

Ministry of Higher Education
and Scientific Research
Tishk International University
Faculty of education
Department of Biology



Adaptive Immunity

By

Lecture-5-

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Objectives

- To clarify specificities, types, and functions of adaptive immunity.
- Contrast host innate resistance with adaptive immunity.
- Outline the localization of B and T cells during development.

Specific (Adaptive) Immunity

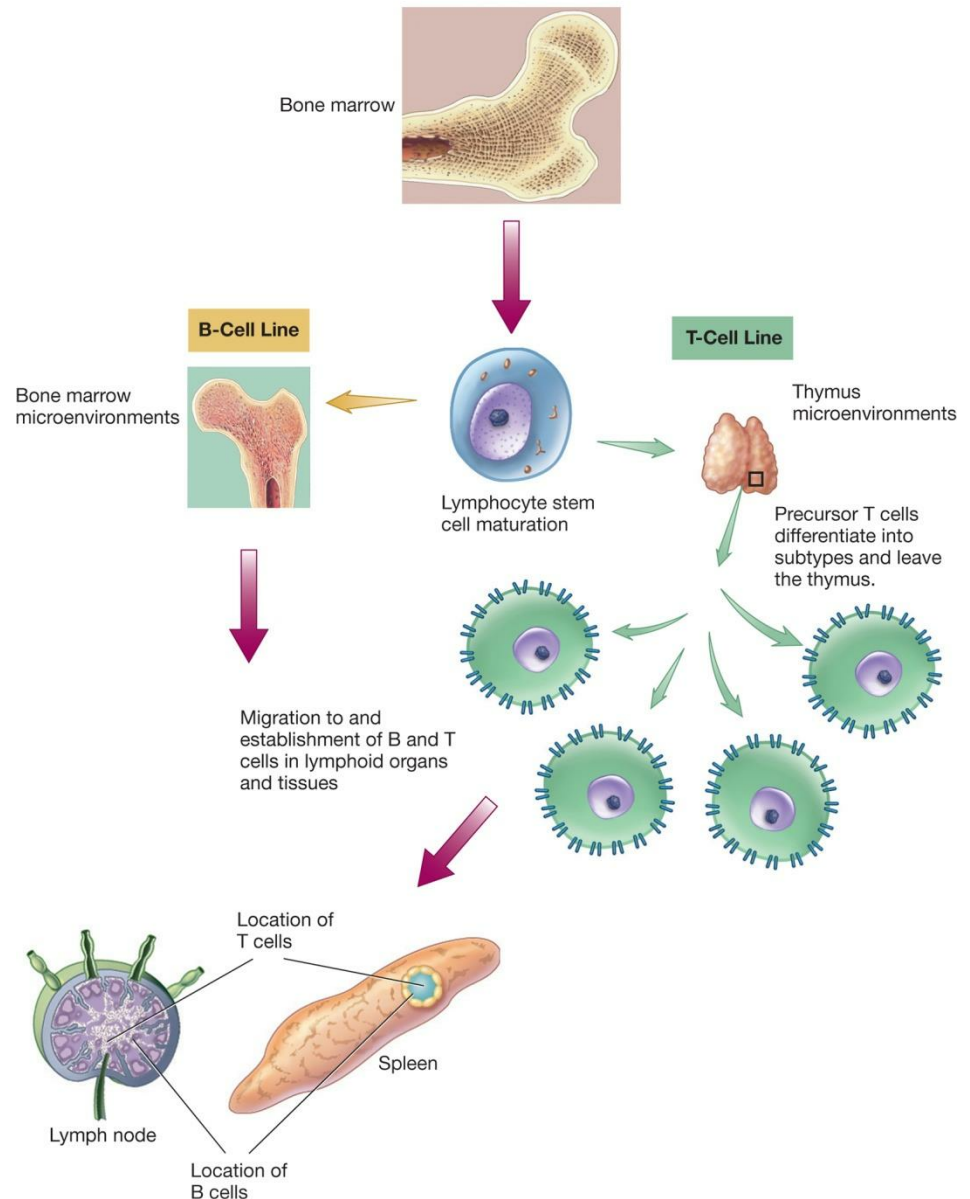
Immunity that an organism develops during lifetime which includes third line of defense

- ❖ Three major functions
 - recognize nonself
 - respond to nonself
 - effector response
 - eliminates or renders foreign material harmless
 - anamnestic response
 - upon second encounter with same pathogen immune system mounts a faster and more intense response
 - remember nonself

Acquired Immune System Development

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- B and T cells initially arise in the bone marrow
 - B cells continue to mature there
 - T cells are moved to the thymus for further maturation
- Both cell types go through extensive screening to avoid self-reactivity



Properties of Specific Immunity

- Discrimination between self and non-self
 - usually responds selectively to non-self, producing specific responses against the stimulus
- Diversity
 - generates enormous diversity of molecules
- Specificity
 - can be directed against one specific pathogen or foreign substance among trillions
- Memory
 - response to a second exposure to a pathogen is so fast that there is no noticeable pathogenesis

Types of Adaptive (acquired) Immunity

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Acquired Immunity

Natural immunity

is acquired through the normal life experiences of a human and is not induced through medical means.

Active immunity

is the consequence of a person developing his or her own immune response to a microbe.



Infection

Passive immunity

is the consequence of one person receiving preformed immunity made by another person.



Maternal antibody

Artificial immunity

is that produced purposefully through medical procedures (also called immunization).

Active immunity

is the consequence of a person developing his or her own immune response to a microbe.



Vaccination

Passive immunity

is the consequence of one person receiving preformed immunity made by another person.



