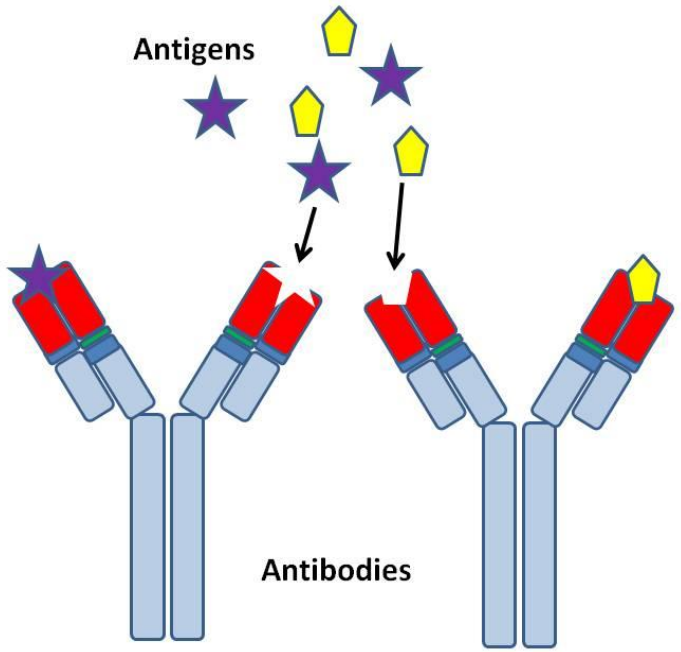
CRIMEA FEDERAL UNIVERSITY

Responses to Antigens



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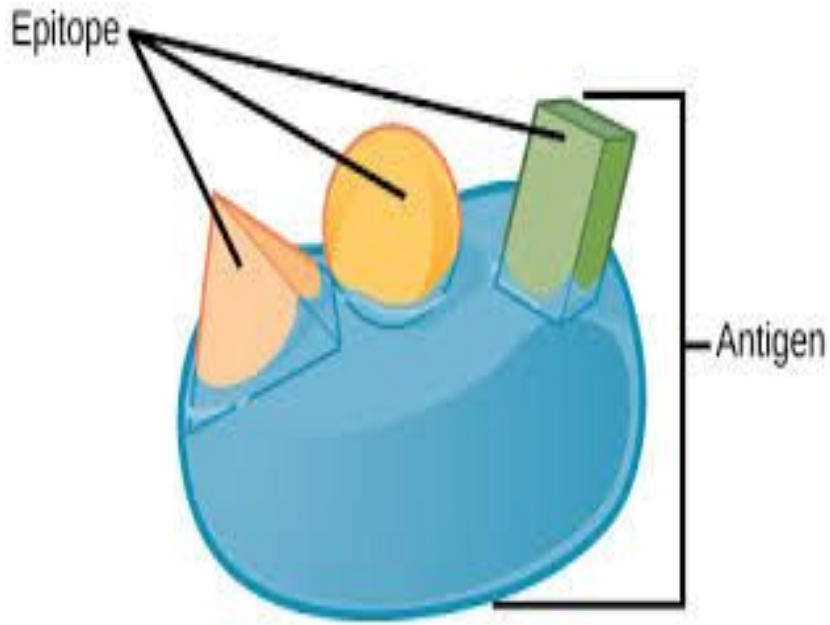
Presented by: Ranjan Kumar Jha
(Gr.-191B)

- **Antigen**-Any foreign particle
- **Immunogen**-Antigen which can provoke immune system
  Minimum molecular weight of an antigen to behave as immunogen should be 750Da.
- **Hapten**- Antigen of lower molecular weight.

- **Epitoke**-Antigenic determining site of antigen.

  site of antigen to which antibody binds



Major Histocompatibility Complex/MHC

- Gene for MHC is located on chromosome no:6
  which code for cell surface protein essential for the acquired immune system

Types

MHC Class I

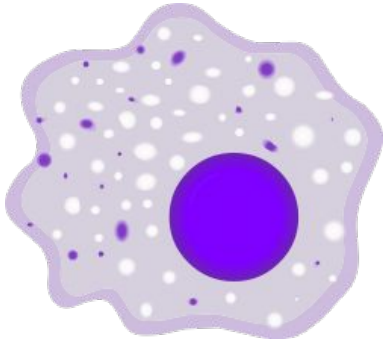
- Works in association with killer T-lymphocytes(CD-8 receptor)

MHC Class II

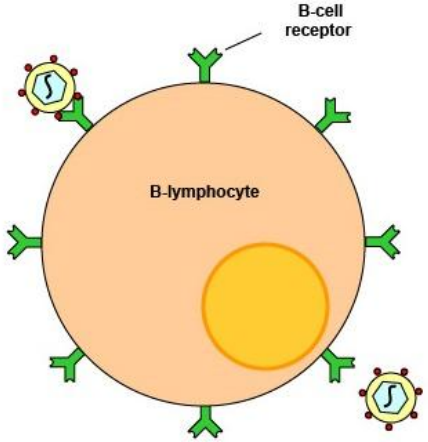
- Works in association with Helper T-lymphocytes (CD-4 Receptor)

Tissue typing: Matching of MHC during tissue/organ transplantation

Antigen presenting cell-these cell captures and process the antigen.



