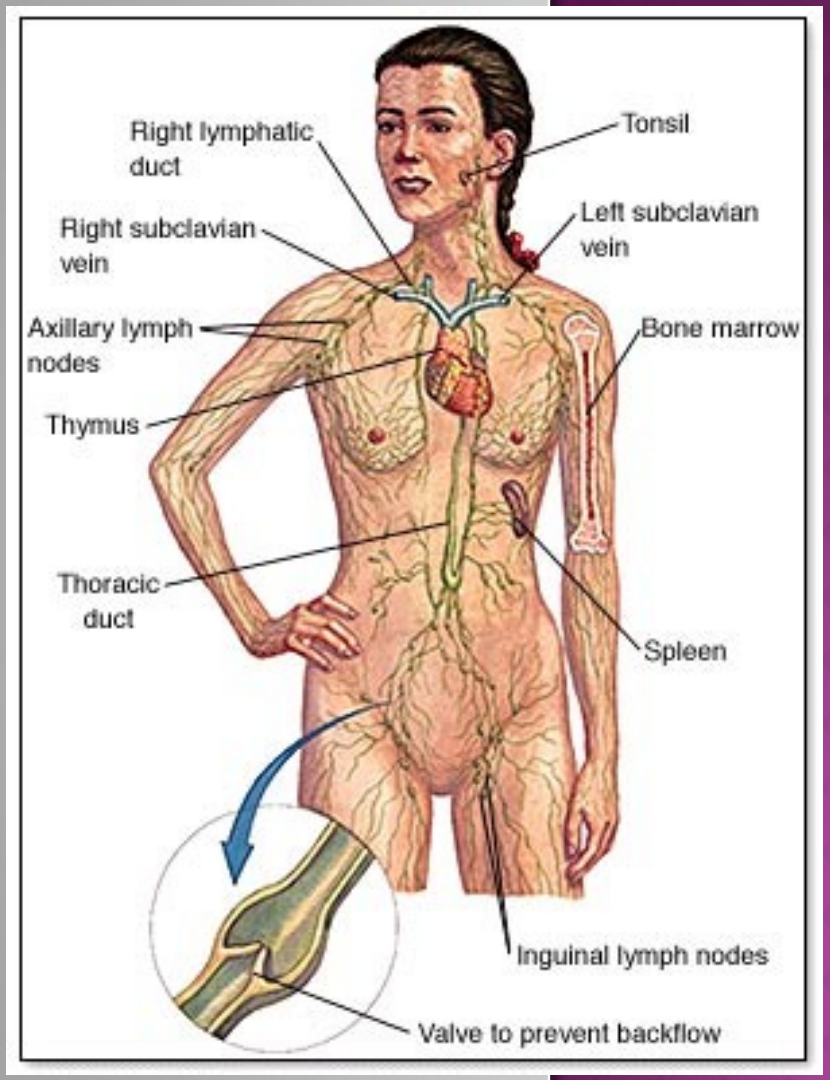


GHC 2013

LYMPHATIC & IMMUNITY SYSTEM

VISION COLLEGE

LEARNING OBJECTIVES

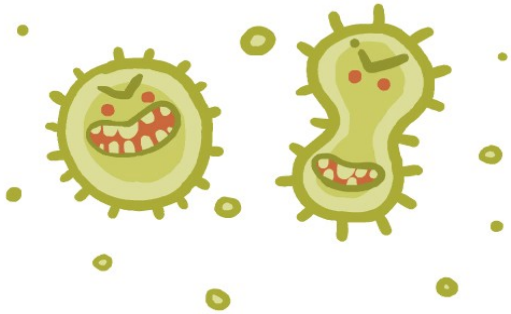
- State the functions of the lymphatic system
- Describe the composition of the lymphatic system.
- Describe the function of lymph.
- Discuss the routes of fluid transport in lymphatic system.
- Describe the structure of lymph vessels.

LEARNING OBJECTIVES

- Describe the distribution of lymph nodes.
- Discuss the functions of lymph nodes.
- Describe the structures of the lymphatic organs.
- Discuss the functions of the lymphatic organs.

FUNCTIONS OF LYMPHATIC SYSTEM

1. Filters bacteria, foreign materials, toxins, and any harmful materials.
2. Drain away excess fluids to prevent water clogging of the tissues and cells.
3. Transport proteins back into blood supply.



FUNCTIONS OF LYMPHATIC SYSTEM

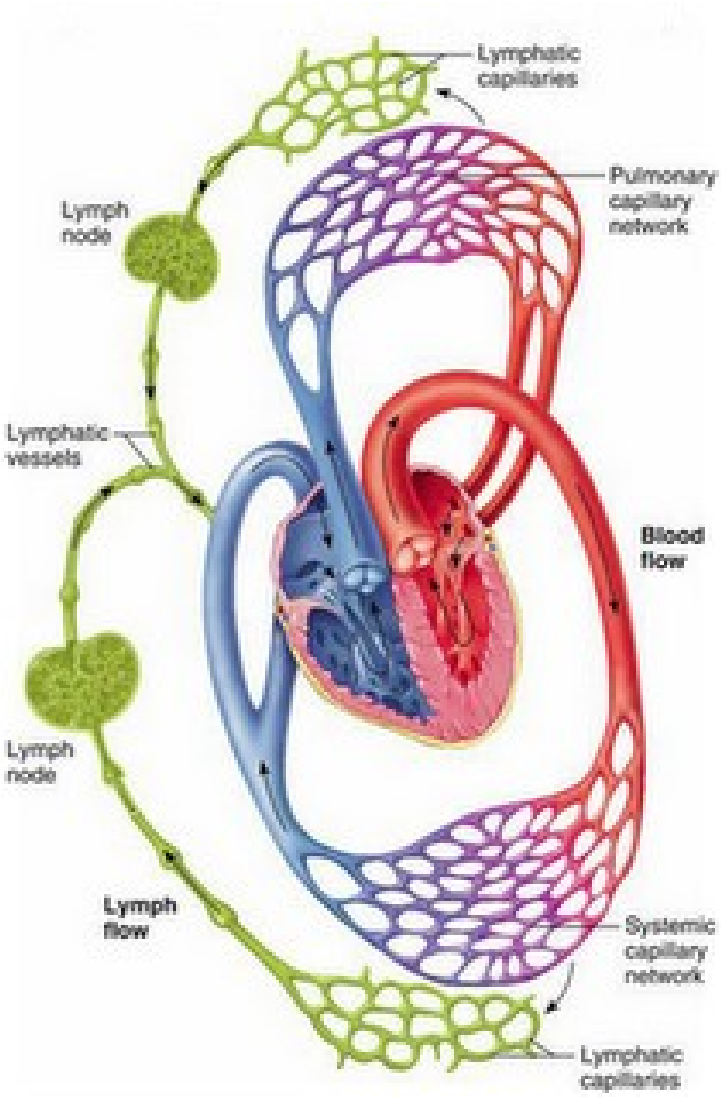
4. Produces lymphocytes which protect and defend the body against infection.

