

Immunity

“Building the immune system and understanding its function”

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Homeostasis?

Immunology & Cell Biology

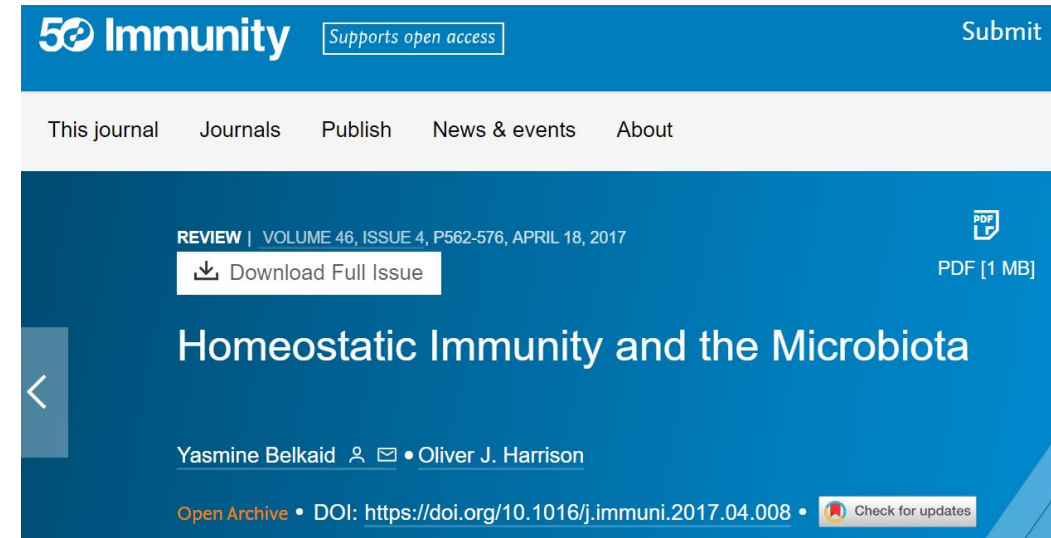
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Immune homeostasis in health and disease

Nicholas D Huntington , Daniel HD Gray 

First published: 21 May 2018 | <https://doi.org/10.1111/imcb.12043> | Citations: 14



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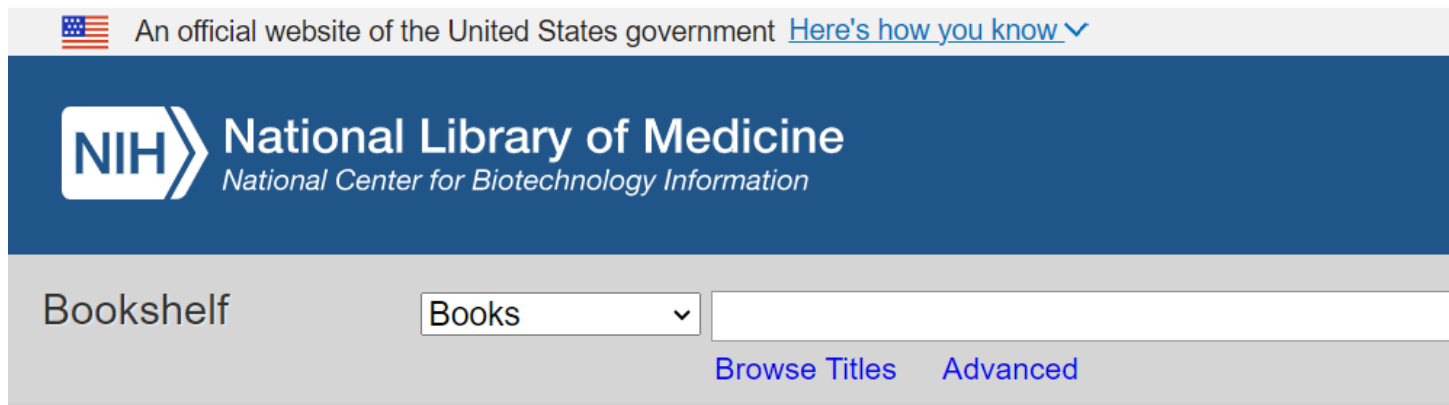
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Homeostatic Immunity and the Microbiota

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In brief: How does the immune system work?

Last Update: June 6, 2023; Next update: 2026.

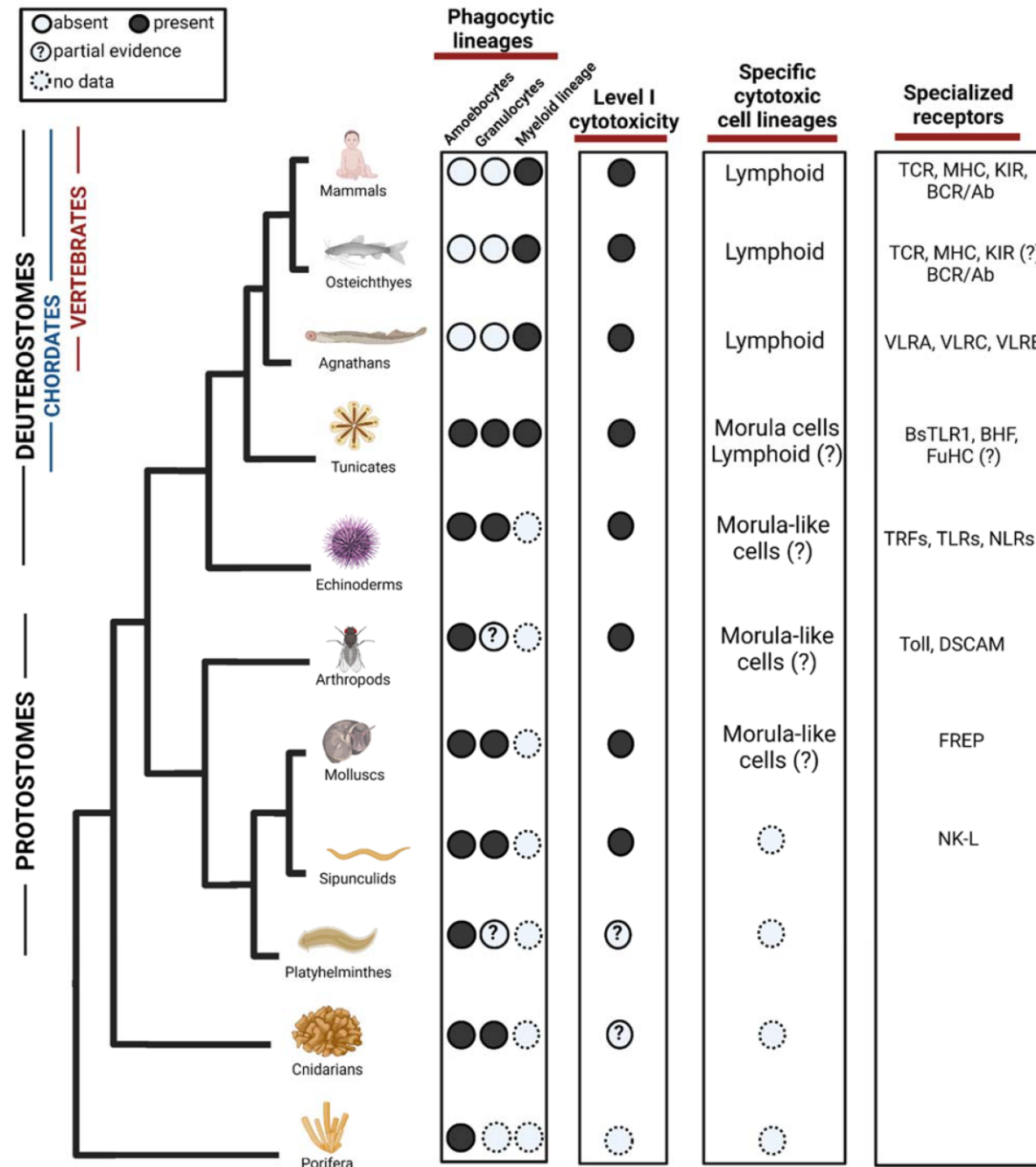
The immune system has a vital role: It protects your body from harmful substances, germs and cell changes that could make you ill. It is made up of various organs, cells and proteins.

As long as your immune system is running smoothly, you don't notice that it's there. But if it stops working properly – because it's weak or can't fight particularly aggressive germs – you get ill. Germs that your body has never encountered before are also likely to make you ill. Some germs will only make you ill the first time you come into contact with them. These

Immunity

Evolution of the immune system

Figure 2. Evolution of phagocytic and cytotoxic cell lineages in the immune system. Among phagocytic lineages, amoebocytes and granulocytes are present in invertebrates, while myeloid lineage seems to evolve in the ancestor of tunicates and vertebrates. Cells representing the Level I cytotoxicity exist in Protostomes but might appear in cnidarian. Among specific cytotoxic cell lineages, morula cells have been found in tunicates although partial evidence suggests that they may evolve in earlier ancestors. Lymphoid cells are found in agnathans and have diversified in vertebrates, there are suggestions of their form in Tunicates but not validated yet. In the third column, we show examples of diversification of specialized receptors acting in both phagocytosis and cytotoxicity. TLR = Toll-like receptors, TCR = T-cell receptor, MHC = Major histocompatibility complex, KIR = Killer Inhibitory Receptors, BCR = B cell receptor, VLR = Variable lymphocyte receptor, BHF = Botryllus histocompatibility factor, TRF = Transformer proteins, NLR = NOD like receptors, DSCAM = Down syndrome cell adhesion molecule, FREP = Fibrinogen-related proteins, NK-L = Natural killer-like receptor. ?—Represents missing functional or molecular validation. Created with BioRender.com. Data sources are summarized in Table 1.



Immunity

Evolution of the immune system

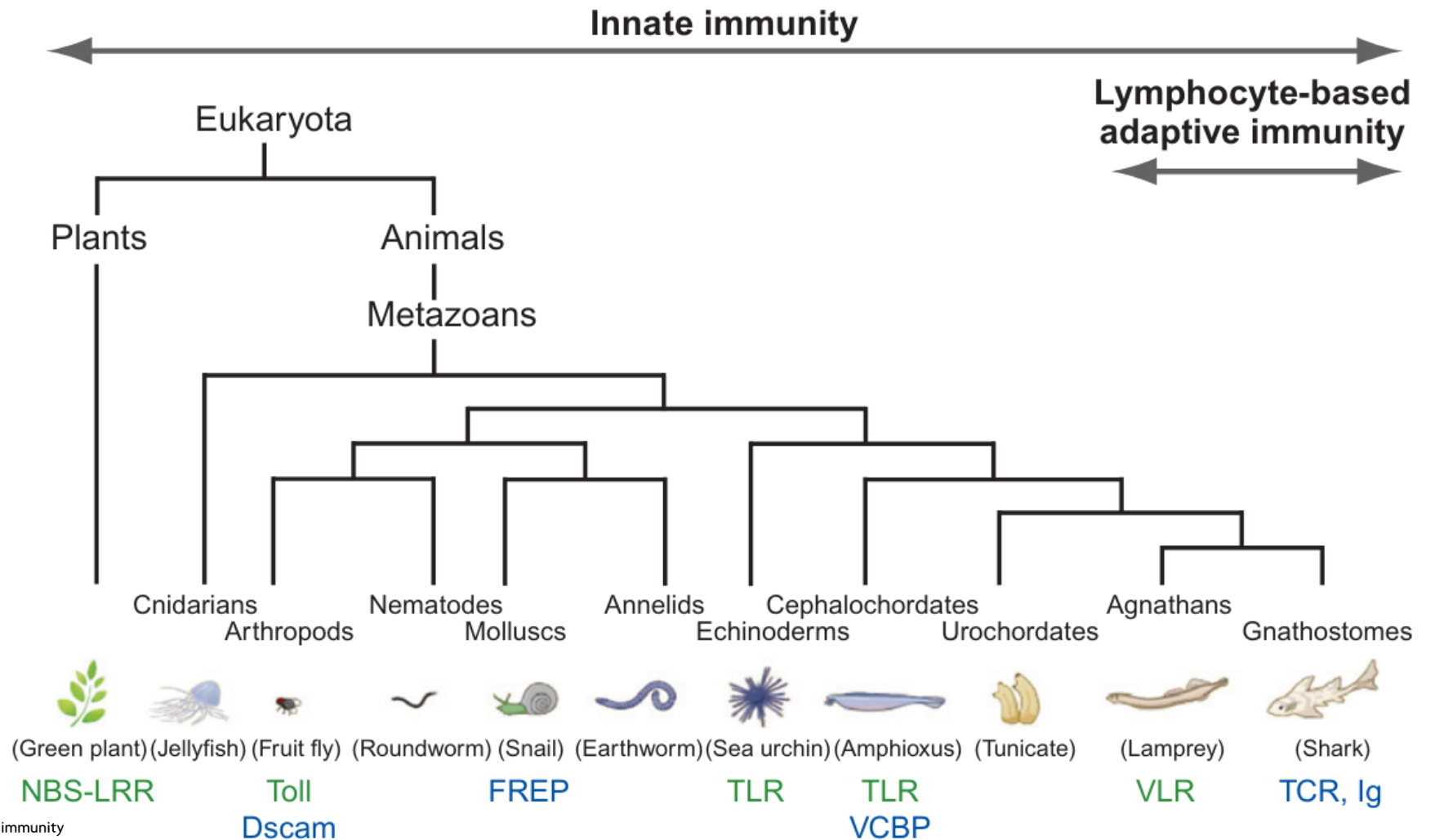
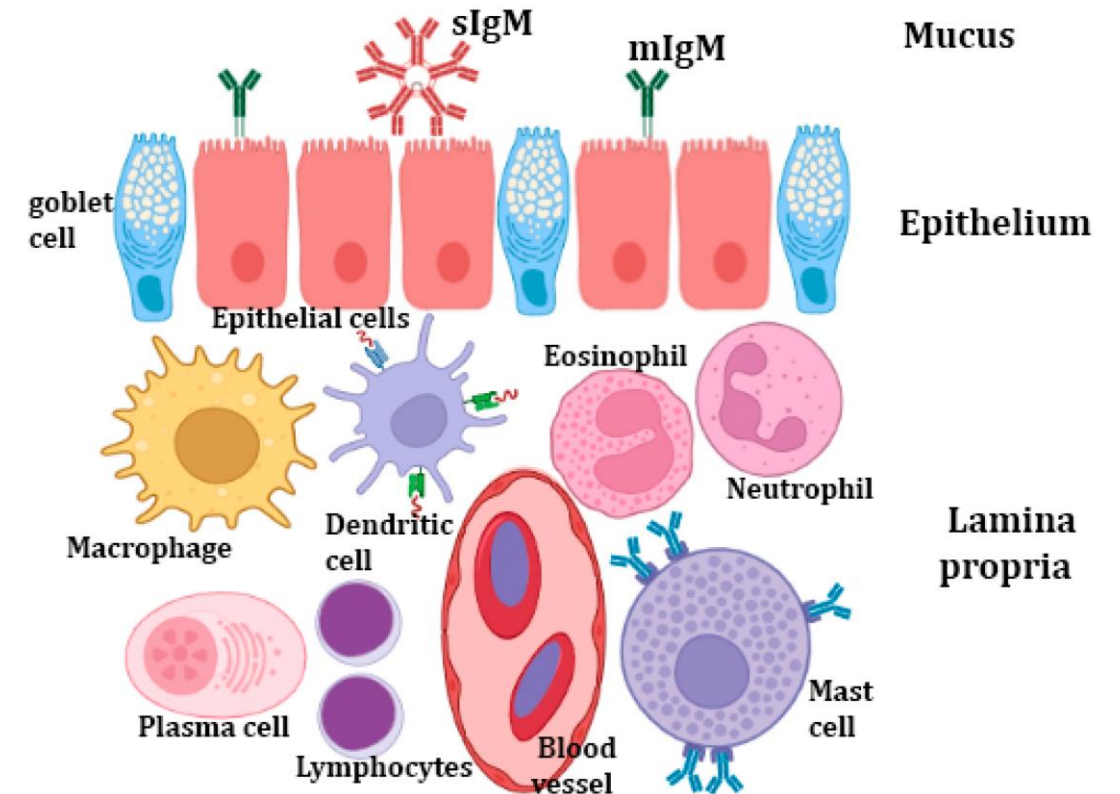
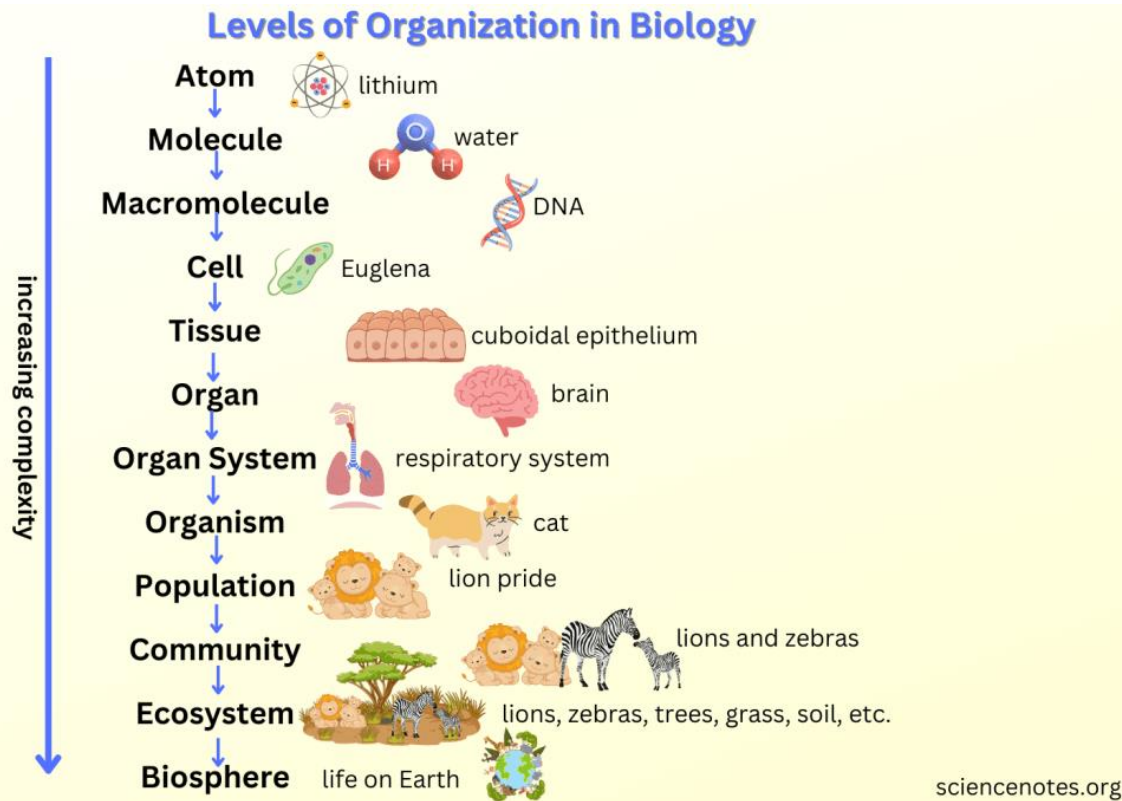