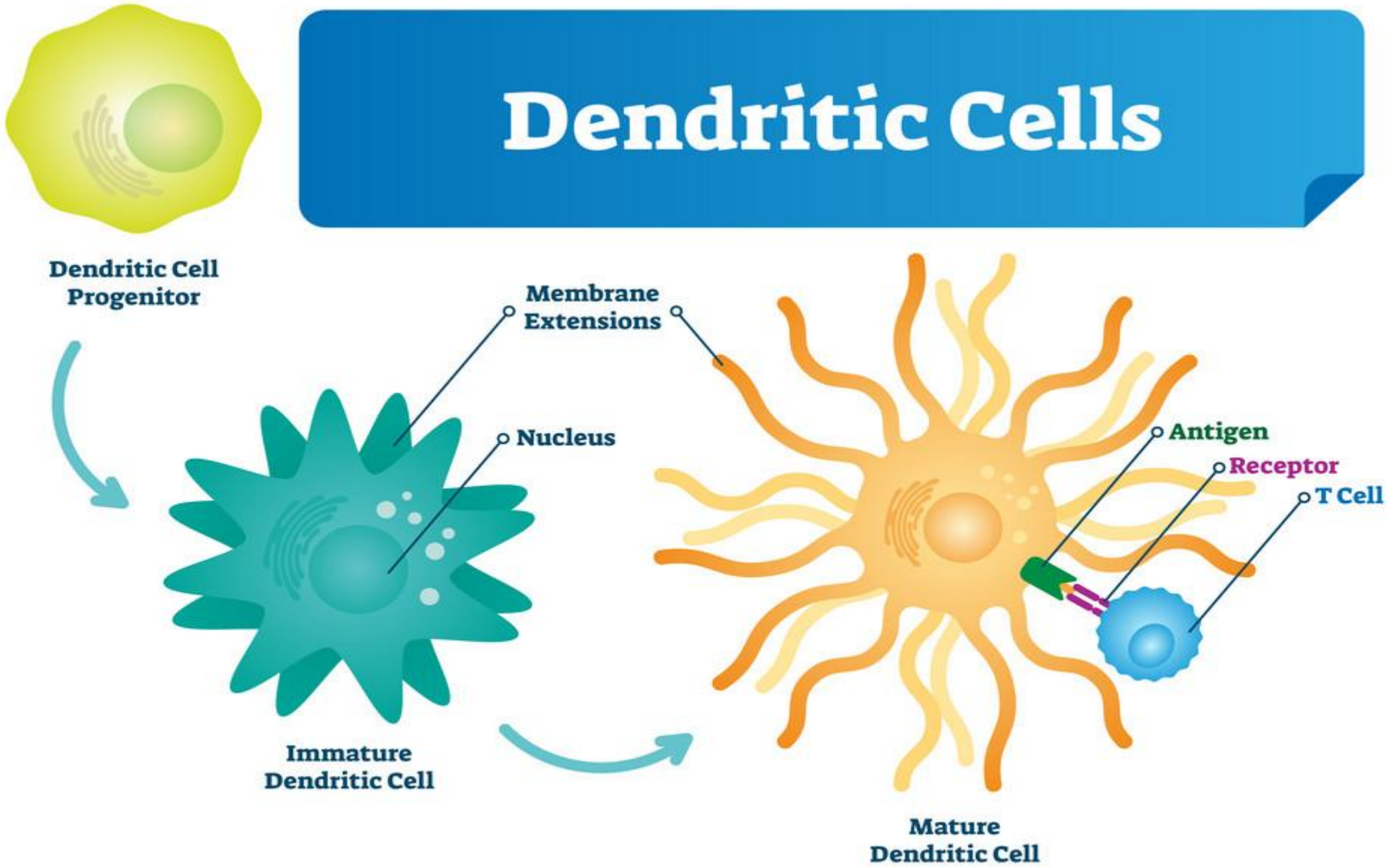
macrophage



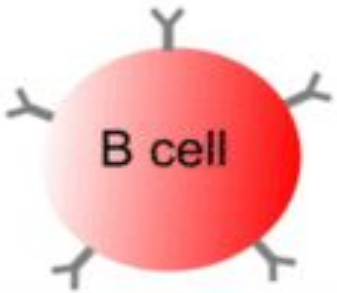
B-lymphocyte

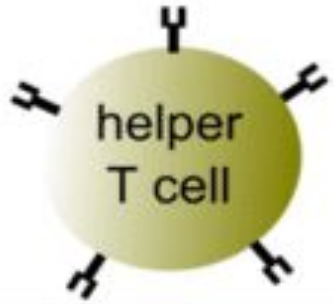
★ Dendritic cell also act as antigen presenting cell