5. Produces antibodies to fight bacteria.

6. Absorbs fat and fat soluble vitamins from the small intestine and transport it to the liver.

THE LYMPHATIC SYSTEM

- Lymph
- Lymph vessels
- Lymph nodes
- Lymph organs



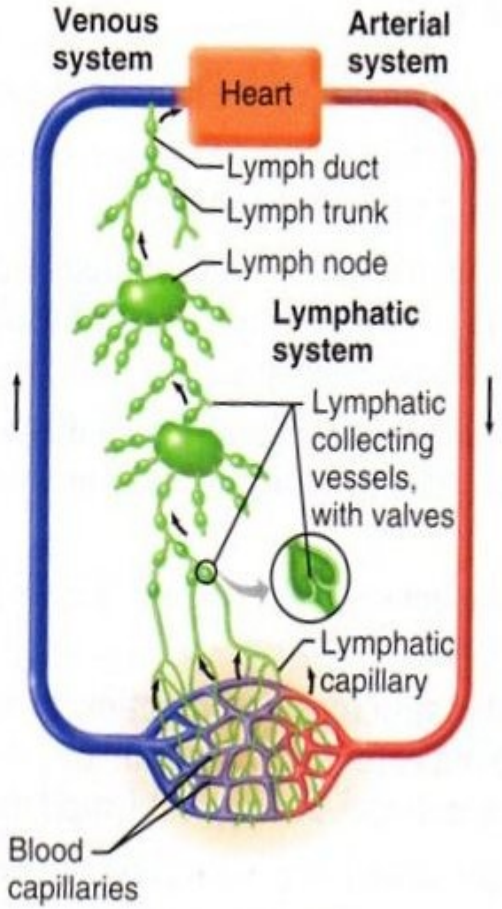
LYMPH

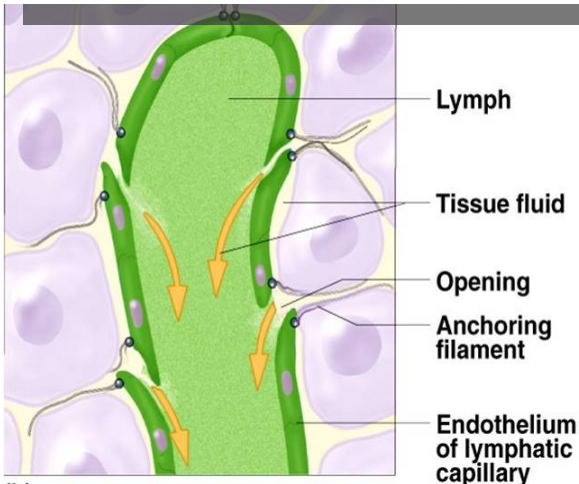
- Clear fluid (similar to interstitial fluid)

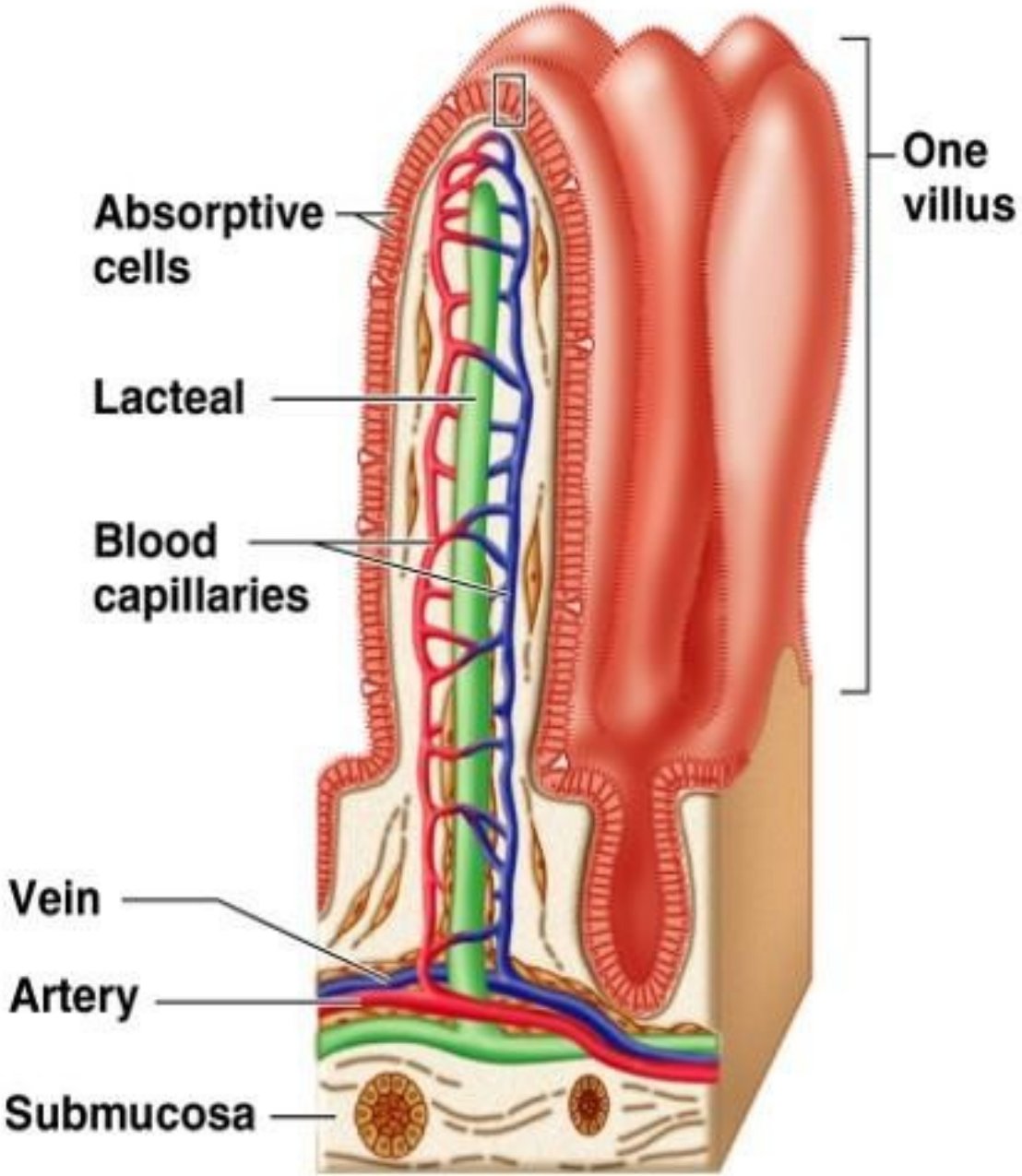
- Contains ions, gases, nutrients, some proteins, hormones, enzymes and waste products (much less protein than plasma).

FORMATION OF LYMPH

- Interstitial fluid that passes into lymphatic capillaries
- Fluid leaves capillaries by diffusion and filtration
- If lymph flow blocked = tissue swelling or edema
- Specialized lymphatic capillaries in villi of small intestine transport lipids
  - called **lacteals**
  - fluid is called **chyle**







(b) Villi

FUNCTIONS OF LYMPH

– transport plasma proteins (that seeps out of the capillaries) back to the bloodstream.

- carries bacteria and cell debris from damaged tissues to lymph nodes where it gets filtered out and destroyed.

LYMPH FLOW

A. The hydrostatic pressure of tissue fluid drives the entry of lymph into lymphatic capillaries.

B. Lymph Flow -lymph needs help to flow through the lymph vessels

- *forces that help the flow are – contraction of the skeletal muscles, pressure changes due to the action of breathing muscles & contraction of smooth muscles in the walls of the larger lymphatic trunks. The flow of lymph peaks during physical exercise.

