

Human Biology 175

Lecture Notes: Lymphatic System

Section 1 Introduction

A) Basic Functions:

- 1) Return _____ to the blood stream
- 2) _____

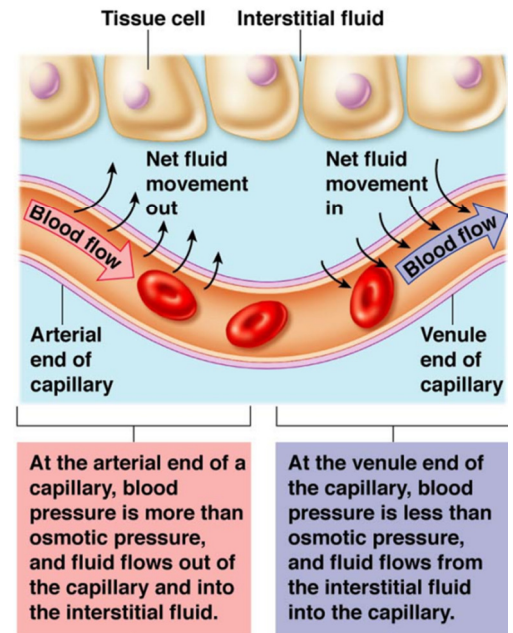
B) Organs/Tissues of the Immune System

- 1) Lymphatic vessels
- 2) Lymph nodes
- 3) Spleen
- 4) Thymus
- 5) _____ (Mucosal Associated Lymphatic Tissues)
 - a) Tonsils
 - b) Peyer's patches
 - c) Appendix

Section 2 Lymphatic Vessels

A) Blood Capillaries:

- 1) Function: _____
Exchange between the plasma and the _____ (fluid between the cells of tissues)
- 2) Fluid leaves at _____
- 3) Fluid enters at _____
- 4) _____ force of the fluid against the wall of the vessel
- 5) _____ force created due to the uneven solute concentrations between the vessels
- 6) _____ condition where there's excess fluid within body tissues.

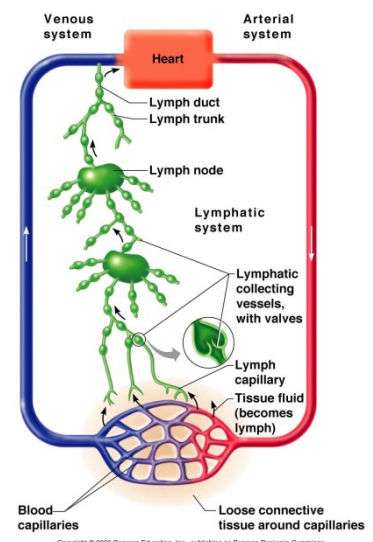


B) Lymphatic Capillaries

- 1) Blind ended
- 2) _____ cells overlap forming _____
- 3) Pressure of fluids forces cell to open/close
- 4) _____ tissue fluid within lymphatic vessels

C) Movement of Lymph within lymphatic vessels

- 1) Similar in structure to veins
 - a) 3 tunics
 - b) valves
 - c) Lymph passes through lymph nodes on return
- 2) _____ movements 'milk'
- 3) _____ changes in thoracic cavity volume
- 4) Lymph is dumped back into venous system to the _____



Section 3 Lymphatic Organs

A) Lymph Nodes:

1) General:

- a) Vary in size/shape
- b) Clusters—axillary, inguinal, cervical
- c) Buried in CT

2) Lymph will pass through several lymph nodes before returning to venous system

- a) _____ phagocytes
- b) _____ stimulated to produce _____

B) Spleen

1) General:

- a) Abdominal cavity
- b) Reticular tissue
- c) _____ areas with many RBCs
- d) _____ areas with many WBCs

2) Function:

- a) _____ remove bacteria, viruses and destroy worn out RBCs
- b) RBC degradation products used by liver to make _____
- c) Return _____ to liver for storage
- d) _____ stores platelets
- e) _____ (blood loss): spleen and liver contract and empty blood reservoir into blood vessels to increase blood volume

C) Thymus

1) Endocrine System: _____ aids in T-cell maturation

2) Lymphatic System:

- a) _____
- b) Highest activity in youth
- c) As age, replaced with fibrous CT

D) Mucosal Associated Lymphatic Tissues

- 1) _____ pharynx
- 2) _____ intestinal wall
- 3) _____ attached to cecum
- 4) Trap/remove debris-- _____ (phagocytes)

Section 4 Immune Response

A) Immune Response: All defense mechanisms that target a threat

B) Antigen:

- 1) Molecule that is recognized as foreign and initiates an immune response
- 2) Large/complex molecules
 - a) Protein
 - b) Carbohydrates
 - c) Nucleic acids
 - d) Some lipids
- 3) Bacteria: _____
- 4) Fungi: _____
- 5) Viruses: _____

C) Body cells have antigens/recognition markers

- 1) _____
- 2) _____
- 3) _____

The Immune System		
Innate (nonspecific) defense mechanisms		Adaptive (specific) defense mechanisms
First line of defense	Second line of defense	Third line of defense
<ul style="list-style-type: none">• Skin• Mucous membranes• Secretions of skin and mucous membranes	<ul style="list-style-type: none">• Phagocytic cells• Antimicrobial proteins• The inflammatory response	<ul style="list-style-type: none">• Lymphocytes• Antibodies• Macrophages

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Section 5 Nonspecific Defense Mechanisms

A) General Characteristics:

- 1) _____
- 2) _____
- 3) _____

B) Includes

- 1) 1st Line of Defense/Barriers to entry:
 - a) Skin (and its secretions)
 - b) Mucous membranes
- 2) 2nd Line of Defense
 - a) Cells
 - b) Proteins
 - c) Inflammation
 - d) Fever

C) 1st Line of Defense: Skin and Mucous Membranes

- 1) _____ unbroken
- 2) Secretions are antimicrobial:
 - a) _____ sebaceous glands (pH 3-5)
 - b) _____ stomach (pH 2)
 - c) _____ goblet cells—cilia move trapped pathogens across surface
 - d) _____ enzyme—tears/saliva
- 3) _____ filter—nasal cavity/eye lashes/eye brows

D) 2nd Line of Defense: _____

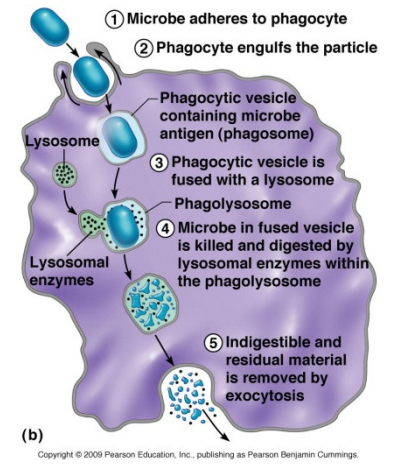
- 1) Cells:
 - a) Phagocytes
 - b) Natural Killer Cells
- 2) Proteins:
 - a) Complement _____
 - b) Interferon _____
- 3) Inflammation
- 4) Fever

E) Phagocytes

- 1) located in virtually all body organs/tissues
- 2) Engulf pathogen in vacuole and fuse with lysosome (enzymes digest)

3) Examples:

- a) _____
- b) _____
- c) _____



F) Natural Killer Cells (NK cells)

- 1) unique group of lymphocytes

2) Target:

- a) _____
- b) _____

- 3) Kill with _____ protein that forms holes in target cell's membrane allowing fluid to rush in resulting in _____

G) Inflammation

- 1) Triggered by tissue/cell damage (physical/heat/viral/bacterial) release _____

2) 4 Hallmark Signs of Inflammation:

- a) _____
- b) _____
- c) _____
- d) _____

3) Histamine/kinins cause

- a) blood vessels to _____ (plasma)

- b) Activate pain receptors

c) Chemoattractant:

- (1) _____ neutrophils/macrophages

- (2) _____ aid in attack

4) Purpose of Inflammation

- a) _____ isolate/wall off

- b) _____ dispose of pathogens/dead cells and debris

- c) _____ provides scaffold for repair

- d) _____ increases metabolism/activity of WBCs

H) Antimicrobial Protein: _____

- 1) _____ circulate in blood
- 2) Attach/bind to _____
- 3) Form a 'donut protein' / Membrane attack complex allowing fluid to enter the cell causing _____