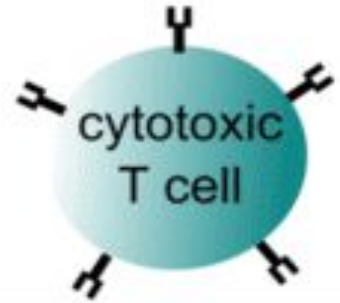
Dendritic Cells

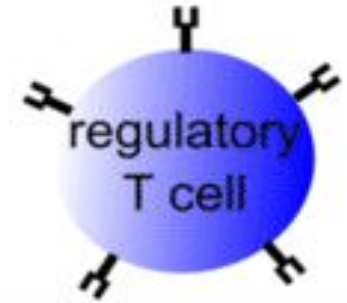


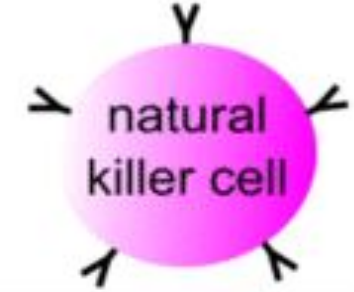
Types of lymphocytes





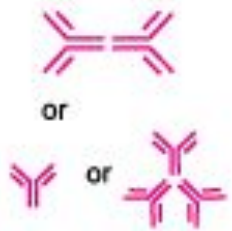




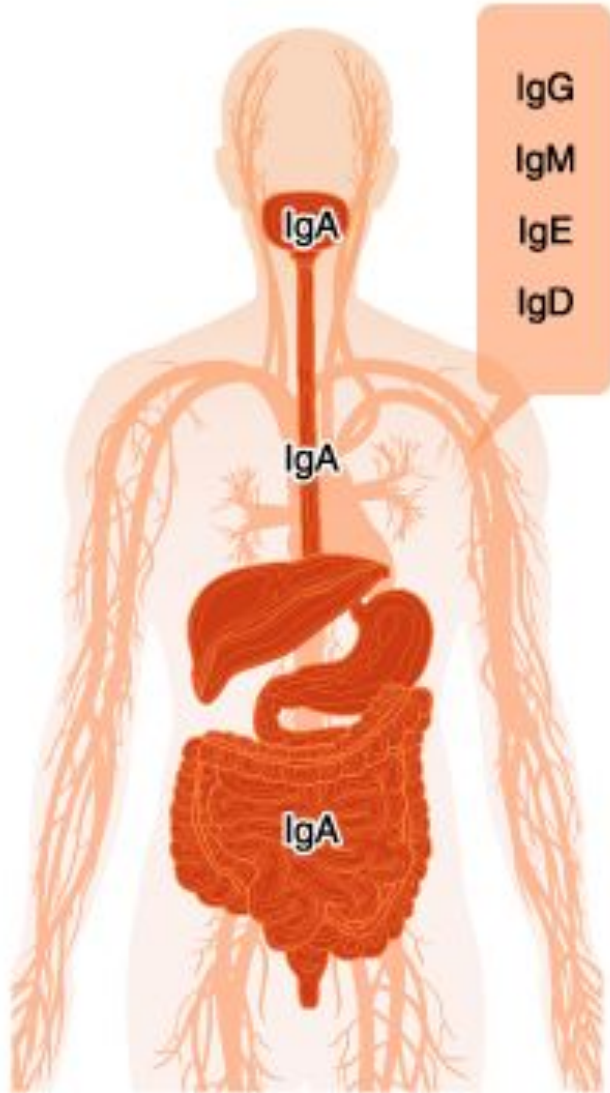


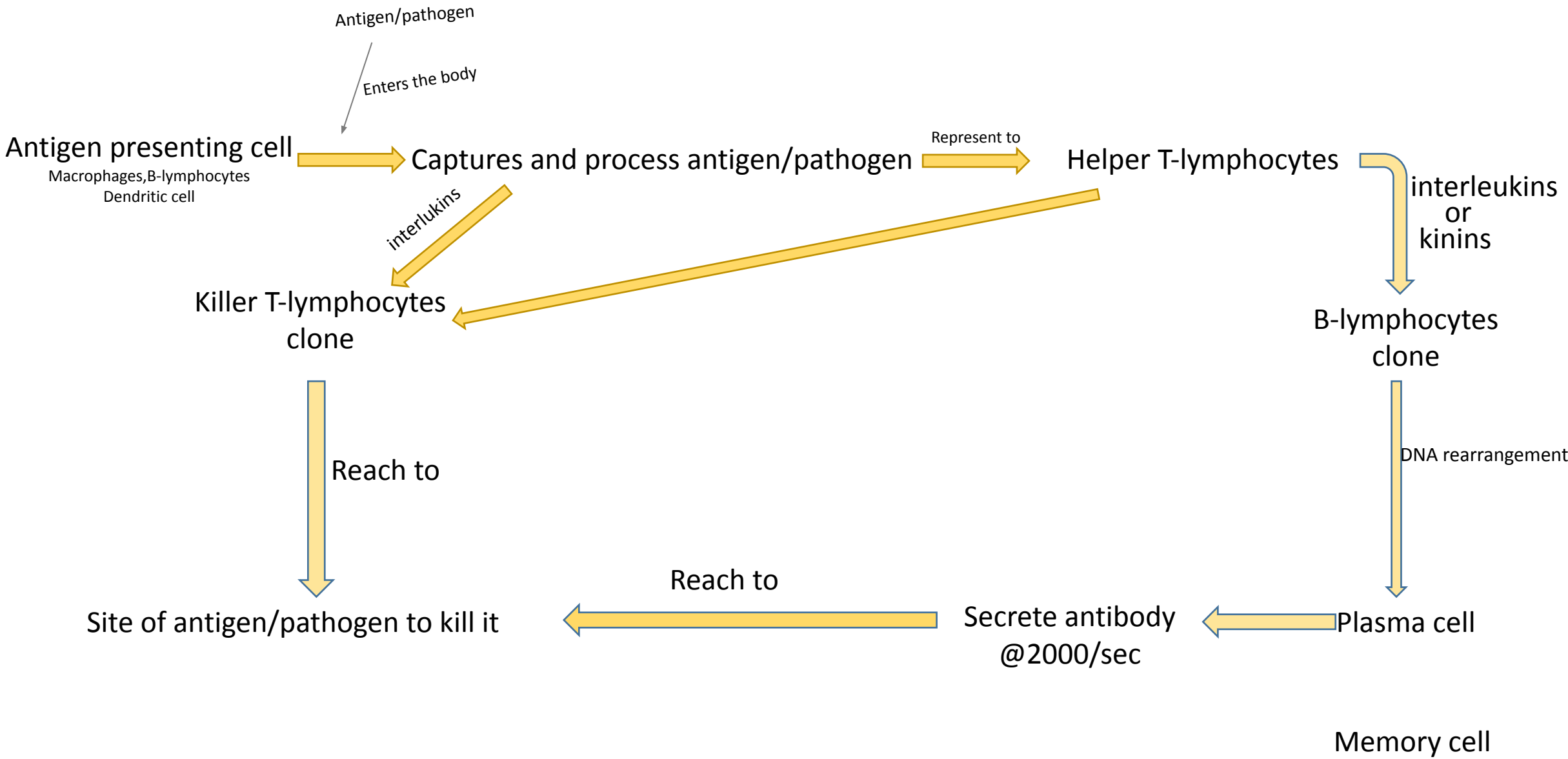
	B cell	helper T cell	cytotoxic T cell	regulatory T cell	natural killer cell
Antigen recognition	antigen on pathogens/ soluble antigen	antigen presented by professional APC	antigen presented by infected/ malignant cells	no antigen recognition function	self-antigen/ foreign antigen on host cells
Effector functions	production of antibodies neutralization of pathogens phagocytosis complement activation	secretion of cytokines activation of macrophages activation of other T and B cells inflammation	elimination of infeceted/ malignant cells	regulate and/ or suppress immune response	elimination of infeceted/ malignant cells

