Antigen presentation process

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APC

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Antigen Presentation

Antigen presentation is a process of displaying parts of antigenic fragments—epitopes—to the immune cells bearing corresponding antigen receptors.

From: Encyclopedia of Infection and Immunity, 2022

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General definitions

Qiujun Zhou, ... Shasha Fan, in Biomedicine & Pharmacotherapy, 2022

2.1 Antigen presentation by EVs

Antigen presentation is a central biological process that links nonspecific and specific immunity and activates the specific immune system [14]. This process is mediated by antigen-presenting cells (APCs), a class of immune cells that can ingest and process antigens, and present the processed antigens to T cells. APCs include monocytes, DCs, B cells, Langerhans cells, endothelial cells, tumor cells, and virus-infected target cells [15]. Vesicles can carry antigens and transport them to APCs, where they are processed to form major histocompatibility complex (MHC) molecules that bind to T cell receptor and activate T cells [16]. Interestingly, MHC molecules and some proteins thought to be canonical markers, such as flotillin 1 and 70 kDa heat shock protein, have been identified in almost all exosomes [9].

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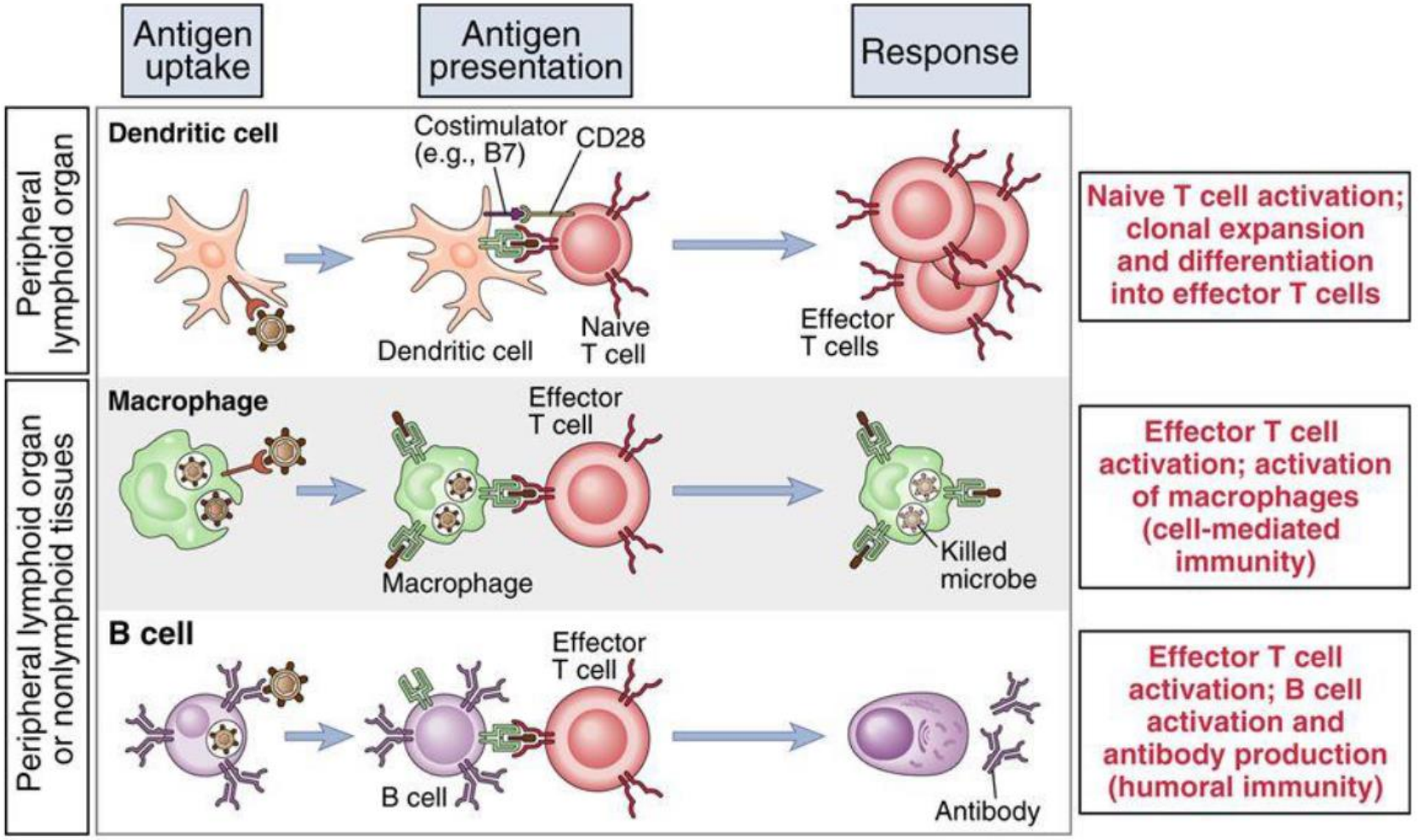
Functions of Different Antigen Presenting Cells



Abbas & Lichtman. Cellular and Molecular Immunology, 5th ed. W. B. Saunders 2003

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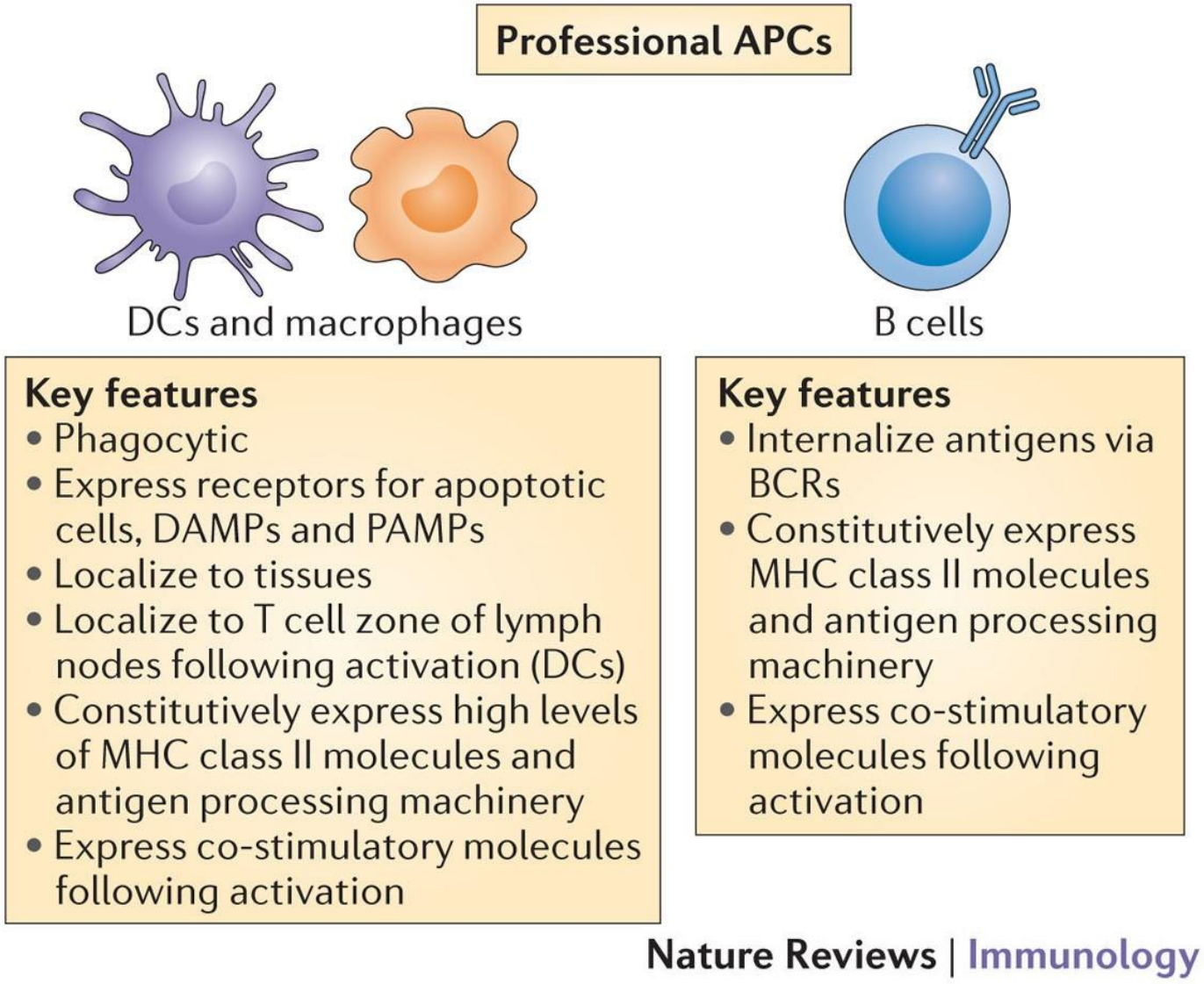
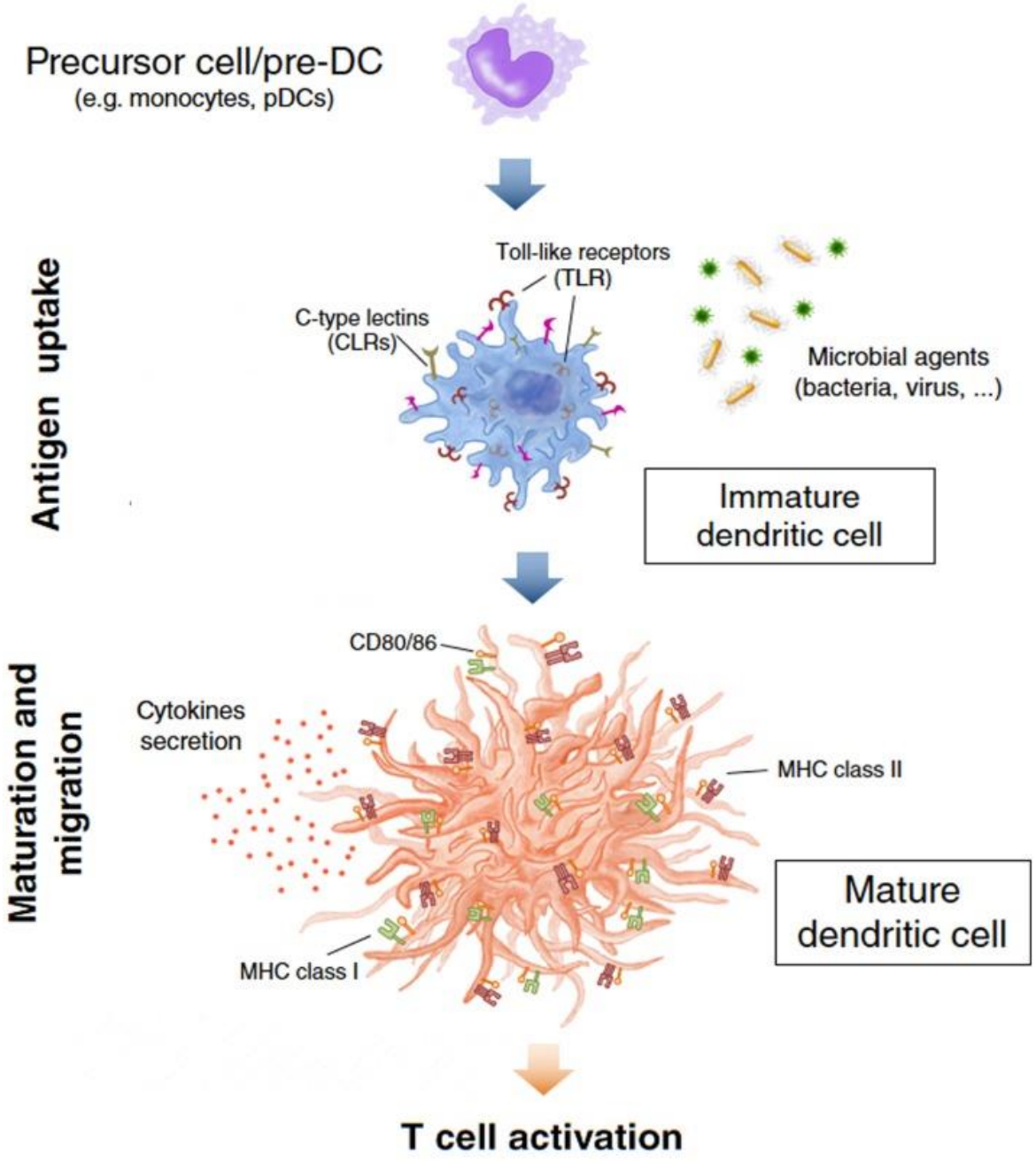
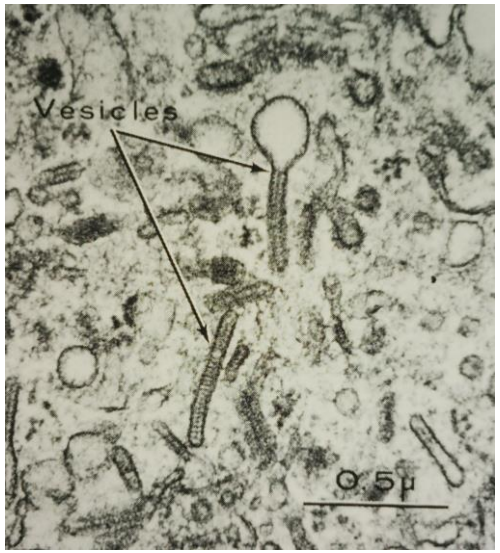
APCs?