Immune globulin therapy

(Infection, Maternal antibody, Vaccination): © Photo-Disc RF/Getty; (Immune globulin therapy): © Creatas/PictureQuest

Adaptive Immunity working bases

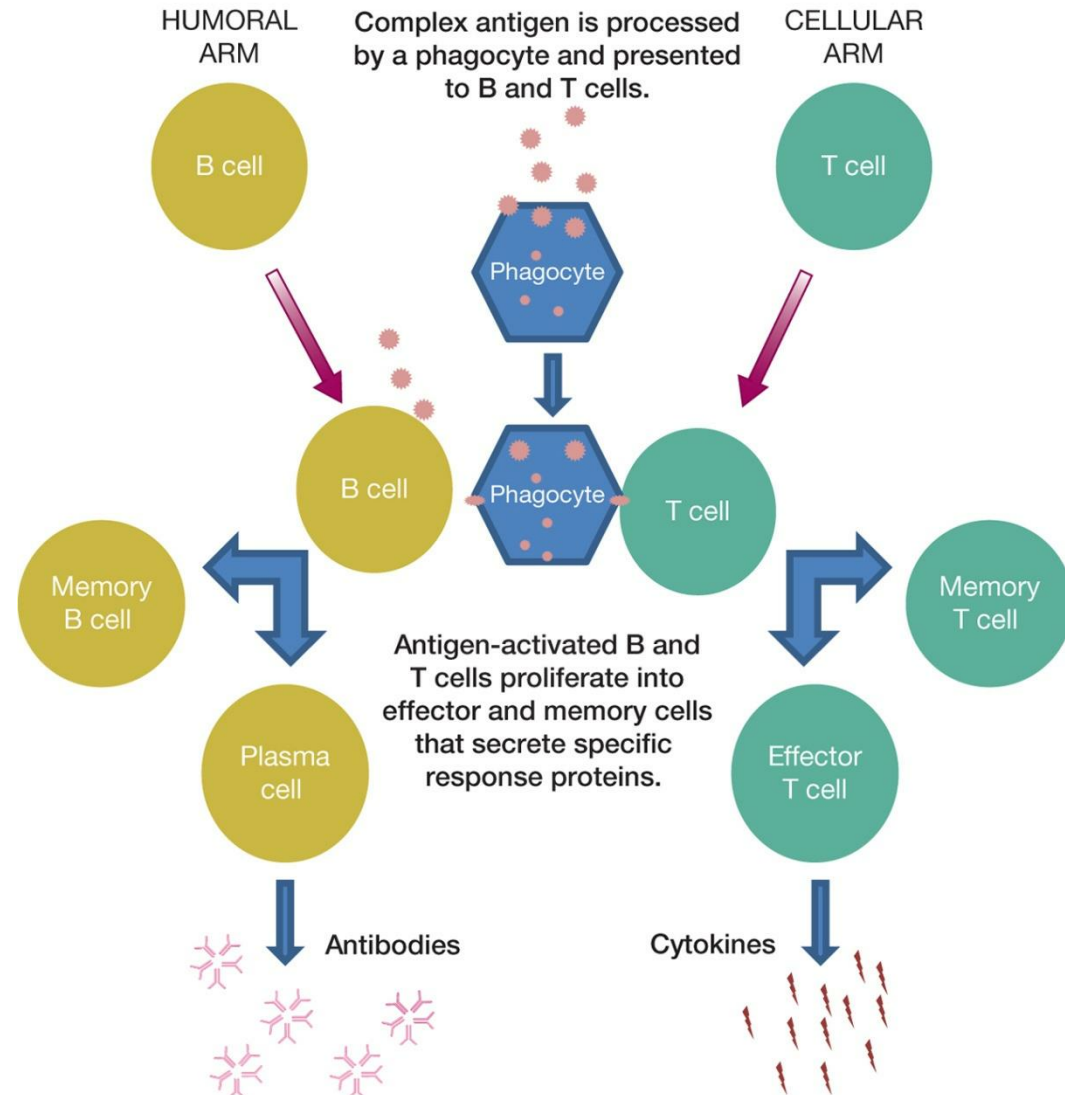
- **Humoral immunity**

- also called antibody-mediated immunity that works based on antibody activity

- **Cellular immunity**

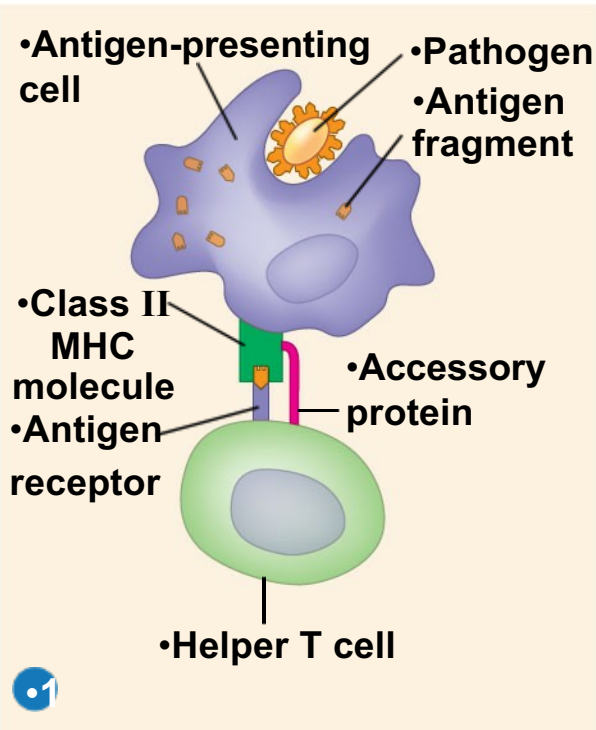
- also called cell-mediated immunity based on action of specific kinds of T lymphocytes

