**AP Biology 12**

**Analyzing how the animal immune system defends the body against disease**

**Chapter 43**

*You Must Know...*

* Several elements of an innate immune response
* The differences between B and T cells relative to their activation and actions
* How antigens are recognized by immune system cells.
* The differences in humoral and cell-mediated immunity
* Why helper T cells are central to immune responses

Innate Immune Responses of Vertebrates….are the same whether or not the pathogen has been encountered previously

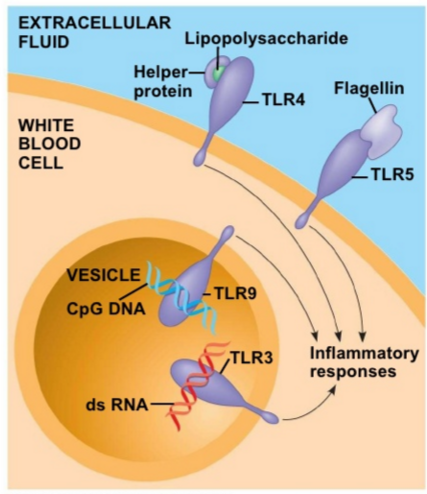
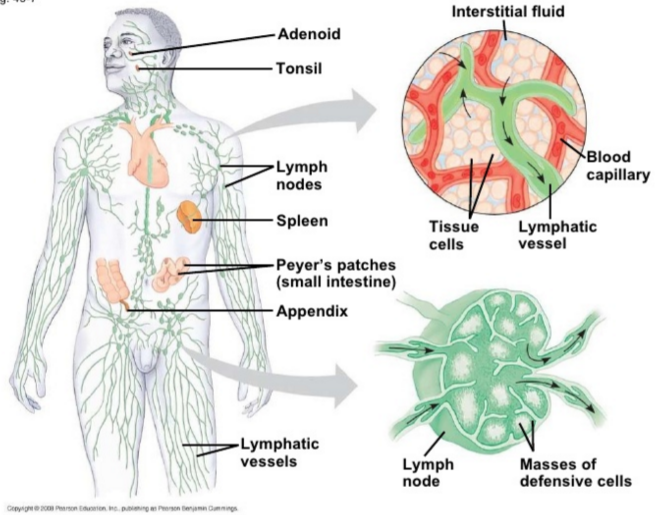
Phagocytic White Blood Cells (leukocyte) – remember what phagocytosis is?

**1. Barrier defenses** → \_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_ membranes. A physical barrier as well as production of secretions to regulate skin pH, tears and antimicrobial lysozyme in saliva.

**2. Cellular innate defenses** → Phagocytic white bloods cells and antimicrobial proteins that combat pathogens that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_i.e. a cut.

**3. Toll-like Receptors (TLRs)** → Phagocytic white blood cells recognize microbes using these \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

TLR Signalling The Human Lymphatic System:

**Neutrophils** → white blood cells that ingest and destroy microbes by **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Monocytes** → migrate into tissues and develop into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Eosinophils** → defend against parasitic invaders such as worms by positioning themselves near the parasite and releasing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Dendritic cells** → populate tissues in contact with the environment.  They capture \_\_\_\_\_\_\_\_\_\_\_\_\_\_, display \_\_\_\_\_\_\_\_\_\_\_ and start the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Antimicrobial Proteins

**Interferon** → proteins provide innate defense against \_\_\_\_\_\_\_\_\_\_\_\_\_\_ infections.  They cause cells adjacent to infected cells to produce substances to inhibit viral replication

**Complement System** → roughly 30 proteins with a variety of functions that \_\_\_\_\_\_\_\_\_\_\_\_\_\_the immune response.

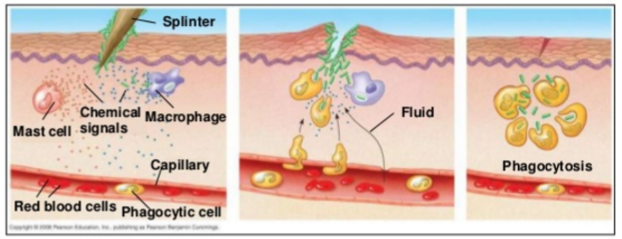
         Example:  Lyse invading cells.

Inflammatory Response

1. Activated macrophages and \_\_\_\_\_\_\_\_\_\_\_\_\_ at the injury site release signaling molecules that act on nearby capillaries

2.  Capillaries widen and become more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, allowing fluid containing antimicrobial peptides to enter the tissue.  Signaling molecules released by immune cells attract additional phagocytic cells.

3.  Phagocytic cells \_\_\_\_\_\_\_\_\_\_\_\_\_ pathogens and cell debris at the site, and the tissue heals



**Histamine** → released by mast cells in response to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  They trigger the dilation and permeability of nearby capillaries.  This aids in delivering \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and phagocytic cells to the injured area.