FIGURE 4.1 Hypothetical evolutionary scheme of the emergence of adaptive immunity in conjunction with innate immunity. Families of leucine-rich-repeat (LRR)-based receptors used as immune molecules are indicated in green: nucleotide-binding site-leucine-rich repeat (NBS-LRR), Toll-like receptors (TLRs), and variable lymphocyte receptors (VLRs). Ig-based receptors used in immune defense are indicated in blue: Down's syndrome cell adhesion molecule (Dscam), fibrinogen-related proteins (FREPs), V-type Ig domains and a chitin-binding domain containing proteins (VCBP), T cell receptors (TCR), and immunoglobulins (Ig). One representative for each lineage is named in parentheses.

Immunity



Open Access Review

Main Components of Fish Immunity: An Overview of the Fish Immune System

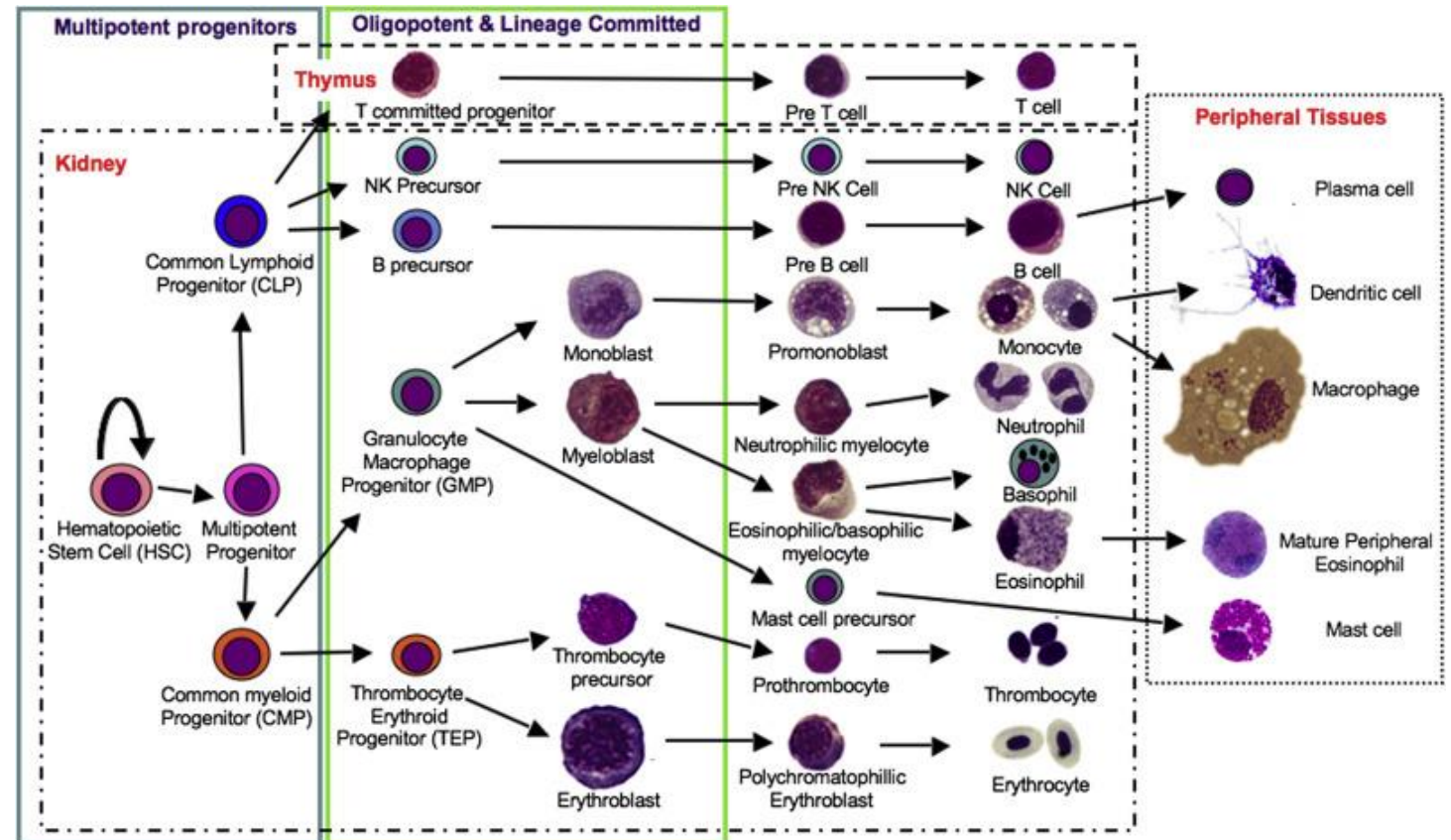
by Doaa M. Mokhtar^{1,2}, Giacomo Zaccone³ , Alessio Alesci⁴ , Michal Kuciel^{5,*} , Manal T. Hussein¹ and Ramy K. A. Sayed⁶

Haematopoiesis and haematopoietic organs in fish

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Haematopoiesis is a complex process in which haematopoietic stem cells, the most immature elements of the haematopoietic hierarchy, proliferate and differentiate into various classes of haematopoietic progenitor cells. These progenitor cells have been shown to be able to differentiate into mature blood cells: erythrocytes, lymphocytes, thrombocytes, granulocytes, and monocytes. The pronephros, or head kidney, is a basic organ forming the blood elements, and is also a reservoir of blood cells. Basic haematopoietic structures and mechanisms in fish are similar to those functioning in other vertebrates, and all haematopoietic cell types are very similar to those of mammals.



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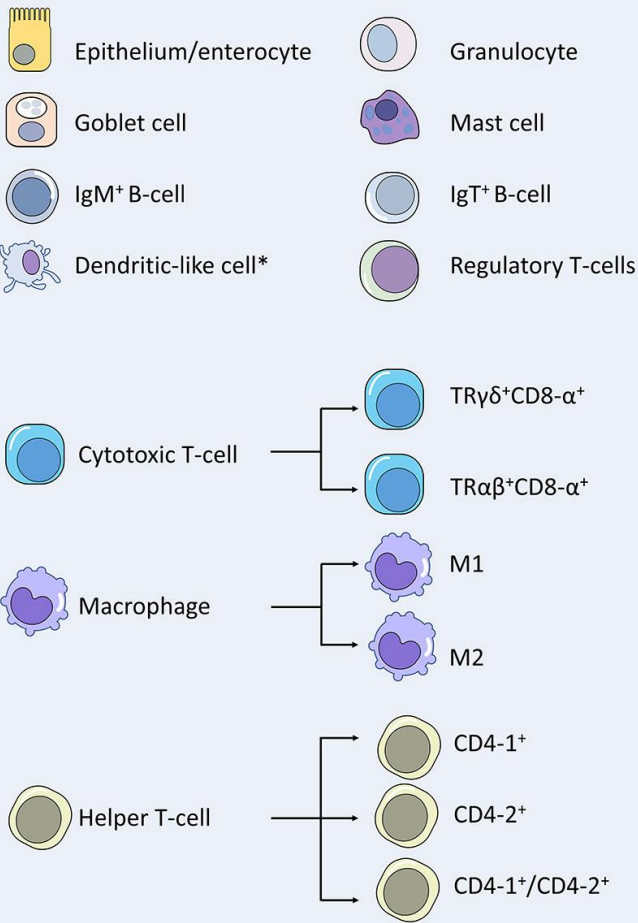
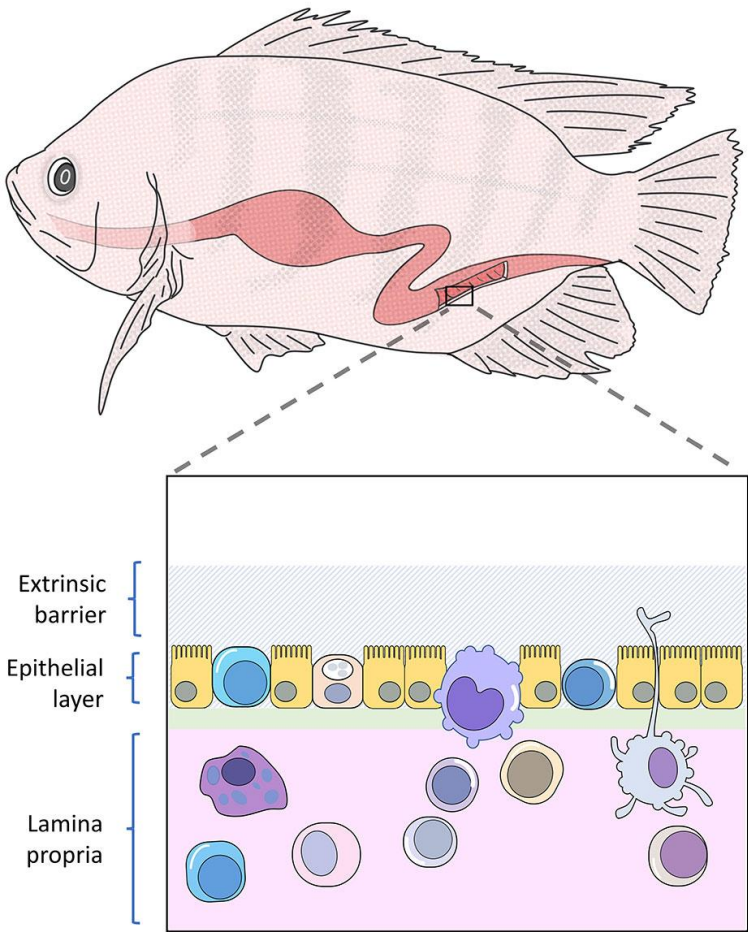
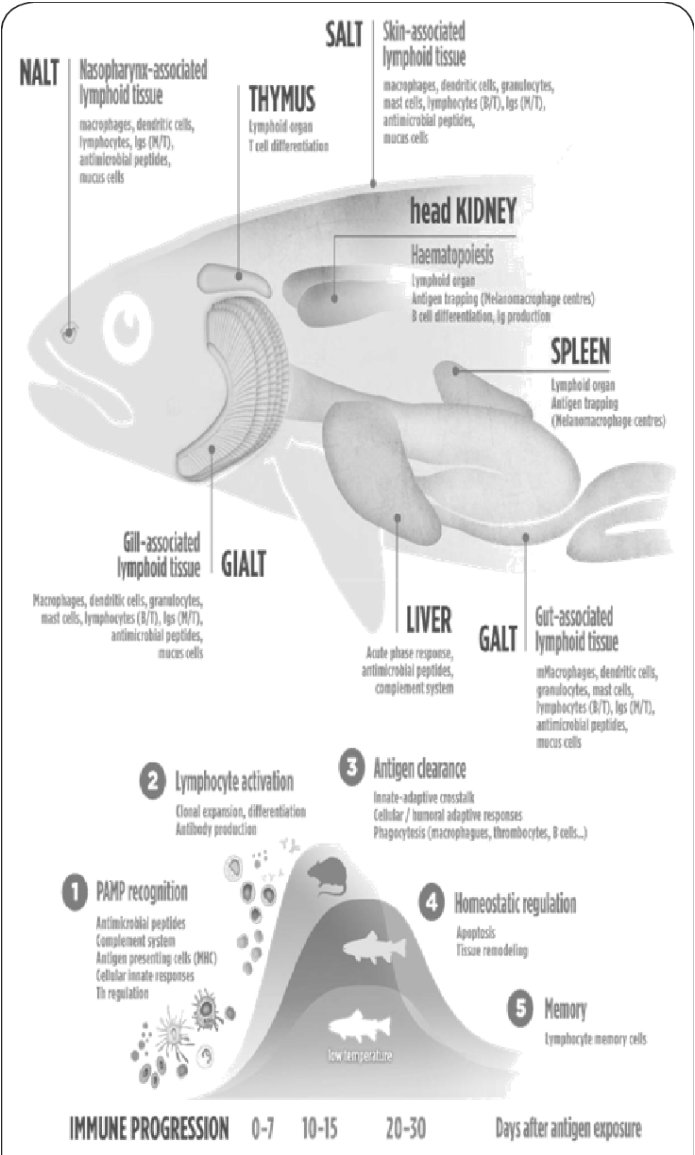