LYMPH FLOW

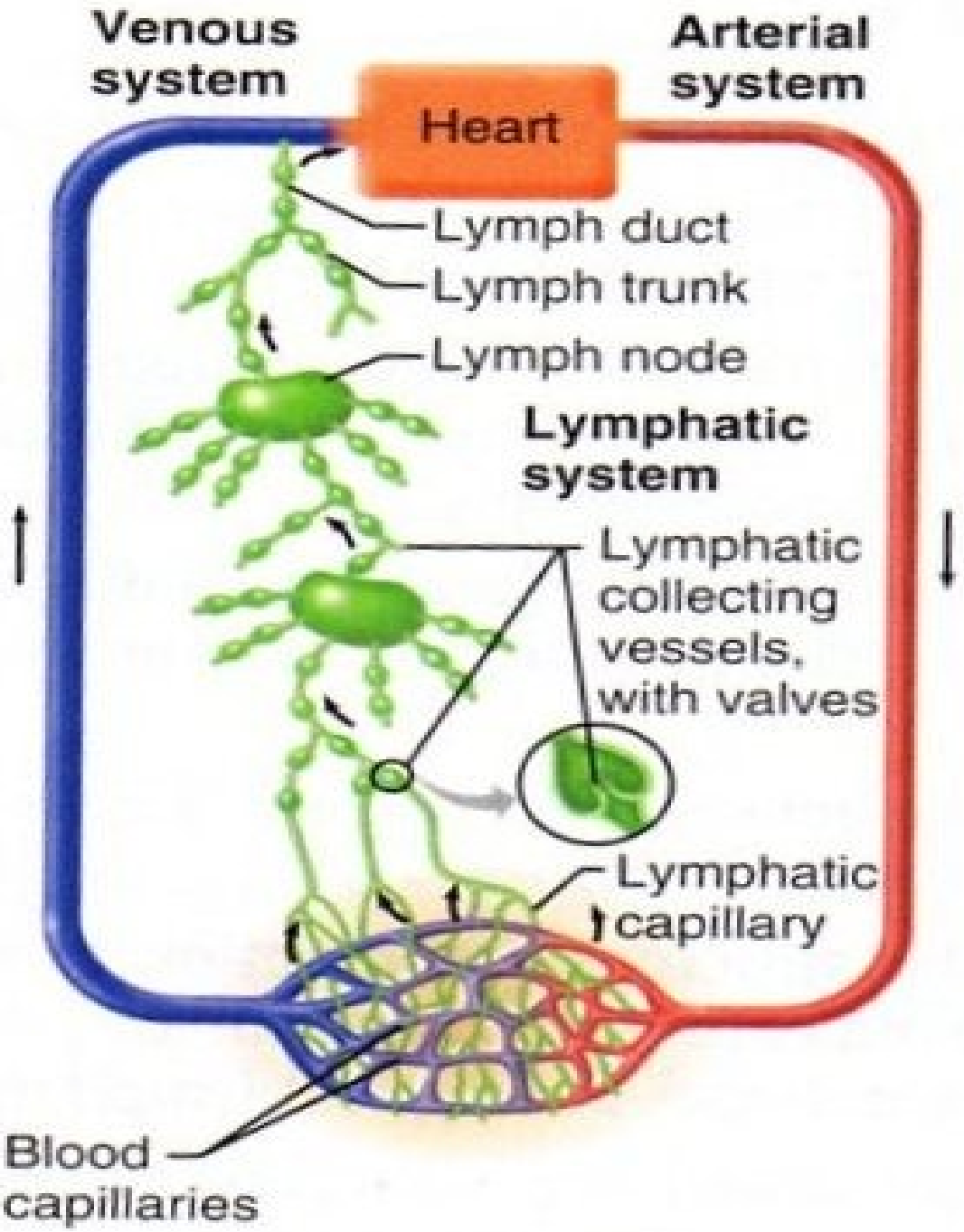
C. Obstruction of Lymph Flow

- *Conditions that interfere with lymph movement cause tissue fluids to accumulate in the interstitial spaces, producing edema.

- *Edema can occur as a result of lymphatic tissue being removed during surgery.

LYMPH VESSELS

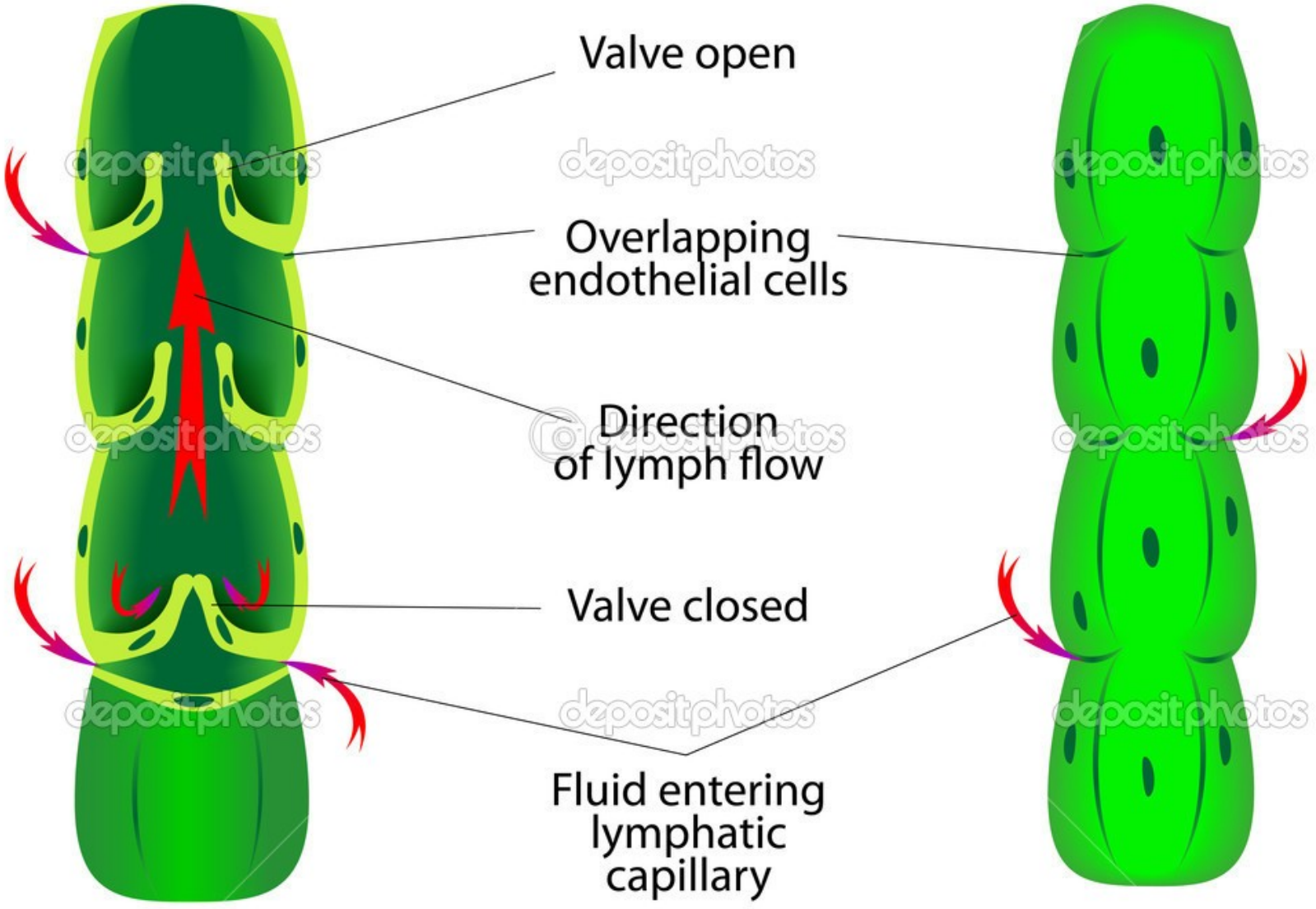
- NOT a complete circuit
- One-way system
- Begin as closed ended lymph capillaries
  - in tissue spaces between cells
- Interstitial fluid
  - drains into lymphatic capillaries, forming lymph
- Lymph capillaries
  - merge to form lymphatic vessels
- Lymphatic vessels
  - carry lymph into and out of lymph nodes
  - finally back to vascular system


Venous system
Arterial system
Heart
Lymph duct
Lymph trunk
Lymph node
Lymphatic system
Lymphatic collecting vessels, with valves
Lymphatic capillary
Blood capillaries