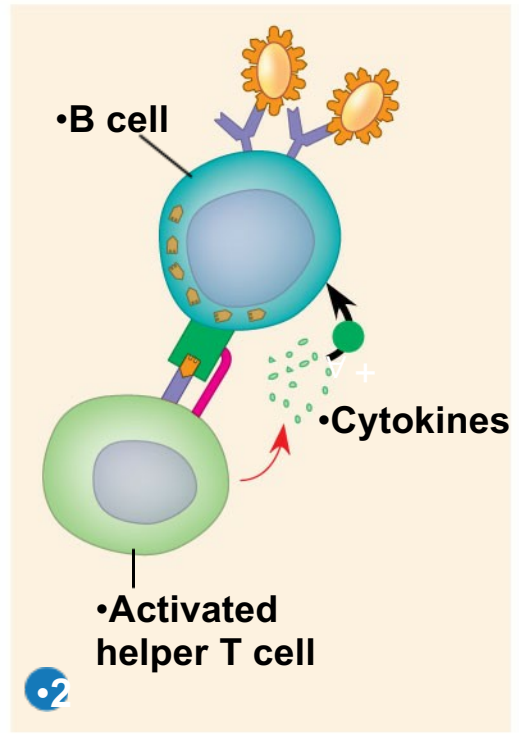
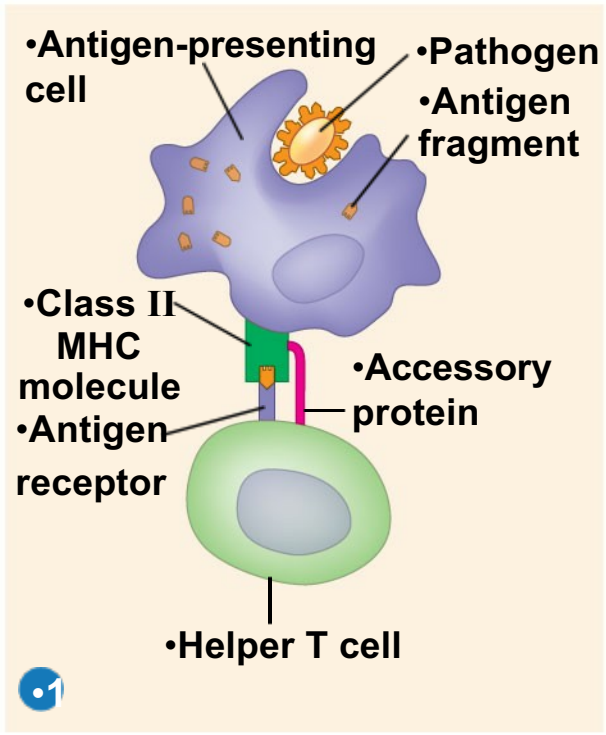
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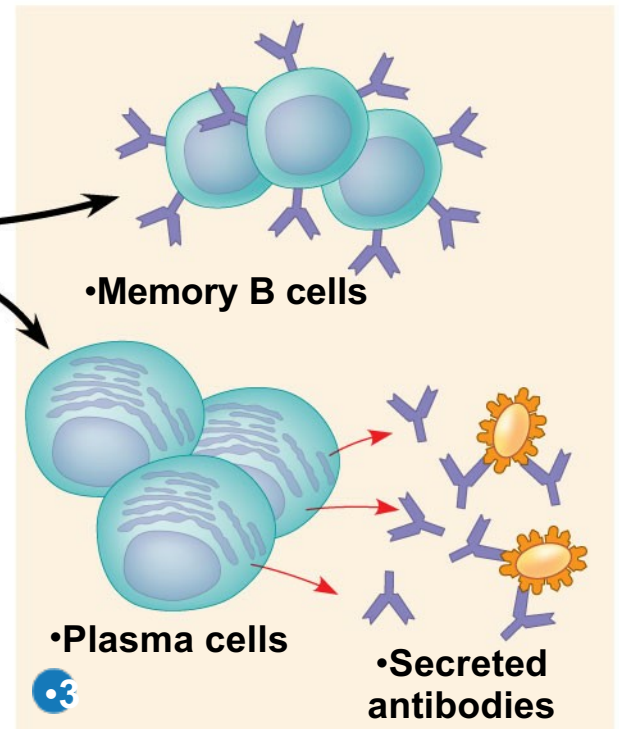
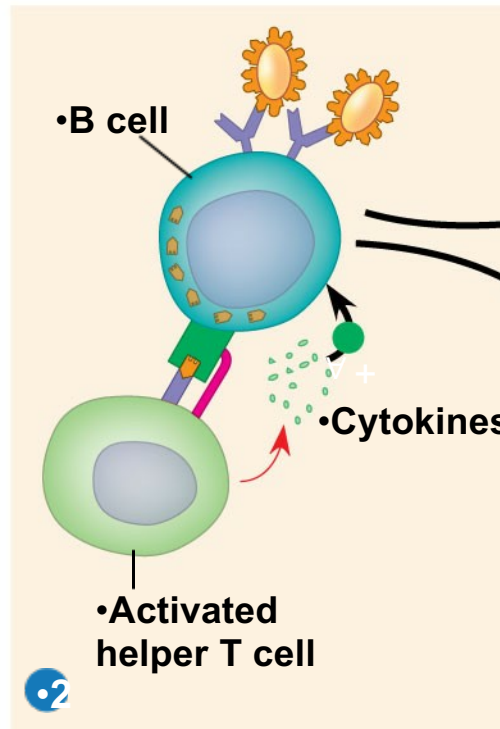
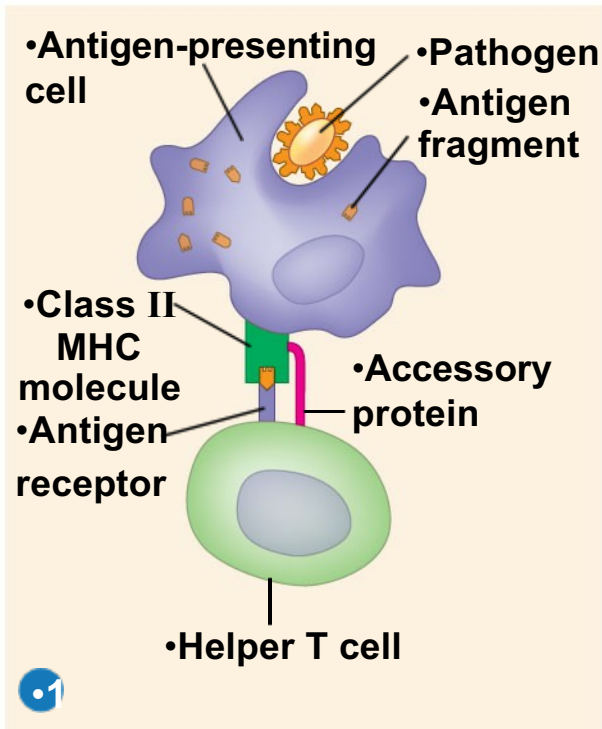