Chapter 2 - Cellular dissection of zebrafish hematopoiesis

D.L. Stachura*, D. Traver

Immunity

Cells Tissues Organs



Immunity

Adaptive Innate

Antigen
Specific

Antigen
Non-specific

- Cellular
- Humoral

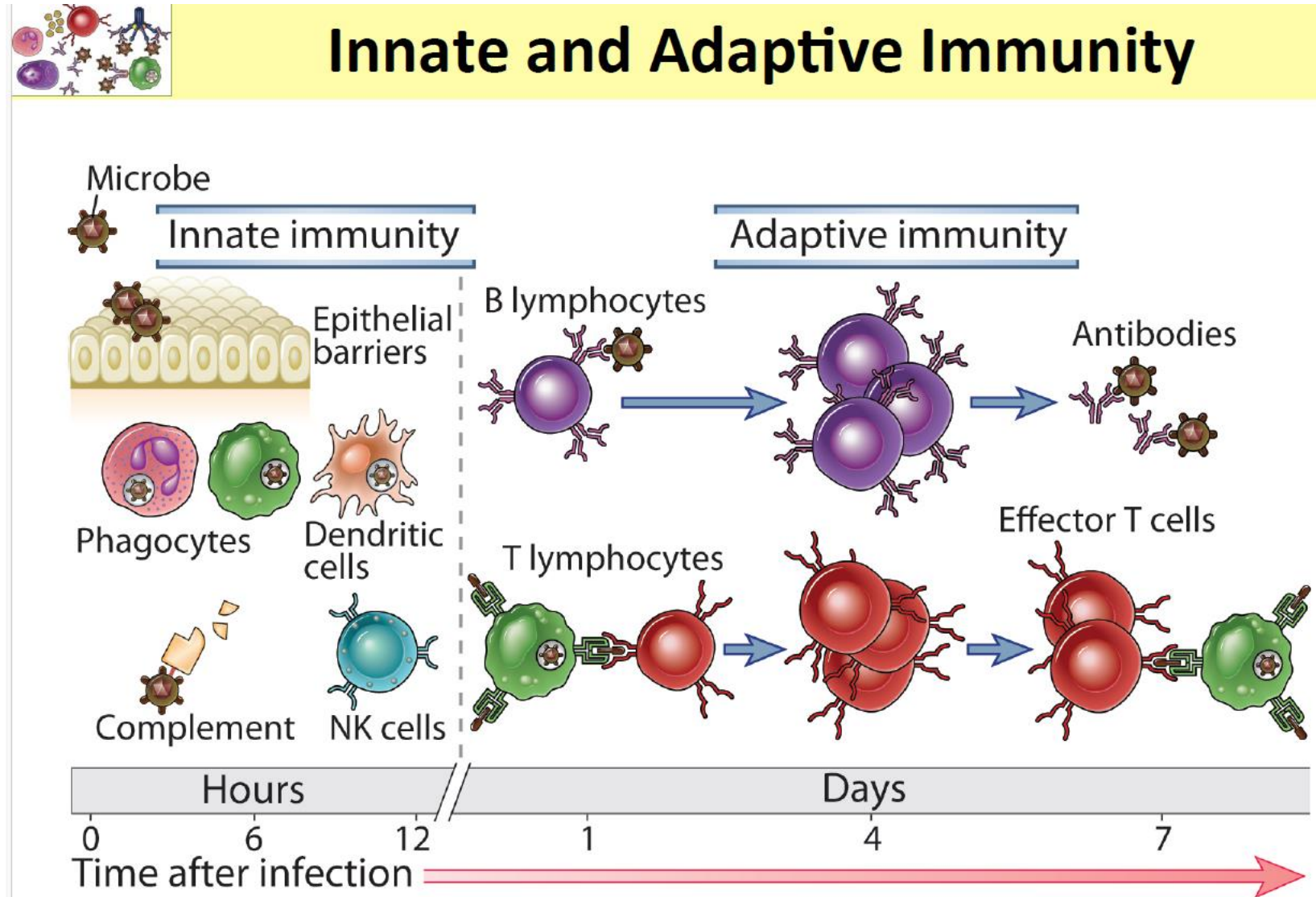
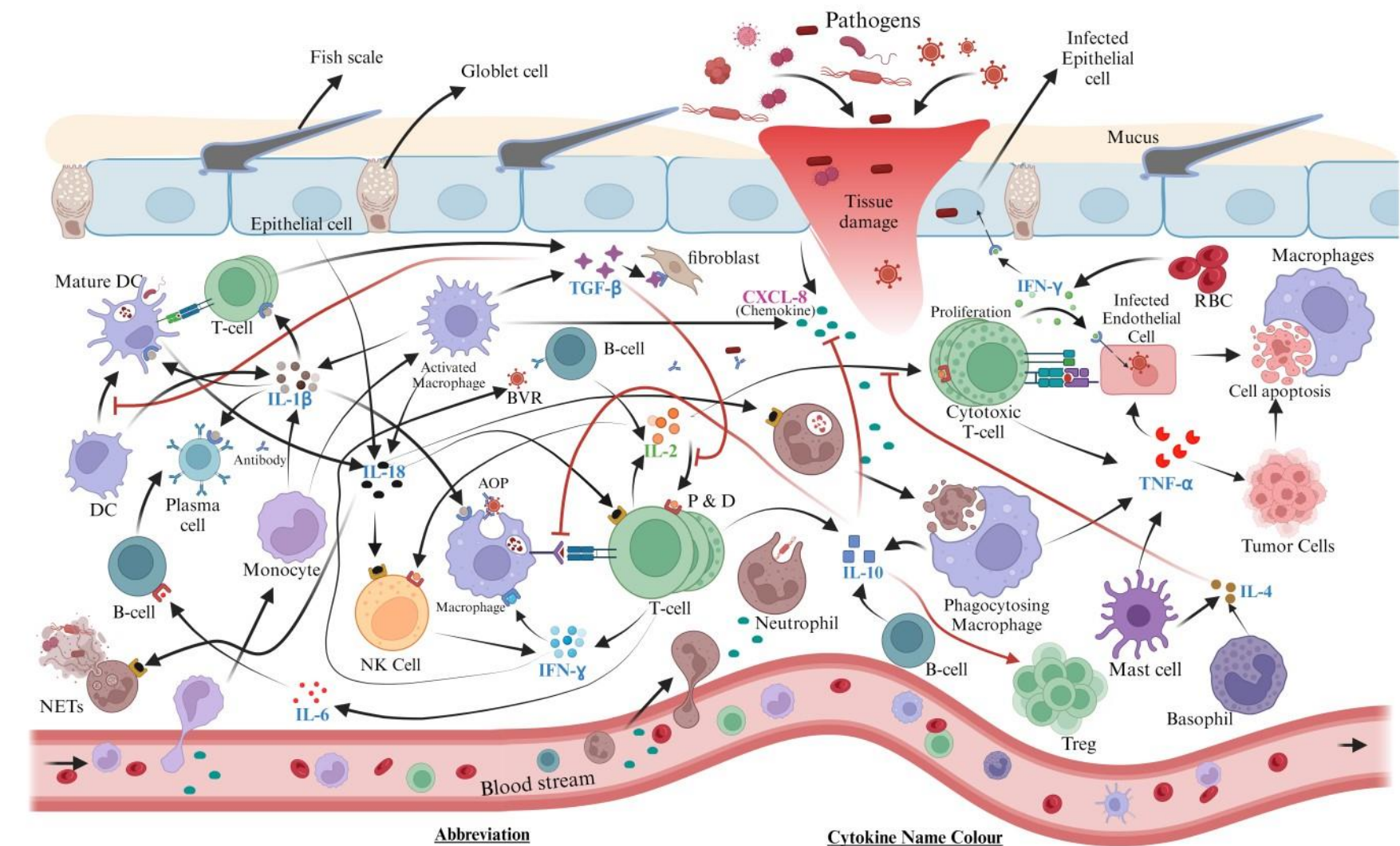


Fig. 1-1

Immunity

Cytokines



Abbreviation		
DC - Dendritic Cell	NETs - Neutrophil Extracellular Traps	
IFN - Interferon	P & D - Proliferation & Differentiation	
IL - Interleukin	TGF - Transforming Growth Factor	
NK - Natural Killer	Treg - Regulatory T cell	
RBC - Red Blood Cell	TNF - Tumor Necrosis Factor	
BVR - Blocked Viral Replication	AOP - Antibodies Opsonizing Pathogen	

Cytokine Name Colour
Green - Autocrine
Blue - Procrine
Pink - Endocrine



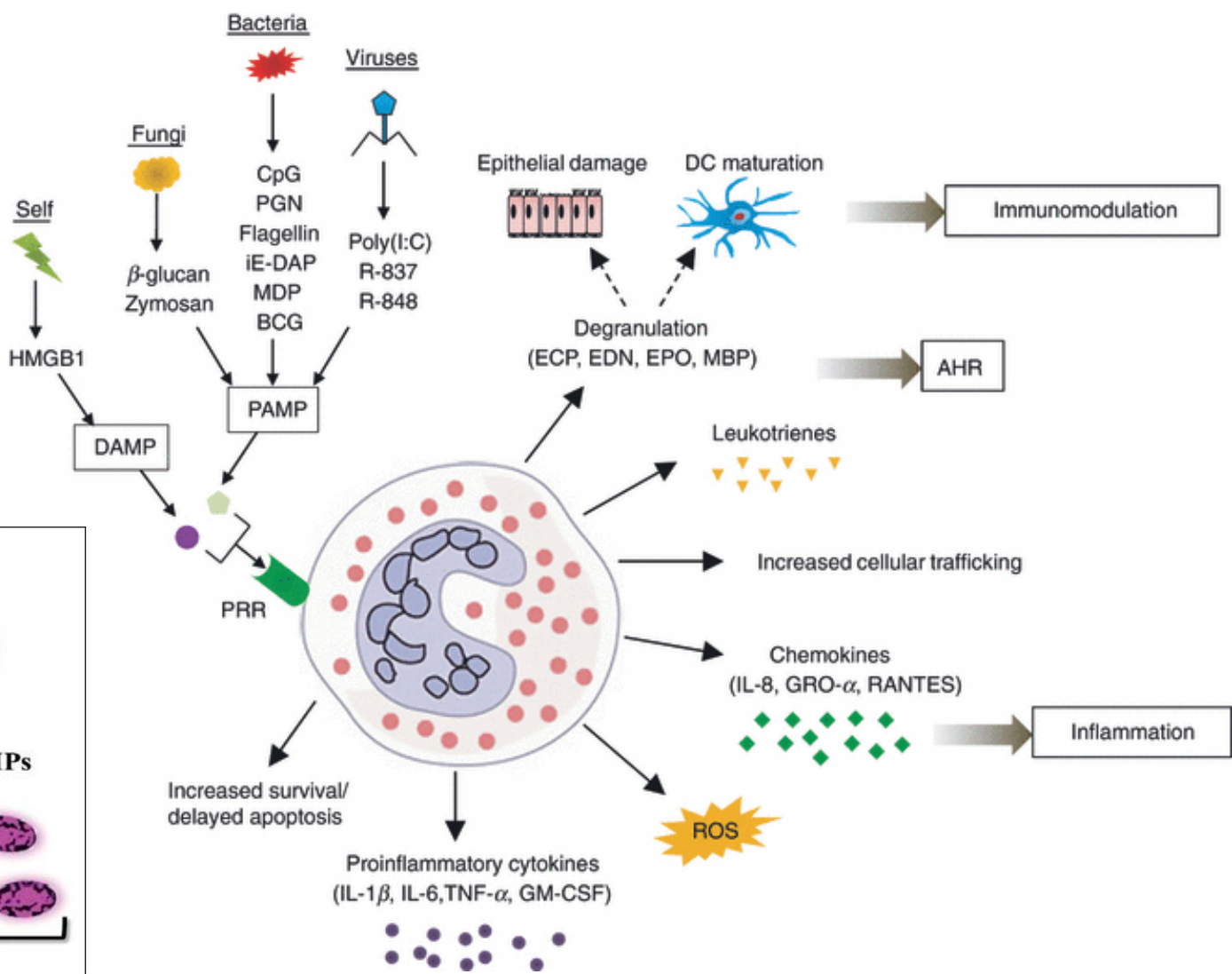
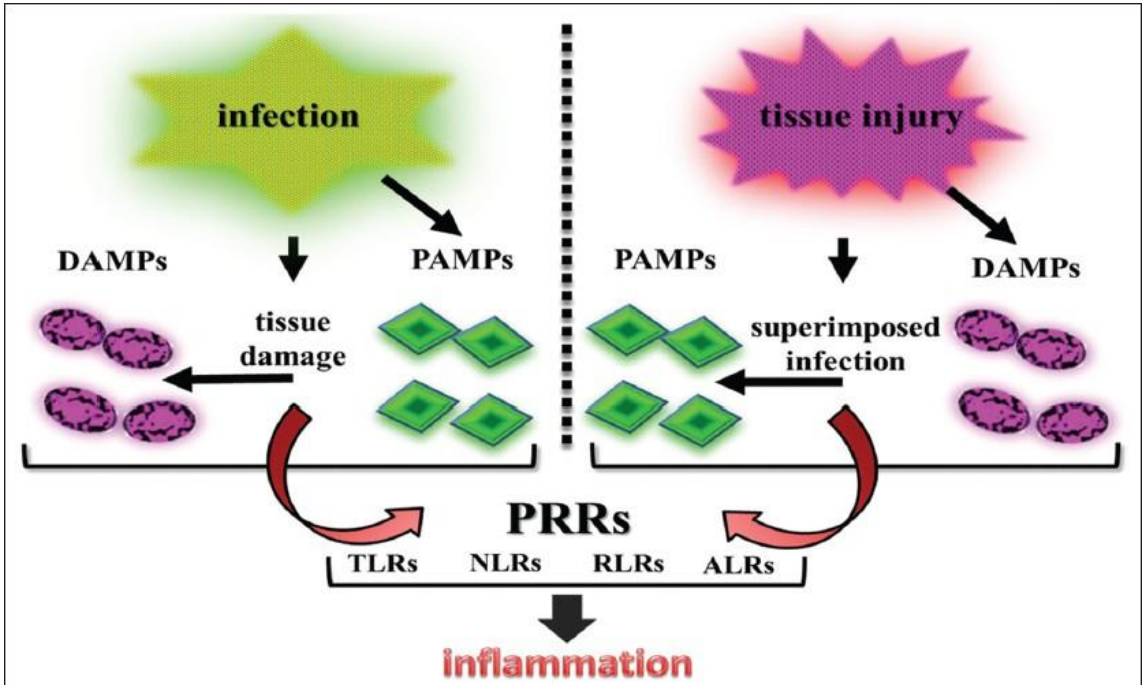
Immunity

