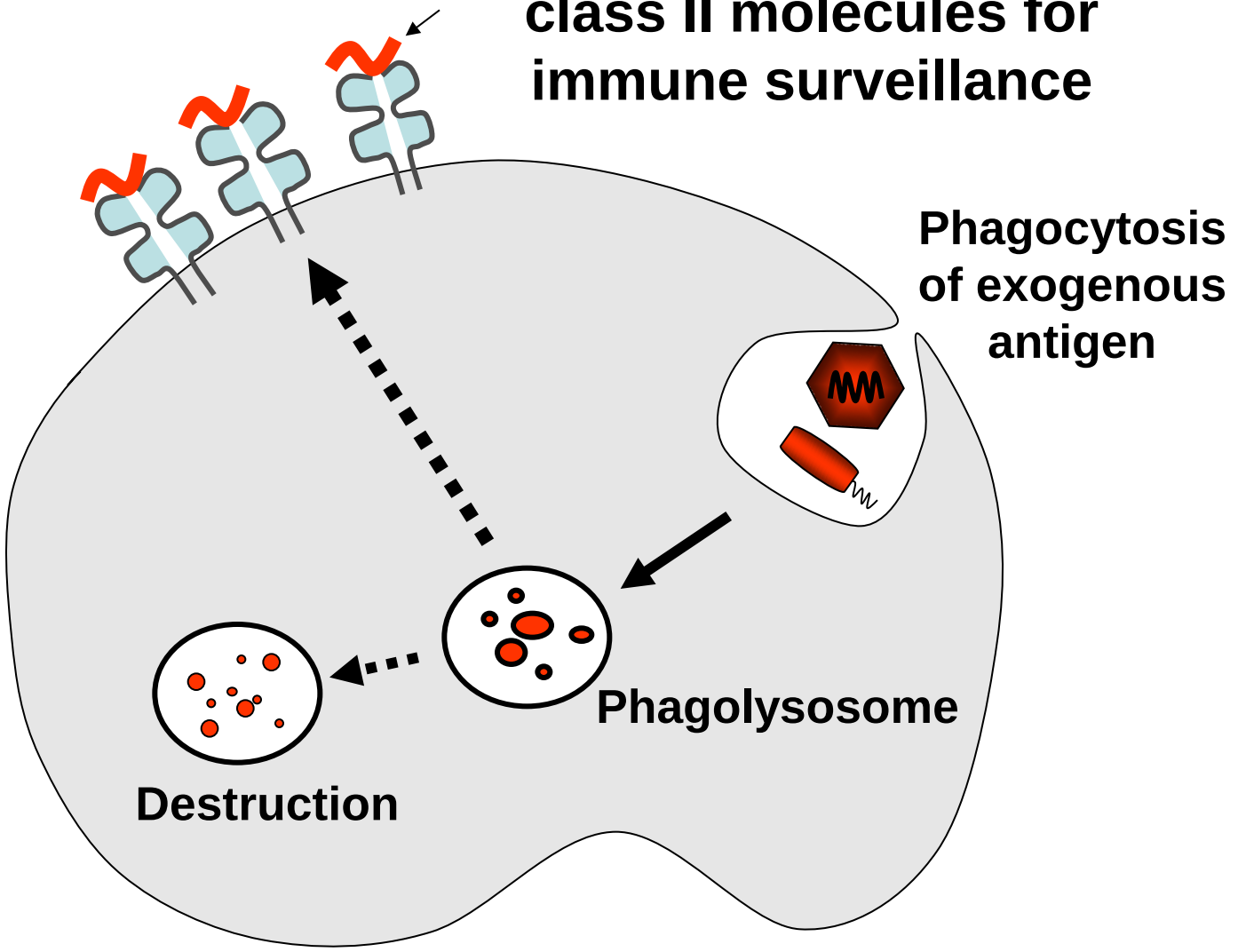
The ‘proteasome’ degrades cytoplasmic proteins to peptides.



MHC-I antigen processing

- Antigens are degraded in the cytoplasm by the proteasome to peptides.
- Peptides are imported into endoplasmic reticulum (ER).
- Peptide loading of MHC-I takes place in ER.

Exogenous antigens



MHC-II antigen processing

- Antigenic proteins are degraded in acidic phagolysosome.

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

Summary

- Subsets of white blood cells mediate the immune response
- Antigen (self or foreign) is anything that an immune system recognises
- Peptides are fragments of protein antigen that are displayed by MHC-I and MHC-II on cells
- Endogenous (e.g. viral) antigens displayed on MHC-I
- Exogenous (e.g. extracellular bacteria / viruses) antigens displayed on MHC-II

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The best definition of antigen is:

A) A substance that causes allergies

B) Anything that can be recognised by an immune system.

C) A substance that causes inflammation.

D) A molecule released by frightened ants

MHC-I molecules present antigens from which source?

A) Exogenous (antigens originate from outside cells)

B) Microbes that cause sepsis

C) Macrophages

D) Endogenous (antigens expressed in cytoplasm)

The following is true of exogenous antigen processing

A) It only occurs when antigen is directly expressed in the cytoplasm

B) Antigen from extracellular bacteria / viruses is presented by this pathway

C) It does NOT involve phagocytosis.

D) Exogenous antigen is destined for MHC-I presentation

The adaptive immune system:

A) Evolved prior to innate immunity

B) Operates independently of the innate immune system

C) Is present in humans and apes, but absent in fish and reptiles

D) Evolved 500 million years ago

MHC-I is present on ____, while MHC-I and MHC-II are both present on _____.

A) virus infected cells / bacteria-infected cells

B) vertebrates / dendritic cells

C) antigen presenting cells / all nucleated cells

D) all nucleated cells / antigen presenting cells

Cell-mediated immunity mainly involves:

A) Activated white blood cells (leukocytes) killing infected cells

B) Complement and its membrane attack complex

C) Lysozyme killing of bacteria

D) Antibodies killing live cells such as bacteria

Mucus and sweat are examples of:

A) The cellular innate immune response

B) Physical and Chemical barriers

C) Cytokines

D) Adaptive Immunity

Fever is caused by:

A) Skin thermostats detecting infection

B) Excessive heat caused by the body's movement away from noxious stimuli

C) Mast cells warming up macrophages through pyogenesis

D) Interleukin 1 (IL-1) acting at a distance on the hypothalamus

Which is a secondary lymphoid organ?

A) Thymus

B) Bone marrow

C) Brain

D) Lymph Node

Which of the following represent primary lymphoid tissue?

A) Bone marrow & thymus

B) Lungs & gut

C) Spleen and skin

D) Thyroid and fingernails

Phagocytosis destroys microbes via:

A) Histamine

B) Enzymes (acid hydrolases), low pH and nitric oxide

C) Pepsin, salt and bile

D) Defensins

HUBS191