Types and characteristics of antibodies

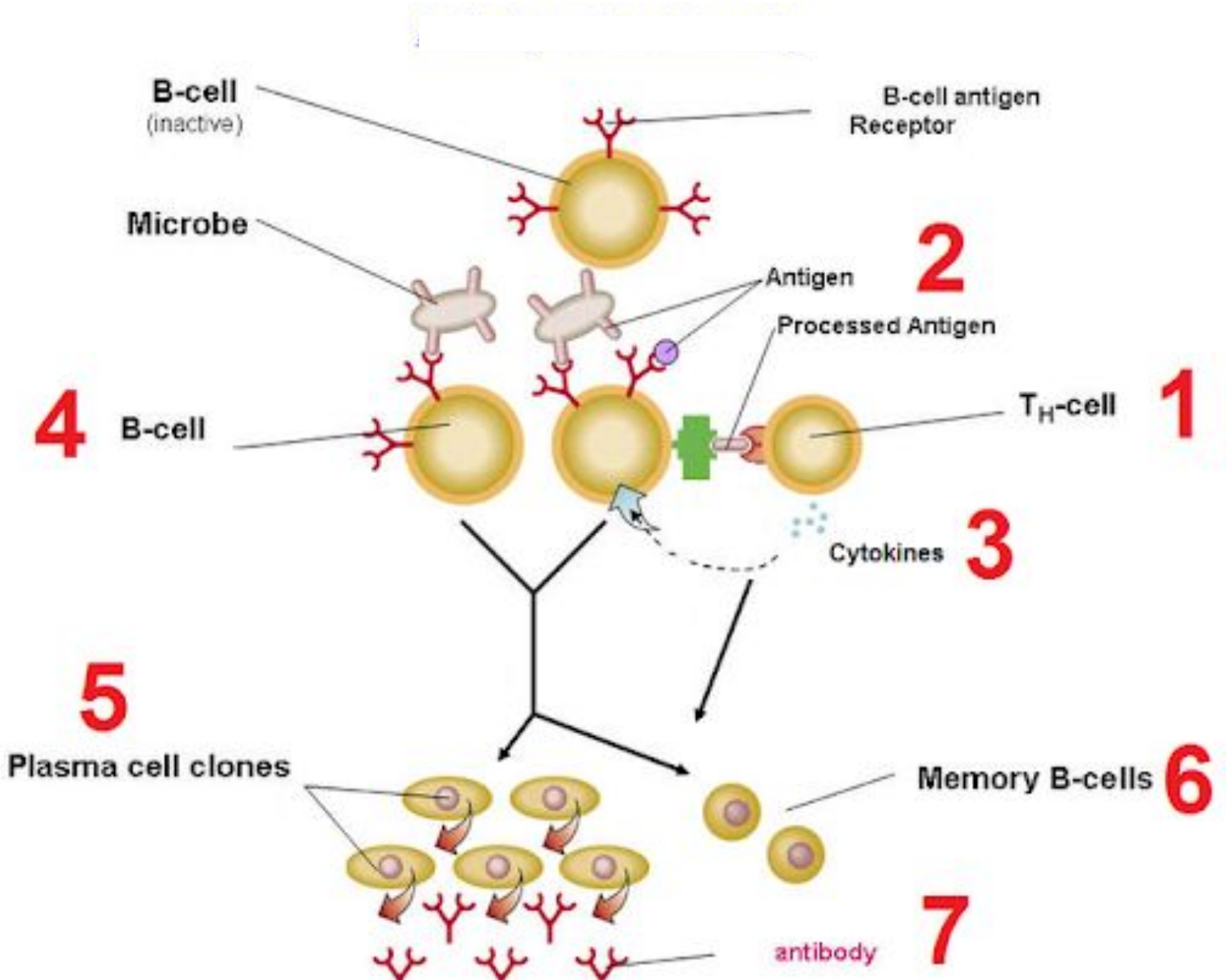
IgG Most abundant 80%		• Highest opsonization and neutralization activities. • Classified into four subclasses (IgG1, IgG2, IgG3, and IgG4).
IgM		• Produced first upon antigen invasion. Increases transiently.
IgA		• Expressed in mucosal tissues. Forms dimers after secretion.
IgD		• Unknown function.
IgE		• Involved in allergy.