ANTIBODY-MEDIATED (HUMORAL) IMMUNITY

- Targets extracellular microorganisms (Bacteria and viruses circulating in the blood)
- B-lymphocytes (B cells)..... **Antibodies**
- **Antibodies... extracellular fluids and surface of B cells**







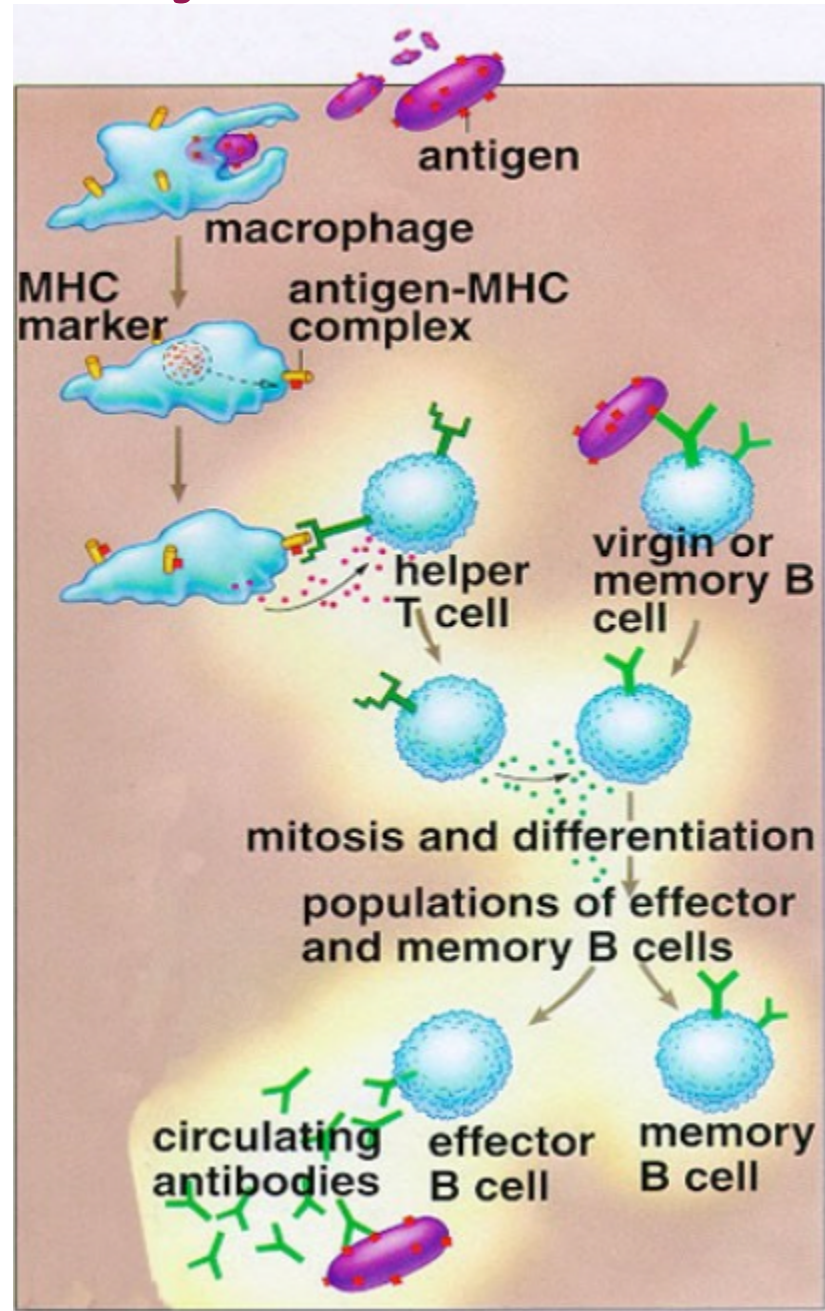
Antibody-mediated (humoral) immunity = AMI

1- Macrophages or dendritic cell phagocytize a pathogen and present an antigen to a matching helper-T cell

2- At the same time, some pathogens contact B-cells matching the pathogen's Antigens

3- The helper-T cells multiply, secrete lymphokines which stimulate the B-cells to multiply and specialize into plasma cells