Professional APCs
DCs and macrophages
B cells
Key features
• Phagocytic
• Express receptors for apoptotic cells, DAMPs and PAMPs
• Localize to tissues
• Localize to T cell zone of lymph nodes following activation (DCs)
• Constitutively express high levels of MHC class II molecules and antigen processing machinery
• Express co-stimulatory molecules following activation
Key features
• Internalize antigens via BCRs
• Constitutively express MHC class II molecules and antigen processing machinery
• Express co-stimulatory molecules following activation
Nature Reviews | Immunology

APC





Birbeck granules

APC

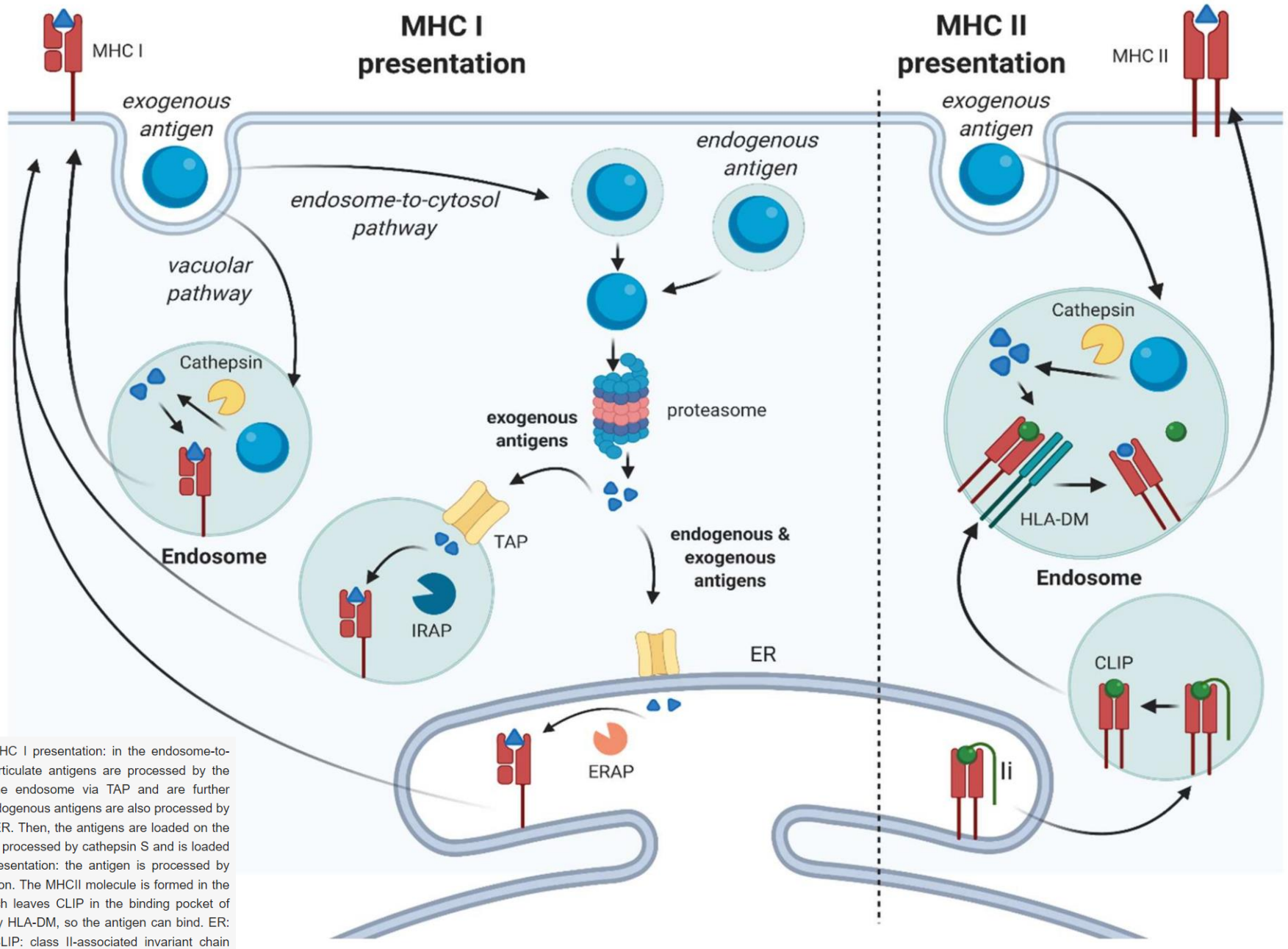


Figure 1. Exogenous antigen processing. MHC I presentation: in the endosome-to-cytosol pathway, exogenous soluble and particulate antigens are processed by the proteasome and enter either the ER or the endosome via TAP and are further processed by ERAP or IRAP, respectively. Endogenous antigens are also processed by the proteasome in the cytosol and enter the ER. Then, the antigens are loaded on the MHCI. In the vacuolar pathway, the antigen is processed by cathepsin S and is loaded onto the MHCI in an endosome. MHC II presentation: the antigen is processed by cathepsins in the endosome after internalization. The MHCII molecule is formed in the ER and Ii is cleaved in the endosome, which leaves CLIP in the binding pocket of MHCII. In the endosome, CLIP is removed by HLA-DM, so the antigen can bind. ER: endoplasmic reticulum; Ii: invariant chain; CLIP: class II-associated invariant chain peptide; TAP: transporter associated with antigen processing; IRAP: insulin-regulated aminopeptidase; ERAP: endoplasmic reticulum aminopeptidase; MHC: major histocompatibility complex.

MHC

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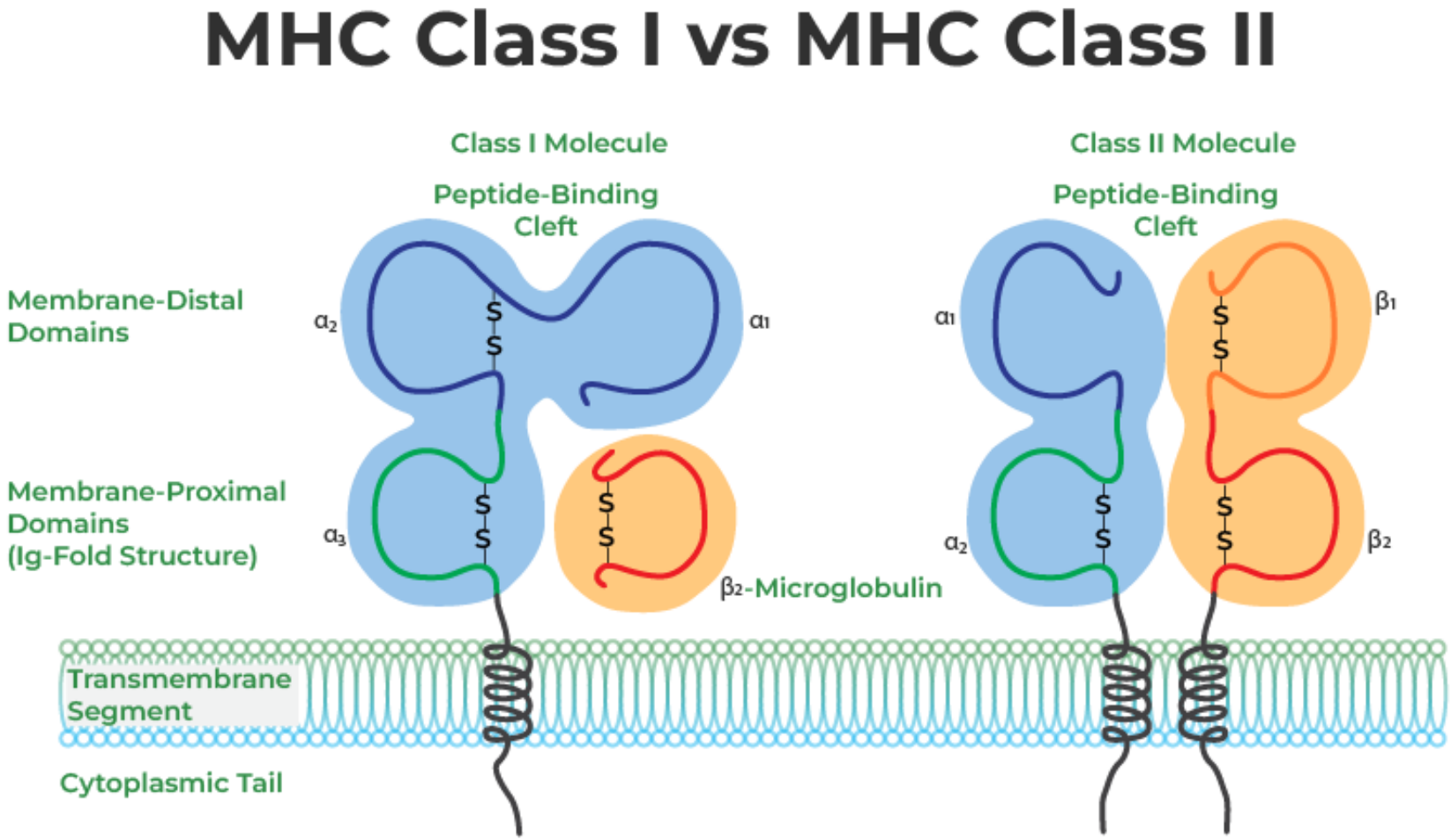
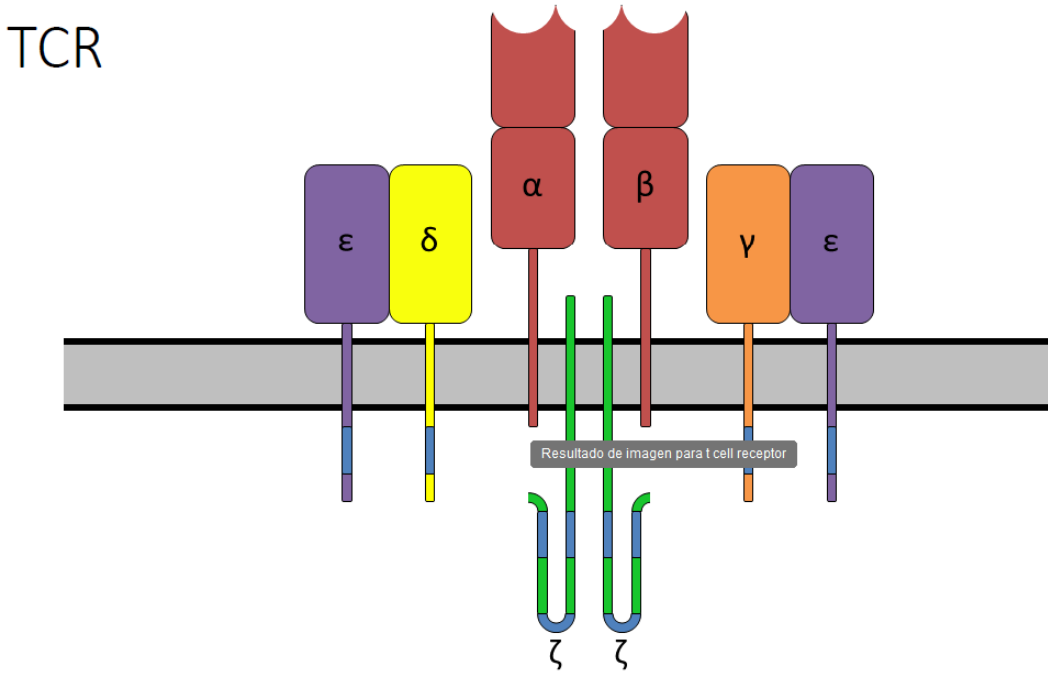
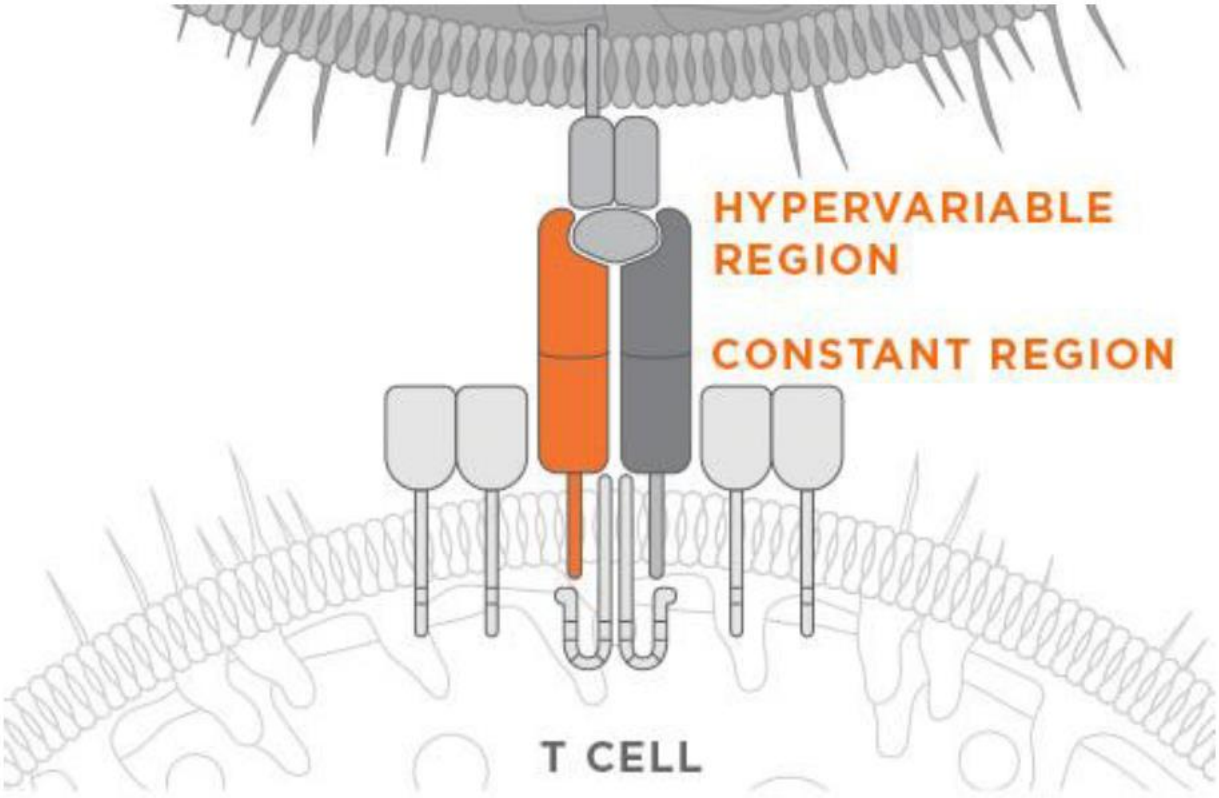
Major histocompatibility complex