Cytokines

Cytokine	Family	Main sources	Function
IL-1 β	IL-1	Macrophages, monocytes	Pro-inflammation, proliferation, apoptosis, differentiation
IL-4	IL-4	Th-cells	Anti-inflammation, T-cell and B-cell proliferation, B-cell differentiation
IL-6	IL-6	Macrophages, T-cells, adipocyte	Pro-inflammation, differentiation, cytokine production
IL-8	CXC	Macrophages, epithelial cells, endothelial cells	Pro-inflammation, chemotaxis, angiogenesis
IL-10	IL-10	Monocytes, T-cells, B-cells	Anti-inflammation, inhibition of the pro-inflammatory cytokines
IL-12	IL-12	Dendritic cells, macrophages, neutrophils	Pro-inflammation, cell differentiation, activates NK cell
IL-11	IL-6	Fibroblasts, neurons, epithelial cells	Anti-inflammation, differentiation, induces acute phase protein
TNF- α	TNF	Macrophages, NK cells, CD4 ⁺ lymphocytes, adipocyte	Pro-inflammation, cytokine production, cell proliferation, apoptosis, anti-infection
IFN- γ	INF	T-cells, NK cells, NKT cells	Pro-inflammation, innate, adaptive immunity anti-viral
GM-CSF	IL-4	T-cells, macrophages, fibroblasts	Pro-inflammation, macrophage activation, increase neutrophil and monocyte function
TGF- β	TGF	Macrophages, T cells	Anti-inflammation, inhibition of pro-inflammatory cytokine production

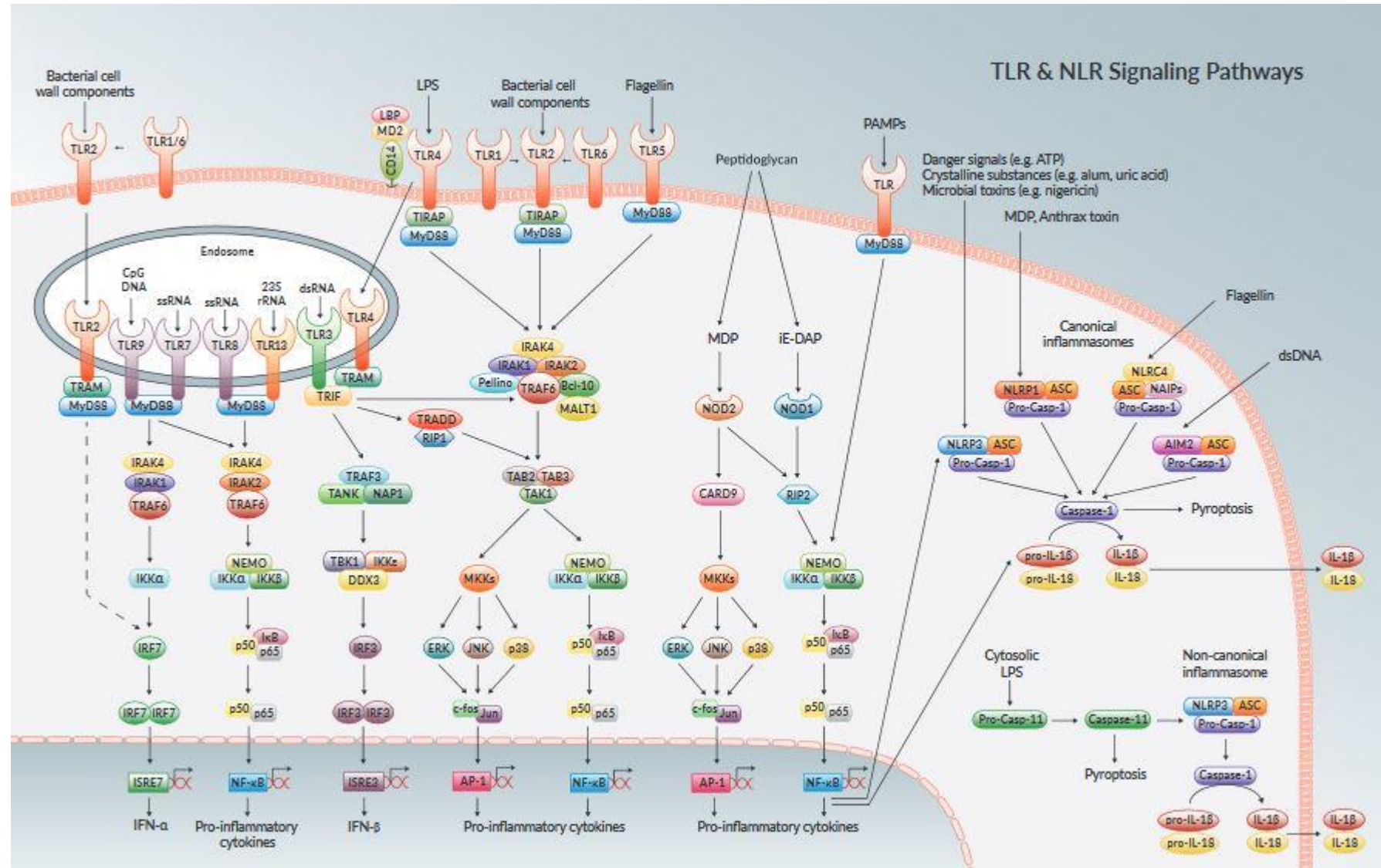
Innate Immunity

PAMPs/MAMPs DAMPs



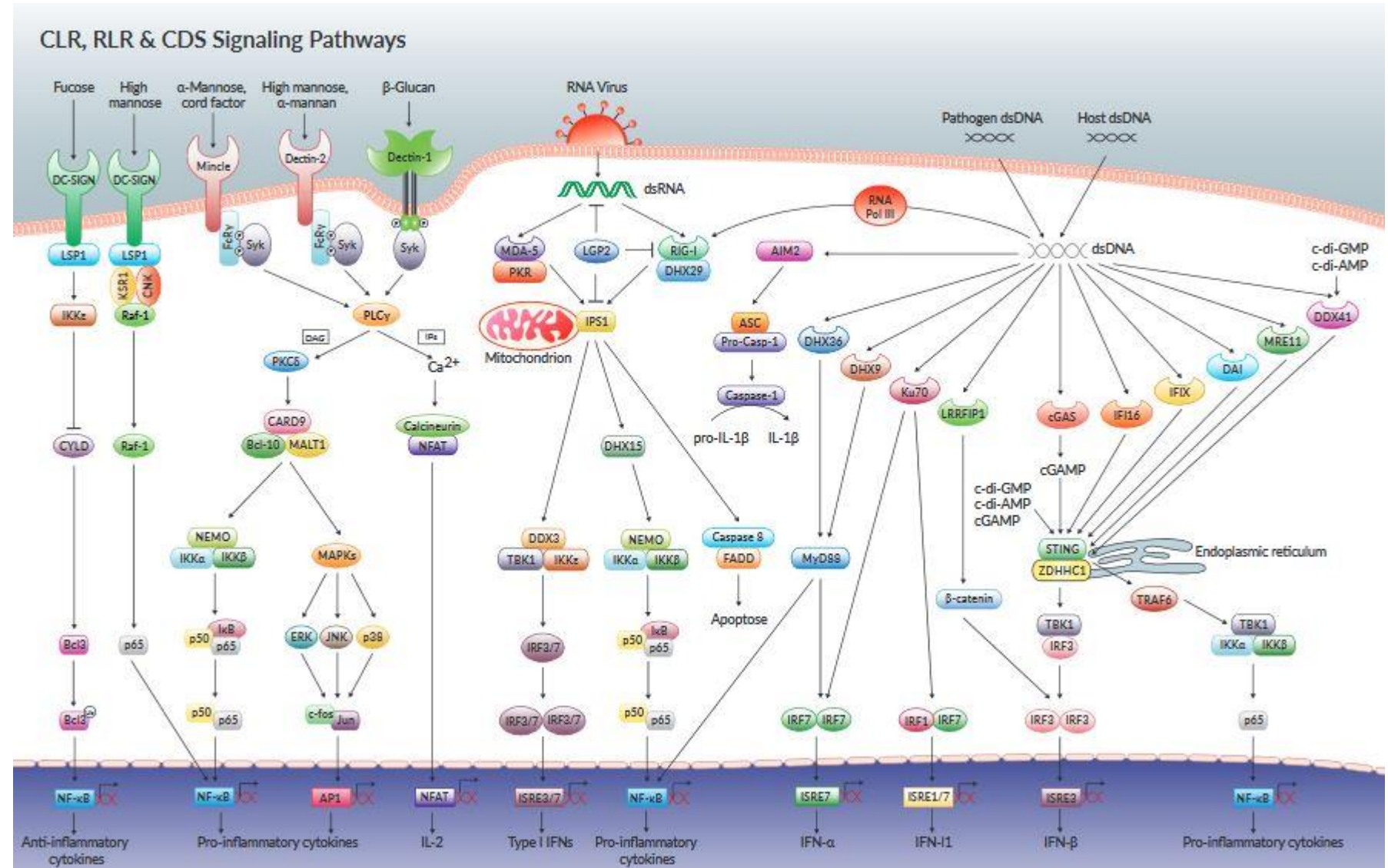
Innate Immunity

Receptors



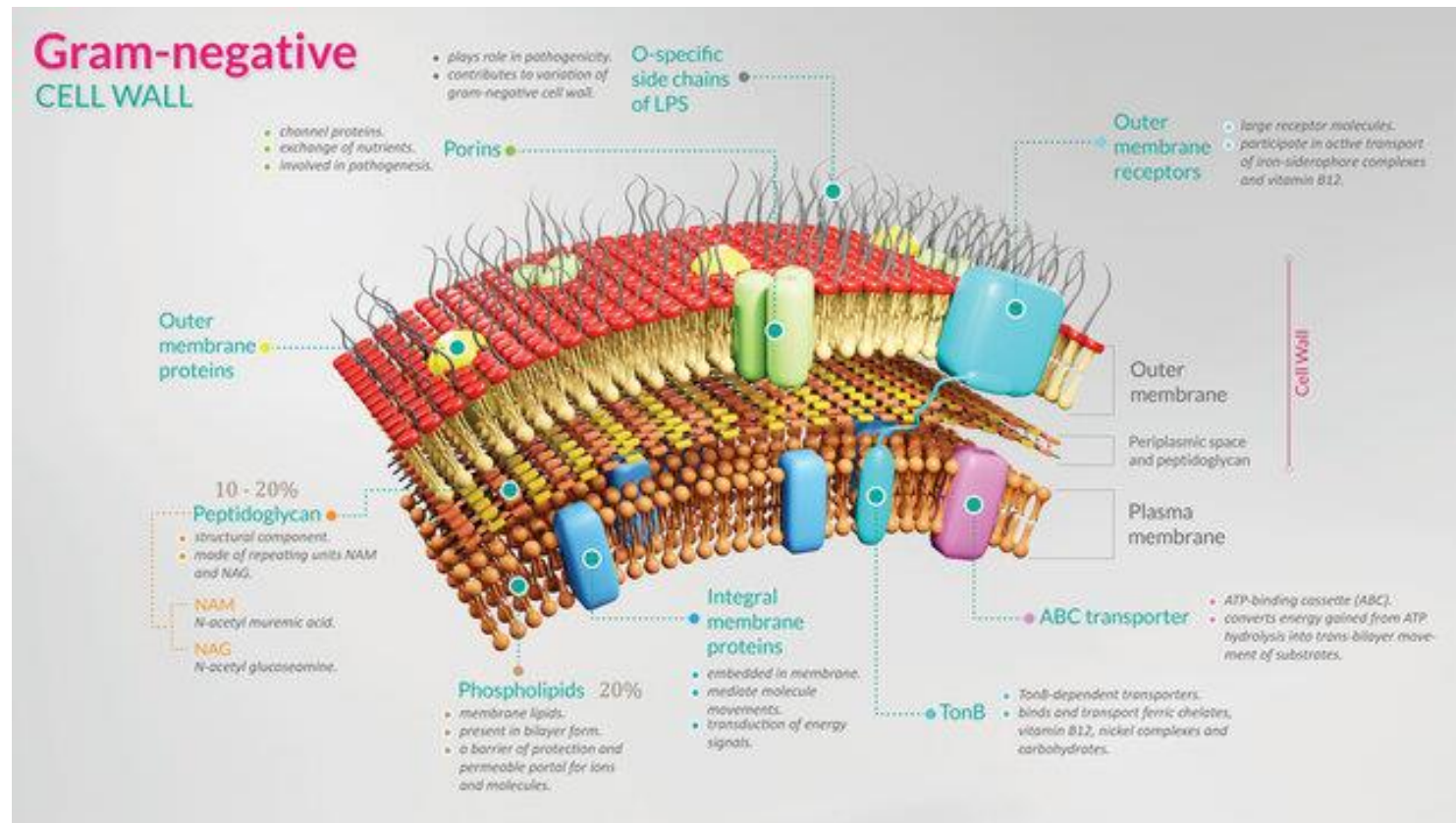
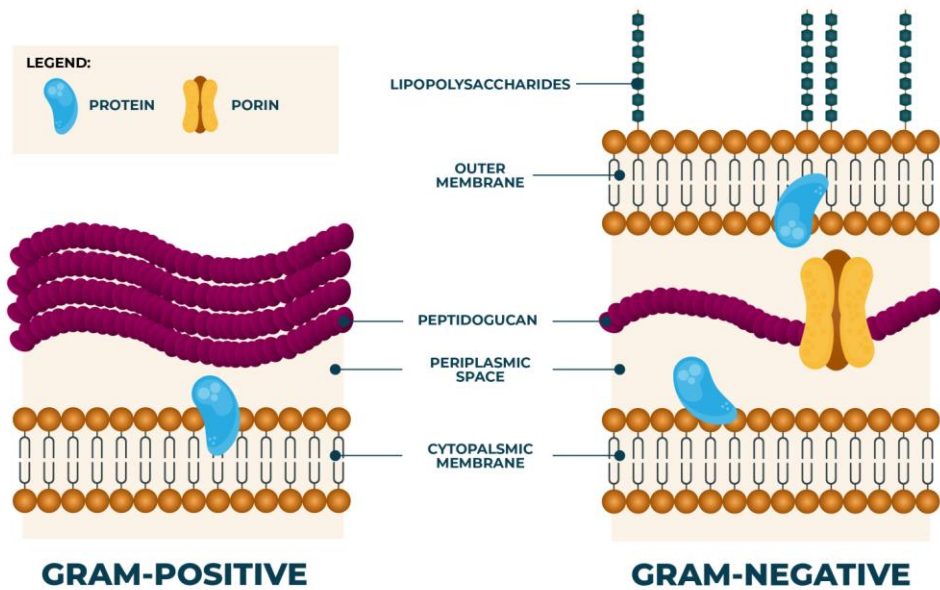
Innate Immunity