4- The plasma cells secretes antibodies



Cell-Mediated Immune Response

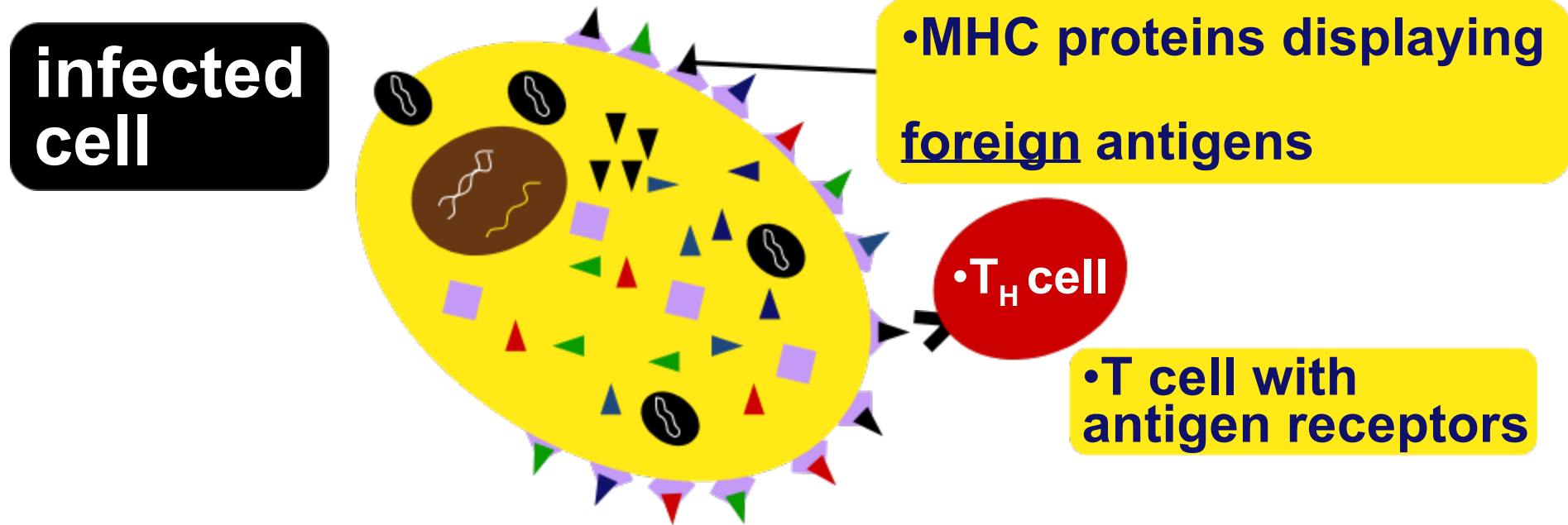


- **T cells**

- **Helper T cells** – secrete CYTOKINES help B cells Tc cells to divide
- **Cytotoxic T cells** (killer T cells) Kill infected body cells
- **Memory T cells** remain in body
- Immune response to **infected cells** (viruses, bacteria and parasites (Pathogens) within cells).
- Defense against cancer and transplant cells.

How do T cells know a cell is infected?

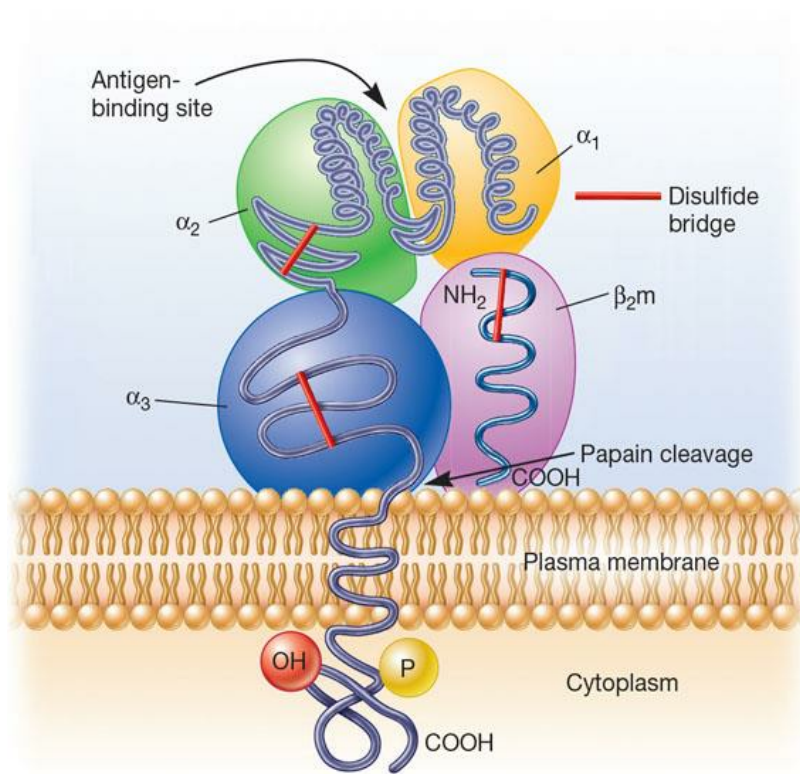
- Infected cells digest some pathogens and MHC proteins carry pieces to cell surface
 - Antigen Presenting Cell (APC)
 - Alerts Helper T cells



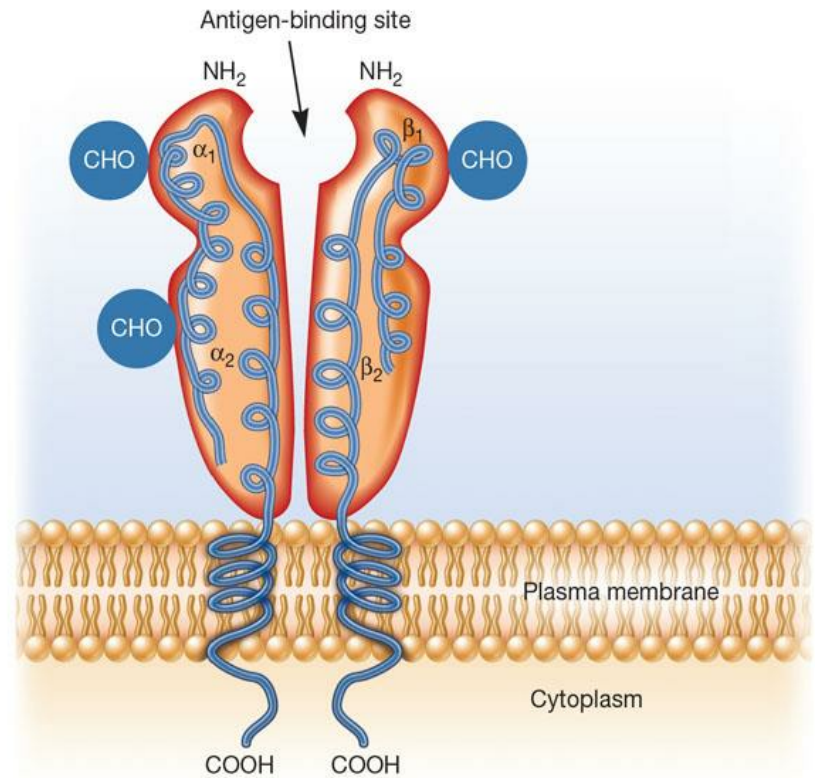
MHC Proteins

- MHC proteins, mark a cell as self
- The two classes of MHC proteins are:
 - Class I MHC proteins – found on virtually all body cells
 - Class II MHC proteins – found on certain cells in the immune response