Distribution in the body

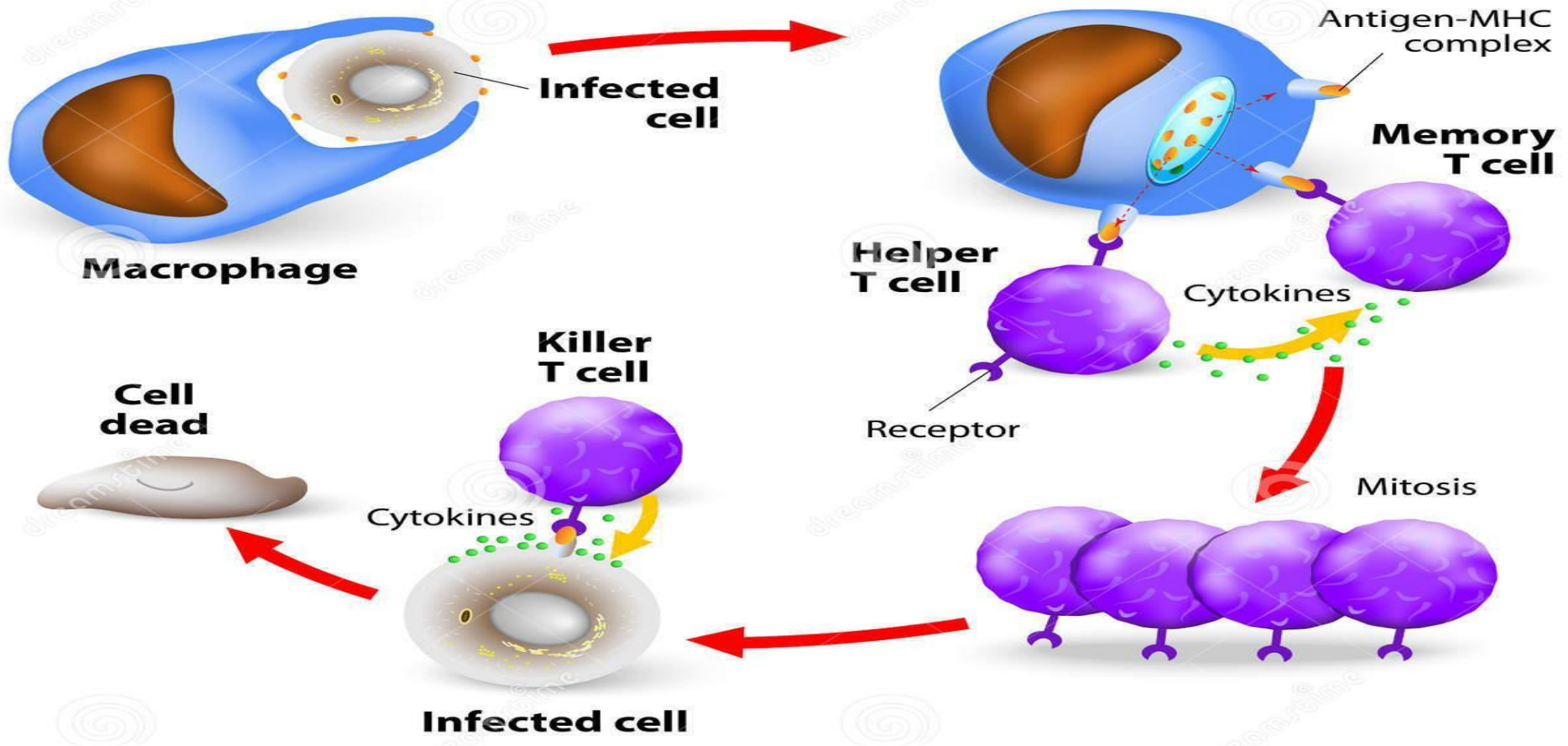


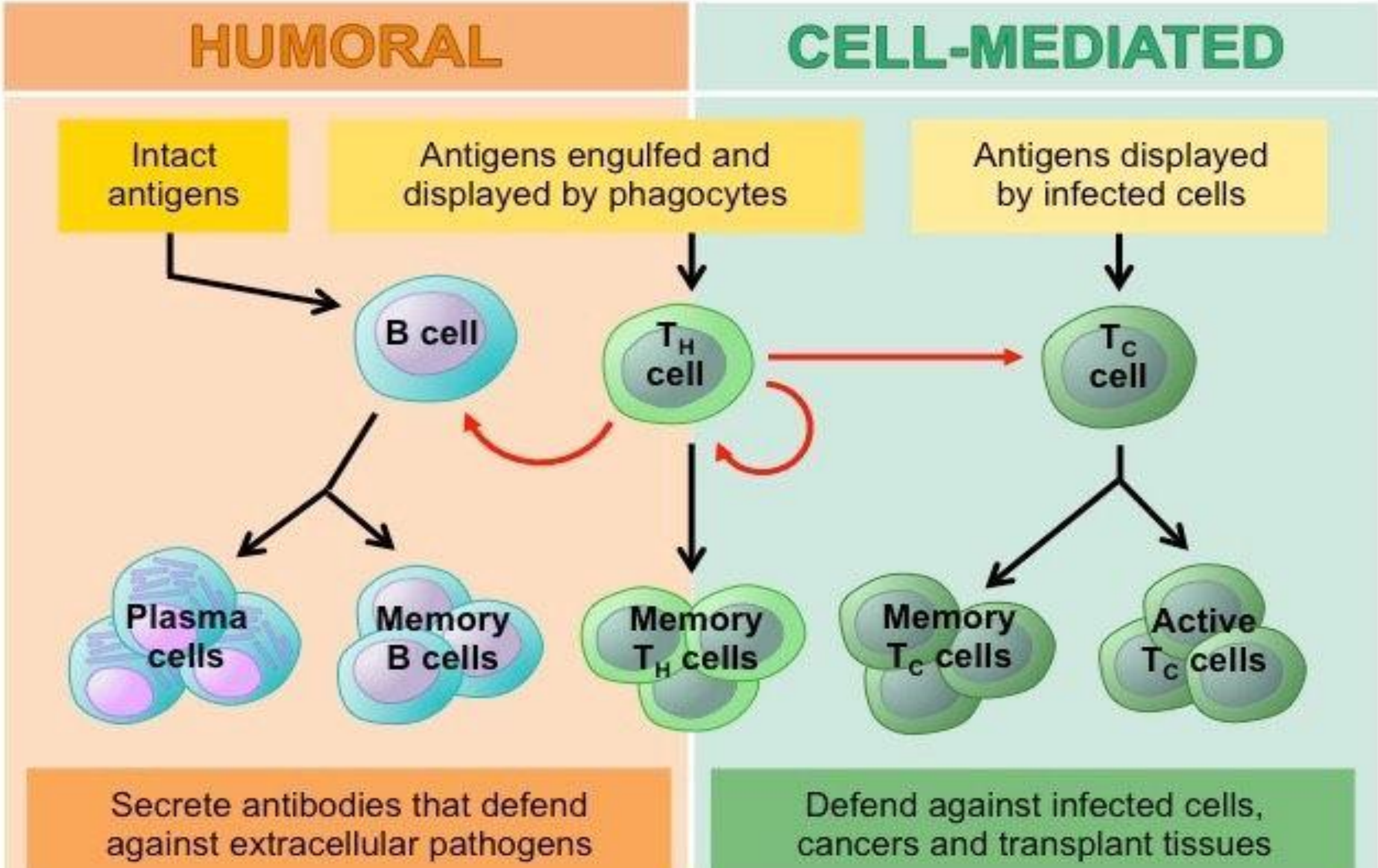

Antigen/pathogen
Enters the body
Antigen presenting cell
Macrophages,B-lymphocytes
Dendritic cell
Captures and process antigen/pathogen
Represent to
Helper T-lymphocytes
interleukins
or
kinins
interlukins
Killer T-lymphocytes
clone
B-lymphocytes
clone
Reach to
DNA rearrangement
Reach to
Site of antigen/pathogen to kill it
Secrete antibody
@2000/sec
Plasma cell
Memory cell