Receptors

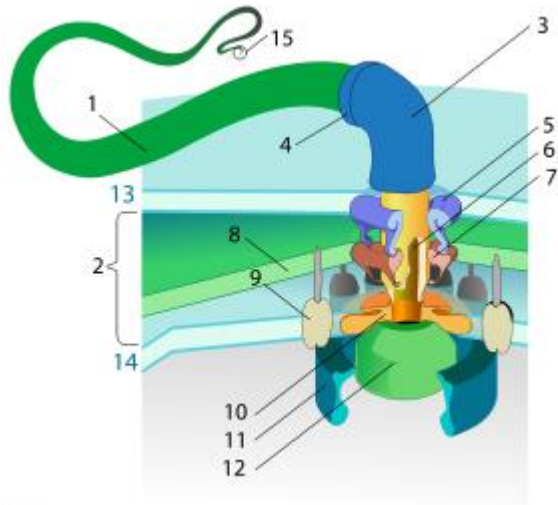


Innate Immunity

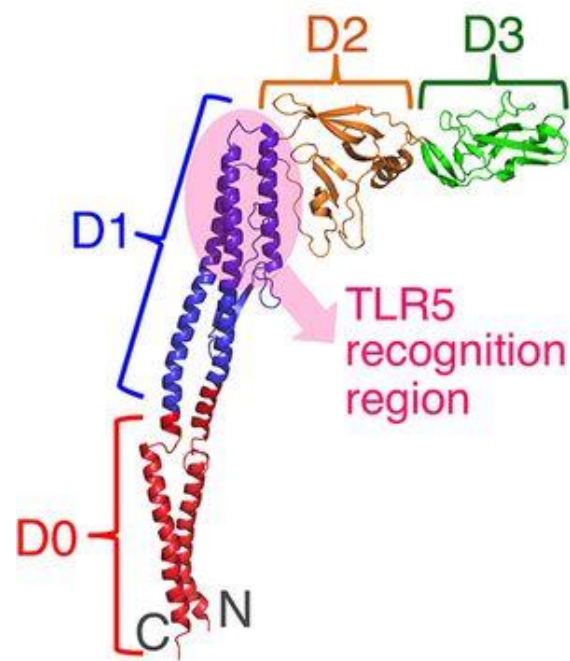
Bacteria



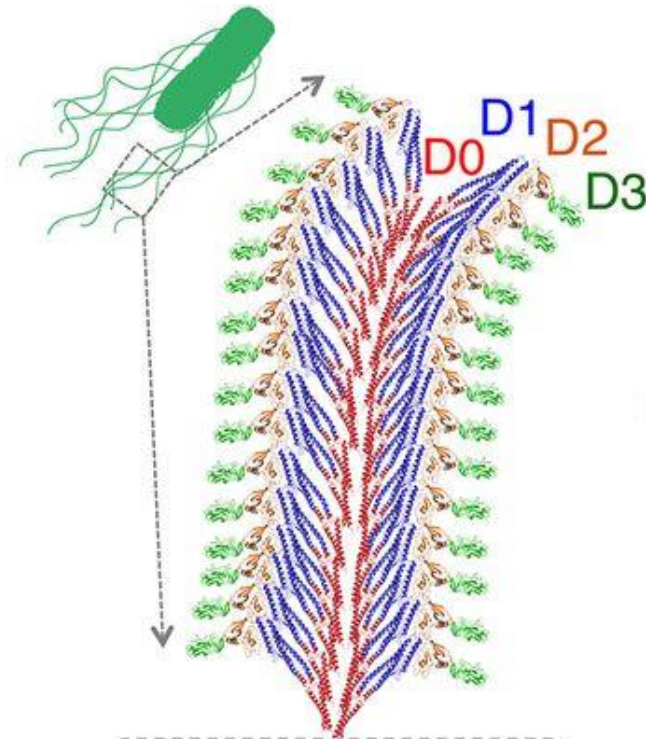
Innate Immunity



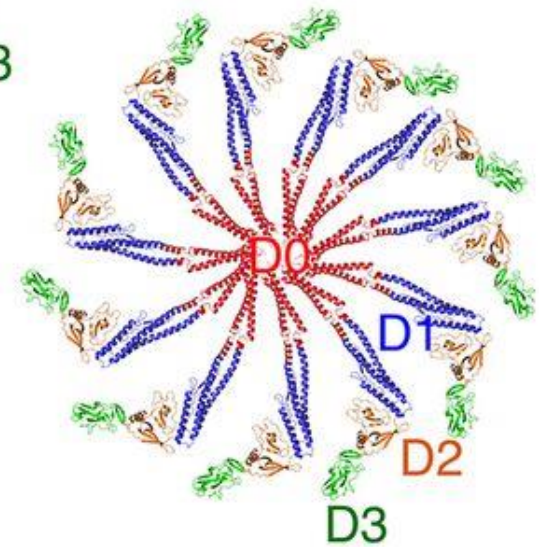
Flagellin



Flagellin



Cross-section view of
the flagellar filament



Top view of the
flagellar filament

Innate Immunity

CpG motifs

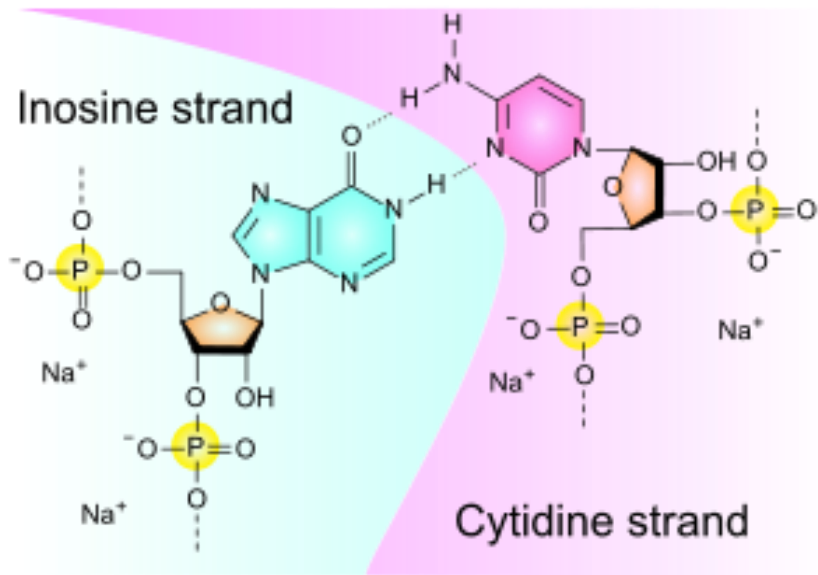


Bacteria

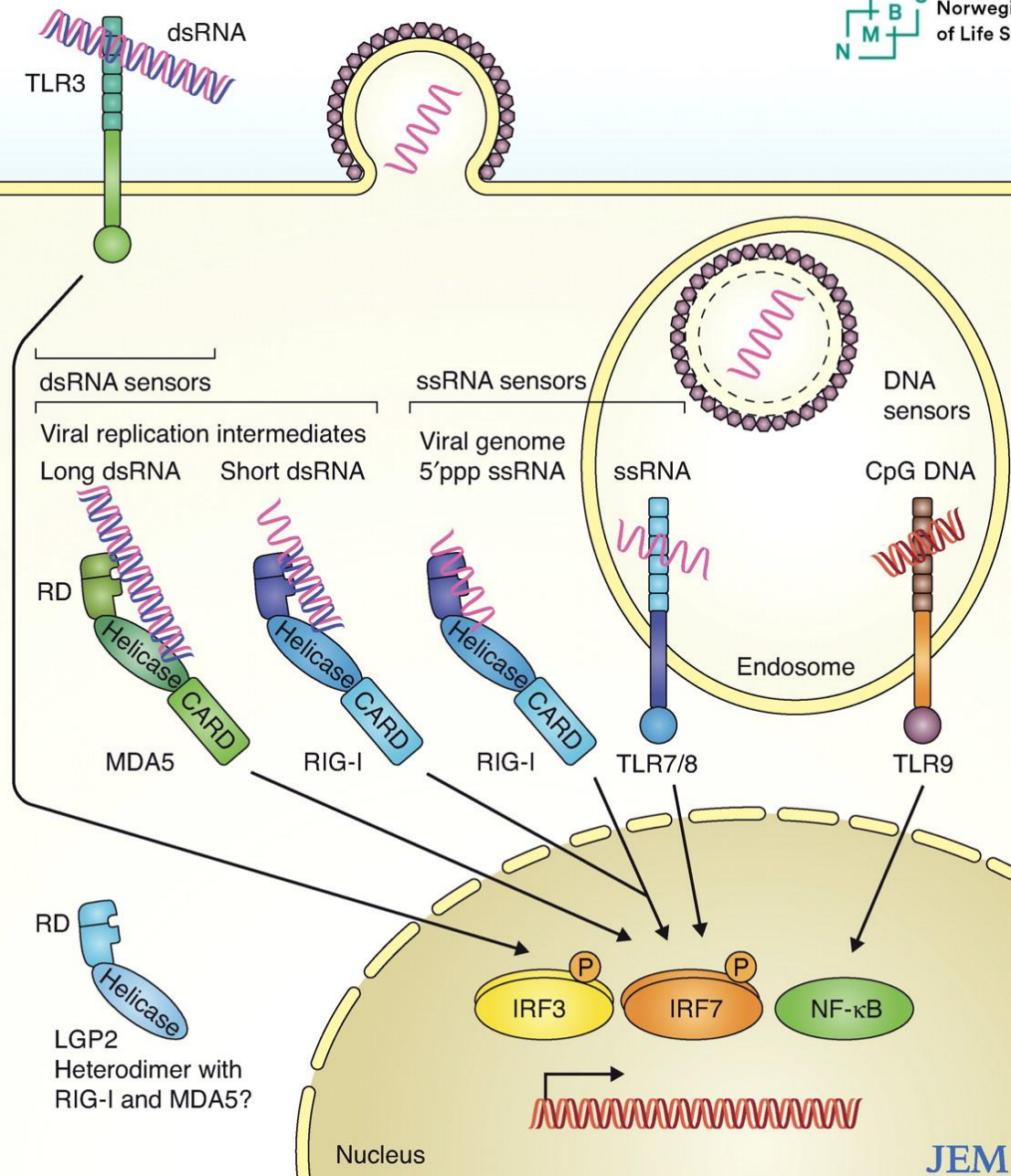
Innate Immunity

Nucleic acids

Poly I:C

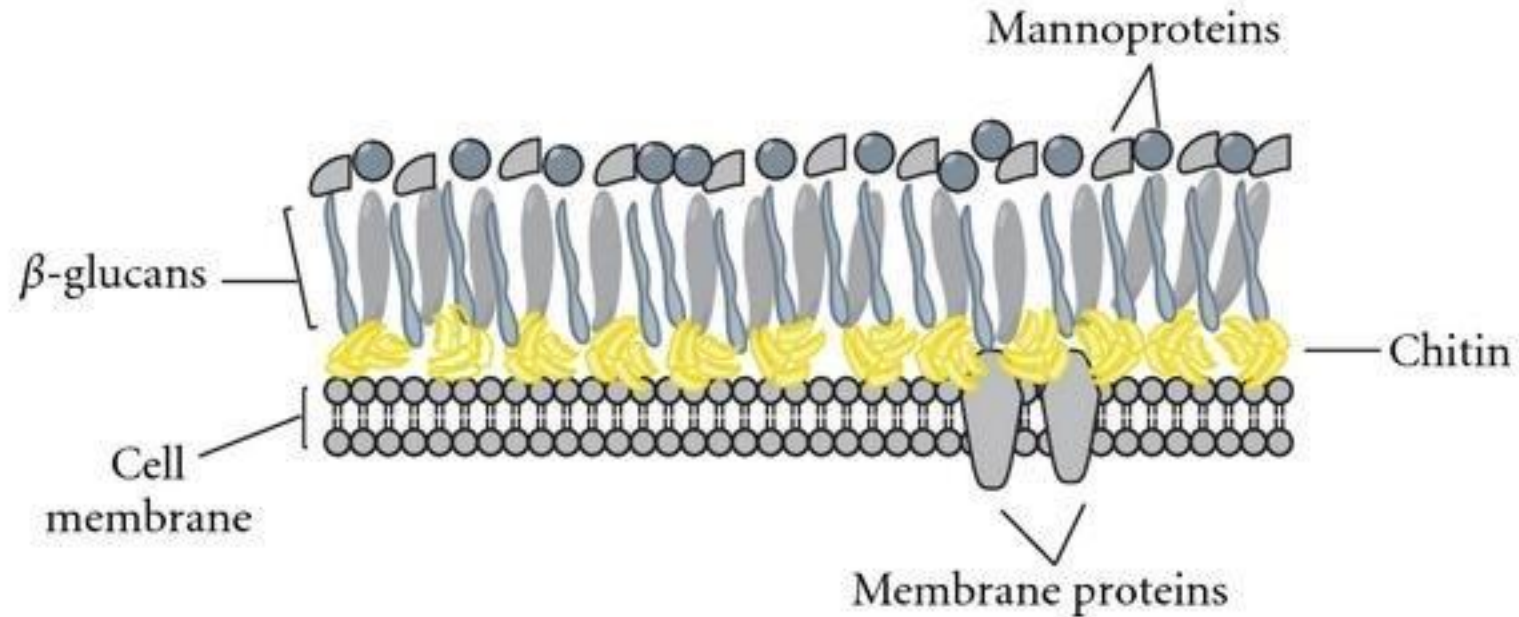


Viral genome	Protection	Deterioration
(+) ssRNA	Poliovirus [12,13], coxsackievirus group B serotype 3 [14] and encephalomyocarditis virus [15]	West Nile virus [20]
dsRNA	Rotavirus [16]	
dsDNA	Herpes simplex virus 1 [17,18] and murine cytomegalovirus [19]	Vaccinia virus [21]
(-) ssRNA		Influenza A virus [22] and phlebovirus [23]