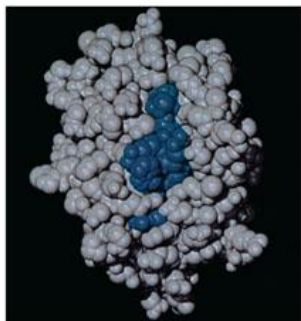
<https://laboratoryinfo.com/difference-between-mhc-class-i-ii-iii-proteins/>



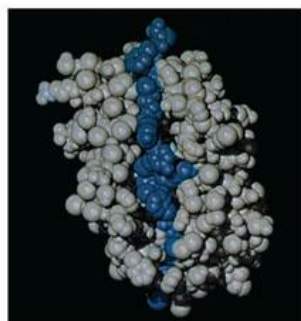
(a) Class I MHC



(b) Class II MHC

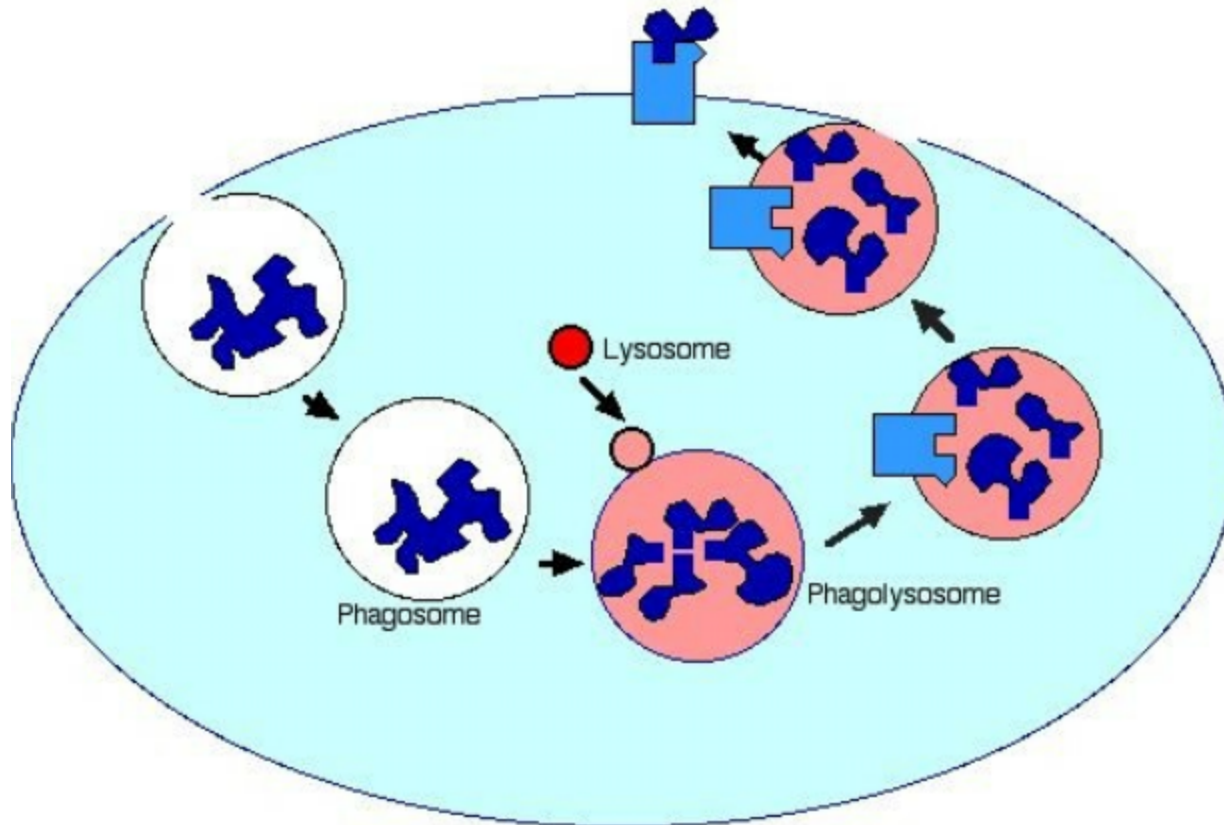
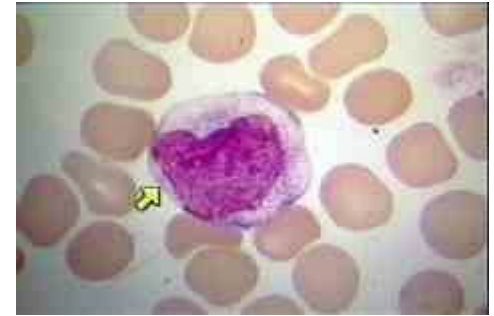


(c)



(d)