LYMPH VESSELS

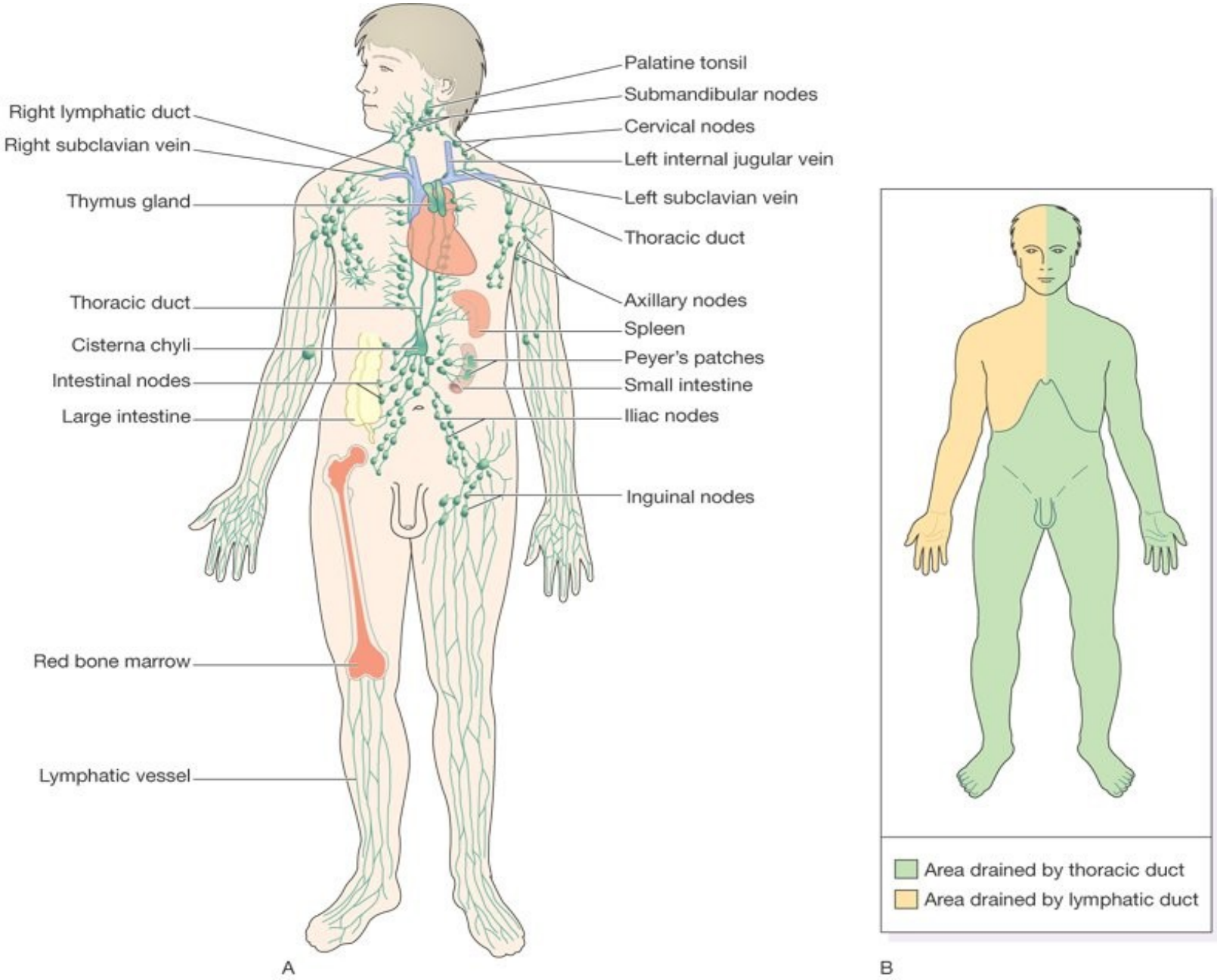
- Resemble veins (same 3 layers)
- Thin-walled
- Valves prevent backflow
- Found throughout body **except:**
  - A vascular tissues (superficial layer of skin)
  - Central nervous system
  - Bone marrow