Antibody mediated immunity/Humoral immunity/B-lymphocyte response



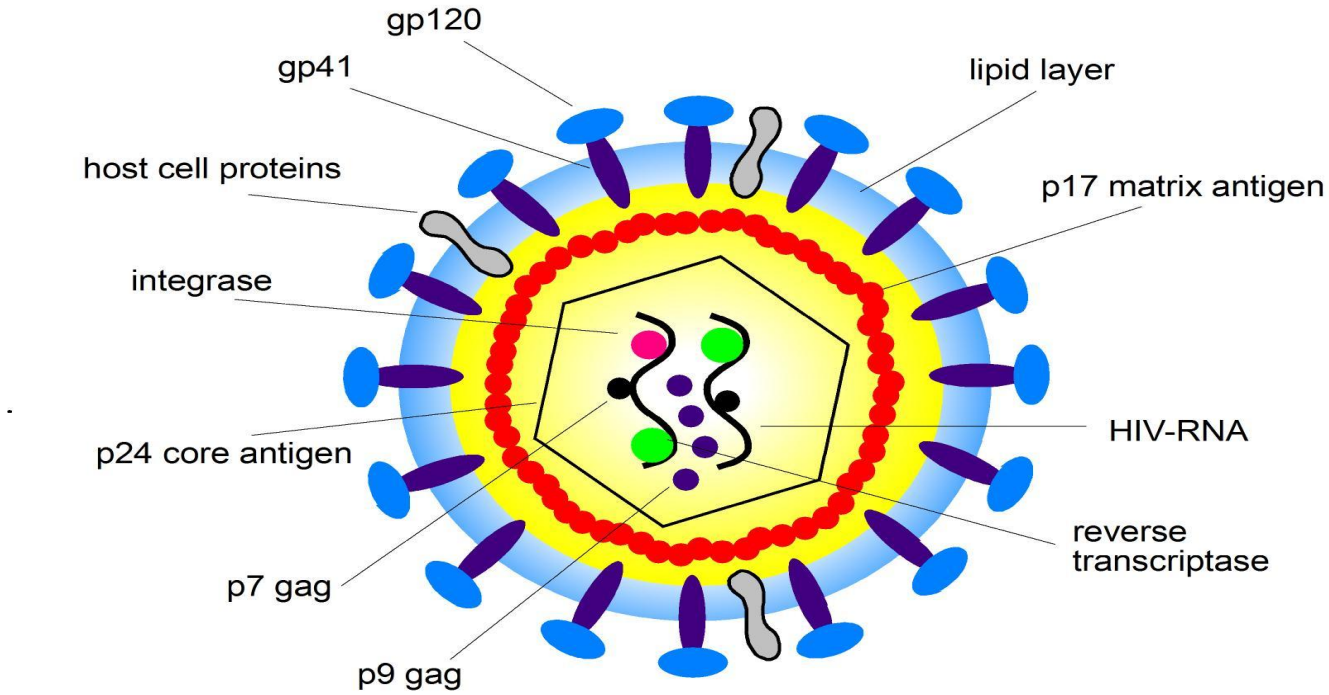
Cell mediated immunity/T-lymphocyte response

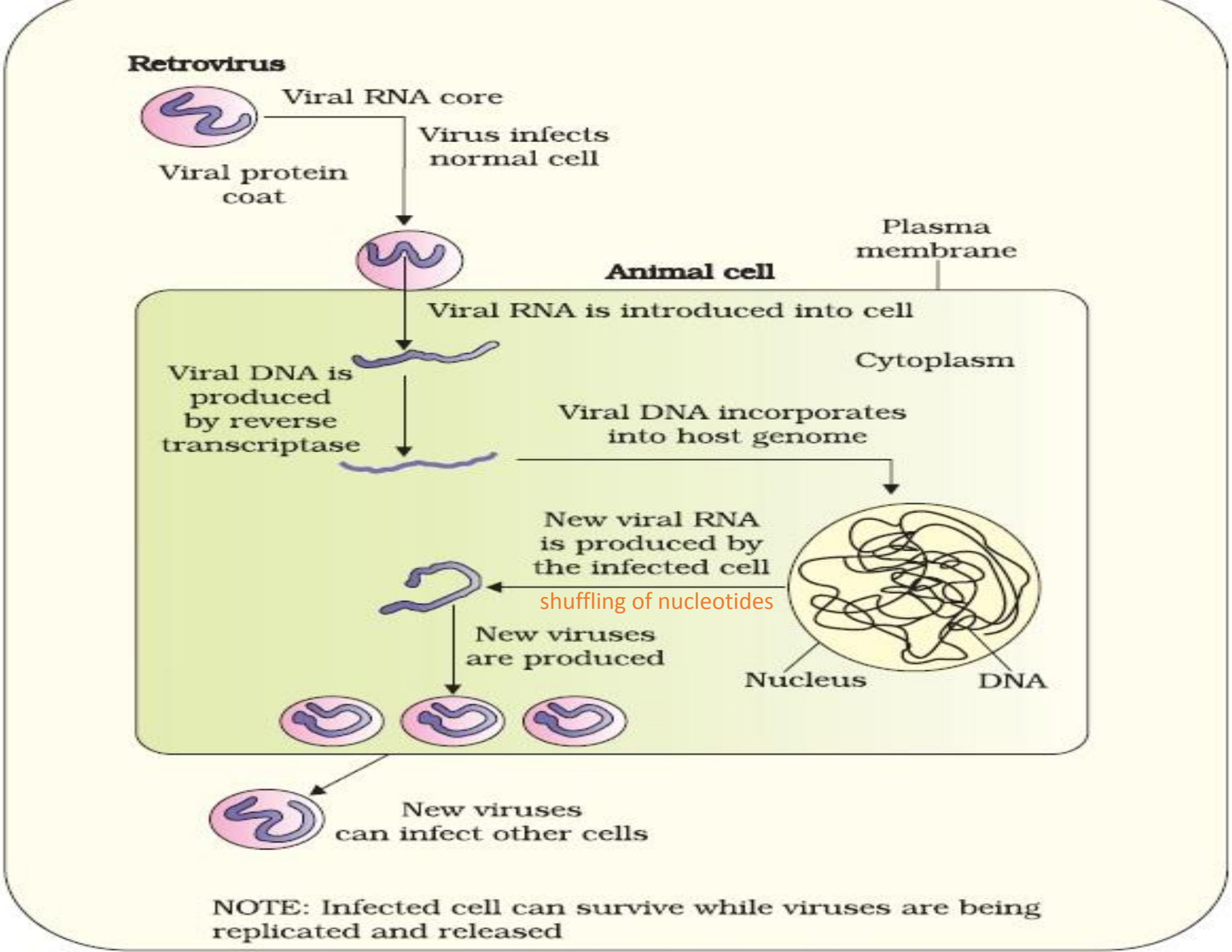



HUMORAL
CELL-MEDIATED
Intact antigens
Antigens engulfed and displayed by phagocytes
Antigens displayed by infected cells
B cell
T_H cell
T_C cell
Plasma cells
Memory B cells
Memory T_H cells
Memory T_C cells
Active T_C cells
Secrete antibodies that defend against extracellular pathogens
Defend against infected cells, cancers and transplant tissues

AIDS (Acquired Immunodeficiency Syndrome)

- Caused by HIV(Retrovirus).
- First case was observed in USA in 1981.
- HIV mainly attacks macrophages and Helper T-Lymphocytes.