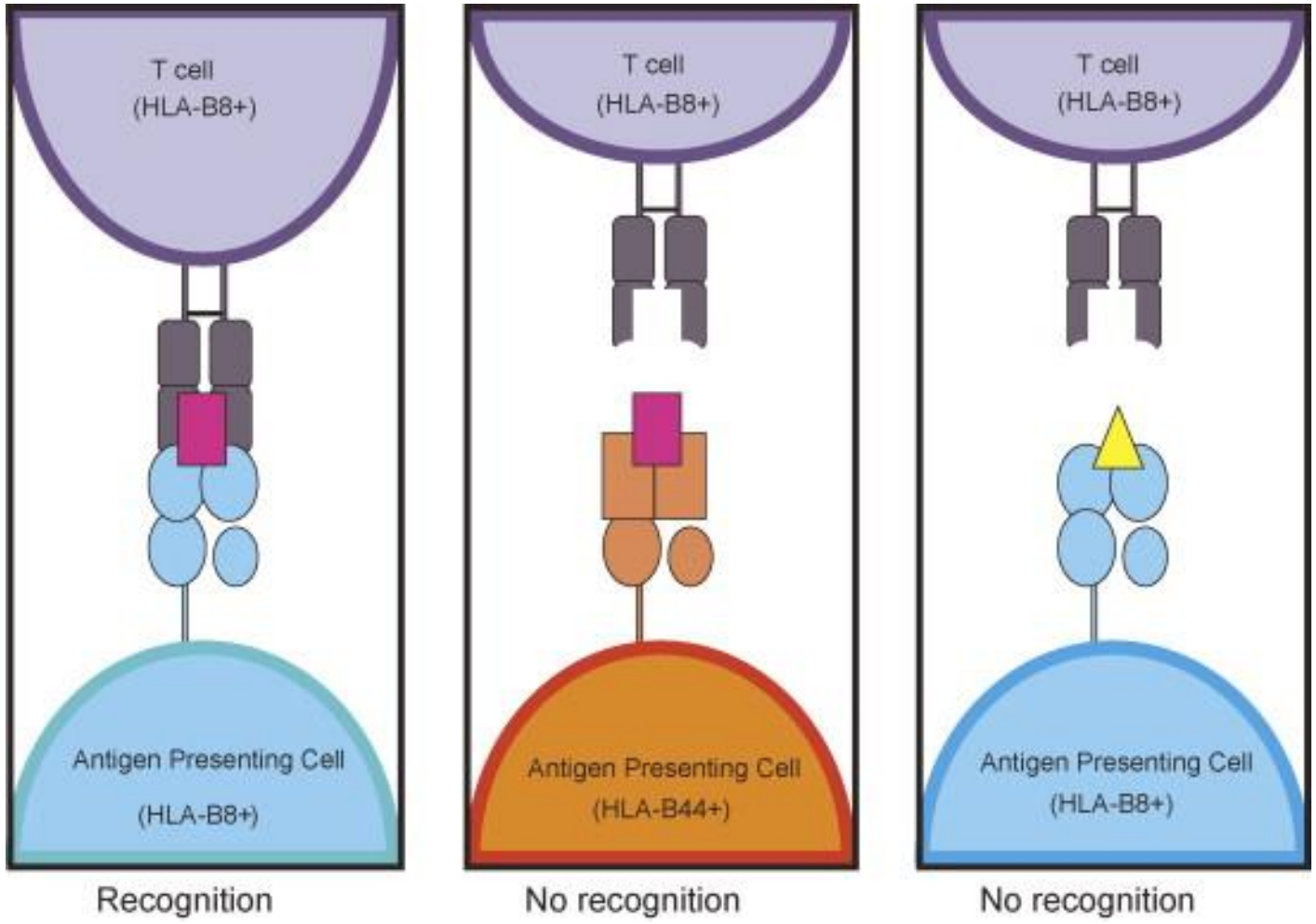
TCR


TCR
ε
δ
α
β
γ
ε
ζ
ζ
Resultado de imagen para t cell receptor


HYPERVARIABLE REGION
CONSTANT REGION
T CELL

Adaptive Immunity

MHC restriction



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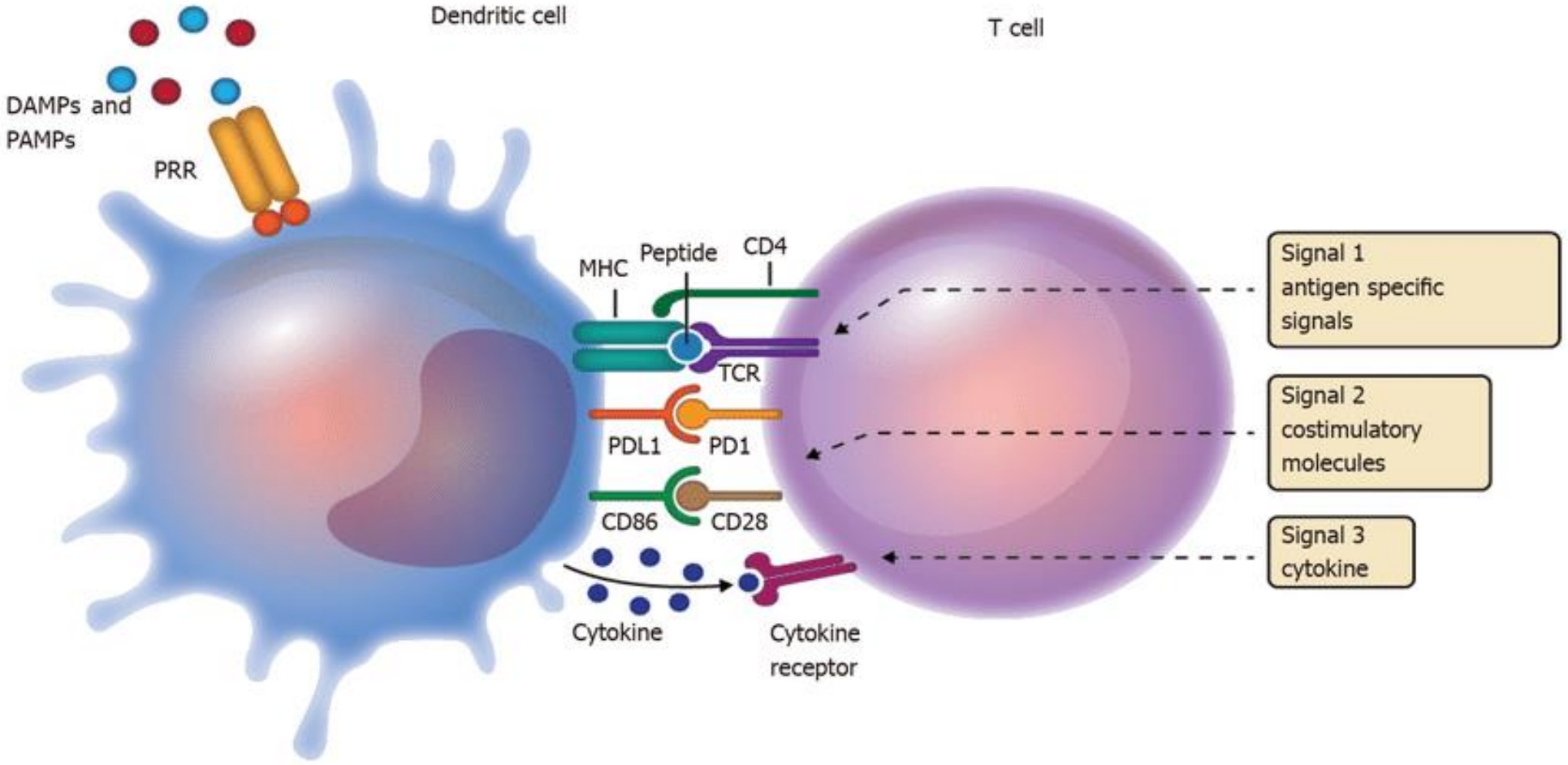
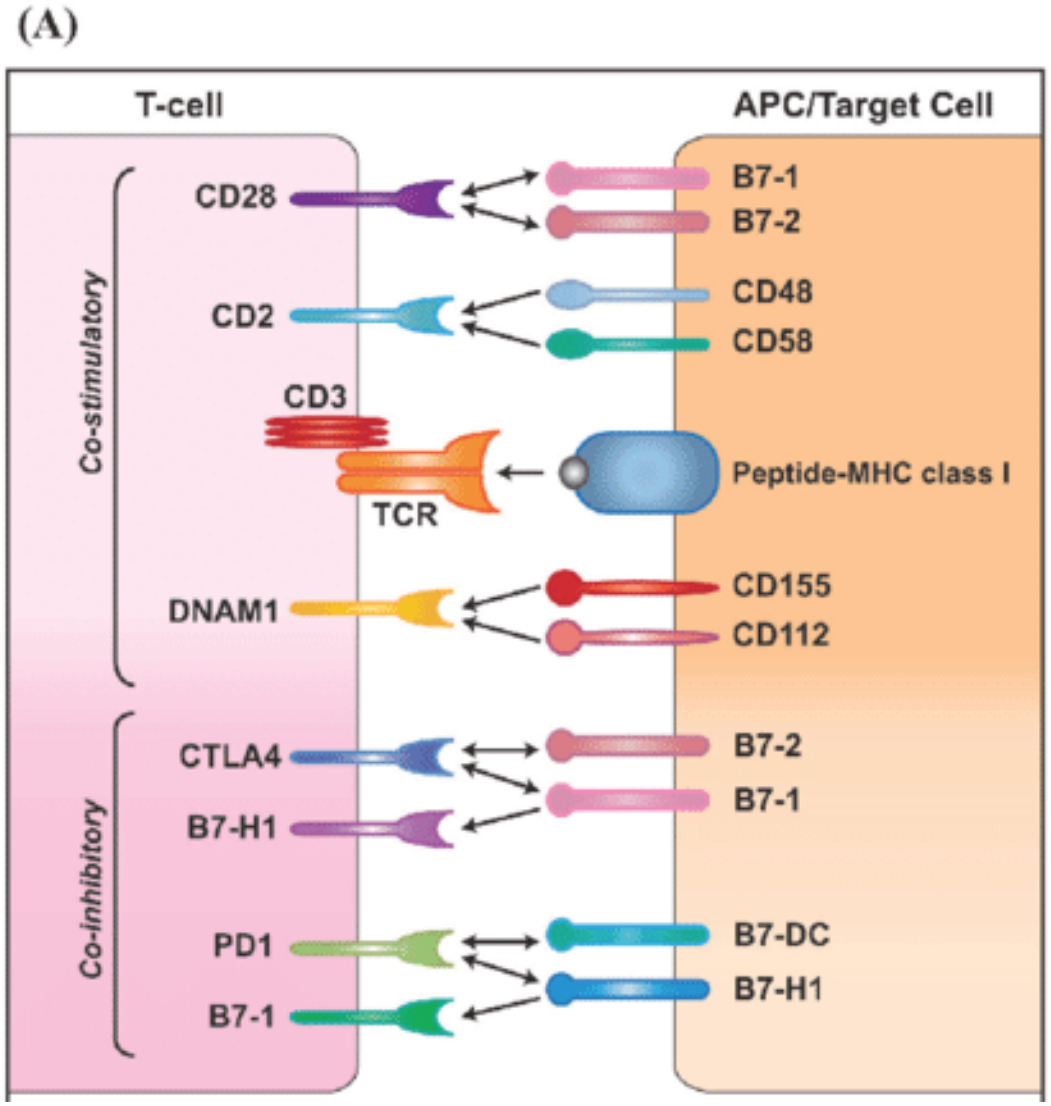


Immunological synapse

Co-stimulation



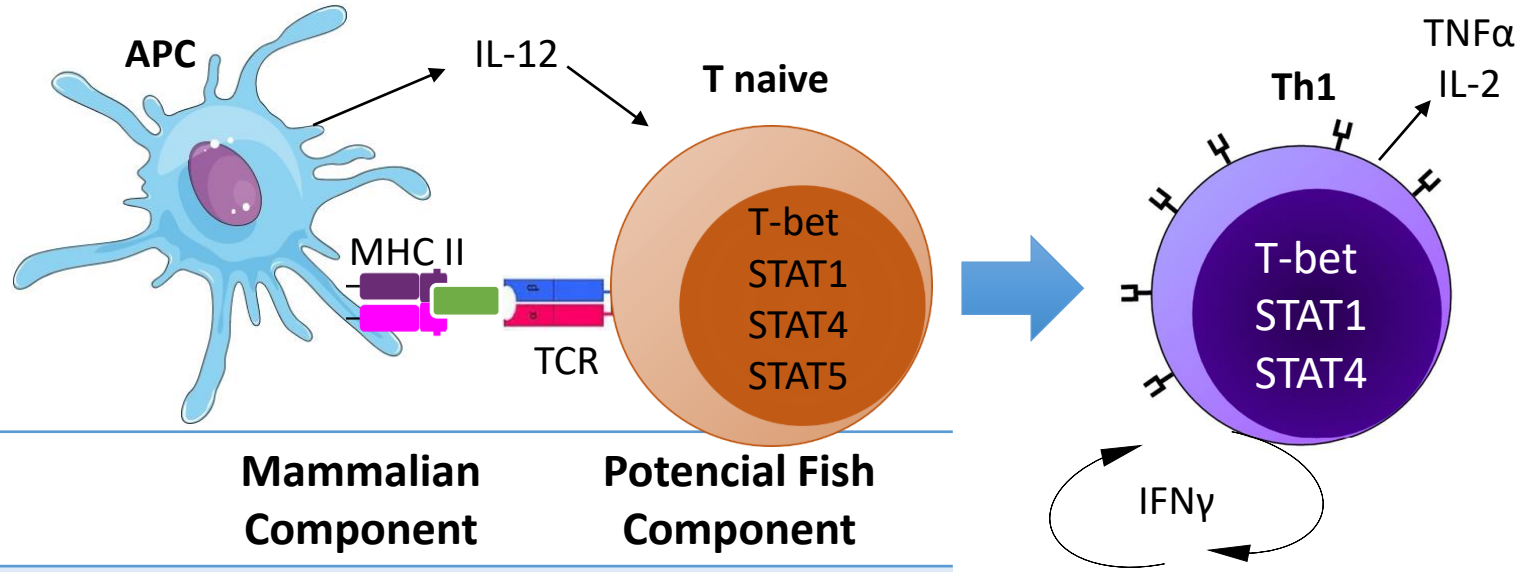
Article | PDF Available | Literature Review

The Role of the Immunological Synapse Formed by Cytotoxic Lymphocytes in Immunodeficiency and Anti-Tumor Immunity

December 2015 · Critical Reviews in Immunology 35(4):325-347
December 2015 · 35(4):325-347
DOI:10.1615/CritRevImmunol.2015014417

Illustration of (A) T-cell co-stimulation versus co-inhibition. Following TCR-mediated recognition of peptide-bound MHC class I, multiple co-inhibitory and co-stimulatory signals dictate if T-cell effector function is initiated, maintained, or terminated. The archetypical co-stimulatory event involves CD28 and B7-1/-2 interaction; however, multiple other co-stimulatory molecules such as CD2 and DNAM-1 can promote effector T-cell function. Co-inhibitory molecules limit T-cell responses, ensuring immune homeostasis is reinstated after activation. CTLA-4 and PD-1 have emerged as potent inhibitors of T-cell activity, both after infection and during cancer. (B) NK cell activatory versus inhibitory receptors. NK cell

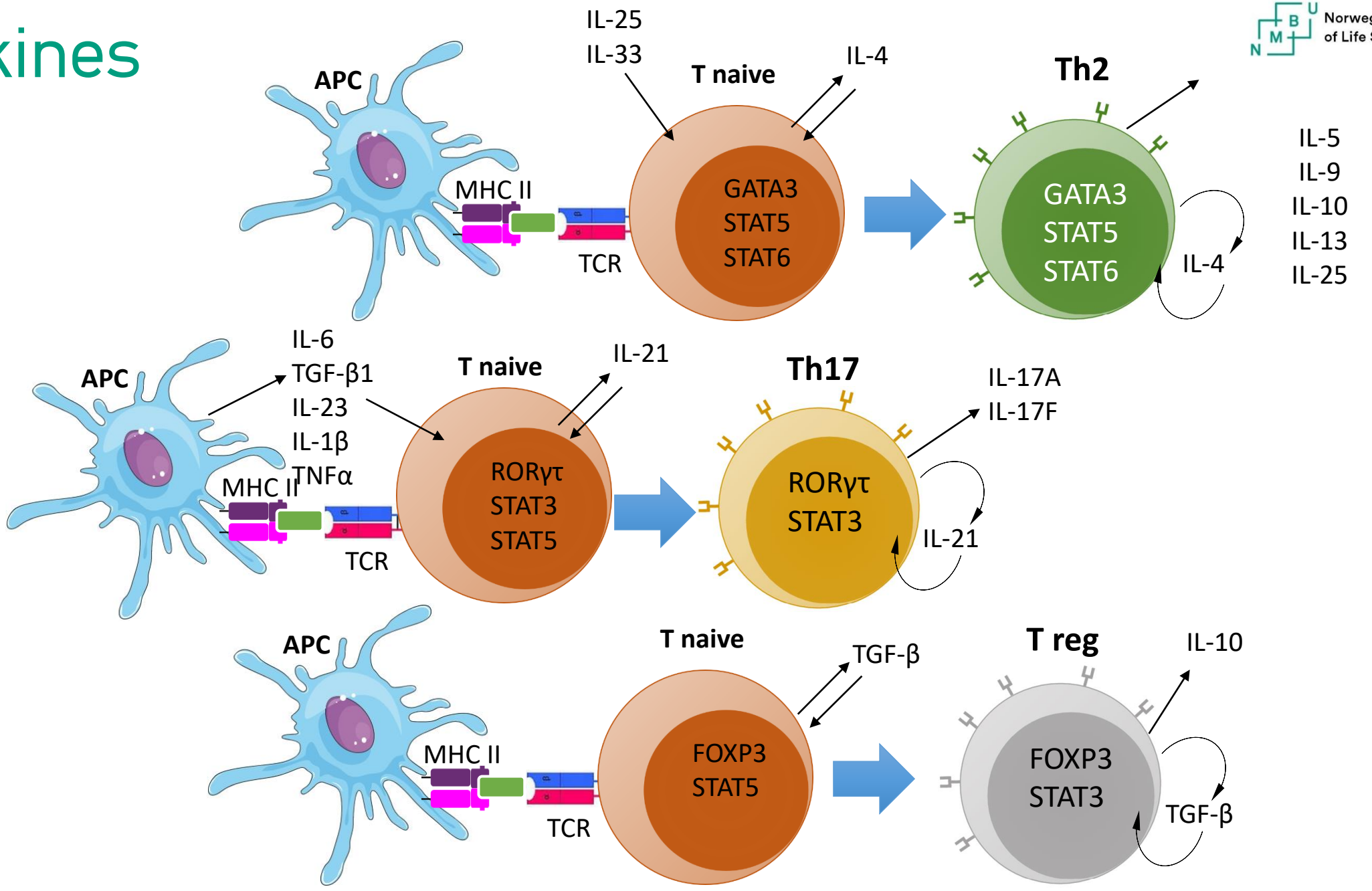
Cytokines



Th1	Mammalian Component	Potencial Fish Component
Driver Cytokines	IL-12	Multiple isoforms
	IFN-γ	IFN-γ, IFN-γ rel
	IL-2	IL-2, IL-2L
Effector Cytokines	IFN-γ	IFN-γ, IFN-γ rel
	IL-2	IL-2, IL-2L
	TNF-α	Two types of TNF-α
Master TF	T-bet	T-bet
Other TF	STAT4	STAT4
	STAT1	STAT1