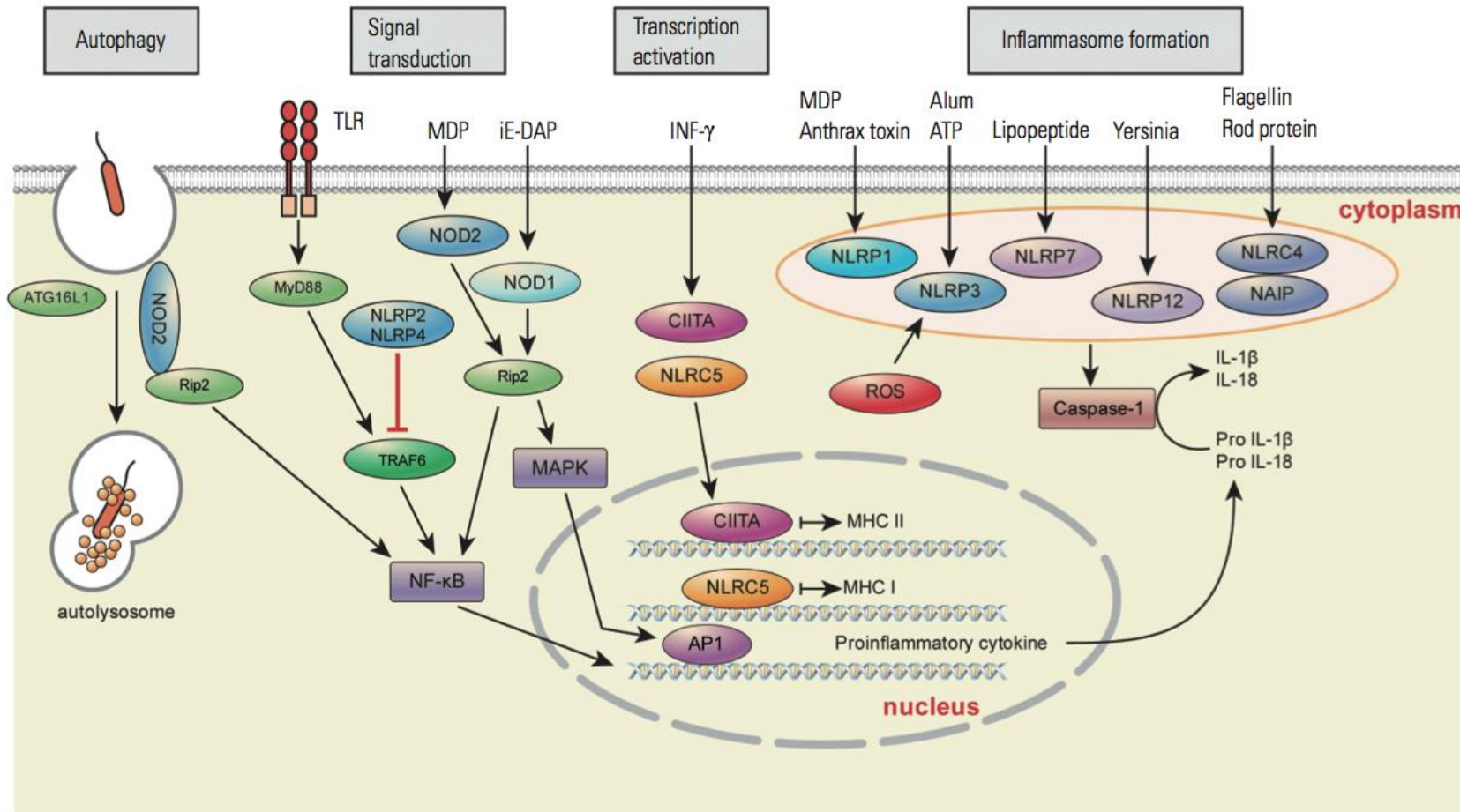


Innate Immunity

Fungi

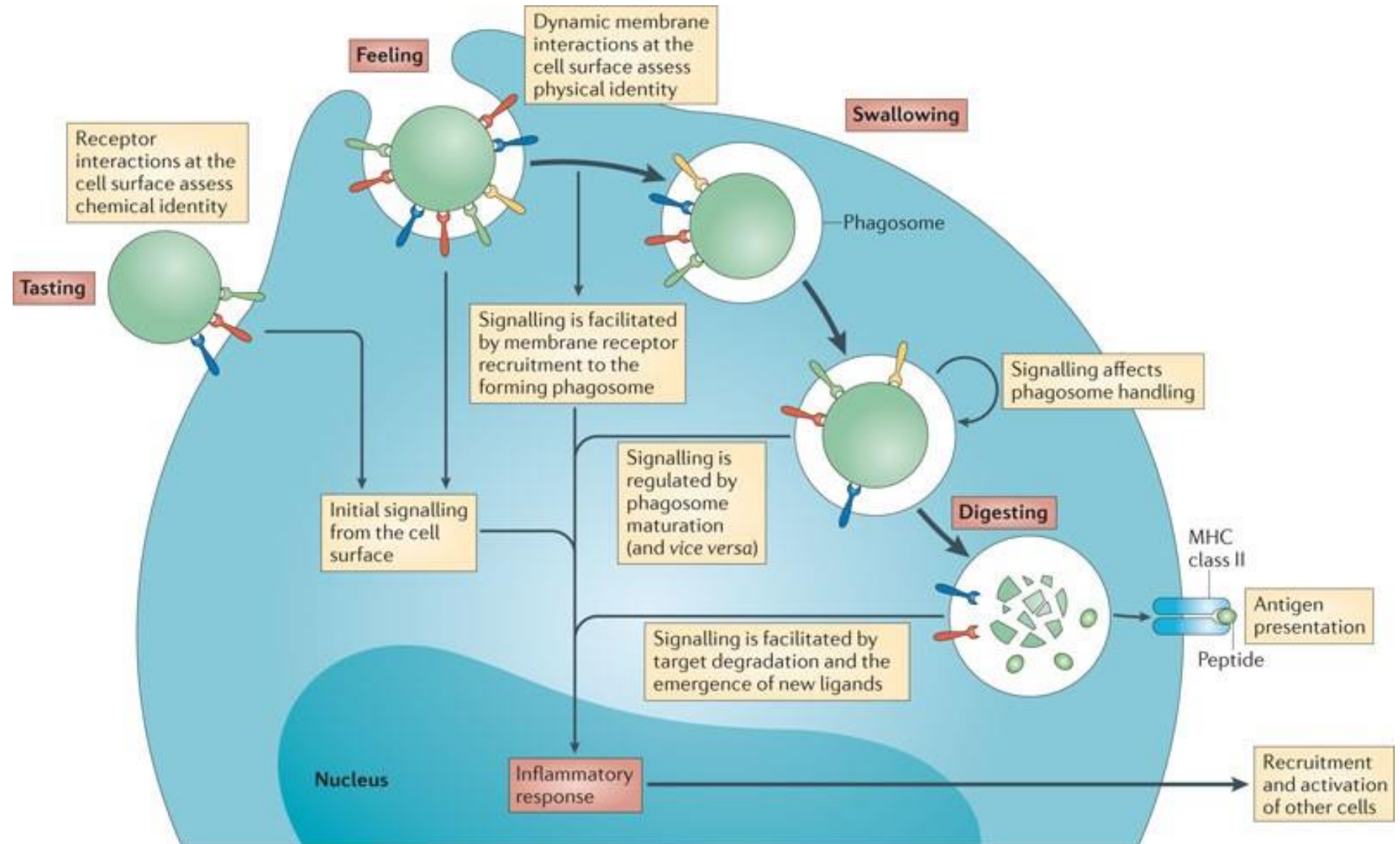


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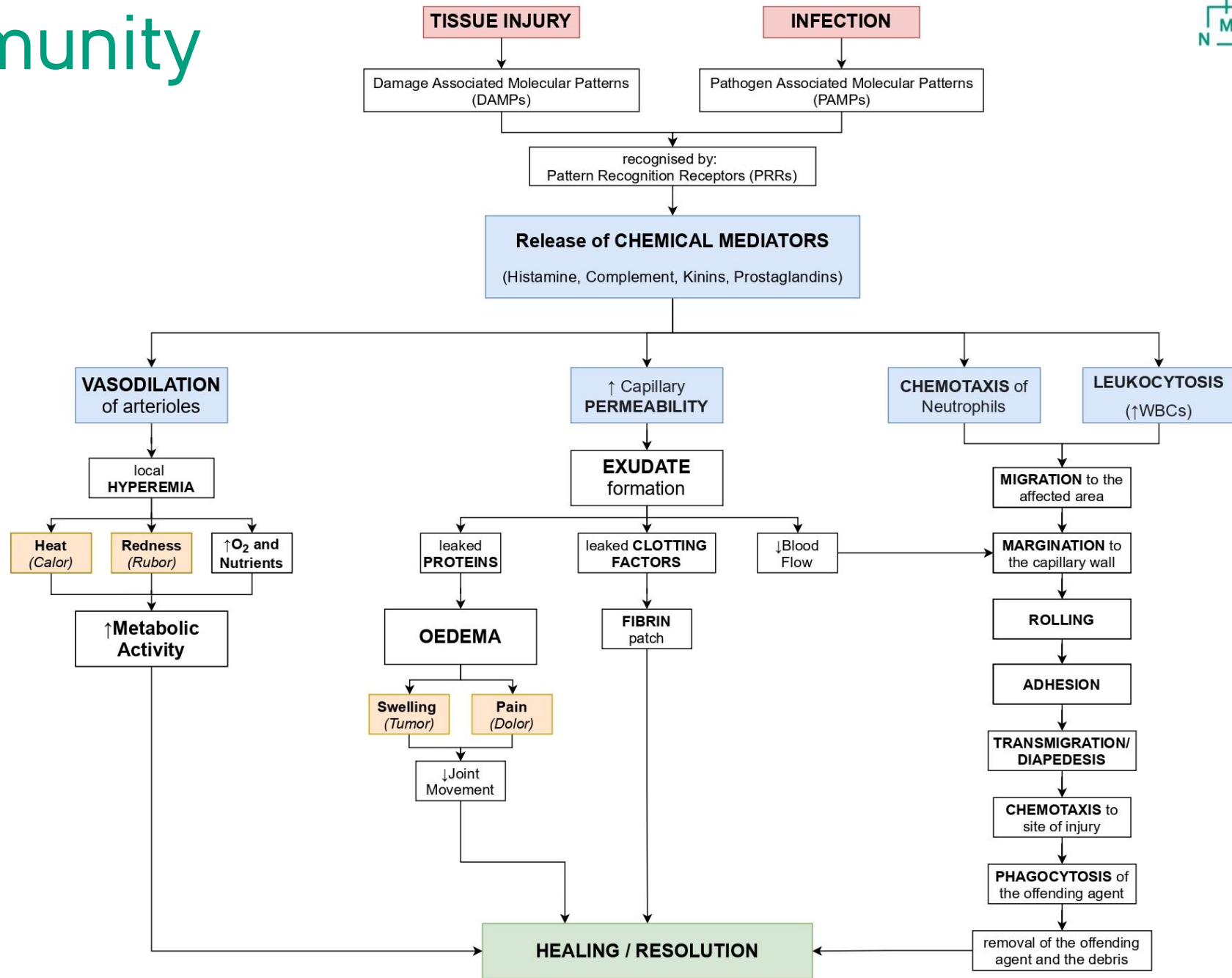
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Phagocytosis