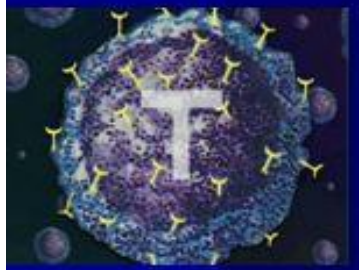

Retrovirus
Viral RNA core
Virus infects normal cell
Viral protein coat
Plasma membrane
Animal cell
Viral RNA is introduced into cell
Cytoplasm
Viral DNA is produced by reverse transcriptase
Viral DNA incorporates into host genome
New viral RNA is produced by the infected cell
shuffling of nucleotides
New viruses are produced
Nucleus
DNA
New viruses can infect other cells
NOTE: Infected cell can survive while viruses are being replicated and released

Vertebrate Immune responses to Protozoan parasites.

1. Innate immune responses.

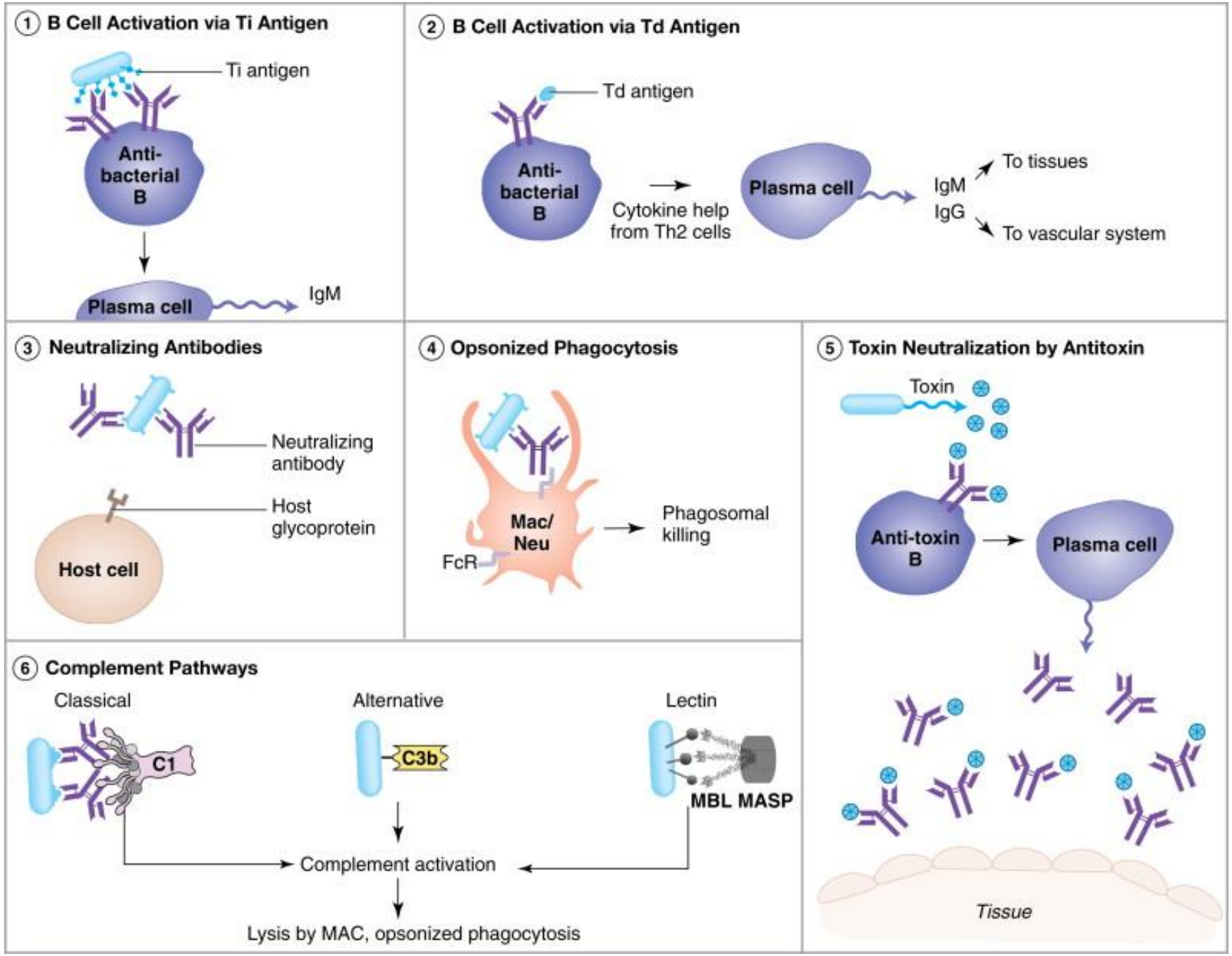
- Extracellular protozoa eliminated - phagocytosis & complement activation.

- **T cell responses.**
  - Extracellular protozoa - T_H2 cytokines - ab production.
  - Intracellular protozoa – T_C (cytotoxic lymphocytes) kill infected cells.
  - T_H1 cytokines activate macrophages & T_C.



Defence mechanism in response to parasite

Mechanism	Effect	Parasite
Neutralization	Blocks attachment to host cell	Protozoa
	Acts to inhibit evasion mechanisms of intracellular organisms	Protozoa
	Binding to toxins or enzymes	Protozoa and worms
Physical interference	Obstructs orifices of parasite	Worms
	Agglutination	Protozoa
Opsonization	Increases clearance by phagocytes	Protozoa
Cytotoxicity	Complement-mediated lysis	Protozoa and worms
	Antibody-dependent cell-mediated cytotoxicity	Protozoa and worms


1 B Cell Activation via Ti Antigen
Ti antigen
Anti-bacterial B
Plasma cell
IgM
2 B Cell Activation via Td Antigen
Td antigen
Anti-bacterial B
Cytokine help from Th2 cells
Plasma cell
IgM
IgG
To tissues
To vascular system
3 Neutralizing Antibodies
Neutralizing antibody
Host glycoprotein
Host cell
4 Opsonized Phagocytosis
Mac/ Neu
FcR
Phagosomal killing
5 Toxin Neutralization by Antitoxin
Toxin
Anti-toxin B
Plasma cell
Tissue
6 Complement Pathways
Classical
C1
Alternative
C3b
Lectin
MBL MASP
Complement activation
Lysis by MAC, opsonized phagocytosis

Protozoa activate quite distinct specific immune responses, which are different from the responses to fungi, bacteria and viruses. Protozoa may be phagocytized by macrophages, but many are resistant to phagocytic killing and may even replicate within macrophages. T. brucei gambiense is the best example of protozoa which can induce humoral immune response because of its extra-cellular location. In Leishmania sp. infections, cellular defense mechanisms depend upon CD4+ T-lymphocytes and activate macrophages as effector cells that are regulated by cytokines of Th1 subset. Plasmodium sp. is a protozoa which show the diversity of defence mechanisms which can be cellular or humoral, depending on Ag and protozoa's location.