Wang & Secombes, 2013

Cytokines



Wang & Secombes, 2013

Fish

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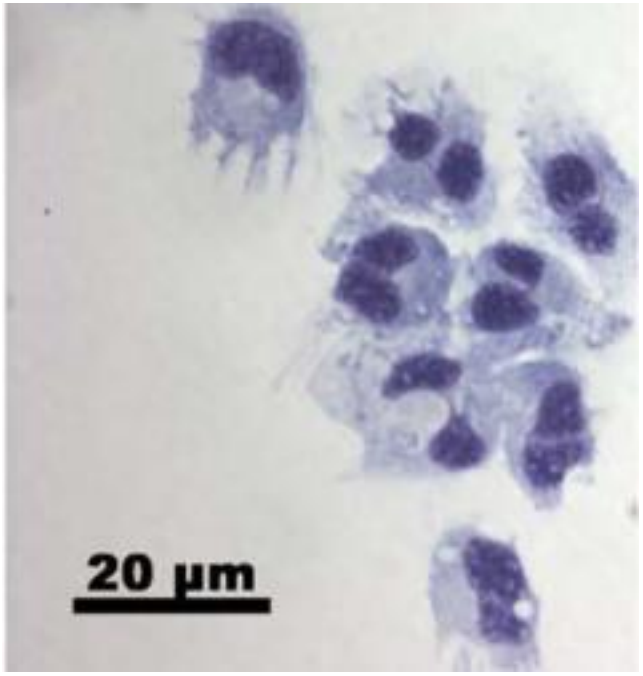
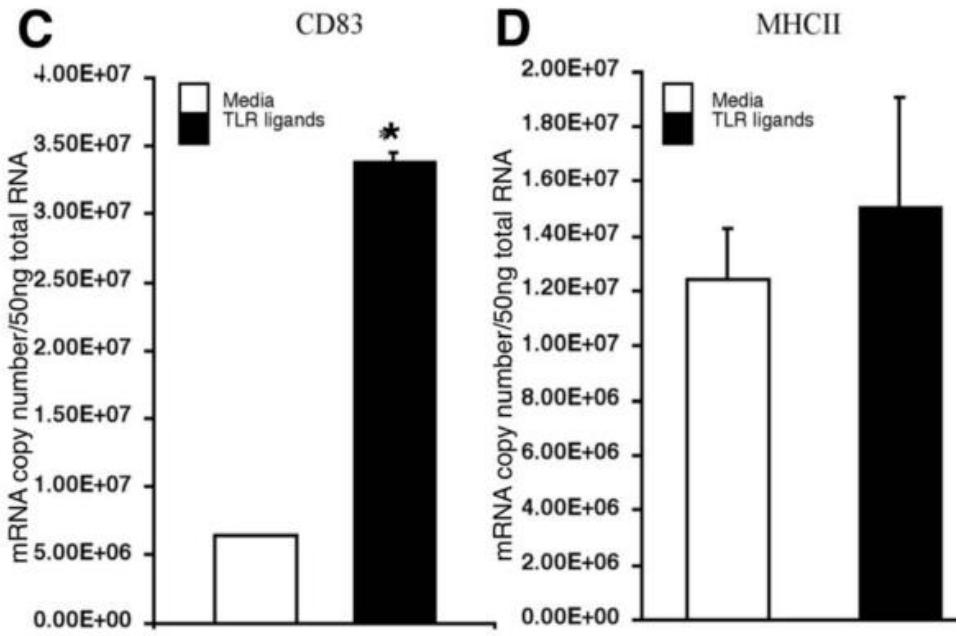
PLOS ONE

Functional Identification of Dendritic Cells in the Teleost Model, Rainbow Trout (*Oncorhynchus mykiss*)

Elizabeth Bassity, Theodore G. Clark

Published: March 12, 2012 • https://doi.org/10.1371/journal.pone.0033196





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ORIGINAL RESEARCH article
Front. Immunol., 13 May 2021
Sec. Comparative Immunology
Volume 12 - 2021 | https://doi.org/10.3389/fimmu.2021.666356

Interferon Gamma Induces the Increase of Cell-Surface Markers (CD80/86, CD83 and MHC-II) in Splenocytes From Atlantic Salmon

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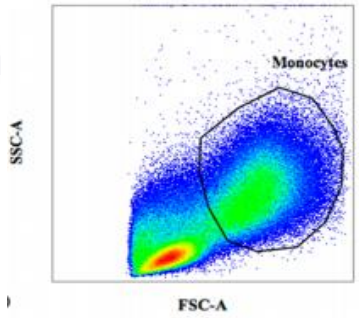
Sebastián Boltaña[6] Javier Alcaino[7] Carlos Soto[8] Luis Mercado[1*]

Journal of Fungi
MDPI
Article

Monocyte Phenotype and IFN-γ-Inducible Cytokine Responses Are Associated with Cryptococcal Immune Reconstitution Inflammatory Syndrome

David B. Meya [1,2,3,*], Samuel Okurut [4], Godfrey Zziwa [4], Stephen Cose [5,6], Paul R. Bohjanen [2], Harriet Mayanja-Kizza [3], Moses Joloba [7], David R. Boulware [2], Carol Yukari Manabe [8], Sharon Wahl [9] and Edward N. Janoff [10]



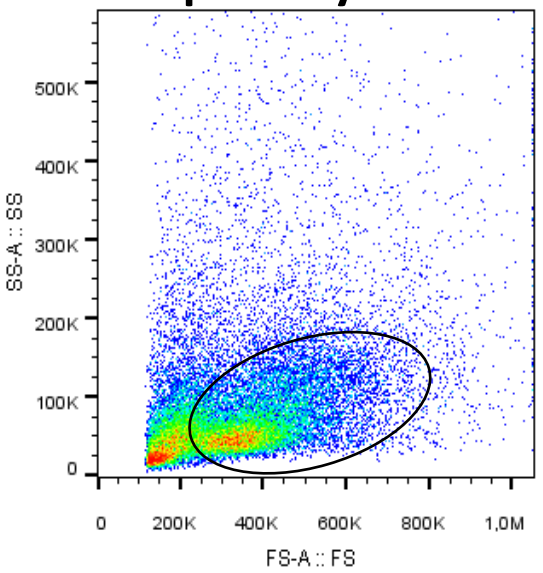
PLOS ONE

Characterization of Small, Mononuclear Blood Cells from Salmon Having High Phagocytic Capacity and Ability to Differentiate into Dendritic like Cells

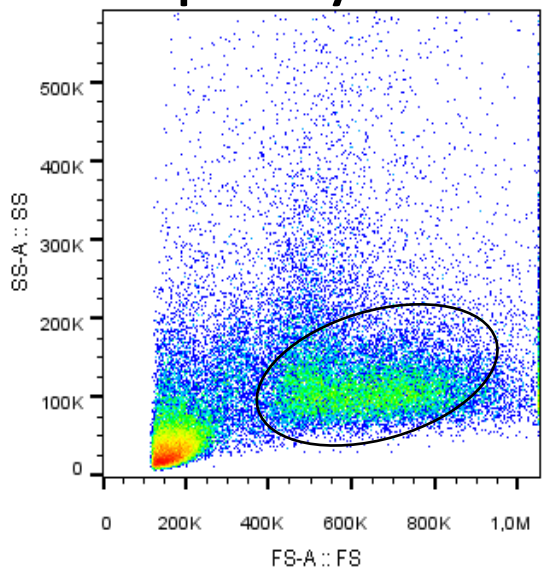
Gyri T. Haugland, Ann-Elise O. Jordal, Heidrun I. Wergeland

Published: November 14, 2012 • https://doi.org/10.1371/journal.pone.0049260

Splenocytes 1D



Splenocytes 15D



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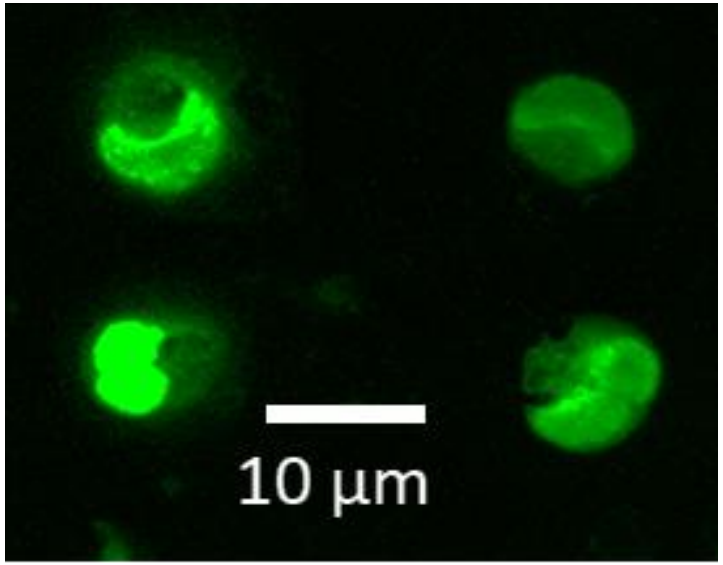
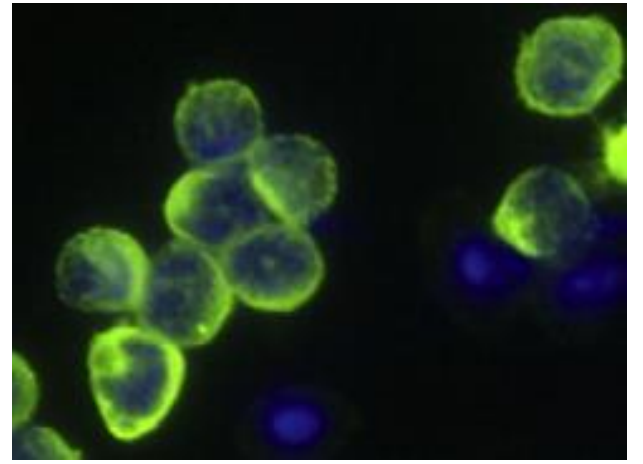
Splenocytes 15D





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Núcleo

Journal of Immunological Methods 362 (2010) 10–21

Contents lists available at ScienceDirect

Journal of Immunological Methods

journal homepage: www.elsevier.com/locate/jim

Research paper

Immunostaining of Atlantic salmon (*Salmo salar* L.) leucocytes

Gyri Teien Haugland, Eirin Fausa Pettersen, Cecilie Sviland, Anita Rønneseth, Heidrun I. Wergeland *

Department of Biology, University of Bergen, Bergen High-Technology Center, NO-5020 Bergen, Norway

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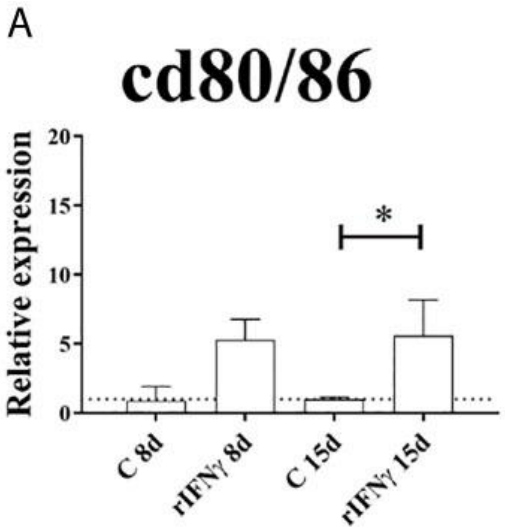

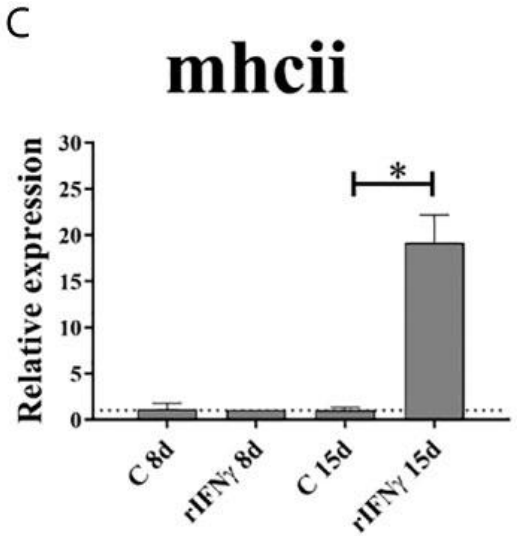

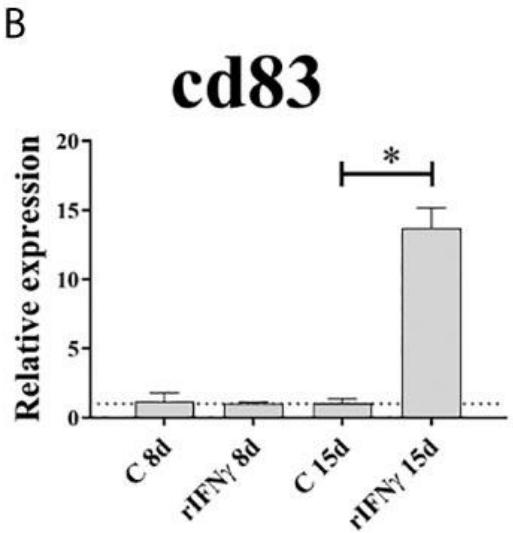

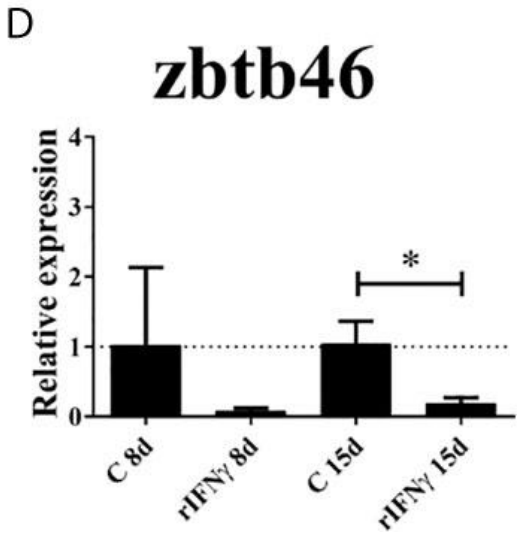

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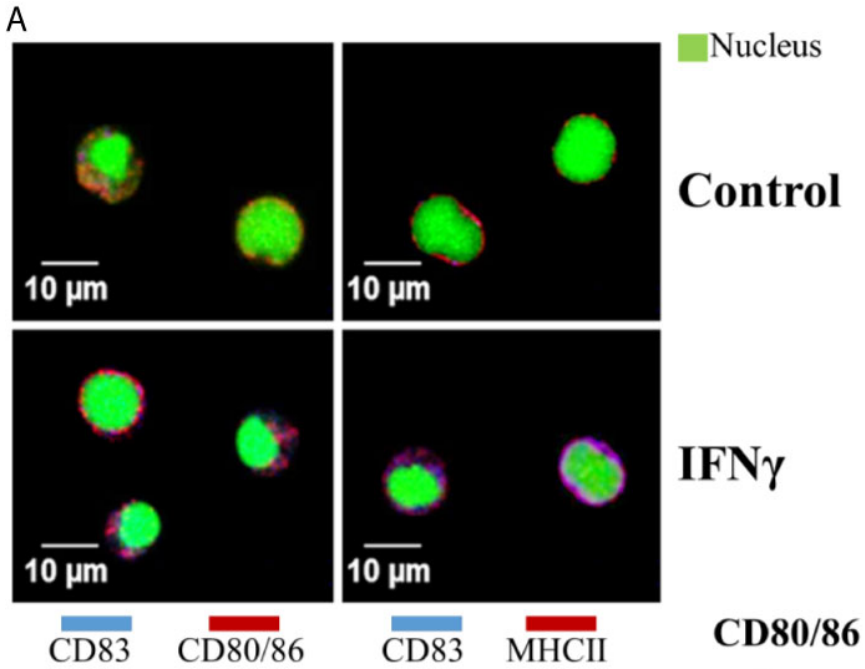