Lymphatic vessel

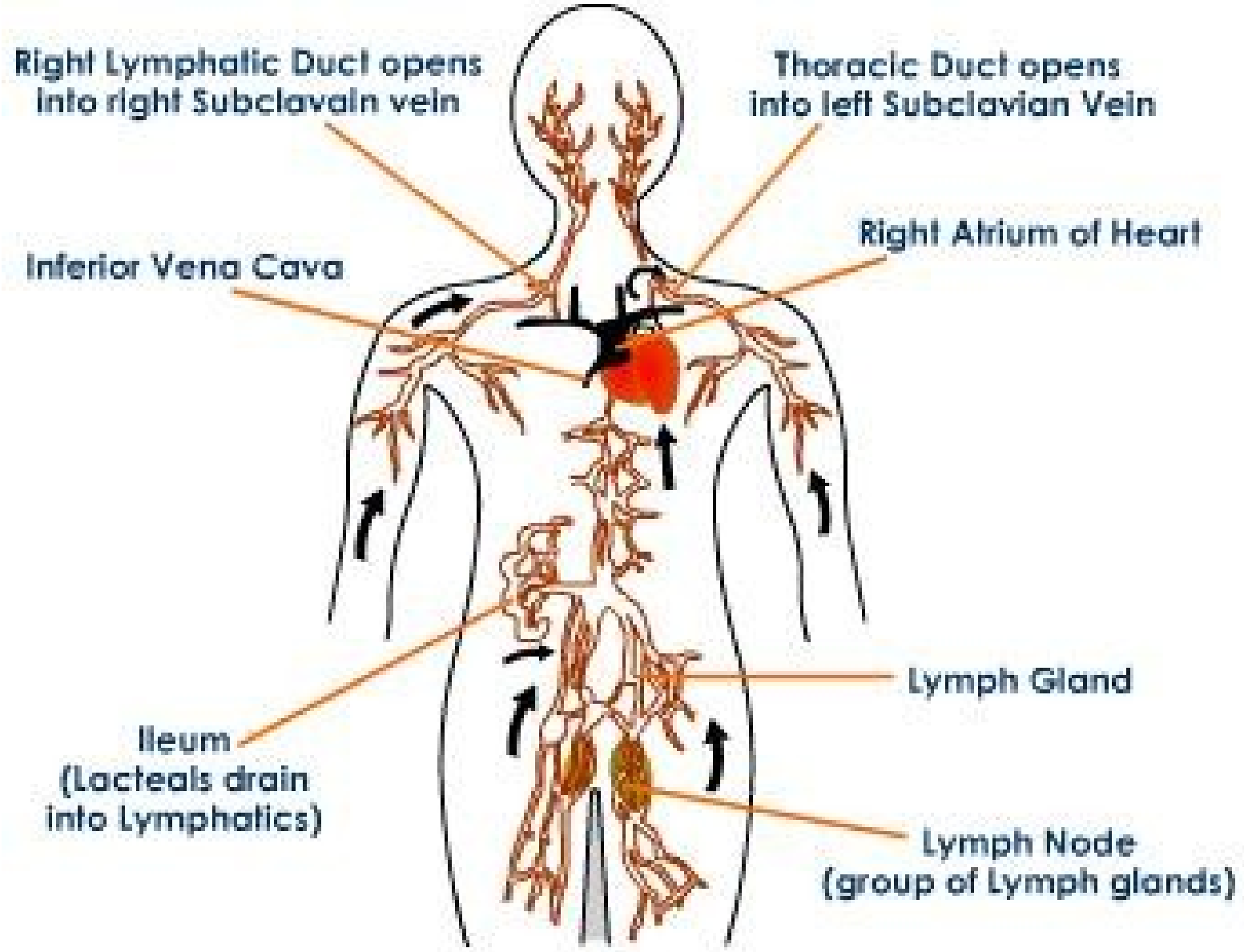


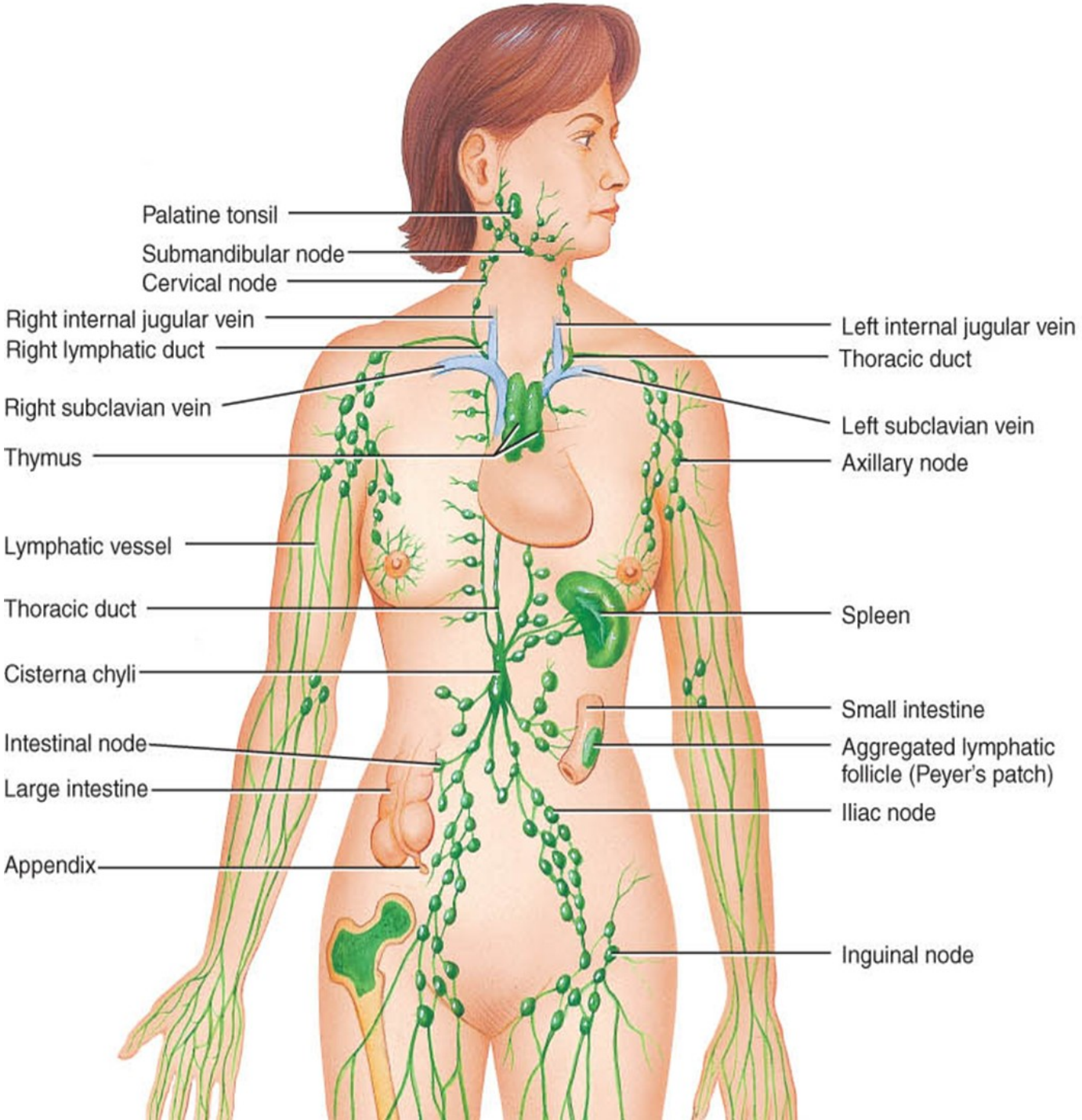
LYMPH VESSELS

- Lymphatic vessels join to form lymphatic trunk : divided to 2
  - Thoracic duct (drains 3/4 of body)
  - Right lymphatic duct (drains right arm, and right side of head, neck and upper torso)
- These empty into subclavian veins at junction with IJV



LYMPHATIC SYSTEM - DRAINAGE ROUTE





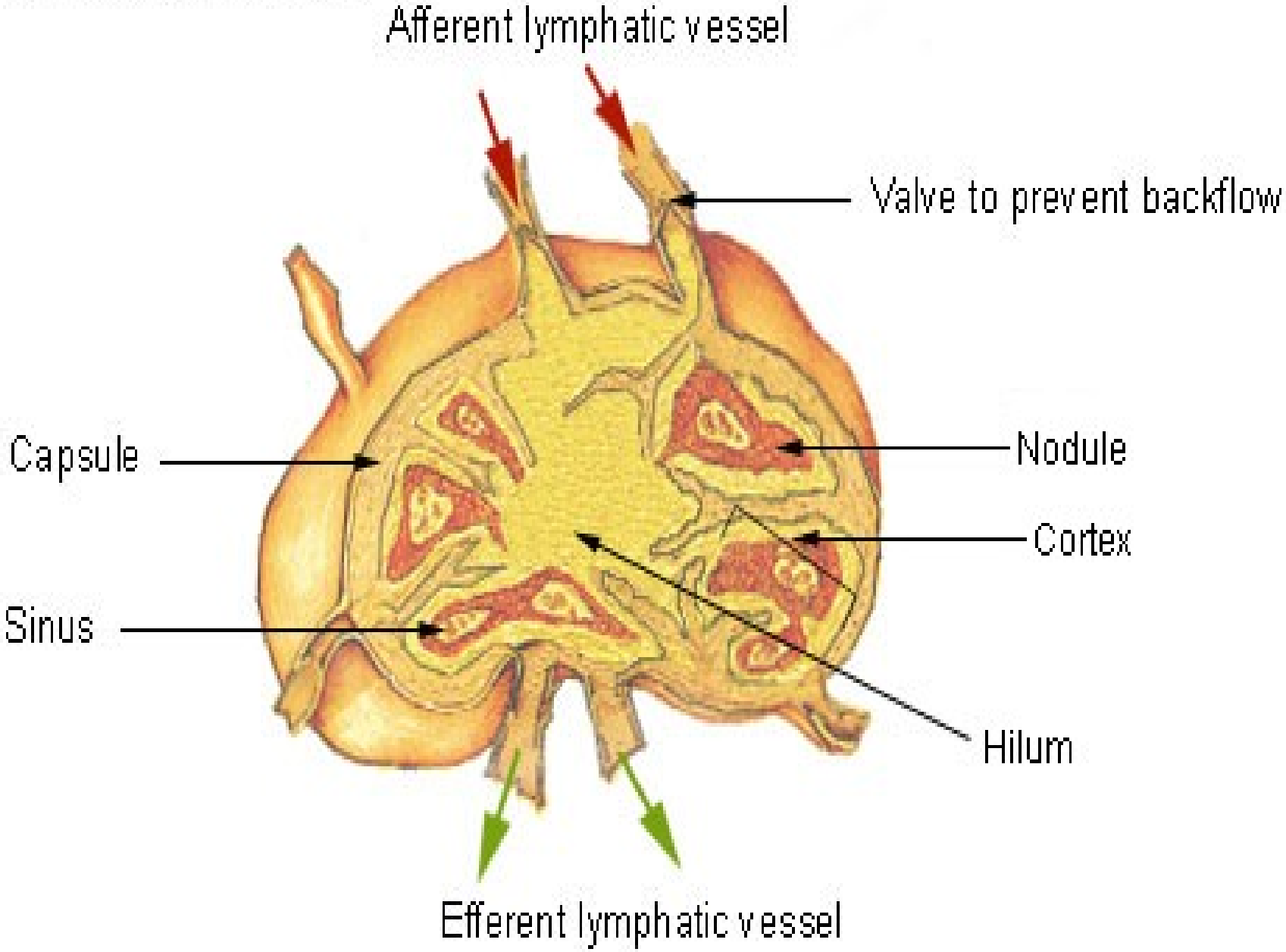
LYMPH NODES

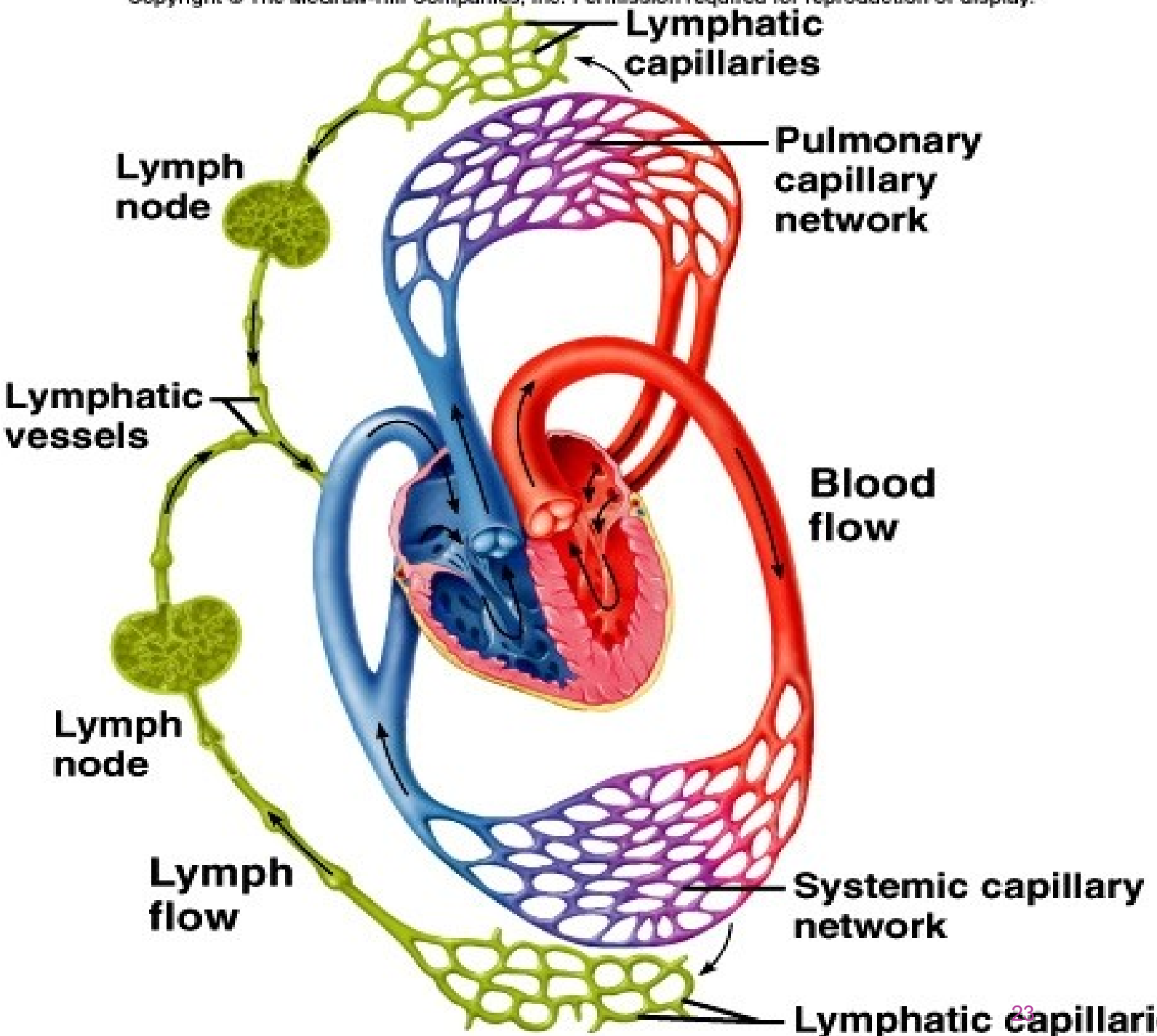
A. Lymph nodes, which contain lymphocytes & macrophages, are located along lymphatic pathways. They fight invading microorganisms.