I) AntiViral Protein: _____

1) Viruses: _____

a) Basic Structure

- (1) Nucleic acid core
- (2) Protein coat

b) Designed to take over the cells metabolic machinery (_____), monomers (_____) and ATP to make more viruses (viral replication)

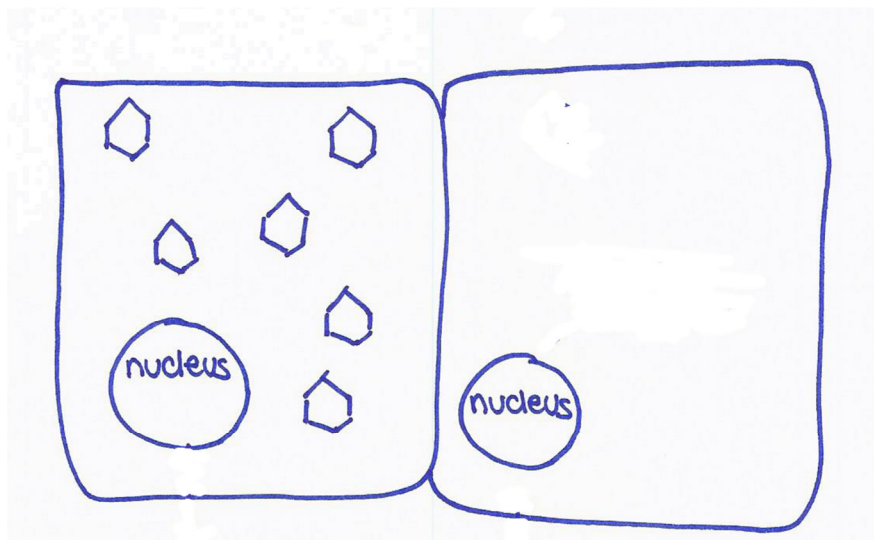
2) Interferon

a) Produced by _____

b) Virally infected body cells destined to die

c) Secrete interferon that binds _____

d) Neighboring cells respond by making _____ to prevent viral replication



J) Fever

- 1) _____
- 2) _____ control center for body temperature
 - a) Normal 98.6F
 - b) **Reset** to higher temperature by proteins
_____ released by WBCs and
macrophages
- 3) Purpose: higher body temperature affects functions
 - a) _____ (mild/moderate fever)
 - b) Liver and spleen take up Zinc and iron decreases bacteria's
ability to multiply

Section 6 Specific Defense Mechanisms--3rd Line of Defense

A) General Characteristics:

- 1) Single target: _____
- 2) _____ whole body involved
- 3) _____ provides recognition to mount stronger response to a second encounter with the same antigen