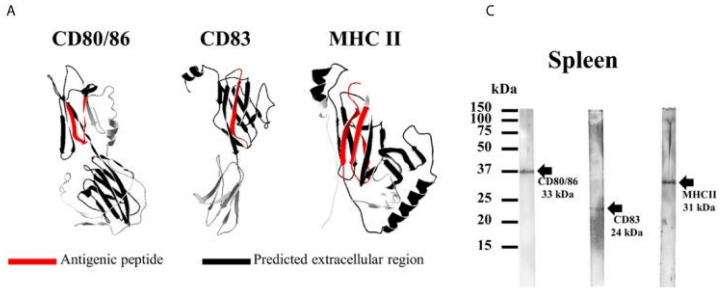

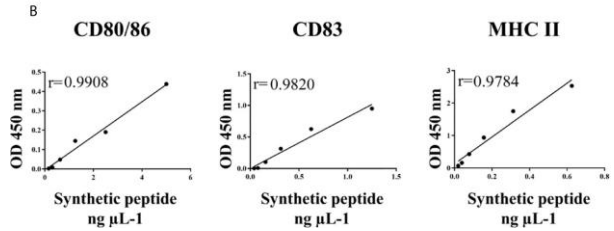

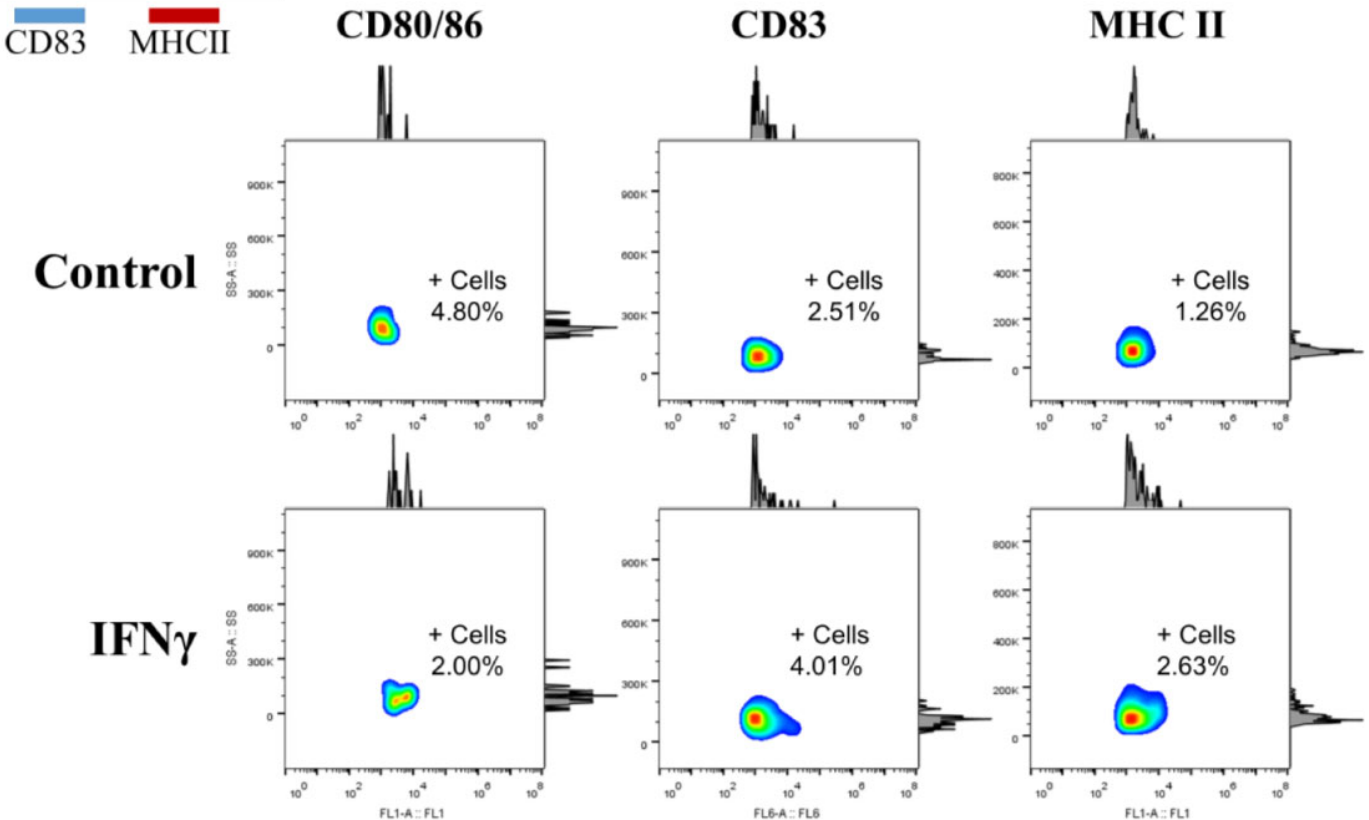

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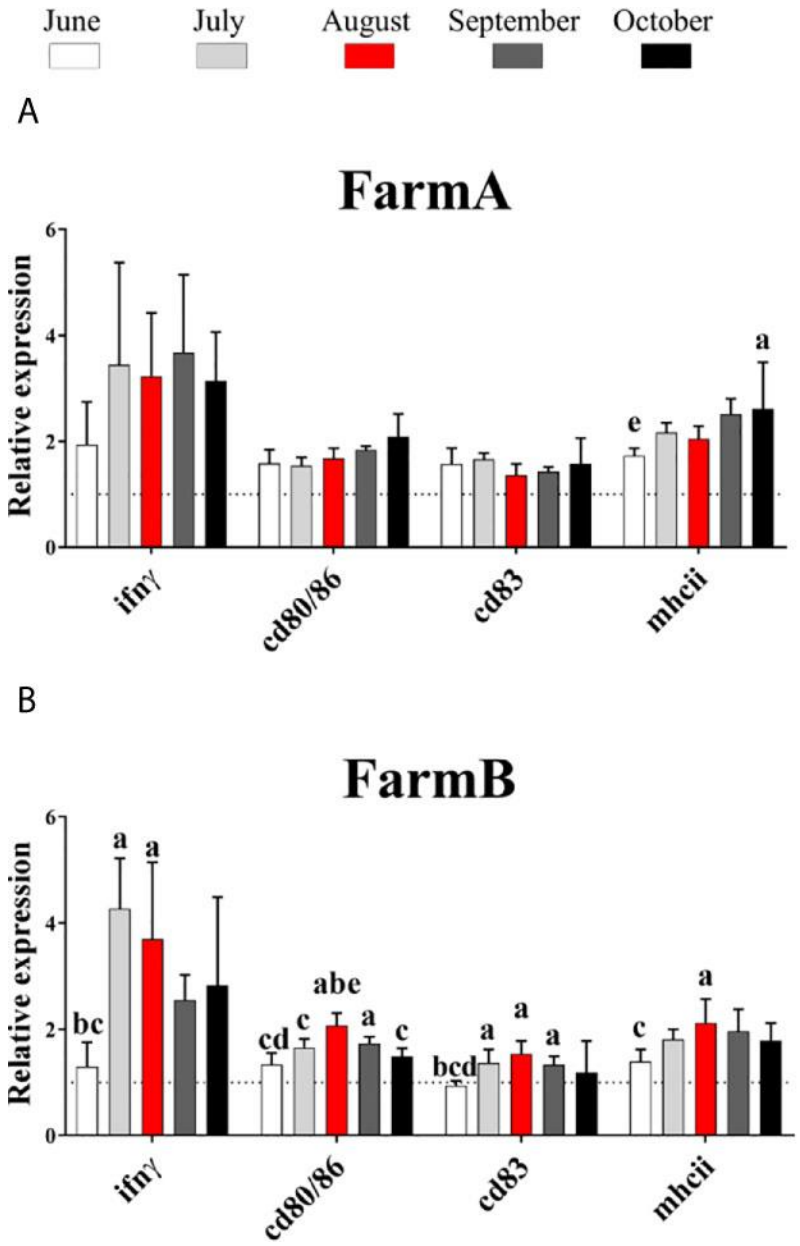

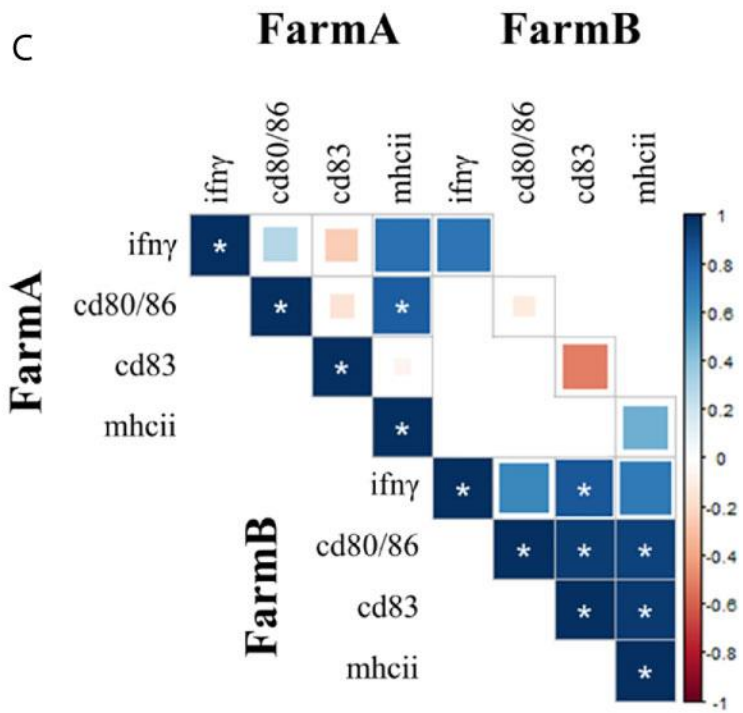

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Figure 1. Non-adherent splenocytes, cultured for 15 days. (**A**). Immunofluorescence (IFAT) on mononuclear splenocytes, I—phase contrast, II—in green CD4, III—in red IgM, IV—Merged. (**B**). $CD4^+$ cells. In gray—secondary antibody control. In green—non-Adherent Splenocytes.

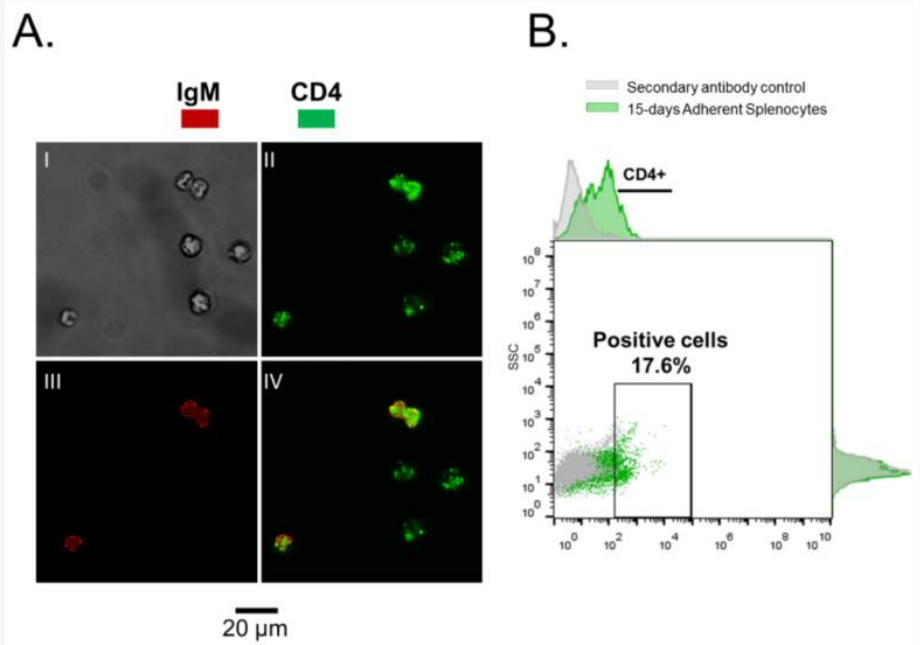
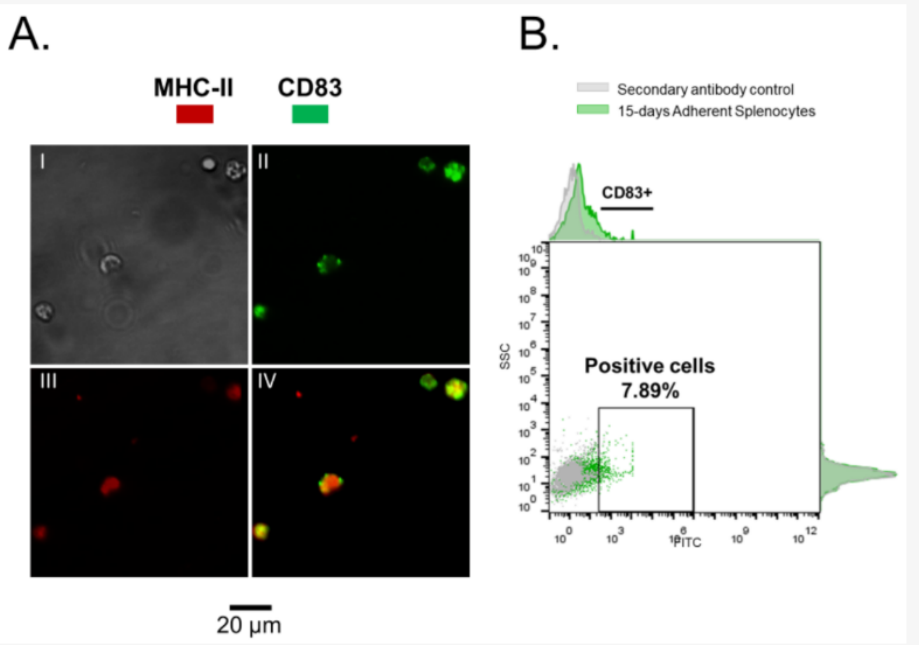


Figure 3. Adherent splenocytes, cultured for 15 days with rIFNγ as inducer. (**A**). Immunofluorescence (IFAT) on mononuclear splenocytes, I—phase contrast, II—in green CD83, III—in red MHC II, IV—Merged. (**B**). $CD83^+$ cells. In gray—secondary antibody control. In green—adherent Splenocytes with rIFNγ.