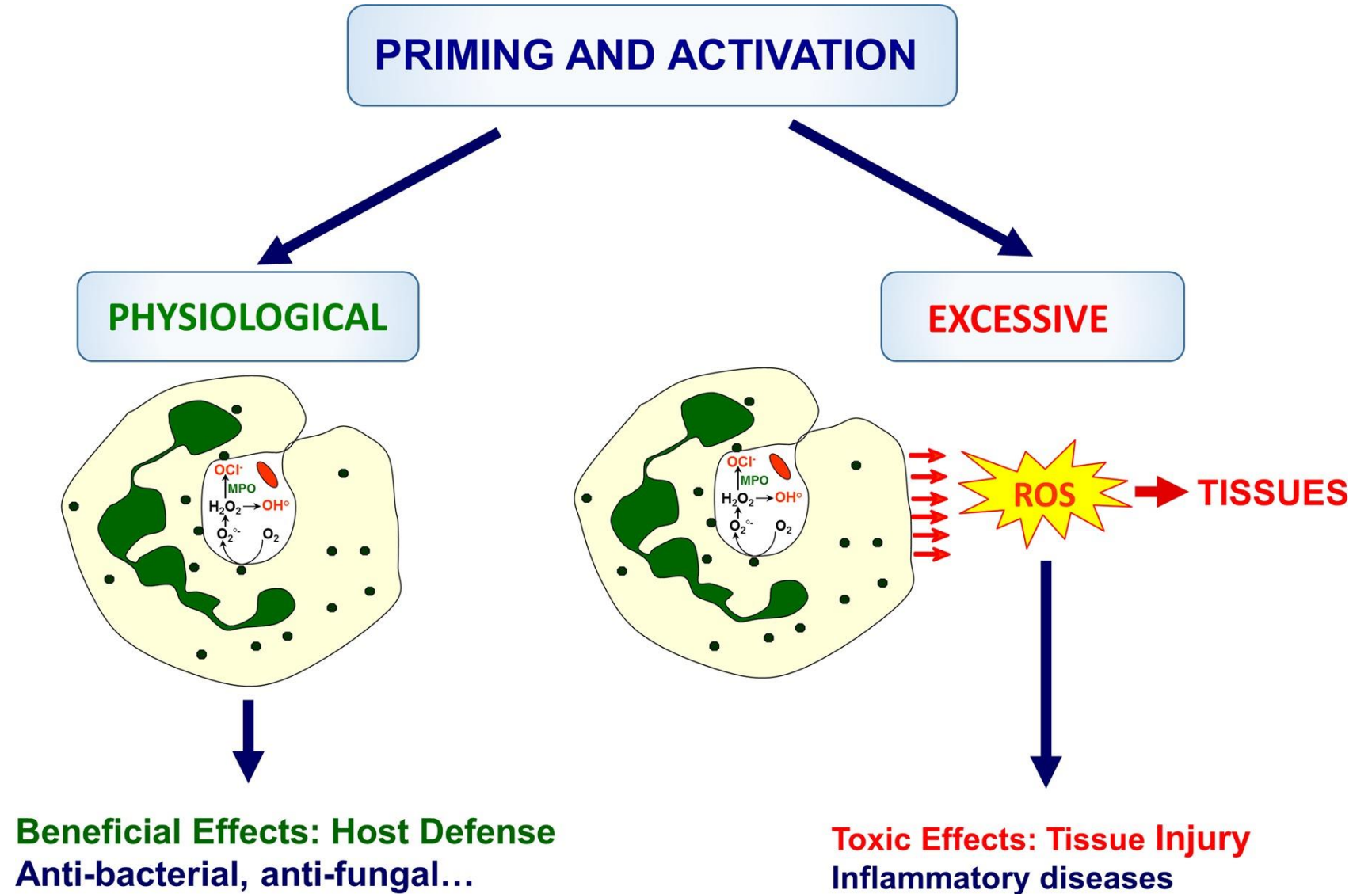
Innate Immunity

Inflammation



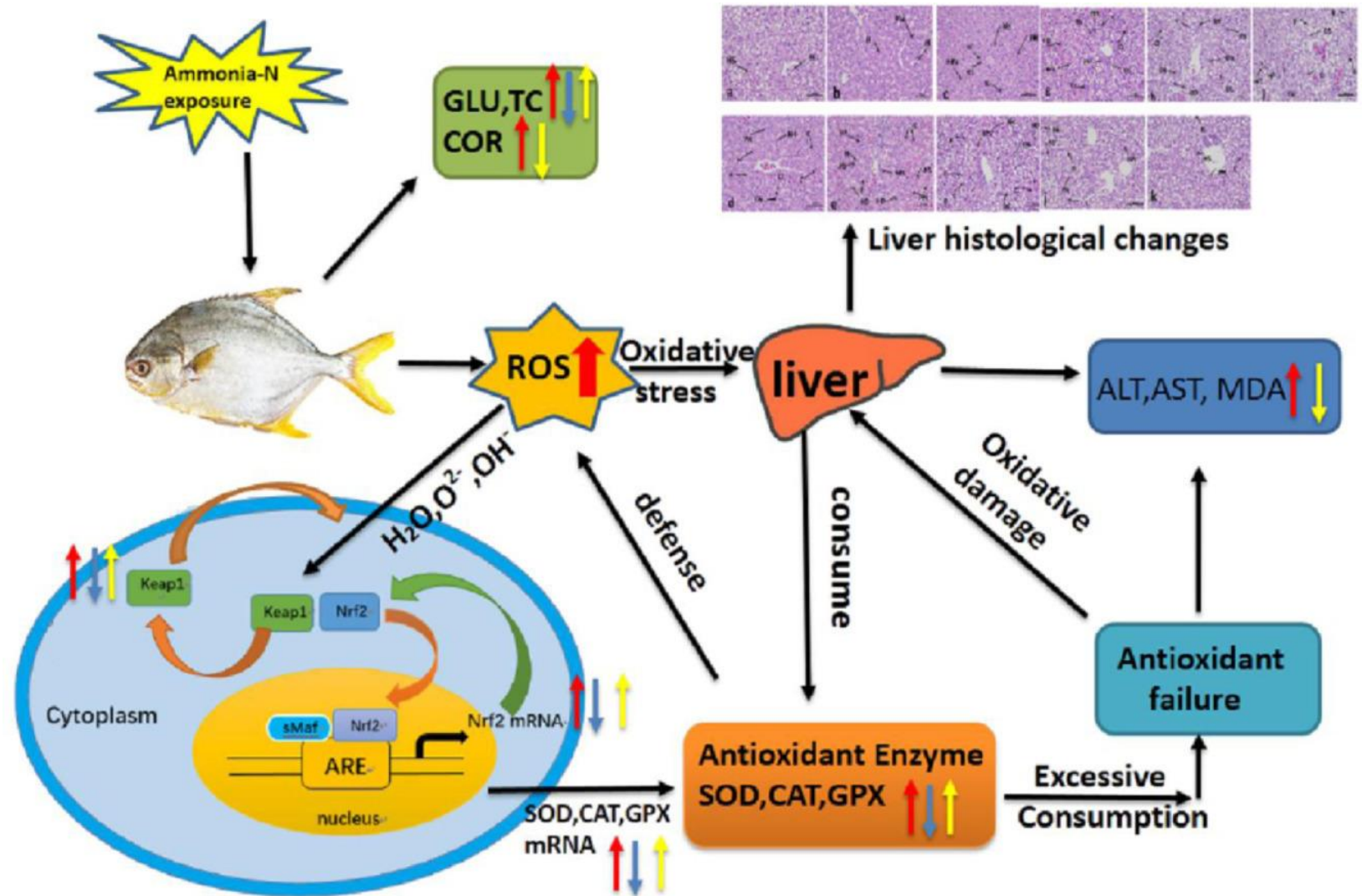
Innate Immunity

Respiratory burst

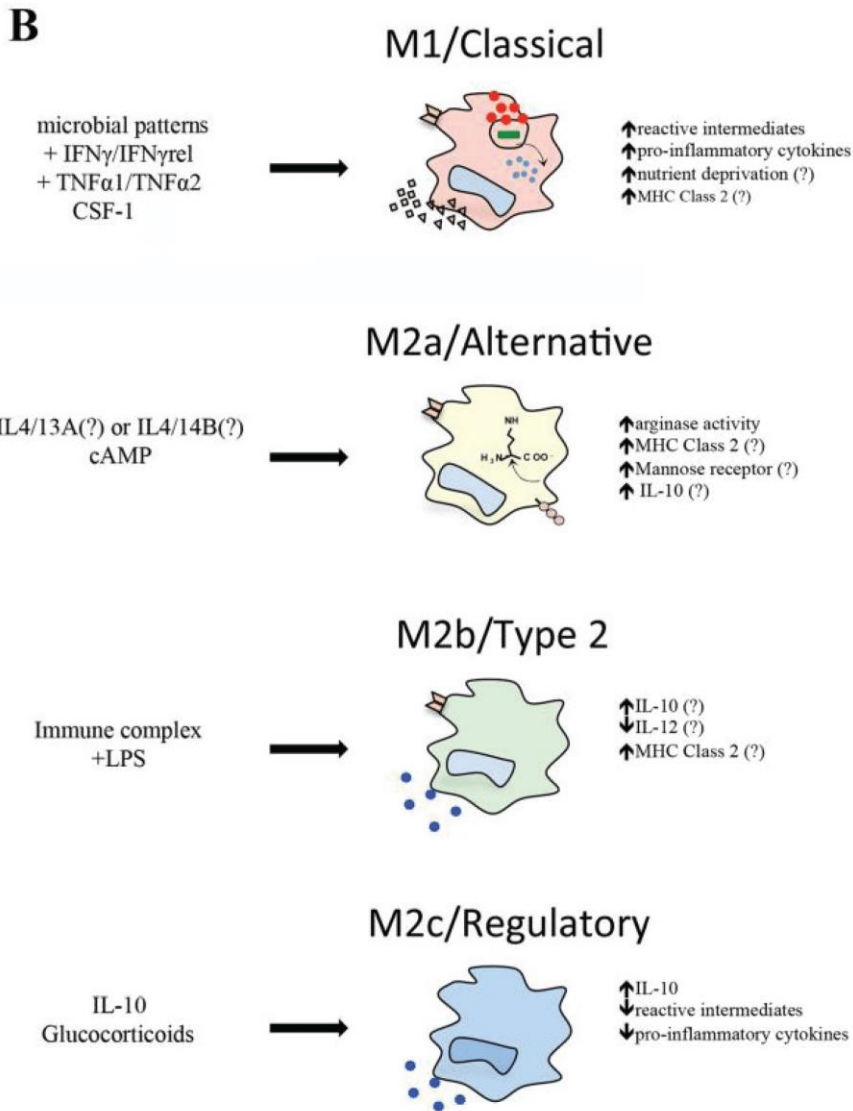
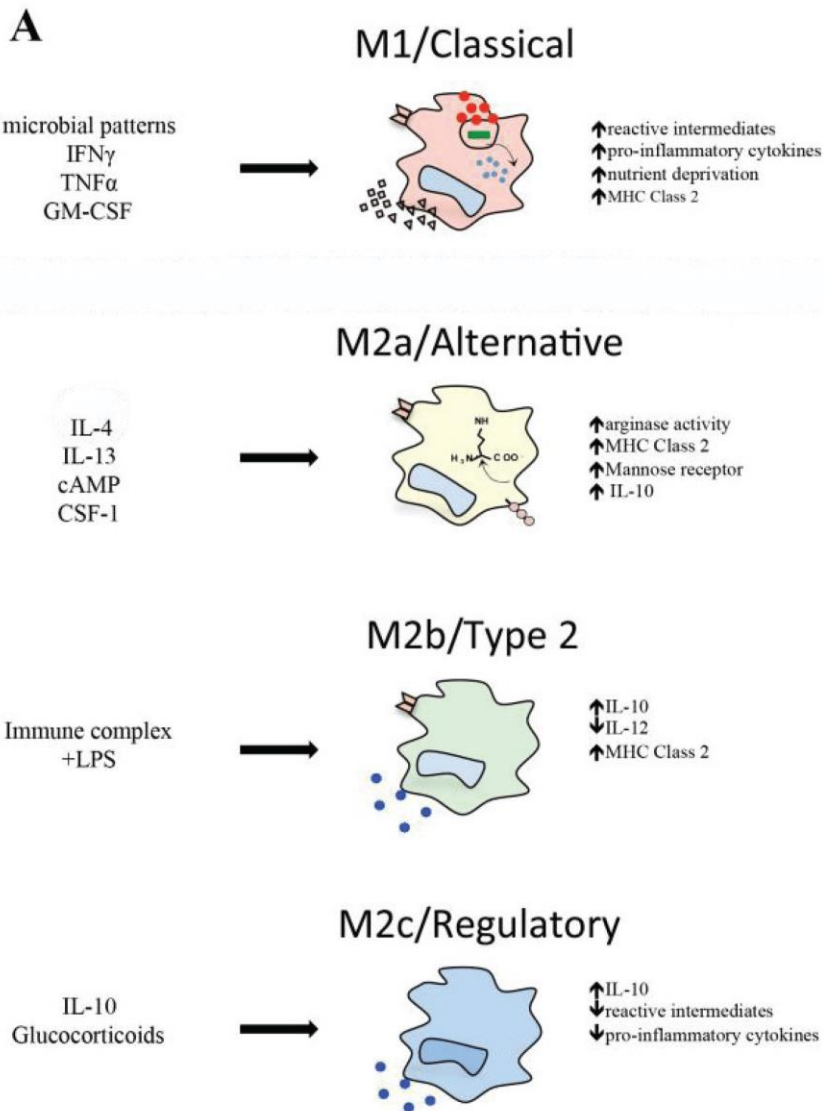


Innate Immunity

Antioxidant response



Innate Immunity

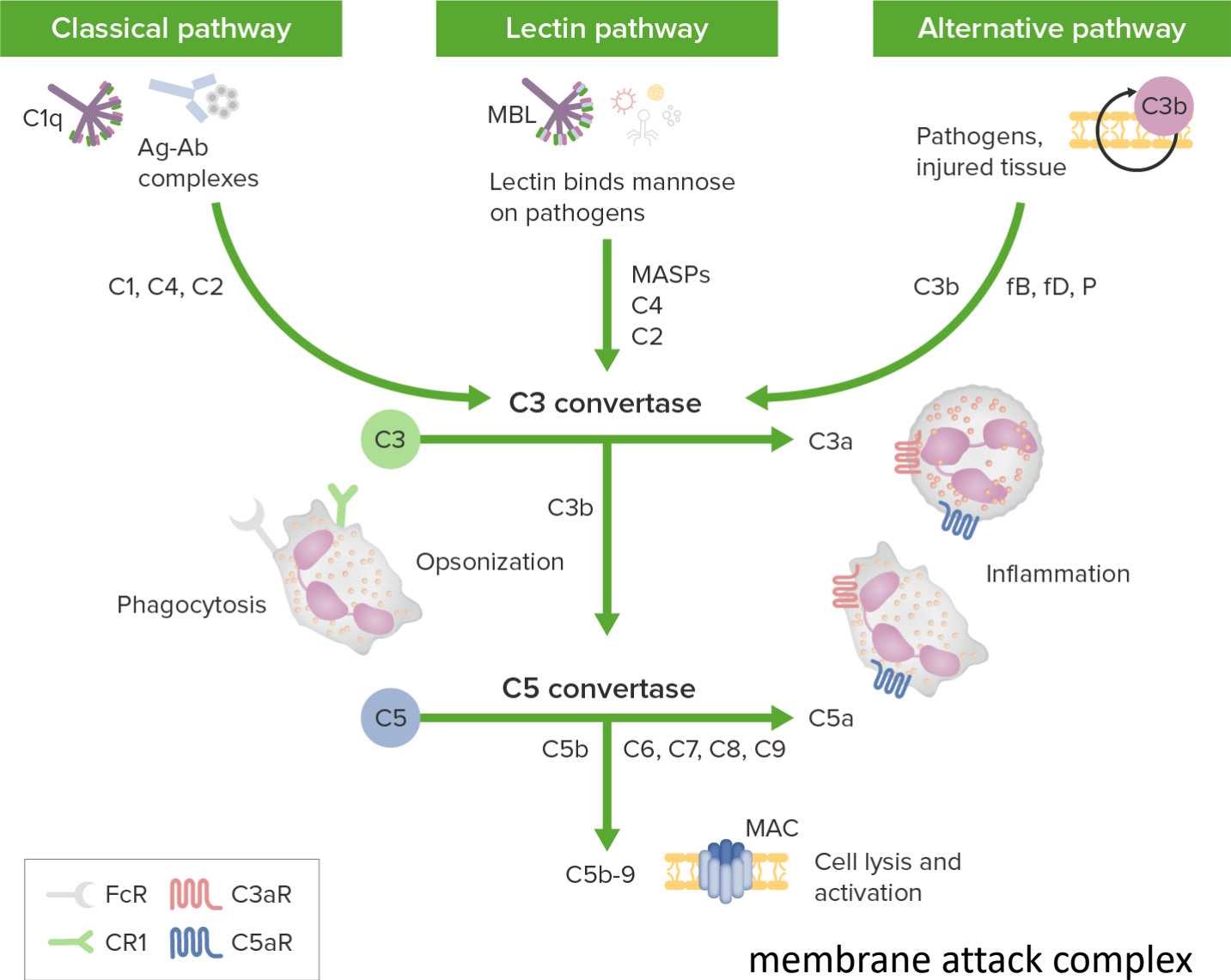


Mammals

Fish

Innate Immunity

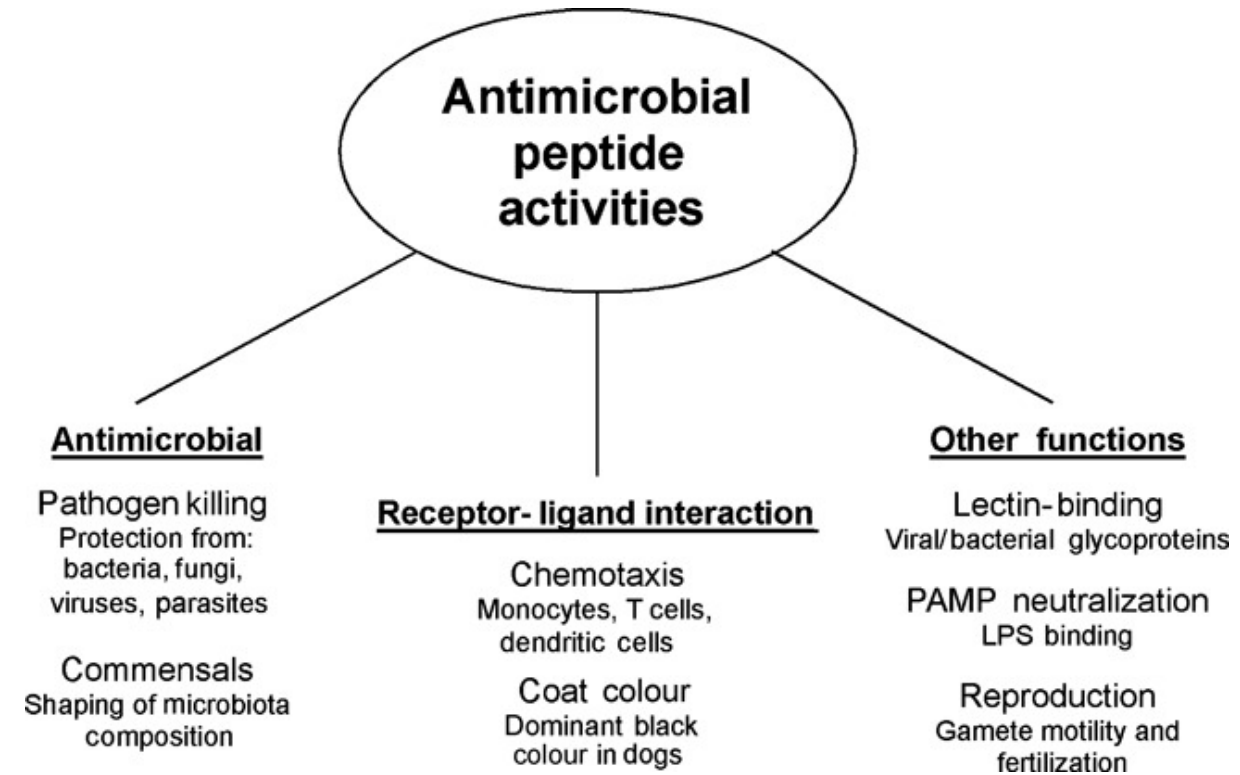
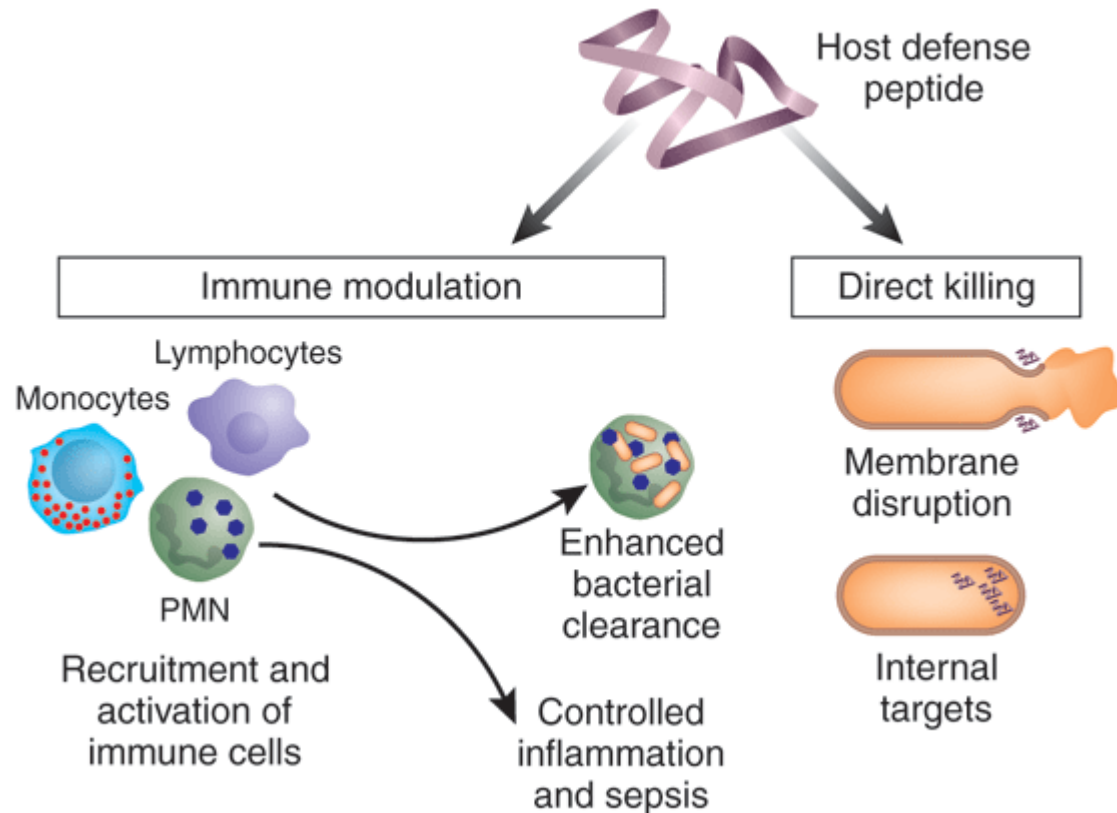
Humoral response