IMMUNE EVASION MECHANISMS OF PROTOZOA:

Different protozoa have developed remarkably effective ways of resisting specific immunity:

a)anatomic sequestration is commonly observed with protozoa Plasmodium and T. gondii;

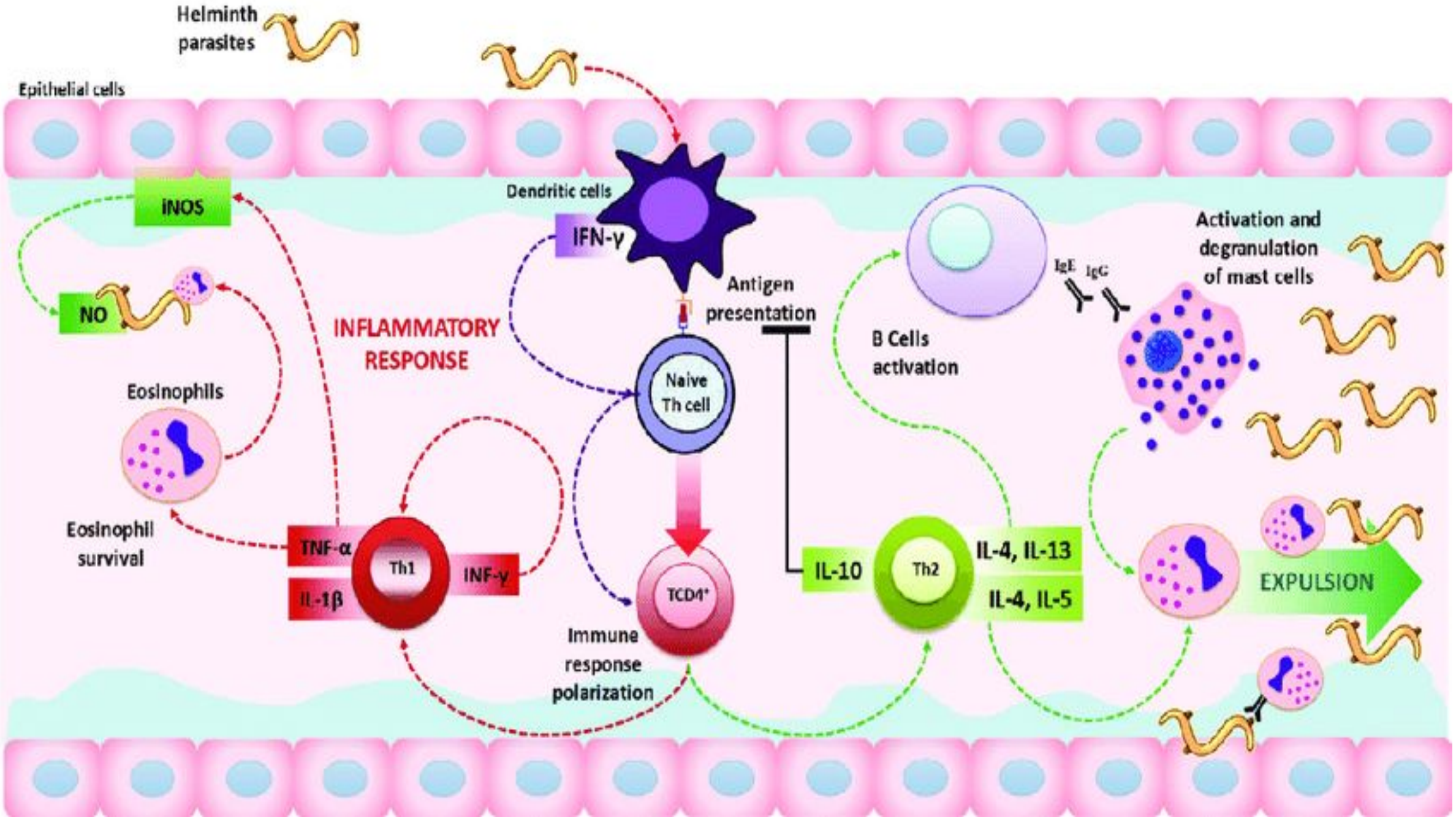
b) some protozoa can become resistant to immune effector mechanisms: Trypanosoma, Leishmania and T. gondii;

c) some protozoa have developed effective mechanisms for varying their surface antigens: Plasmodium and Trypanosoma;

d) some protozoa shed their antigen coats, either spontaneously or after binding with specific antibodies: E. histolytica;

e) some protozoa alter host immune response by nonspecific and generalized immunosuppression (abnormalities in cytokine production, deficient T cell activation): Trypanosoma, Leishmania, Toxoplasma, Entamoeba.

T cells are essential for providing complete protection against *T. gondii*, which is confirmed by the finding that mice deficient in T cells are highly susceptible and die as a result of uncontrollable proliferation of the parasite in various organs, including the brain .Both $CD8^+$ and $CD4^+$ T cells are important for controlling *T. gondii* infection, and IFN-γ production by these cells is critical for protection.


Helminth parasites
Epithelial cells
iNOS
NO
Eosinophils
Eosinophil survival
INFLAMMATORY RESPONSE
Dendritic cells
IFN-γ
Antigen presentation
Naive Th cell
TNF-α
IL-1β
Th1
INF-γ
TCD4+
Immune response polarization
IL-10
Th2
IL-4, IL-13
IL-4, IL-5
B Cells activation
IgE
IgG
Activation and degranulation of mast cells
EXPULSION

IMMUNITY IN PARASITIC INFECTIONS

Because of their biochemical and structural complexity, protozoa and helminths present a large number of antigens to their hosts.

- **Protozoa (micro parasites)** are small and multiply within their vertebrate host, often inside the cells.
  - Thus **posing an immediate threat** unless contained by an appropriate immune response.
- **Helminths (macroparasites)** are large and do not multiply within their vertebrate host.
  - Thus **they do not present** an immediate threat after initial infection.
    - Therefore, immune responses to protozoa and helminths are different from one another.