Open Access Communication

Induction of *foxp3* during the Crosstalk between Antigen Presenting Like-Cells $MHCII^+CD83^+$ and Splenocytes $CD4^+IgM^-$ in Rainbow Trout

by Byron Morales-Lange [1], Ivan Nombela [2,3], María Del Mar Ortega-Villaizán [2], Mónica Imarai [4], Paulina Schmitt [1] and Luis Mercado [1,*]

Fish

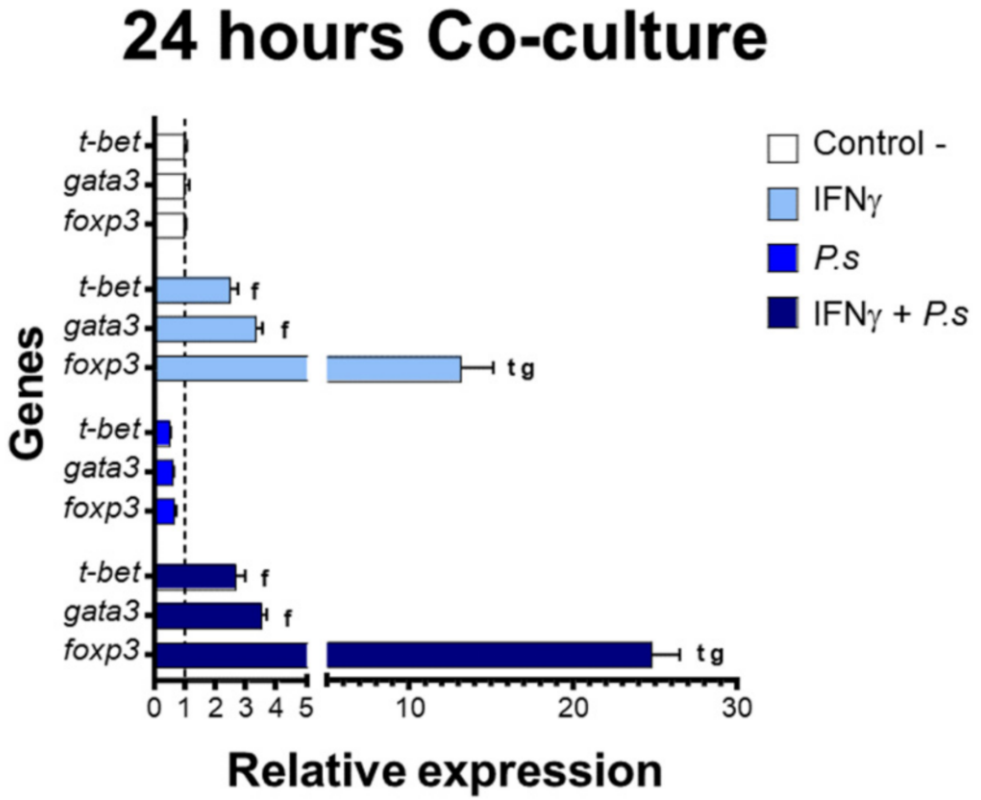


Figure 4. Gene expression presented as fold change relative to controlling T cell transcriptional factors in co-cultures of CD4$^+$ IgM$^-$ cells and mononuclear splenocytes MHC$^+$ CD83$^+$, that include MHC$^-$ CD83$^-$ cells at 24 h. In white—control without induction (C-). In light blue—co-culture of splenocytes with prior induction with IFNγ. In blue—co-culture of splenocytes with prior induction of *P. salmonis* (*P.s*). In dark blue—co-culture of splenocytes induced with IFNγ + *P. salmonis* (IFNγ+*P.s*). Each bar: $n = 3$ fish. Lowercase letters (t, g, and f)—significant differences ($p < 0.05$) compared with *t-bet*, *gata3*, and *foxp3*, respectively.

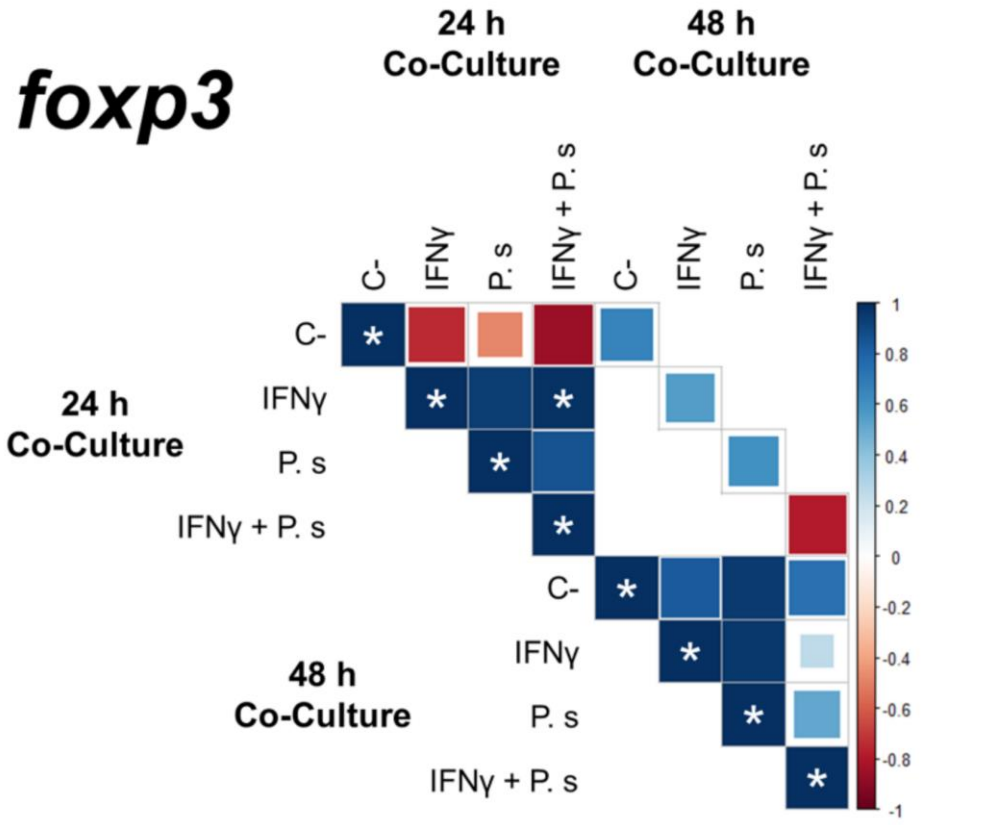
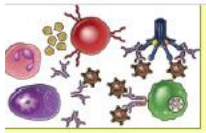


Figure 6. Correlation coefficient of *foxp3* gene expression in co-cultures of CD4$^+$ IgM$^-$ cells and adherent splenocytes (MHCII$^+$ CD83$^+$/MHCII$^-$ CD83$^-$) cells at 24 and 48 h. C-—control without induction. IFNγ—splenocytes cells induced with IFNγ. P.s—splenocytes induced with *P. salmonis*. IFNγ + P.s—splenocytes induced with IFNγ and *P. salmonis*. * significant value ($p < 0.05$).

Adaptive Immunity



Innate and Adaptive Immunity

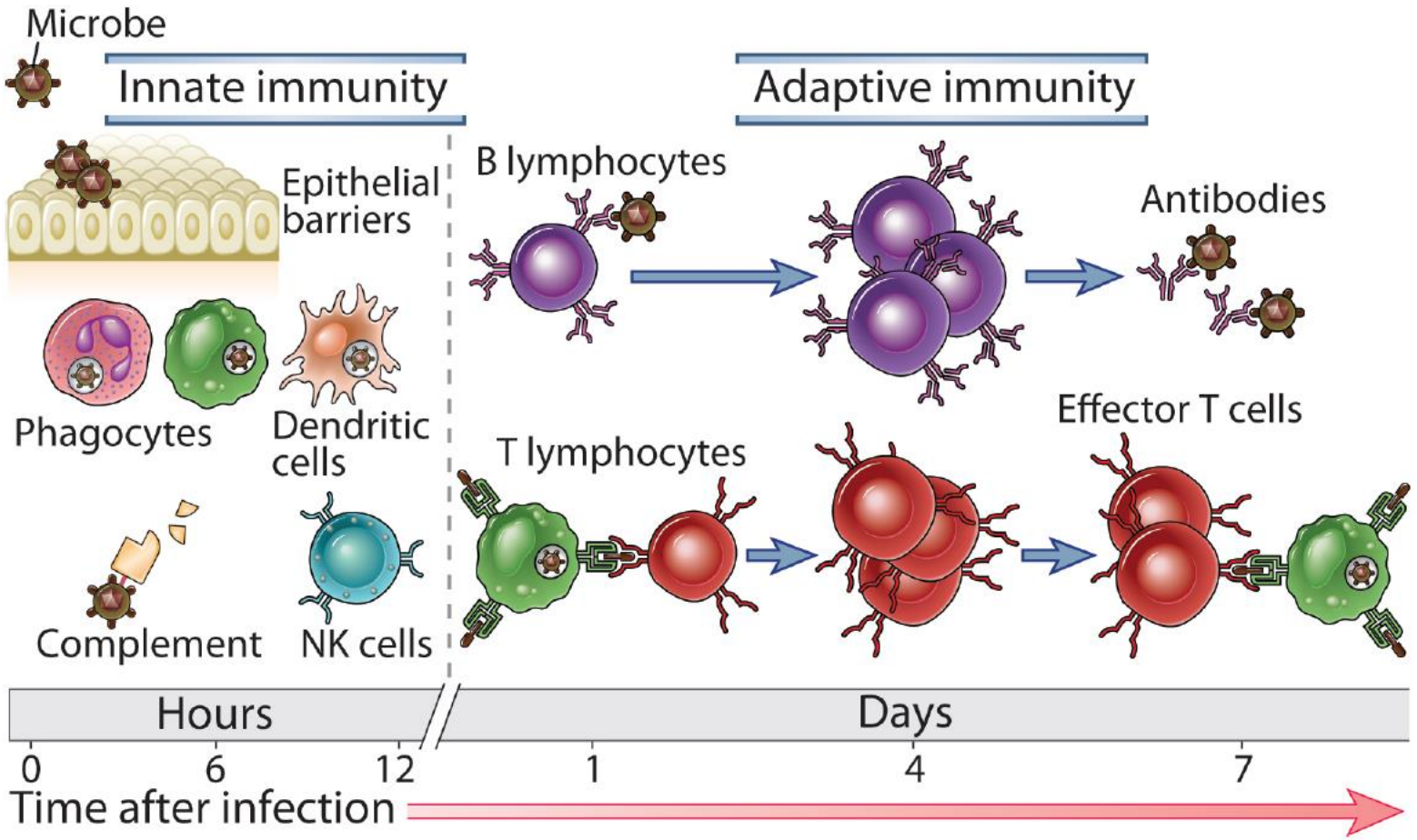
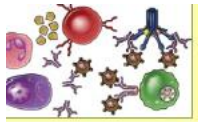


Fig. 1-1

Adaptive Immunity

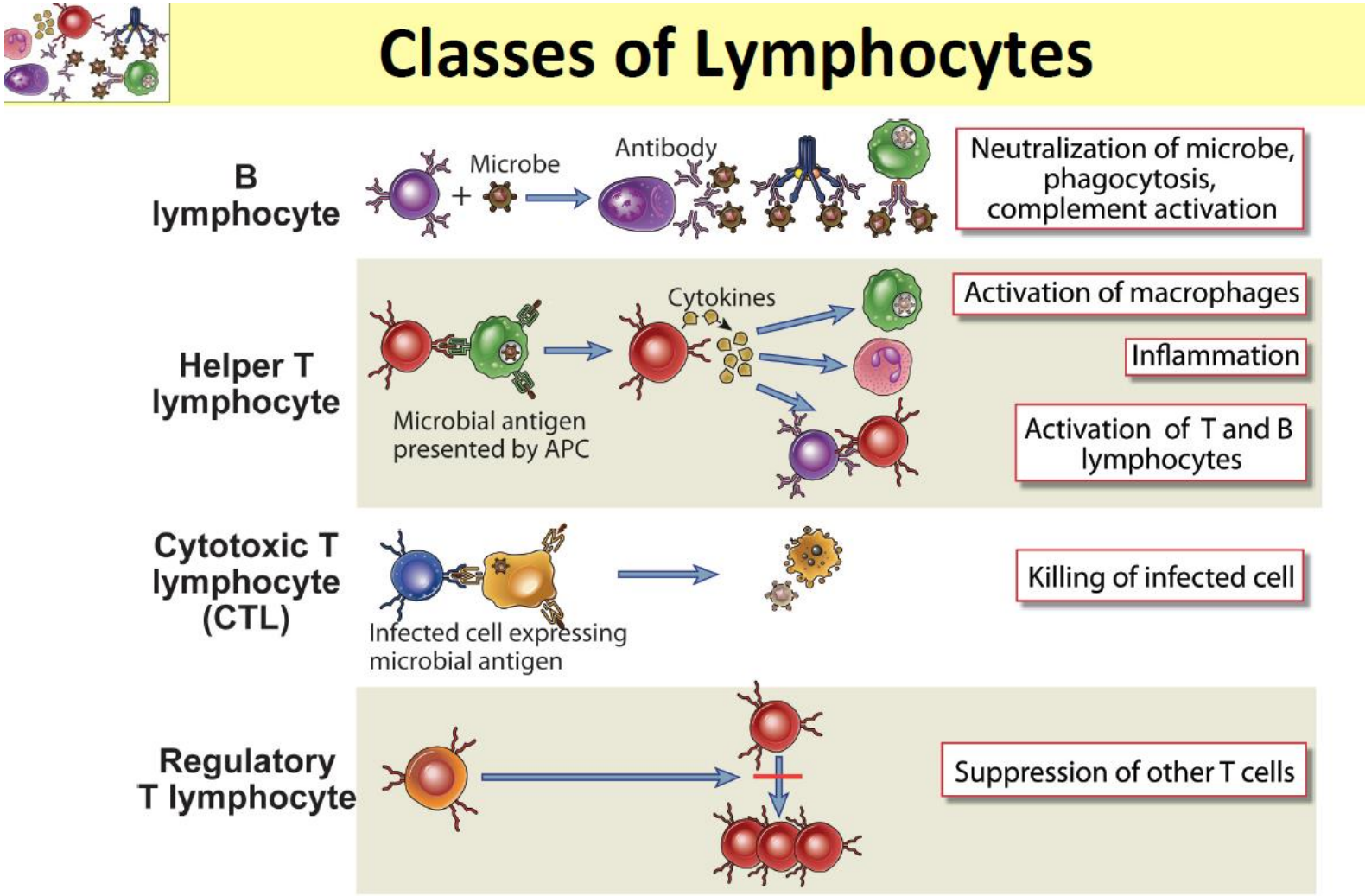


Types of Adaptive Immunity

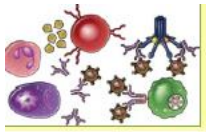
	Microbe	Responding lymphocytes	Effector mechanism	Transferred by	Functions
Humoral immunity	Extracellular microbes	B lymphocyte	Secreted antibody	Serum (antibodies)	Block infections and eliminate extracellular microbes
Cell-mediated immunity	Phagocytosed microbes in macrophage	Helper T lymphocyte		Cells (T lymphocytes)	Activate macrophages to kill phagocytosed microbes
	Intracellular microbes (e.g., viruses)	Cytotoxic T lymphocyte		Cells (T lymphocytes)	Kill infected cells and eliminate reservoirs of infection