Antigen Presentation



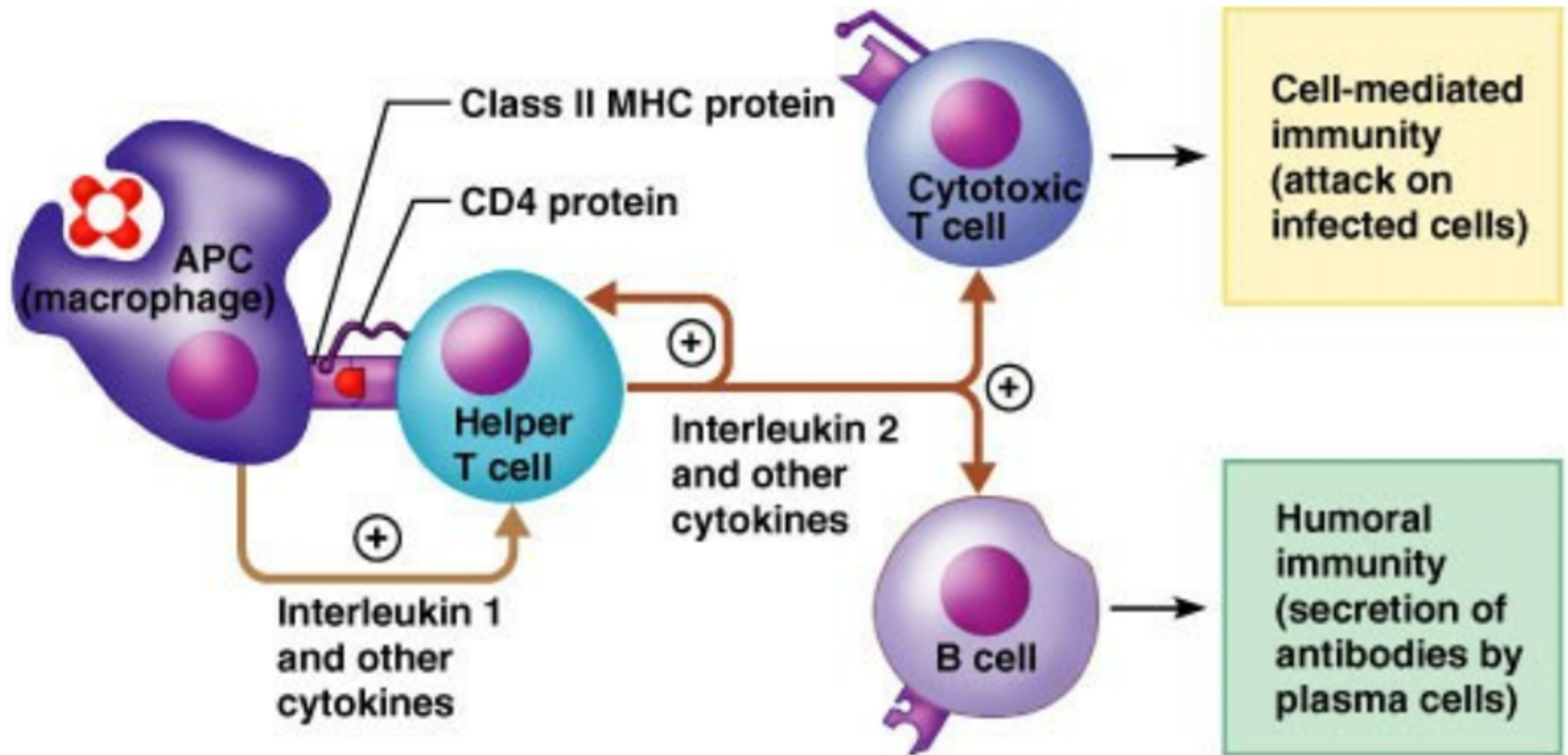
- B cells
- Dendritic cells
- macrophages

Macrophage ("Big Eater" = big phagocyte)

T-Helper Cells

- Also known as CD4+ T cells
- Activated by antigen presentation with class II MHC
- Subdivisions of T helper cells
 - T_H0 – undifferentiated T cells
 - T_H1 – help activate macrophages
 - T_H2 – help B cells produce antibodies
 - T_H17 – assist in antibacterial responses
 - Treg – help control lymphocyte responses

The central role of Helper T Cells (Boss)



•Figure 21.17a

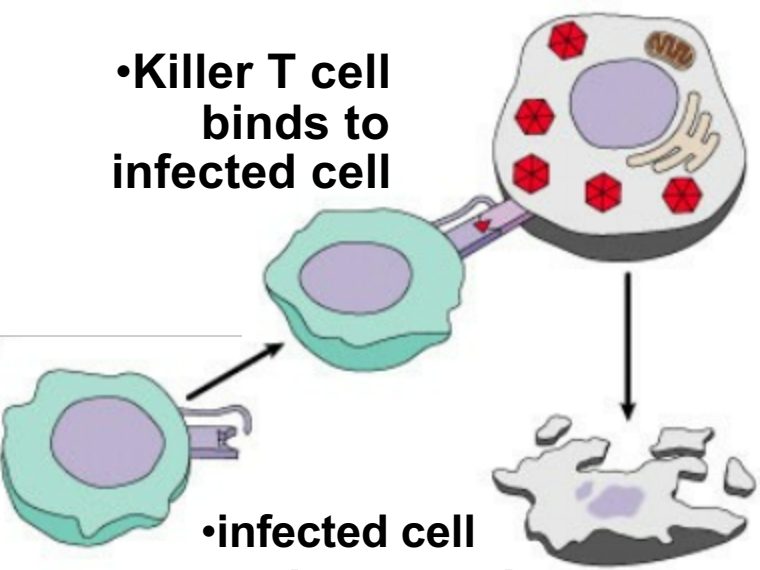
Cytotoxic T Cells (T_Cs)

- Are CD8⁺ T cells that have been activated by antigen presented on MHC-1 molecules of nucleated cells.
- Once activated, these CTLs can kill target cells that have the same antigen-MHC-1 combination that originally activated the CTL.
- combination that originally activated the CTL perforin pathway and CD95 pathway

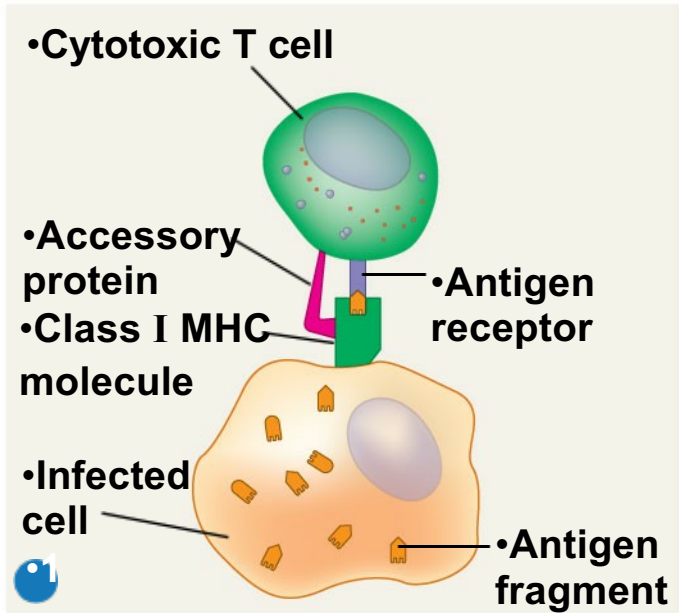
Cytotoxic T cells

- Destroys infected body cells
 - binds to target cell
 - secretes perforin protein
 - punctures cell membrane of infected cell
 - apoptosis

