

12 PART A

The Lymphatic System and Body Defenses

PowerPoint® Lecture Slide Presentation by Jerry L. Cook, Sam Houston University



ESSENTIALS
OF HUMAN
ANATOMY
& PHYSIOLOGY

EIGHTH EDITION

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The Lymphatic System

- Consists of two semi-independent parts
 - Lymphatic vessels
 - Lymphoid tissues and organs
- Lymphatic system functions
 - Transport fluids back to the blood
 - Play essential roles in body defense and resistance to disease

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Lymphatic Characteristics

- Lymph – excess tissue fluid carried by lymphatic vessels
- Properties of lymphatic vessels
 - One way system toward the heart
 - No pump
 - Lymph moves toward the heart
 - Milking action of skeletal muscle
 - Rhythmic contraction of smooth muscle in vessel walls

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Lymphatic Vessels

- Lymph Capillaries
 - Walls overlap to form flap-like minivalves
 - Fluid leaks into lymph capillaries
 - Capillaries are anchored to connective tissue by filaments
 - Higher pressure on the inside closes minivalves

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Lymphatic Vessels

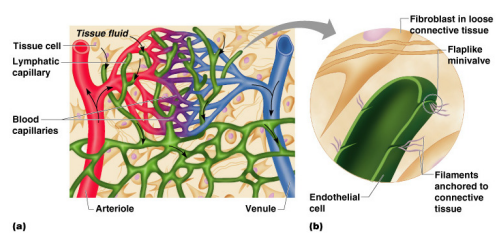


Figure 12.2

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Lymphatic Vessels

- Lymphatic collecting vessels
 - Collects lymph from lymph capillaries
 - Carries lymph to and away from lymph nodes

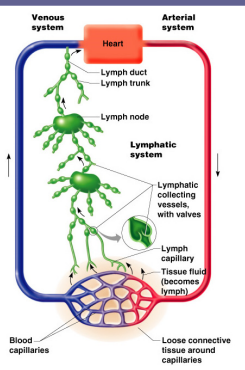


Figure 12.1

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Lymphatic Vessels

- Lymphatic collecting vessels (continued)
 - Returns fluid to circulatory veins near the heart
 - Right lymphatic duct
 - Thoracic duct

Figure 12.1

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Lymph

- Materials returned to the blood
 - Water
 - Blood cells
 - Proteins

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Lymph

- Harmful materials that enter lymph vessels
 - Bacteria
 - Viruses
 - Cancer cells
 - Cell debris

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Lymph Nodes

- Filter lymph before it is returned to the blood
- Defense cells within lymph nodes
 - Macrophages – engulf and destroy foreign substances
 - Lymphocytes – provide immune response to antigens

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Lymph Nodes

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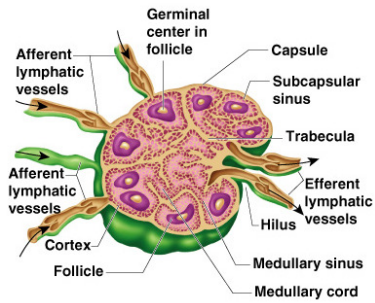
Figure 12.3

Lymph Node Structure

- Most are kidney-shaped, less than 1 inch long
- Cortex
 - Outer part
 - Contains follicles – collections of lymphocytes
- Medulla
 - Inner part
 - Contains phagocytic macrophages

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Lymph Node Structure



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Figure 12.4

Flow of Lymph Through Nodes

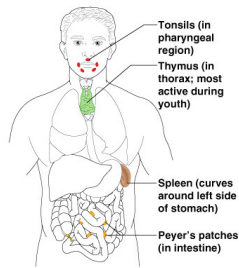
- Lymph enters the convex side through afferent lymphatic vessels
- Lymph flows through a number of sinuses inside the node
- Lymph exits through efferent lymphatic vessels
- Fewer efferent than afferent vessels causes flow to be slowed

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Other Lymphoid Organs

- Several other organs contribute to lymphatic function

- Spleen
- Thymus
- Tonsils
- Peyer's patches



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Figure 12.5

The Spleen

- Located on the left side of the abdomen
- Filters blood
- Destroys worn out blood cells
- Forms blood cells in the fetus
- Acts as a blood reservoir

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The Thymus

- Located low in the throat, overlying the heart
- Functions at peak levels only during childhood
- Produces hormones (like thymosin) to program lymphocytes

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Tonsils

- Small masses of lymphoid tissue around the pharynx
- Trap and remove bacteria and other foreign materials
- Tonsillitis is caused by congestion with bacteria

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Peyer's Patches

- Found in the wall of the small intestine
- Resemble tonsils in structure
- Capture and destroy bacteria in the intestine

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Mucosa-Associated Lymphatic Tissue (MALT)