Fig. 1-2

Adaptive Immunity



Adaptive Immunity



Phases of Adaptive Immune Responses

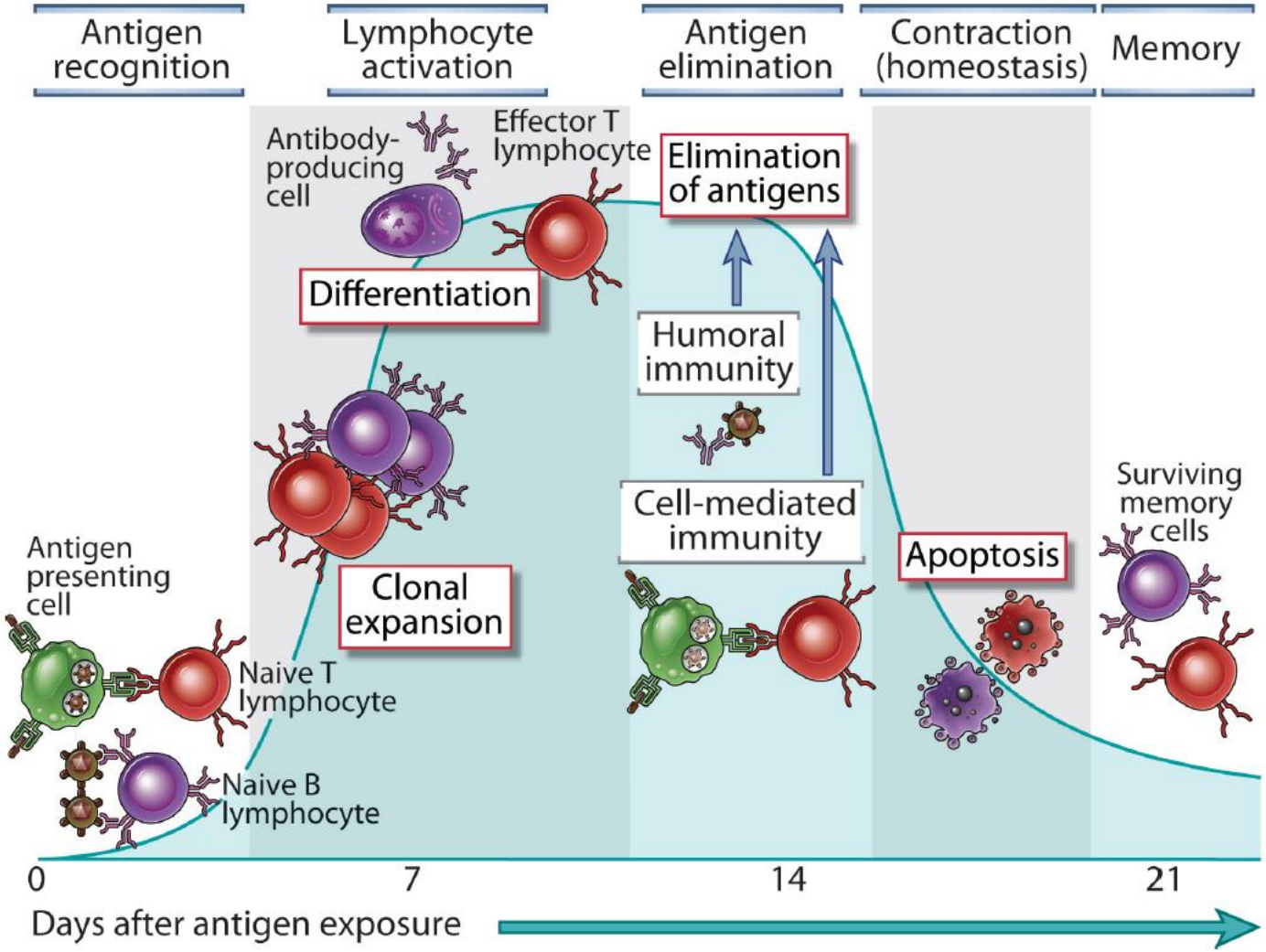
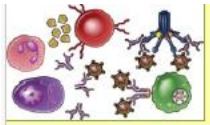


Fig. 1-6

Adaptive Immunity



Specificity Memory and Contraction

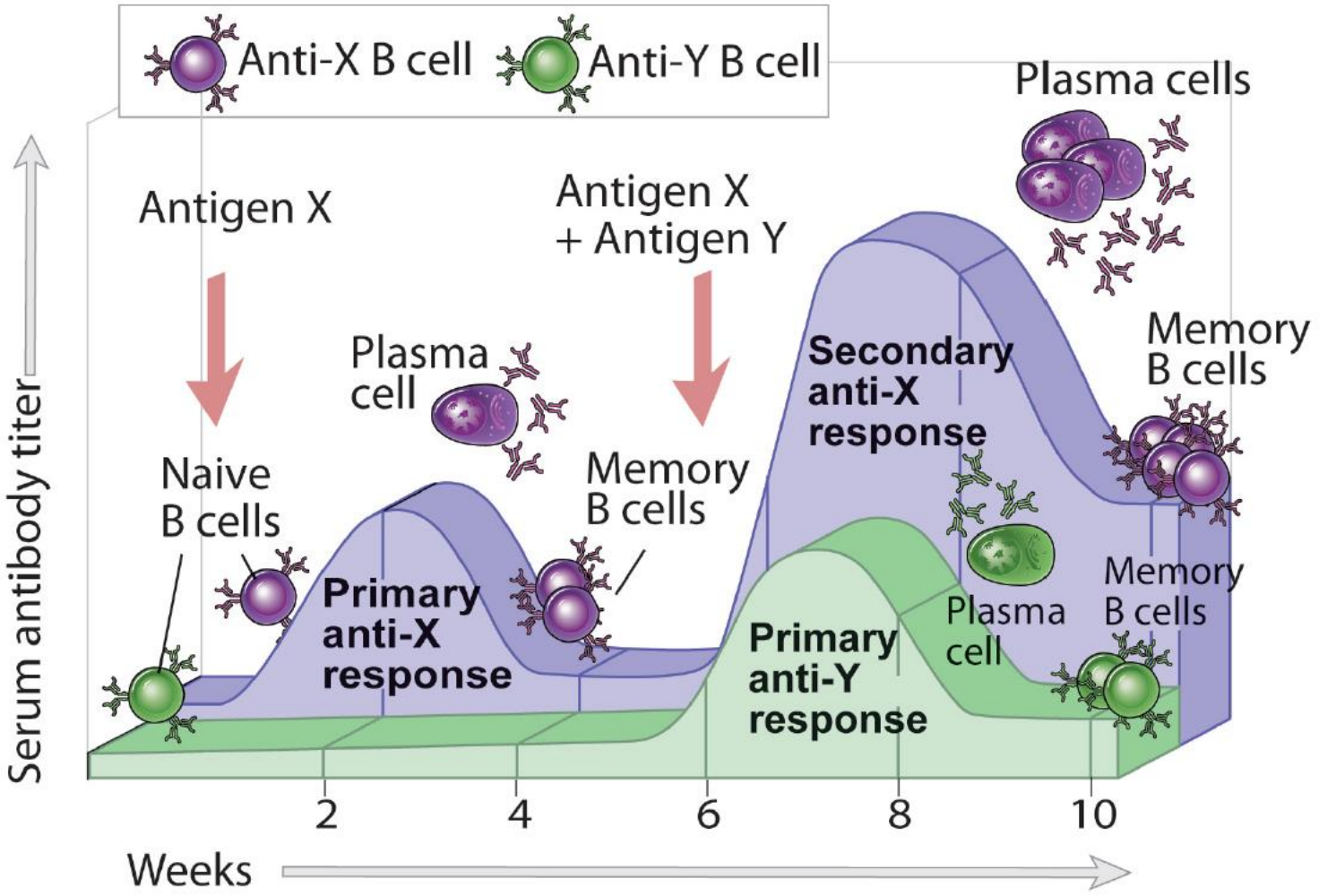
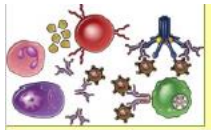


Fig. 1-4

Adaptive Immunity



The Clonal Selection Hypothesis

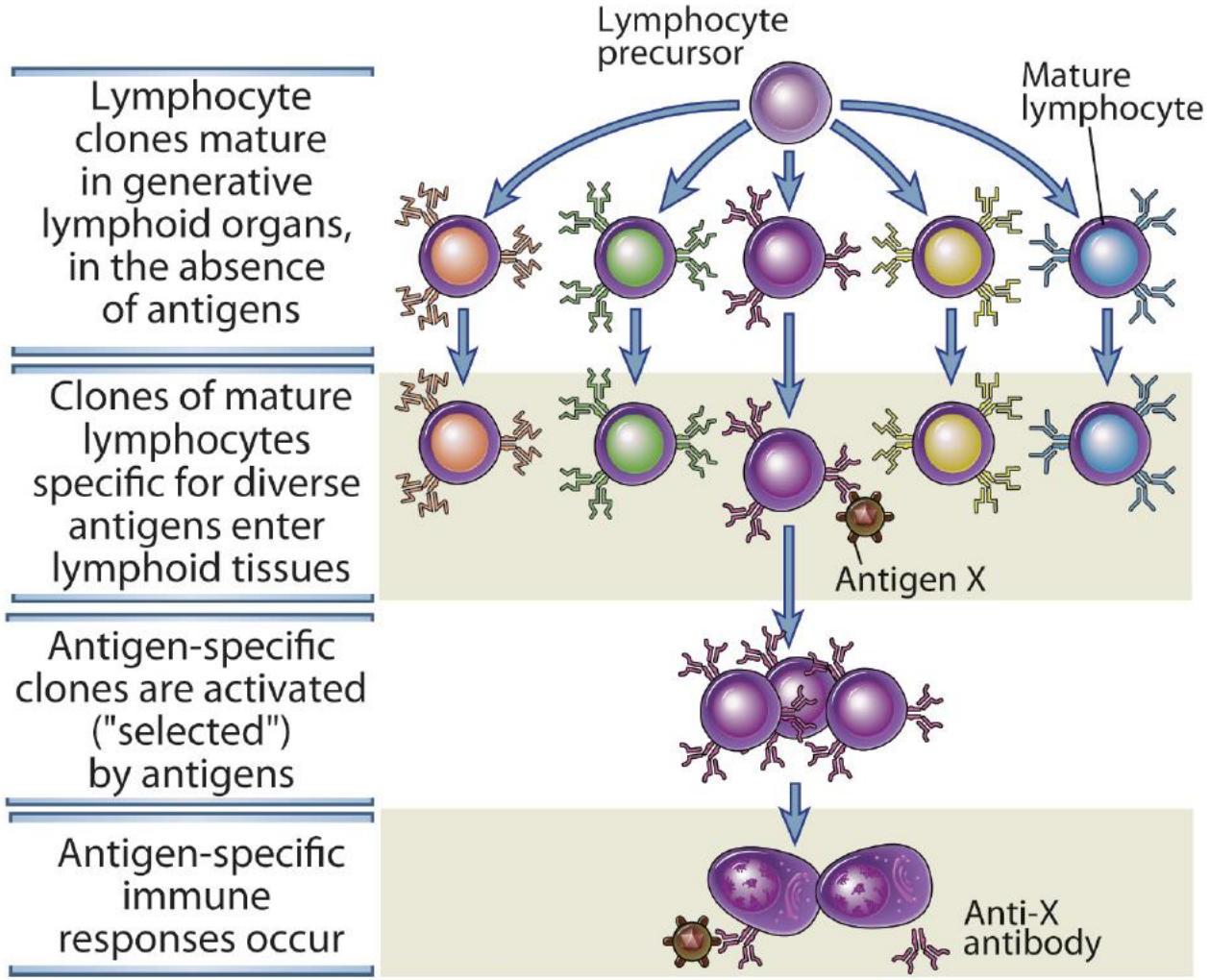
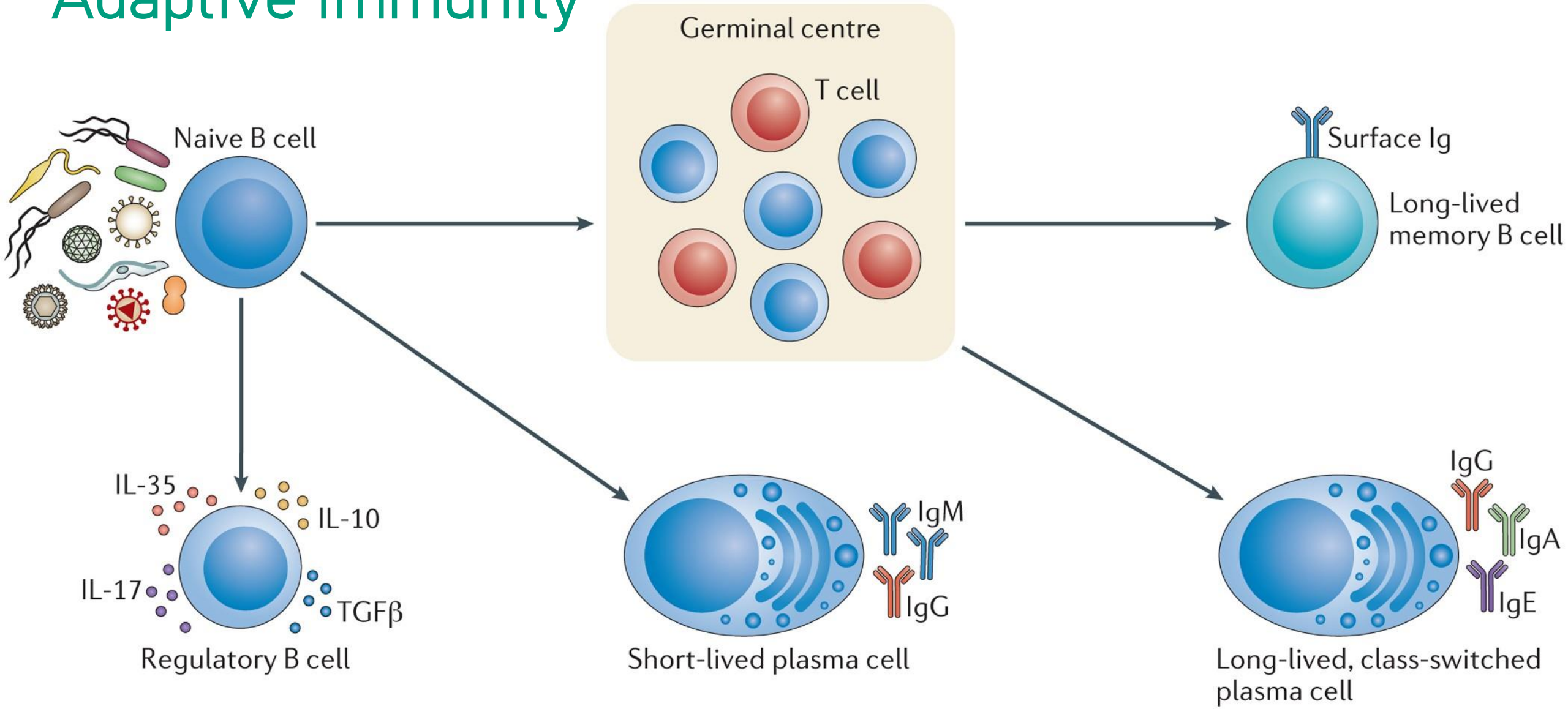