B. Structure of a Lymph Node (gland)

- *vary in size & shape (bean-shaped)
- *hilum – indented region of bean- shaped node, blood vessels & nerves connect at the hilum of the lymph node.
- *afferent vessels enter at various points on the convex surface of the node & this is how lymph enters the node
- *efferent vessels (lymphatic vessels) exit at the hilum of the node & lymph leaves the node through these vessels

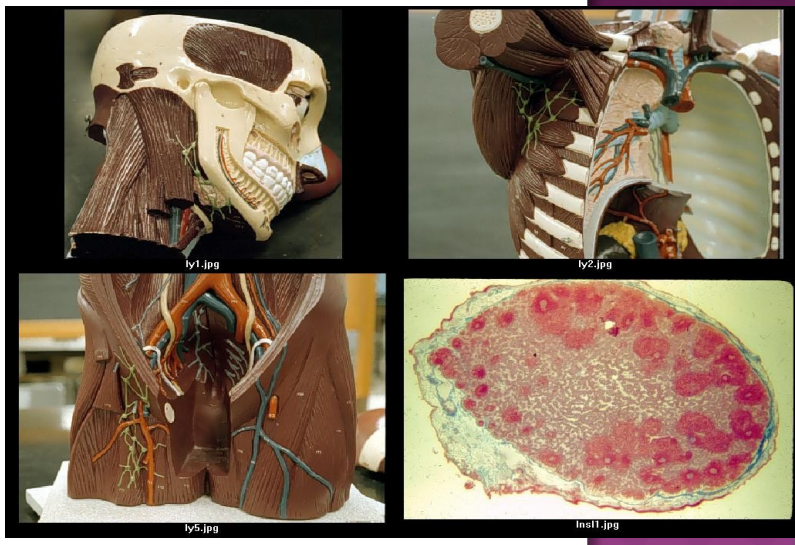
Lymph Node Structure





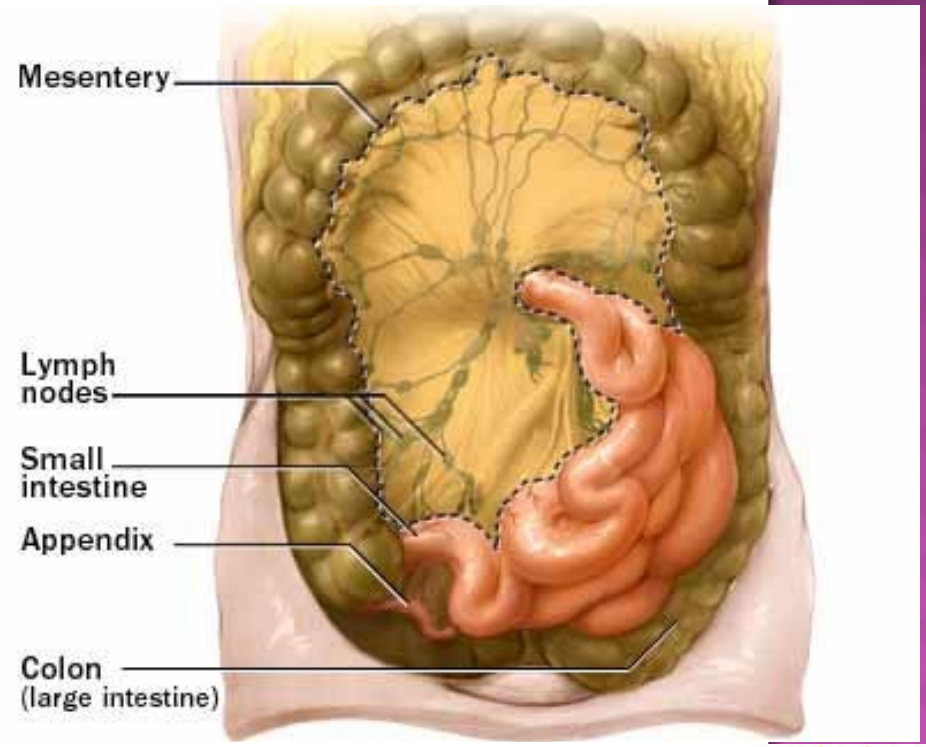
DISTRIBUTION OF LYMPH NODES

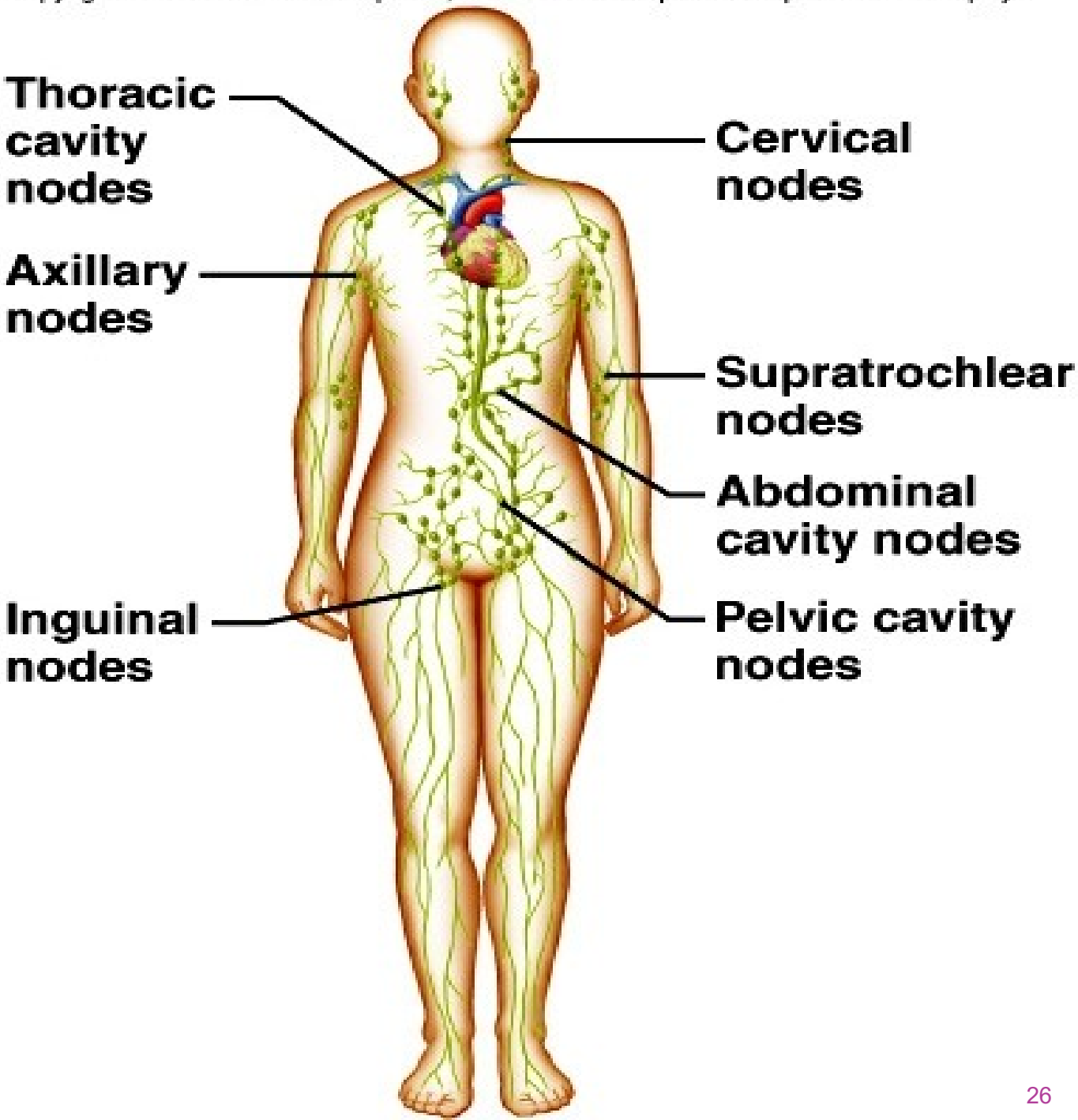
- Cervical nodes
  - Located in neck
  - Drain head and neck
  - Enlarged when upper respiratory tract infections
- Axillary nodes
  - Located in axillae (armpit)
  - Enlarged when infection of upper extremity and breast
- Tracheobronchial nodes
  - Near trachea and larger bronchial tubes