**Natural Killer Cells (NK)** → help to recognize and remove \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells.

Adaptive Immunity - Receptors provide pathogen-specific recognition

Two types of **Lymphocytes** (white blood cells)

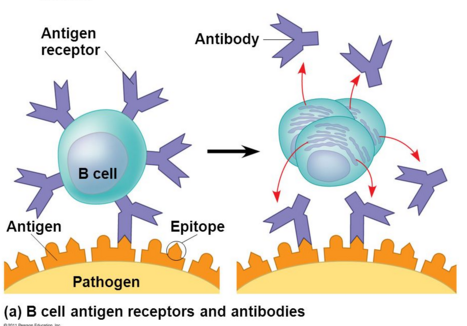
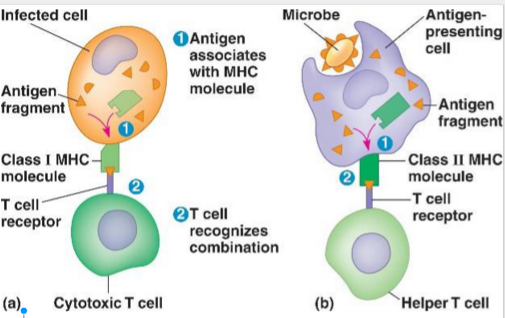
1. B cells - proliferate in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. T cells - mature in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

They both circulate through the blood and lymph and recognize antigens. Each B and T cell responds to \_\_\_\_\_\_\_antigen.

**Antigens** → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that elicit a response by lymphocytes.  B and T cells recognize antigens through their receptors on the membrane

**Antibodies** → proteins secreted by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_during an immune response

**B or T cell activation →** when the antigen binds to a B or T cell.  B cell activation is enhanced by\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (small proteins)

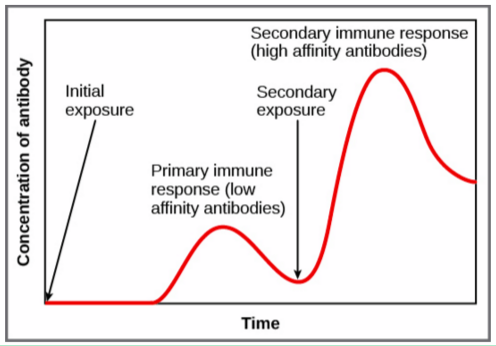
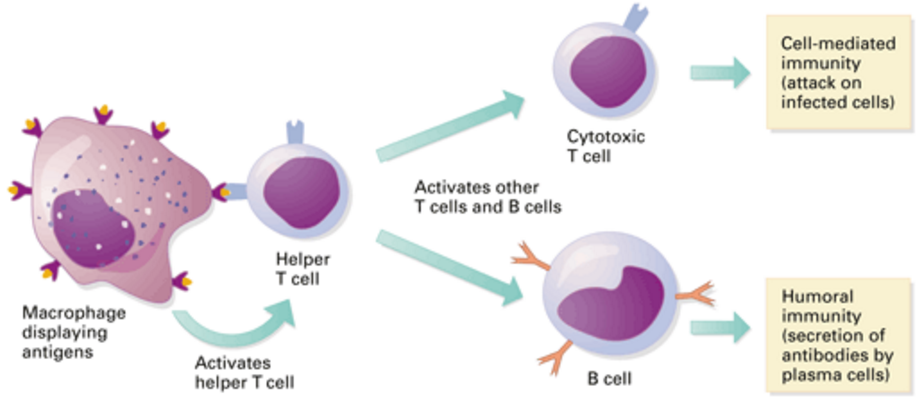
 

* **B cell receptors** bind \_\_\_\_\_\_\_\_\_\_\_\_antigens
* **T cell receptors** bind antigen that are displayed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_cells (APCs) on their MHCs
* Major histocompatibility complex **(MHC)** molecules → proteins that are the product of a groups of genes.
  + Class I MHCs are found on \_\_\_\_\_\_\_\_\_\_\_\_\_\_cells of the body except RBCs
  + Class II MHCs are made by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of the immune system, including dendritic cells, macrophages and B cells.

The main *function* of **MHC molecules** is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to peptide fragments derived from pathogens and \_\_\_\_\_\_\_\_\_\_\_\_\_ them on the cell surface for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by the appropriate T-cells

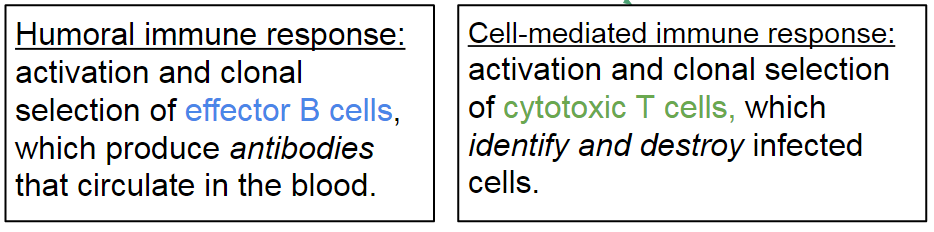
**Primary Immune Response** → when the body is \_\_\_\_\_\_\_\_\_\_\_exposed to an antigen and a lymphocyte is activated

**Secondary Immune Response** → the \_\_\_\_\_\_\_antigen is encountered at a later time.  It is faster and of great magnitude.