B) 2 Types of Immune Response

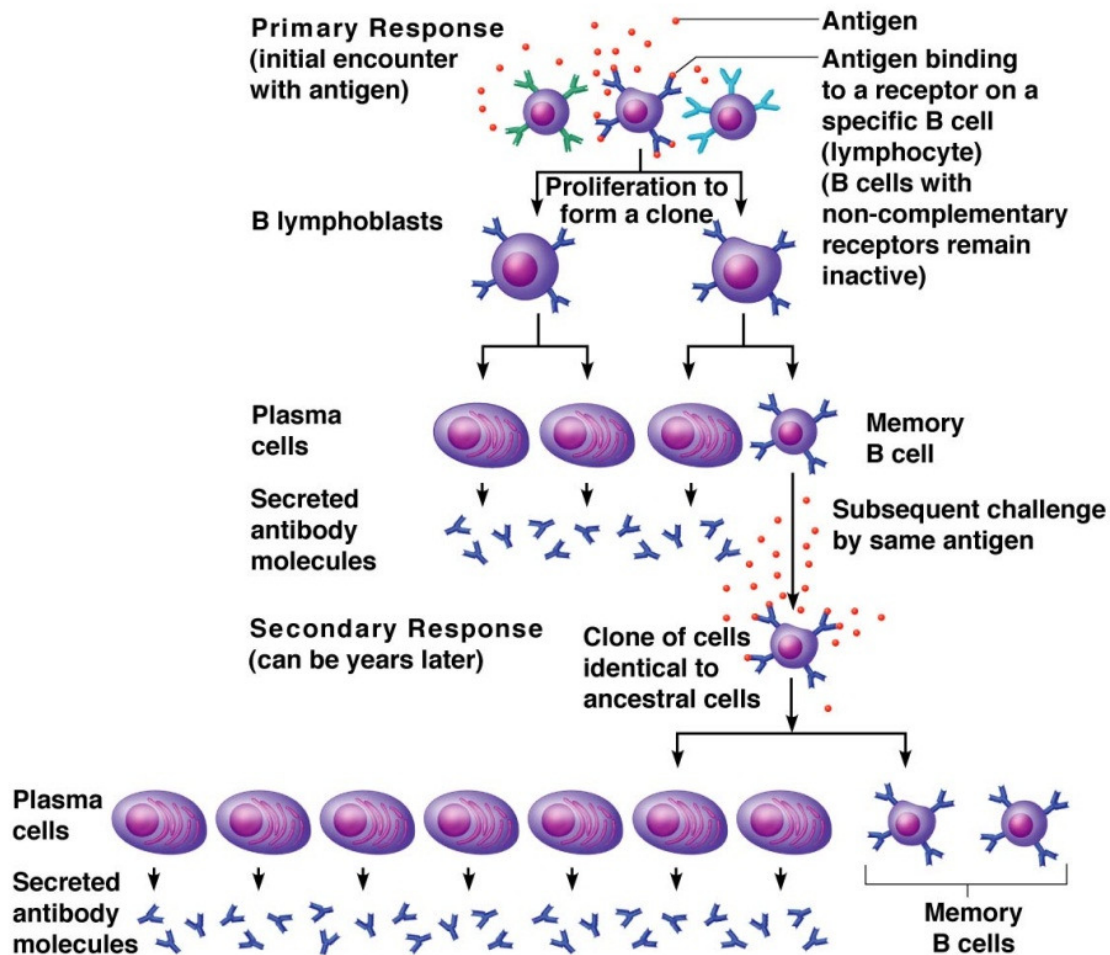
- 1) _____ (carried out by antibodies)
- 2) _____ (carried out by cells)

C) Lymphocytes

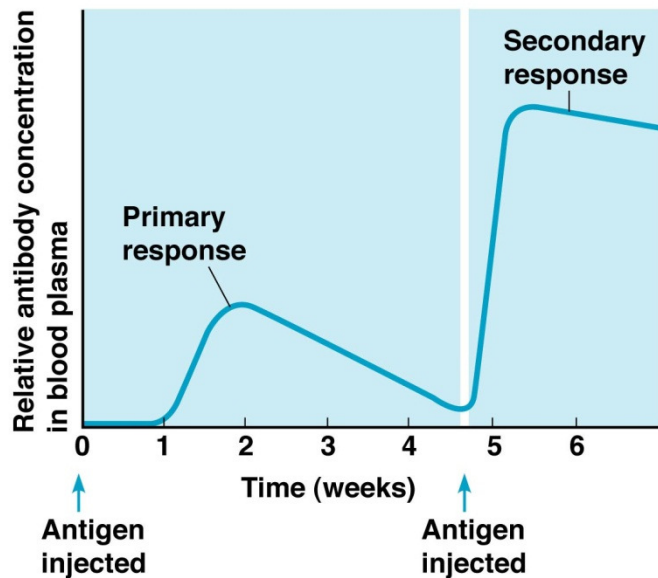
- 1) _____
 - a) Produced/mature in _____
 - b) Reside in _____
 - c) _____ recognize/binds/interacts with a specific antigen
 - d) Function: _____
- 2) _____
 - a) Produced in the _____
 - b) mature in _____
 - c) Reside in _____
 - d) _____ recognize/binds/interacts with a specific antigen WITH a self protein
 - e) Function: _____