Fig. 1-6

Adaptive Immunity



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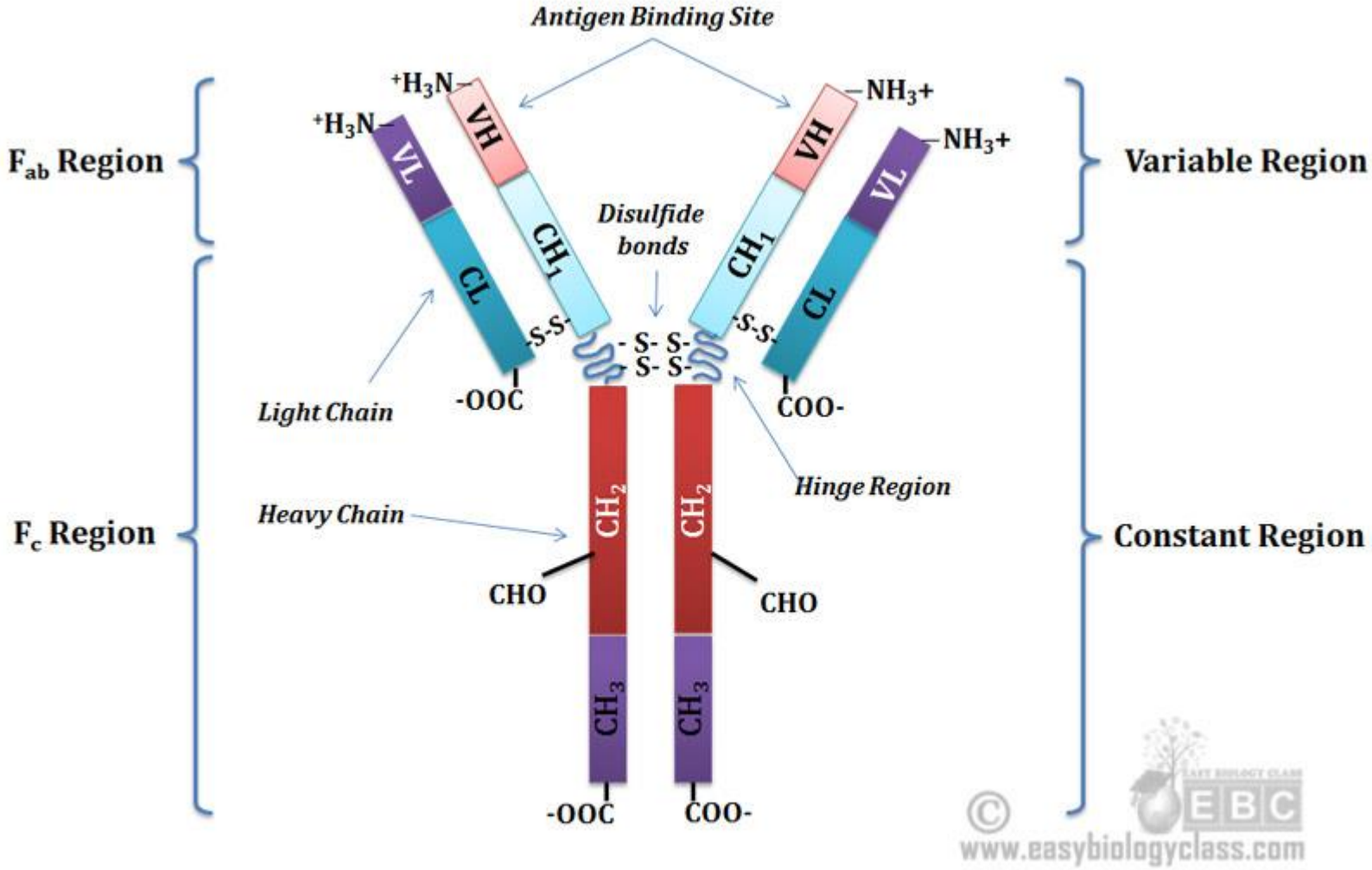
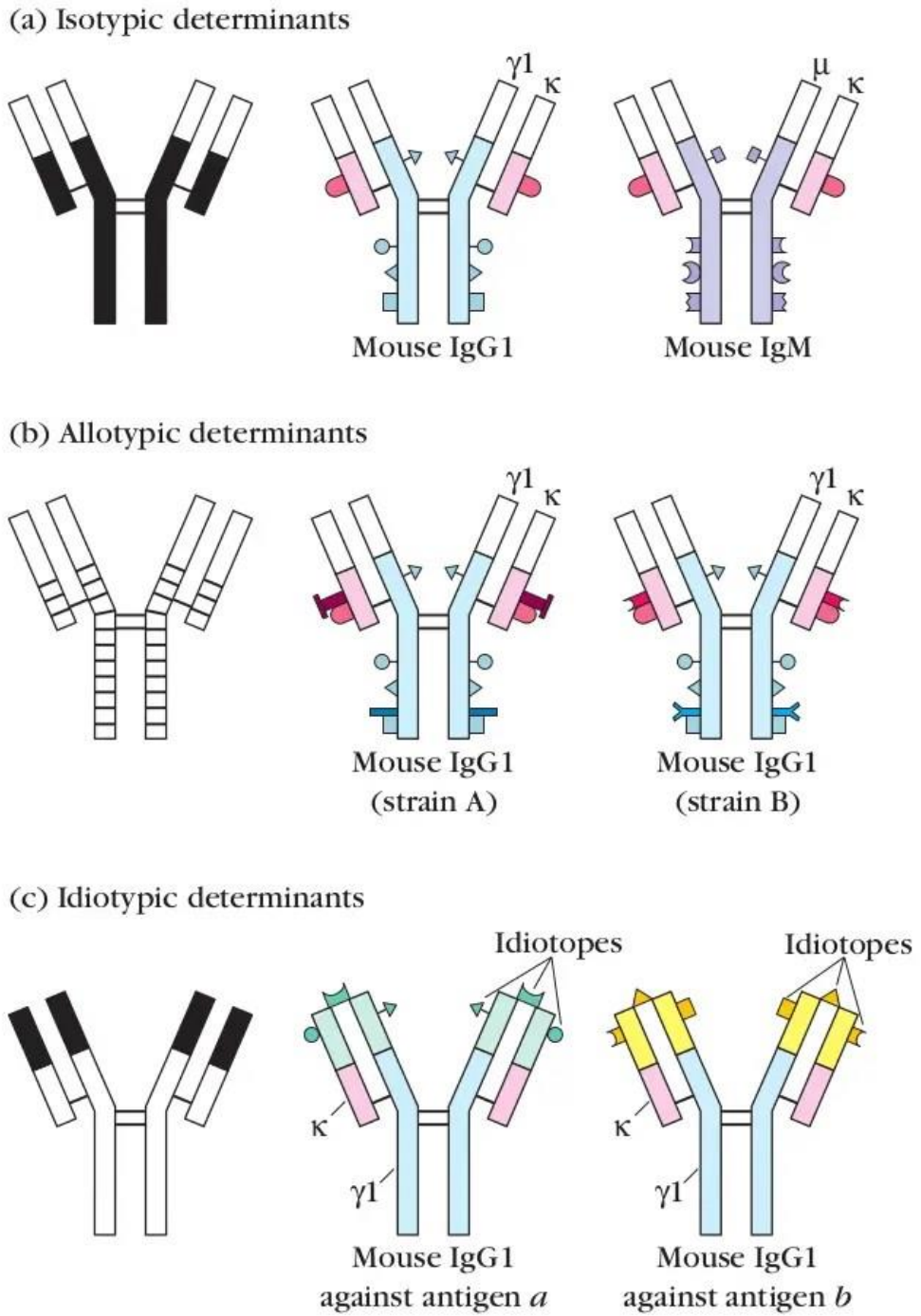
Adaptive Immunity



Variable (V) and Constant (C) Regions of an Antibody

Adaptive Immunity

Isotypes are located in the constant region of the heavy and light chains. Allotypes are specified by allelic forms of immunoglobulin genes and are also in the constant regions. Idiotypes are **unique epitopes located in the variable regions of individual antibody molecules.** 2 mar 2023

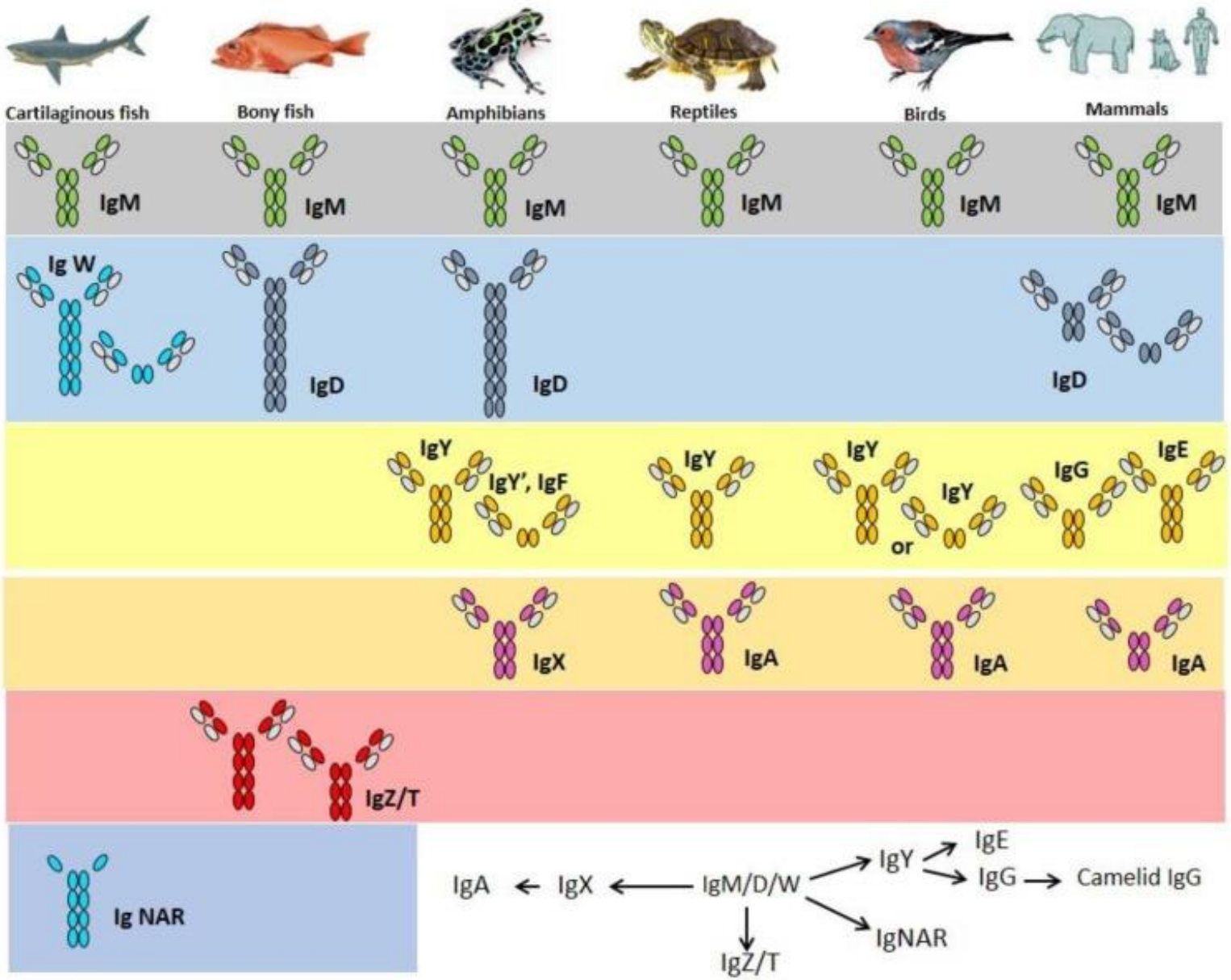


Adaptive Immunity

Norwegian University of Life Sciences

Fish Immunoglobulins

by **Sara Mashoof** [1] and **Michael F. Criscitiello** [1,2,*]

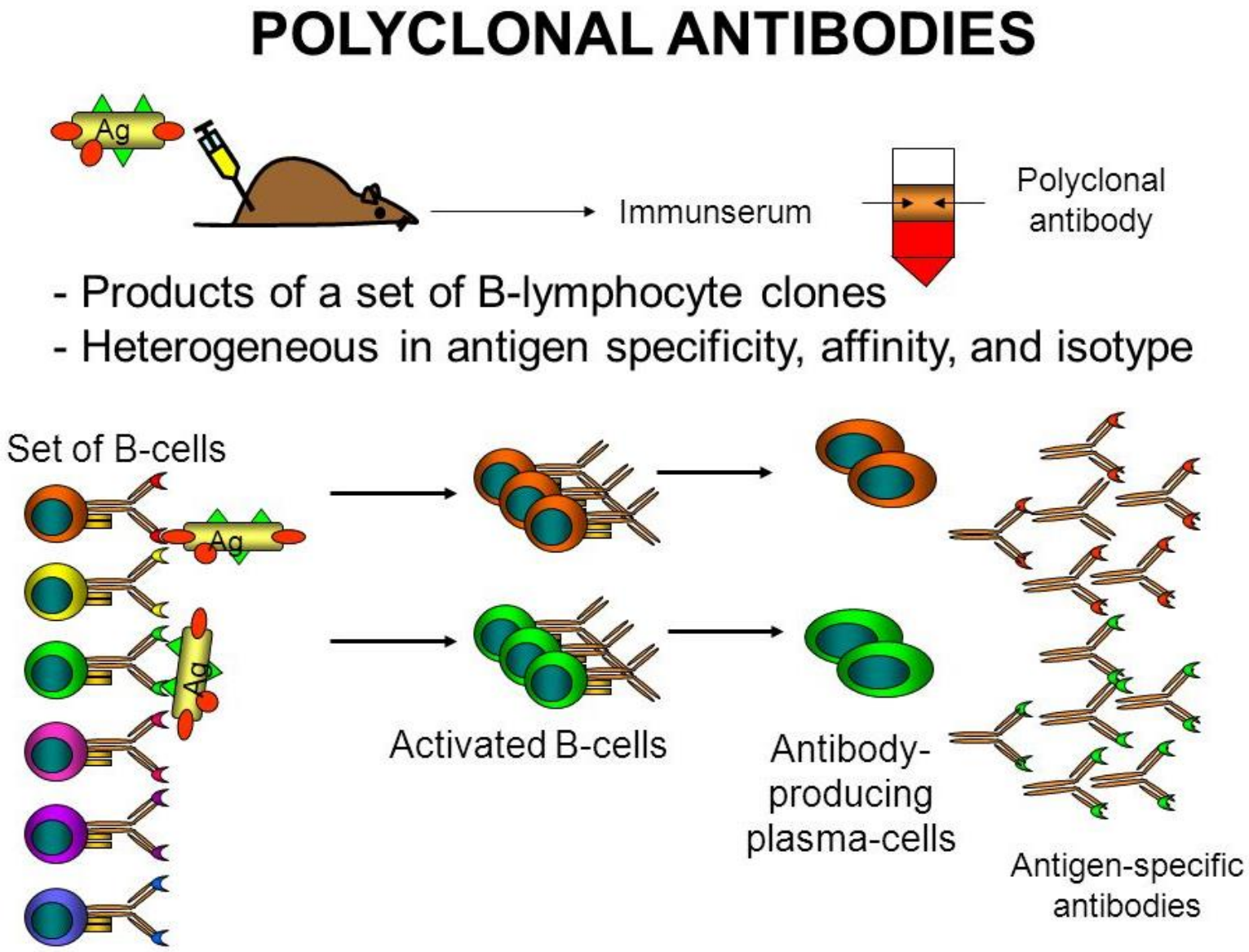


Adaptive Immunity

Norwegian University of Life Sciences

Class of Antibody	Serum levels	Structure	Biological functions
IgM	5%	Monomer Pentamer	Membrane-bound immunoglobulin on the surface of immature and mature B cells First antibody produced in a primary response to an antigen First antibody produced by the fetus Efficient in binding antigens with many repeating epitopes, such as viruses Classical complement activation
IgD	0.3%	Monomer	Membrane-bound immunoglobulin on the surface of mature B cells No biological effector function known
IgA	7-15%	Monomer Dimer	Predominant antibody class in secretions (saliva, tears, breast milk) and mucosa First line of defence against infection by microorganisms
IgG	85%	Monomer	Most abundant class with four isotypes - IgG1, IgG2, IgG3, IgG4 Crosses the placenta Opsonization
IgE	0.02%	Monomer	Defence against parasite infections Associated with hypersensitivity reactions (allergies) Found mainly in tissues

Adaptive Immunity



Adaptive Immunity