•Killer T cell
binds to
infected cell



•infected cell
•destroyed



•Cytotoxic T cell

•Accessory
protein

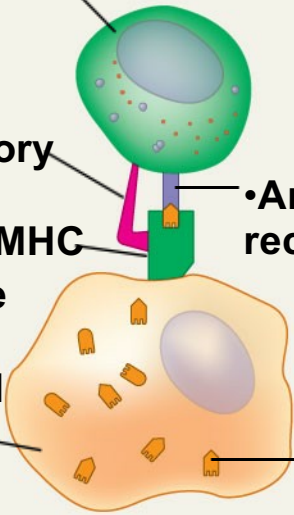
•Class I MHC
molecule

•Infected
cell

•Antigen
receptor

•Antigen
fragment

1

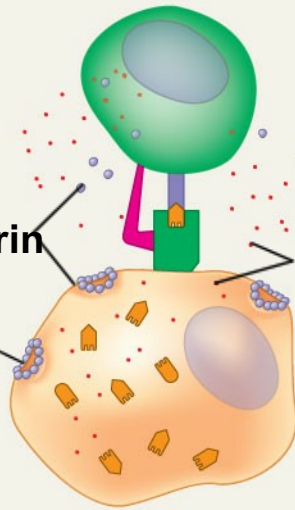


•Perforin

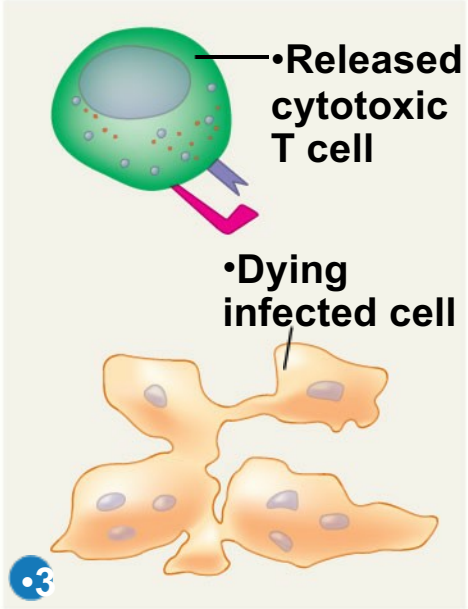
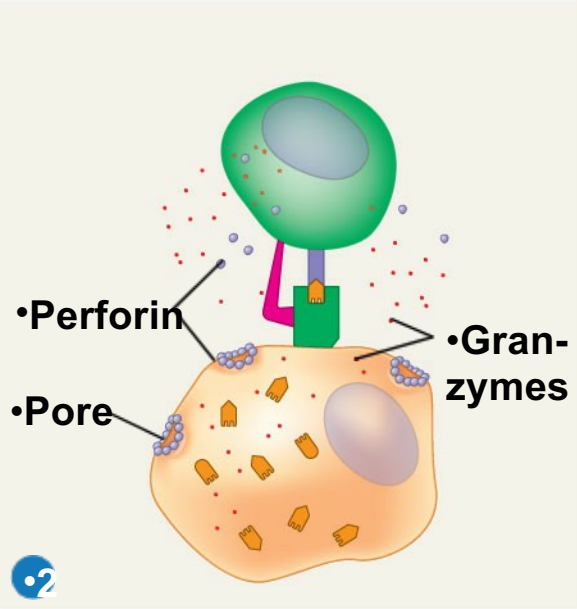
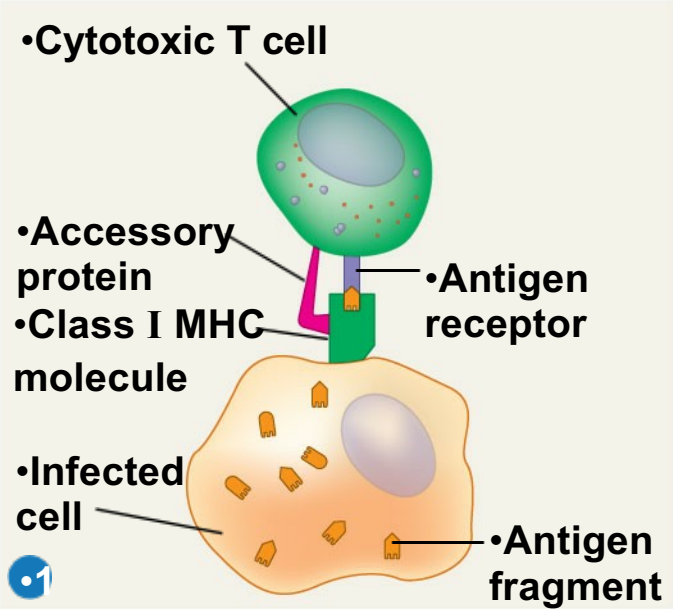
•Pore

•Gran-
zymes

2



The killing action of cytotoxic T cells on an infected host cell.



References:

- Abbas, A.K., Lichtman, A.H. and Pillai, S., 2014. *Cellular and molecular immunology E-book*. Elsevier Health Sciences.
- Goldman, A.S. and Prabhakar, B.S., 1996. *Immunology overview*. University of Texas Medical Branch at Galveston, Galveston (TX).
- Abbas, A.K., Lichtman, A.H. and Pillai, S., 2015. *Basic Immunology E-Book: Functions and Disorders of the Immune System*. Elsevier Health Sciences.