- Includes:
 - Peyer's patches
 - Tonsils
 - Other small accumulations of lymphoid tissue
- Acts as a sentinel to protect respiratory and digestive tracts

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Body Defenses

- The body is constantly in contact with bacteria, fungi, and viruses
- The body has two defense systems for foreign materials
 - Nonspecific defense system
 - Specific defense system

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Body Defenses

- Nonspecific defense system
 - Mechanisms protect against a variety of invaders
 - Responds immediately to protect body from foreign materials
- Specific defense system
 - Specific defense is required for each type of invader
 - Also known as the immune system

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Body Defenses

Nonspecific defense mechanisms		Specific defense mechanisms (immune system)
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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Figure 12.6

Nonspecific Body Defenses

- Body surface coverings
 - Intact skin
 - Mucous membranes
- Specialized human cells
- Chemicals produced by the body

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Surface Membrane Barriers – First Line of Defense

- The skin
 - Physical barrier to foreign materials
 - pH of the skin is acidic to inhibit bacterial growth
 - Sebum is toxic to bacteria
 - Vaginal secretions are very acidic

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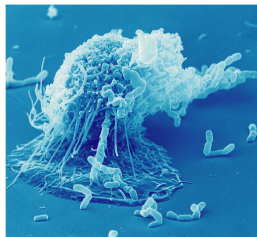
Surface Membrane Barriers – First Line of Defense

- Stomach mucosa
 - Secretes hydrochloric acid
 - Has protein-digesting enzymes
- Saliva and lacrimal fluid contain lysozyme
- Mucus traps microorganisms in digestive and respiratory pathways

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Defensive Cells

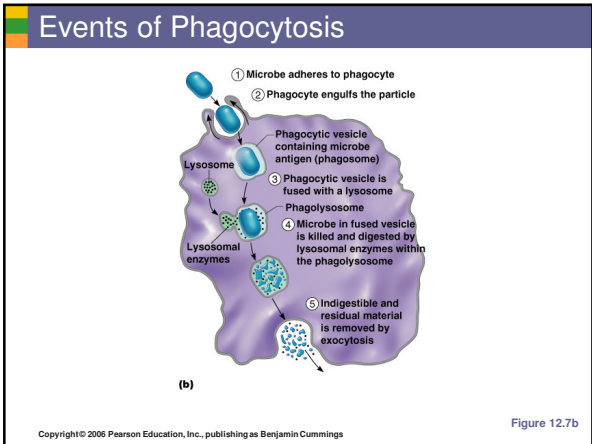
- Phagocytes (neutrophils and macrophages)
 - Engulfs foreign material into a vacuole
 - Enzymes from lysosomes digest the material



(a)

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Figure 12.7a



Defensive Cells

- Natural killer cells
 - Can lyse and kill cancer cells
 - Can destroy virus- infected cells

Killer Cells: T-cell that kills foreign cells

Memory Cells: B-cells capable of responding to the same antigen at a later meeting

Attenuated Cells: Living, but weakened cells in a vaccine.

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Inflammatory Response - Second Line of Defense

- Triggered when body tissues are injured
- Produces four cardinal signs
 - Redness
 - Heat
 - Swelling
 - Pain
- Results in a chain of events leading to protection and healing

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Functions of the Inflammatory Response

- Prevents spread of damaging agents
- Disposes of cell debris and pathogens
- Sets the stage for repair

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Steps in the Inflammatory Response

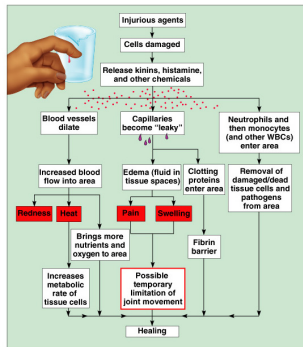


Figure 12.8

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Antimicrobial Chemicals

- Complement
 - A group of at least 20 plasma proteins
 - Activated when they encounter and attach to cells (complement fixation)

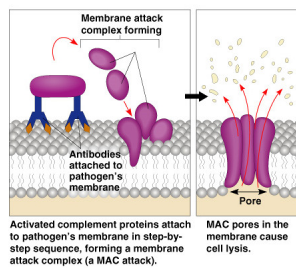


Figure 12.10

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Antimicrobial Chemicals

- Complement (continued)
 - Damage foreign cell surfaces
 - Has vasodilators, chemotaxis, and opsonization

Activated complement proteins attach to pathogen's membrane in step-by-step sequence, forming a membrane attack complex (a MAC attack).

MAC pores in the membrane cause cell lysis.

Figure 12.10

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Antimicrobial Chemicals

- Interferon
 - Secreted proteins of virus-infected cells
 - Bind to healthy cell surfaces to inhibit viruses binding

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