D) Antibody Mediated Immunity

- 1) Carried out by _____
- 2) Activated by a specific _____
(the antigen selects its assassin)
- 3) Activation of a B-cell stimulates _____
 - a) _____ secrete antibodies—identical to receptor into the blood
 - b) _____ reside in lymphatic organs and wait for the next encounter with same antigen
- 4) _____ the antigen selects/binds to a specific unique receptor on a B-cell which undergoes mitosis and produces antibodies



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E) Antibodies

1) Soluble plasma proteins

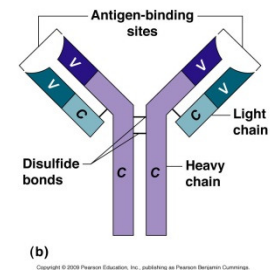
- Secreted by activated B-cells
- Identical to the _____
- Has an antigen-binding site

2) Functions include:

- _____ bacteria cannot adhere to take up residence and cause infection
- _____ prevents toxin from damaging body cells
- _____ large particles more efficiently phagocytized and immobilized

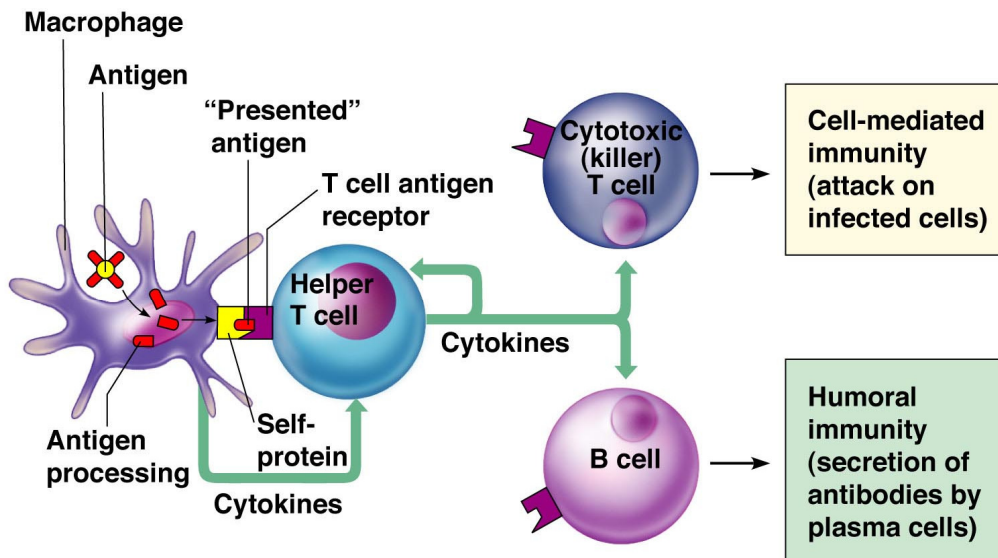
3) Types of Antibodies/ _____

- _____ most common/crosses placenta
- _____ largest/agglutination
- _____ prevents attachment and in secretions (milk/saliva/mucus)
- _____ important in B-cell activation
- _____ allergy/inflammation/parasitic worms



F) Cell Mediated Immunity

- 1) Carried out by _____
- 2) Activated by a specific _____
- 3) _____ present antigen with body marker to T-cell for _____
- 4) Results in _____/clonal expansion
 - a) _____
 - b) _____
- 5) Types of T-cells
 - a) _____
 - (1) Kill virally infected body cells
 - (2) Kill cancer cells
 - (3) perforin
 - b) _____ enhance immune response/recruit other immune cells



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Section 7 Induced Immunity

A) Active Immunity:

1) Characteristics:

- a) _____ in response to an antigen
- b) _____
- c) _____ (generally) long-lived/permanent

2) Natural Active Immunity:

- a) _____
- b) Example: being sick

3) Artificial Active Immunity:

- a) develops after exposure but with decreased symptoms:
- b) Example: _____

B) Passive Immunity

1) Characteristics:

- a) _____ (not produced)
- b) _____ but short-lived
- c) _____

2) Natural Passive Immunity

- a) Mom's antibodies passed to fetus/baby through _____

3) Artificial Passive Immunity:

- a) _____ that bind antigen stimulating phagocytosis and complement