DISTRIBUTION OF LYMPH NODES

- Mesenteric nodes
  - Between 2 layers of peritoneum that form mesentery
- Inguinal nodes
  - Groin area
  - Receive lymph drainage from lower extremity





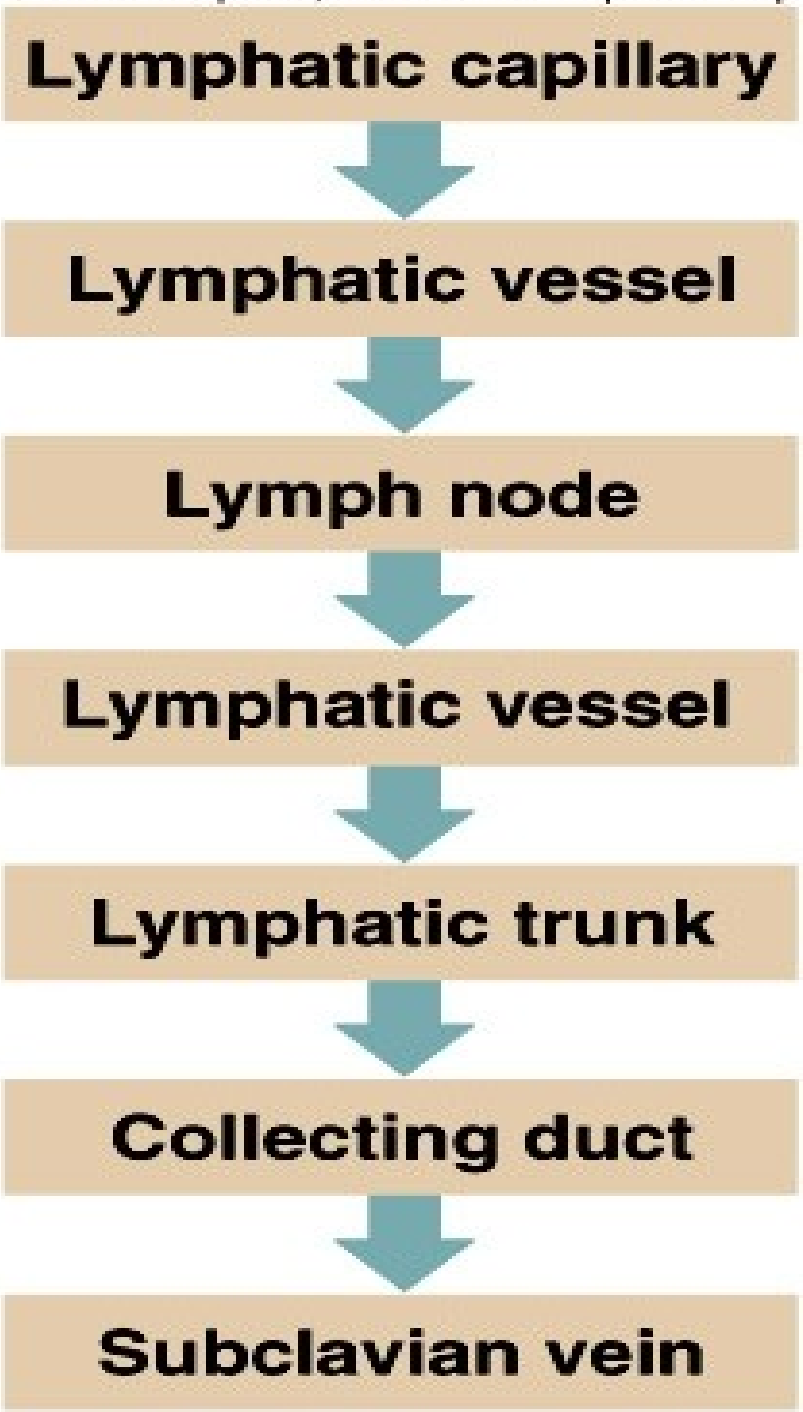
FUNCTIONS OF LYMPH NODES

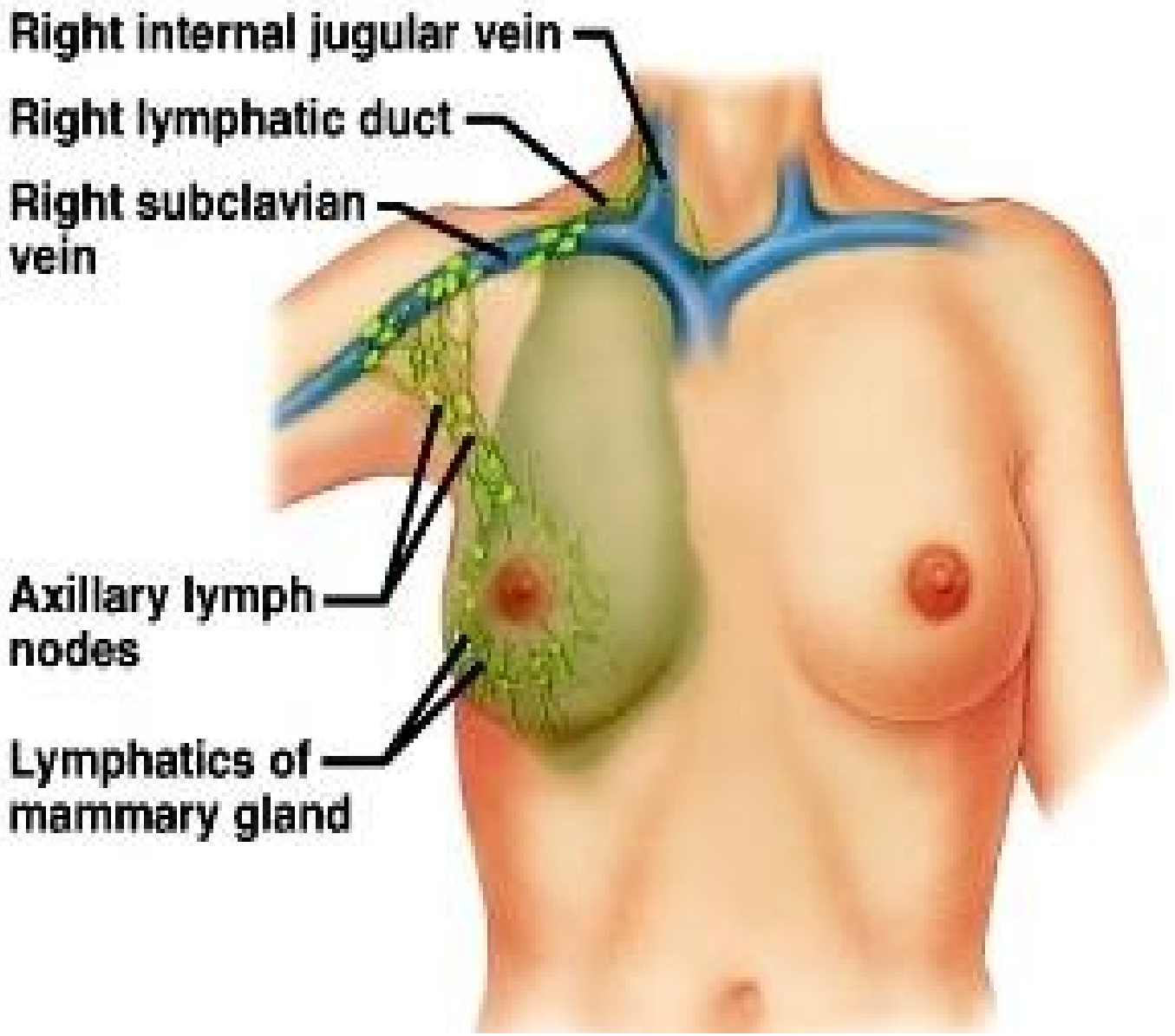
- Filtering and phagocytosis – microbes, phagocytes with ingested microbes, malignant cells, damaged tissues cells and inhaled particles.