**Adaptive immunity defends against infection of body fluids and body cells**

Acquired immunity has 2 branches:

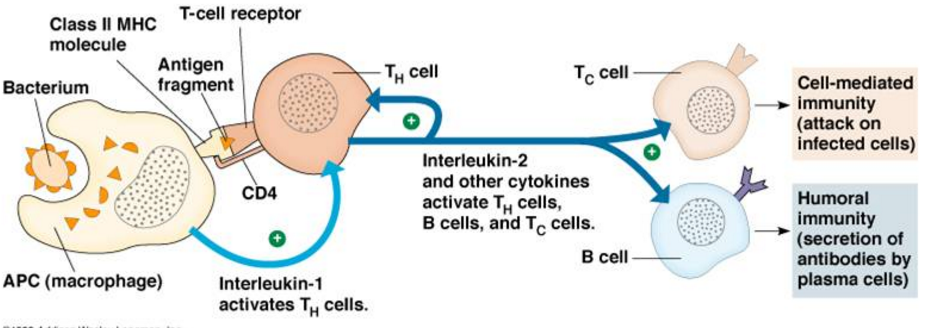


**Helper T Cells**:  aid in *both* Humoral and Cell-Mediated Responses.  When activated by class II MHC molecules, they secrete \_\_\_\_\_\_\_\_\_\_\_\_\_\_that stimulate and activate both \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Cytotoxic T cells:**  bind to class I\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, displaying antigenic fragments on the surface of infected body cells.  Cytotoxic T cells \_\_\_\_\_\_\_\_\_\_\_\_\_\_infected body cells.

RECAP

* **B cells** make antibodies, which provide humoral immunity.  This helps fight pathogens that are circulating in body fluids.
* **Cytotoxic T cells** destroy body cells that are infected by a pathogen or cancer cells.
* **Helper T cells** activate both B and T cells.



Activated B Cells       memory cells & plasma cells. Plasma cells antibodies (circulate and destroy antigens)

Modes of antibody action:

1. Neutralization: antibodies bind the pathogen`s \_\_\_\_\_\_\_\_\_\_\_\_\_ proteins which prevents it from entering infecting cells
2. Opsonization: results in increased \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of the antigen
3. Lysis: caused by activation of the\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Active immunity**: develops \_\_\_\_\_\_\_\_\_\_\_\_\_\_in response to an infection; is also develops artificially by immunization (vaccination)

In **immunization**, a non-pathogenic form of a microbe elicits an immune response resulting in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of that microbe

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**Passive Immunity:** when an individual \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ antibodies.

 Example - those passed to the fetus across the placenta and to infants via milk

Remember...\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on red blood cells determine if a person has type A, B, AB or O.

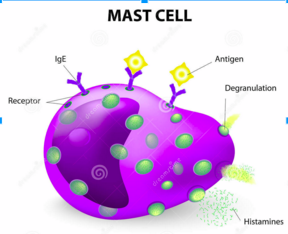
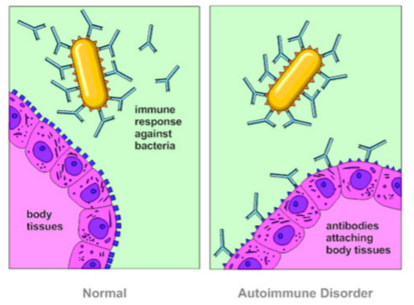
Transfusion with incompatible blood leads to destruction of the transfused cells and life -threatening situation for the patients.  Antibodies to nonself blood antigens already exist in the body.

MHC molecules are responsible for stimulating the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of tissue grafts and organ transplants.  The chances of a successful transplant improve if the donor's tissue bearing MHC molecules closely match the patient's.  The recipient also must take immunosuppressant drugs.

**Disruptions in the immune system**

Allergies (example: hay fever) - IgE antibodies produced after first exposure to an allergen attach to receptors on\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The next time the same allergen enters the body, it bonds to the mast cell-associated IgE molecules, inducing the cell to release \_\_\_\_\_\_\_\_\_\_\_\_\_\_and other mediators that cause vascular changes and typical symptoms.

Mast cell:  a cell filled with basophil granules, found in numbers in connective tissue and releasing histamine and other substances during inflammatory and \_\_\_\_\_\_\_\_\_\_\_\_\_reactions.

The immune system \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the molecules of the body, allowing cytotoxic T cells to attach and damage the body's own healthy cells.

HIV infects helper T cells.  People with AIDS are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.