Innate Immunity

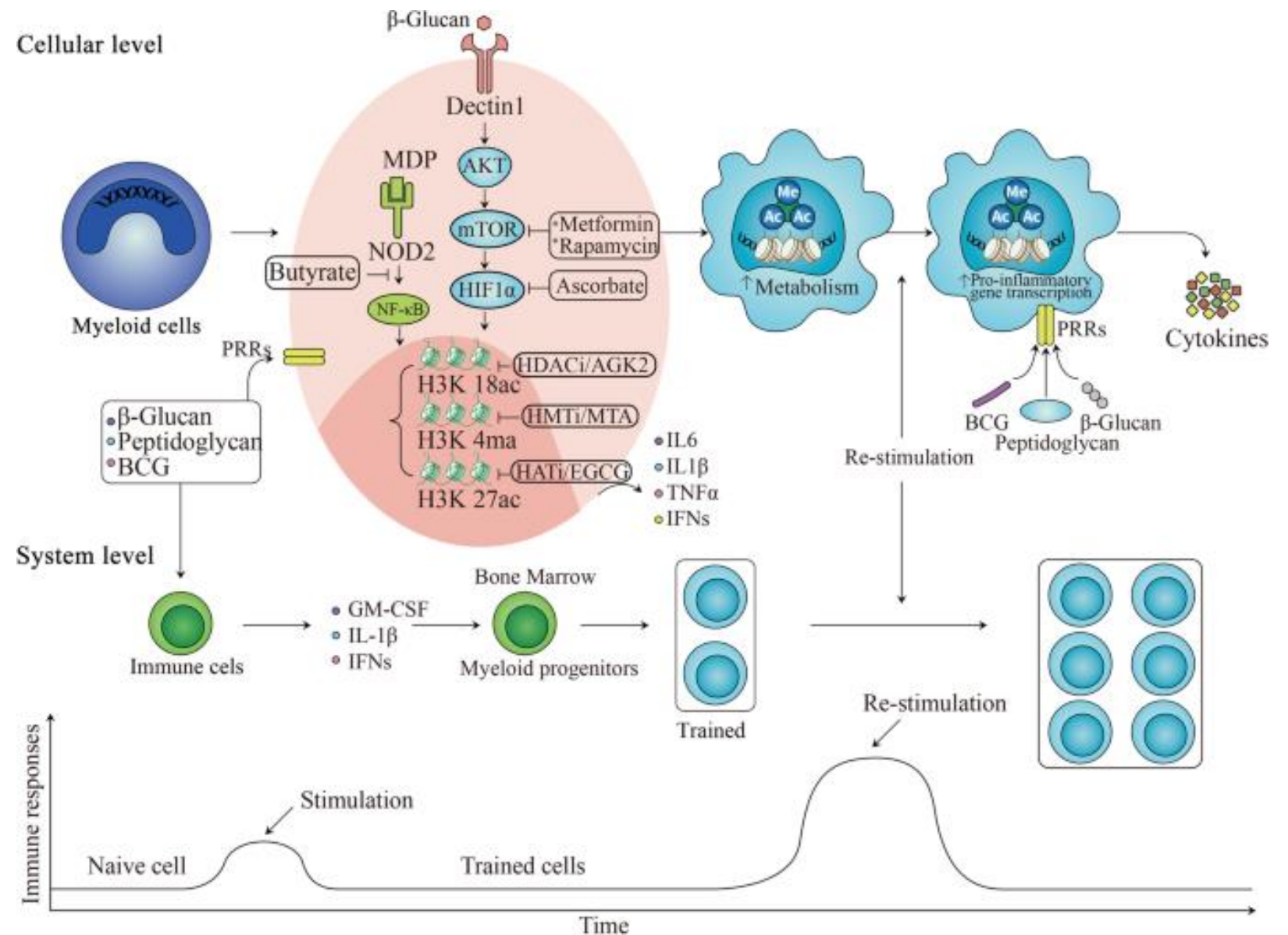
Humoral response

AMPs



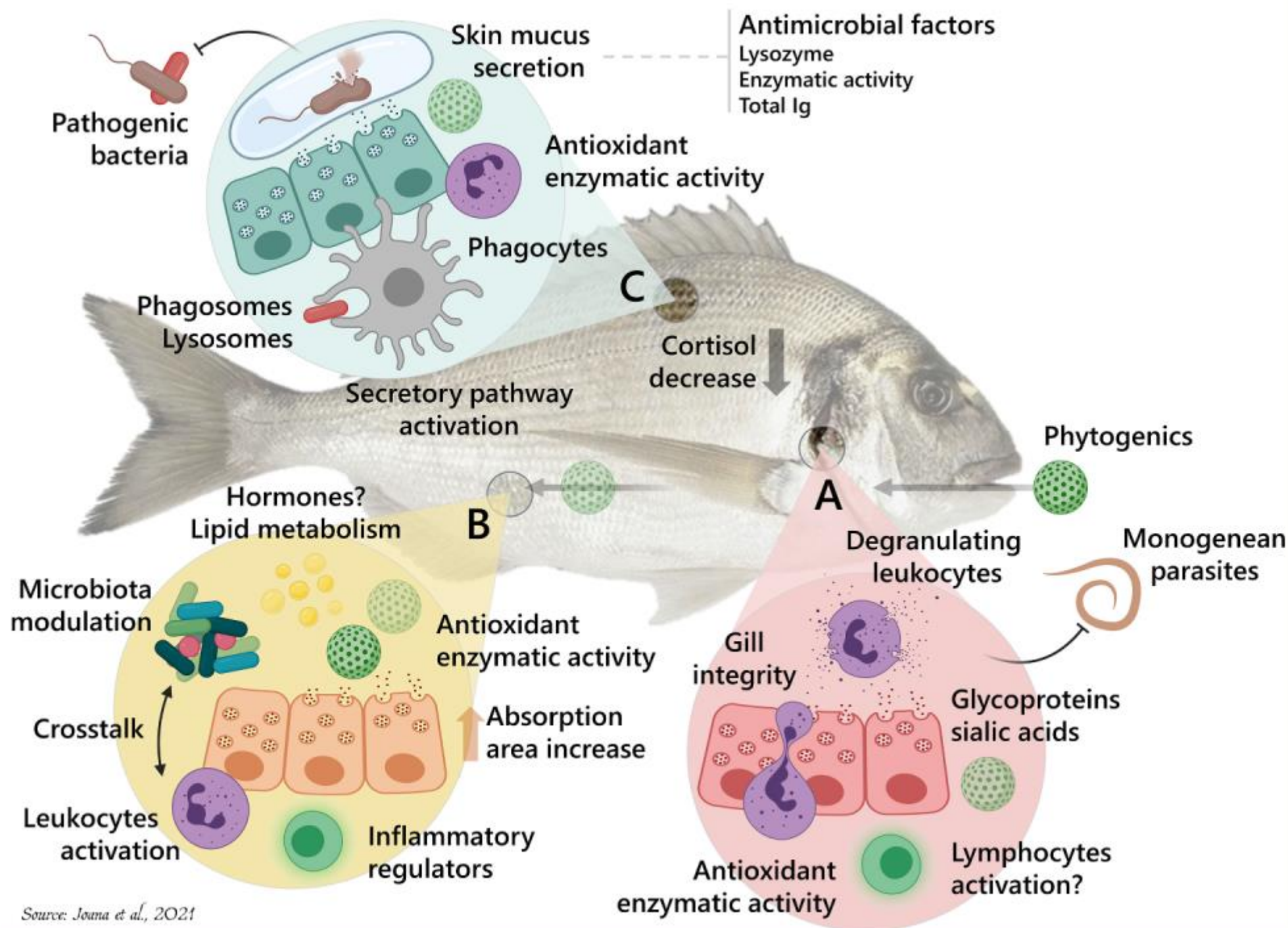
Innate Immunity

Trained immunity



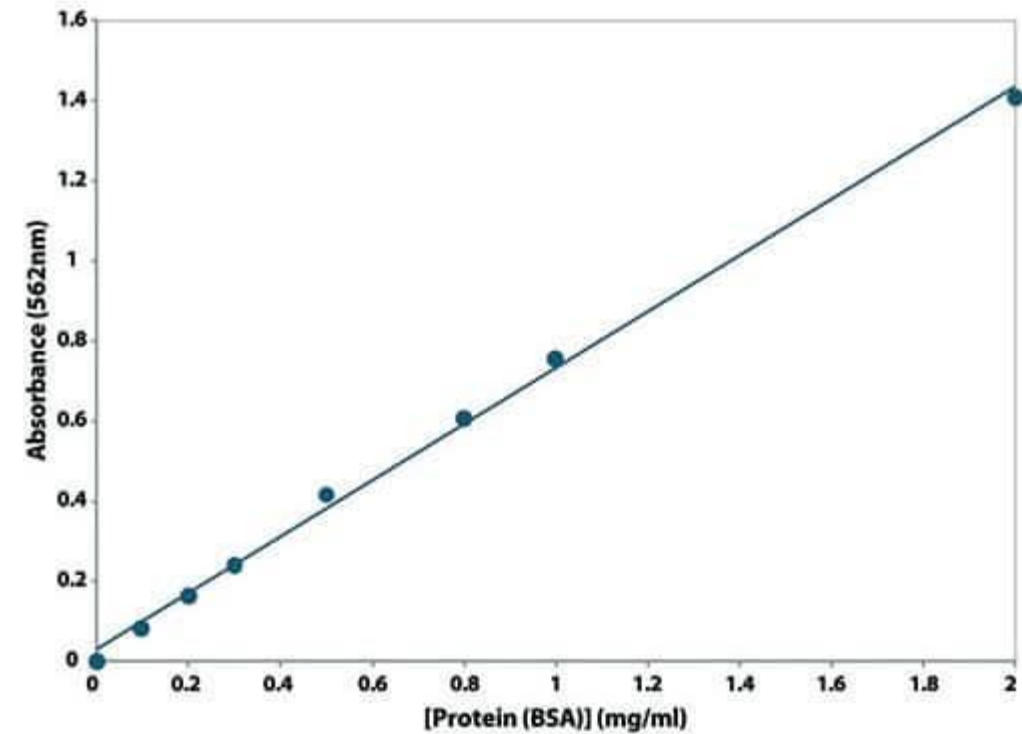
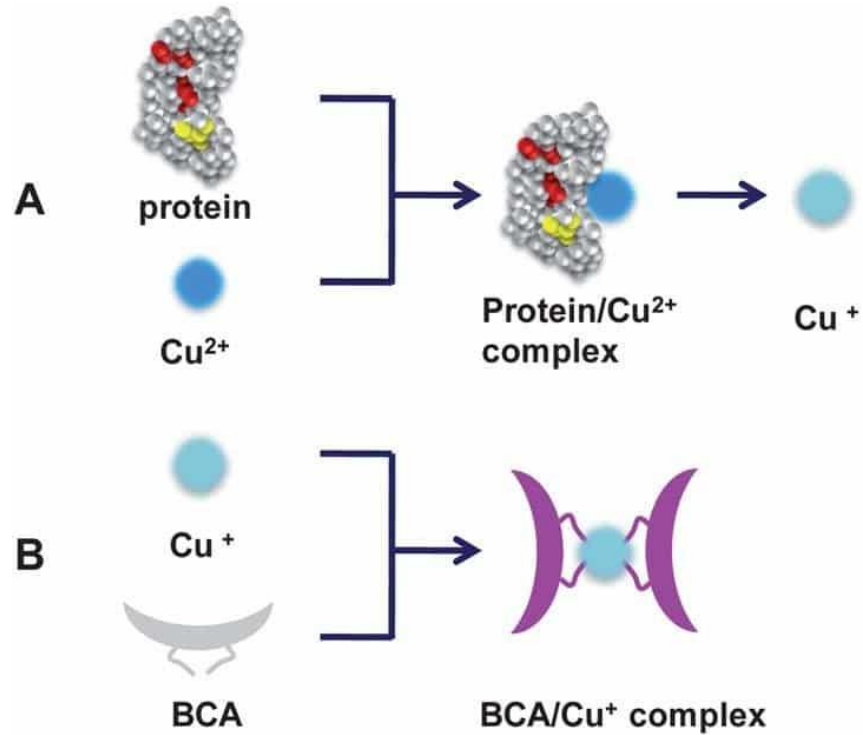
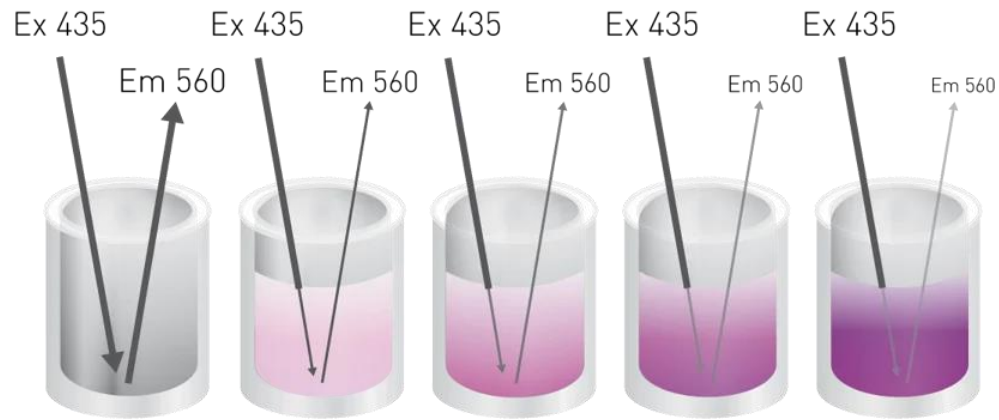
FISH INNATE IMMUNE SYSTEM

UNDERSTANDING THE FIRST LINE
OF DEFENCE



Lab

BCA



ELISA

Enzyme-linked
immunosorbent assay

Types of ELISA