- Proliferation of lymphocytes

  – T and B–cell multiply in lymph nodes. Antibodies produces by B-cell enter lymph and node.

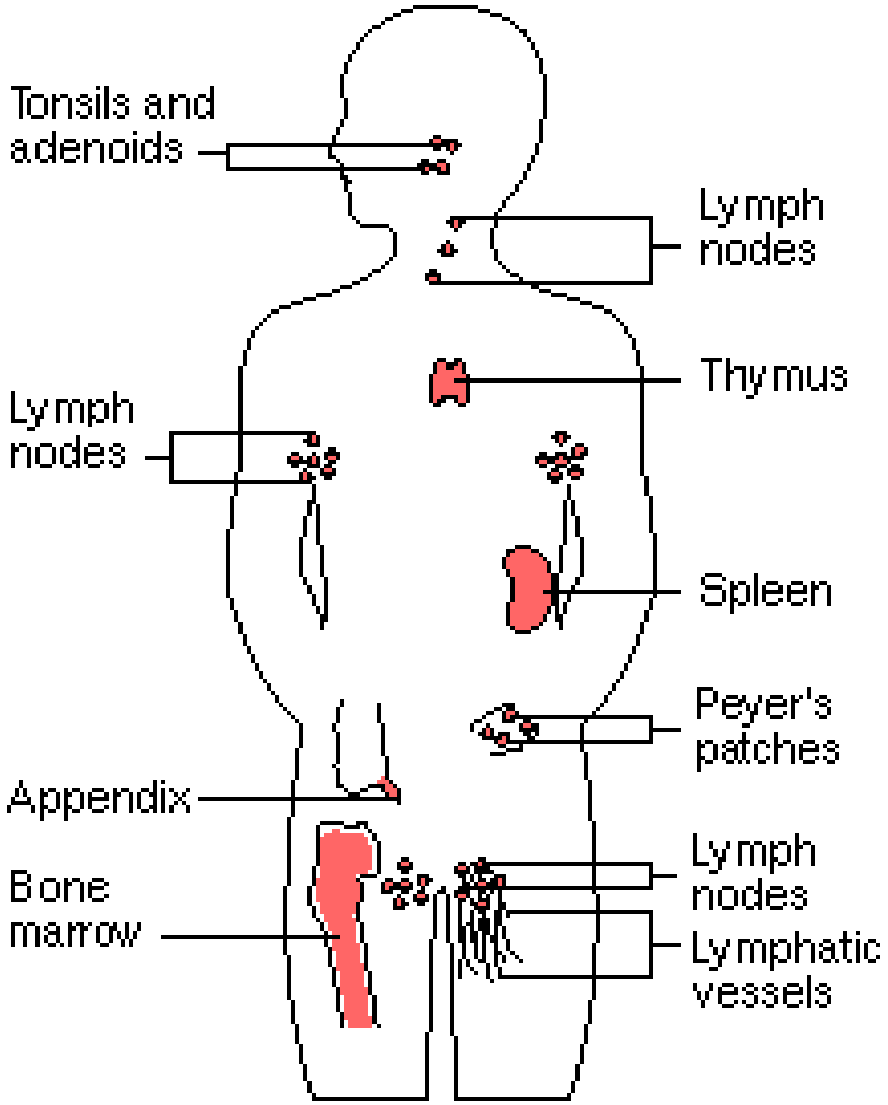
NB: Site for cancer growth and metastasis.





THE LYMPHATIC ORGANS

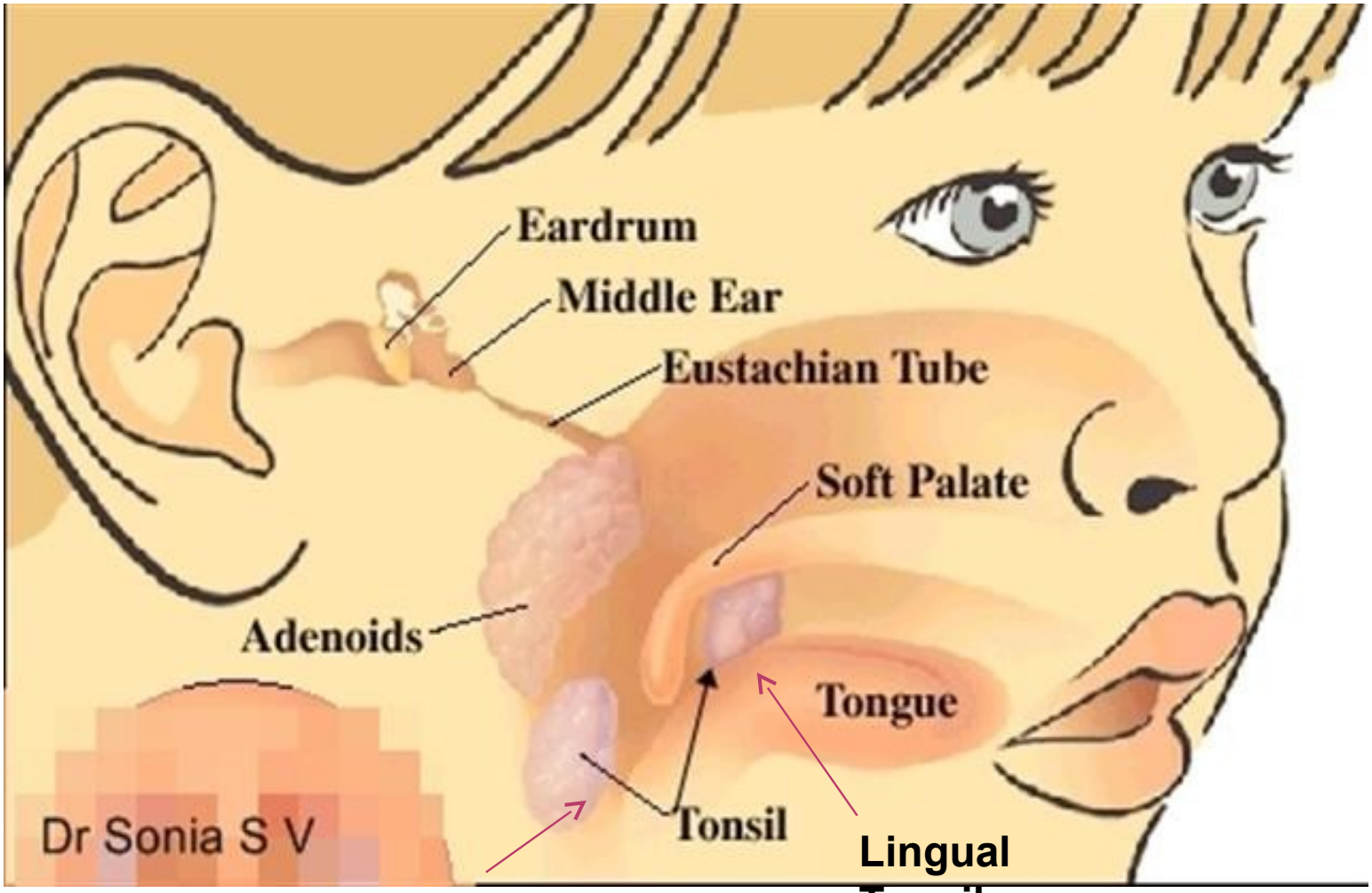
- Tonsils
- Spleen
- Thymus
- Peyers patches



TONSILS

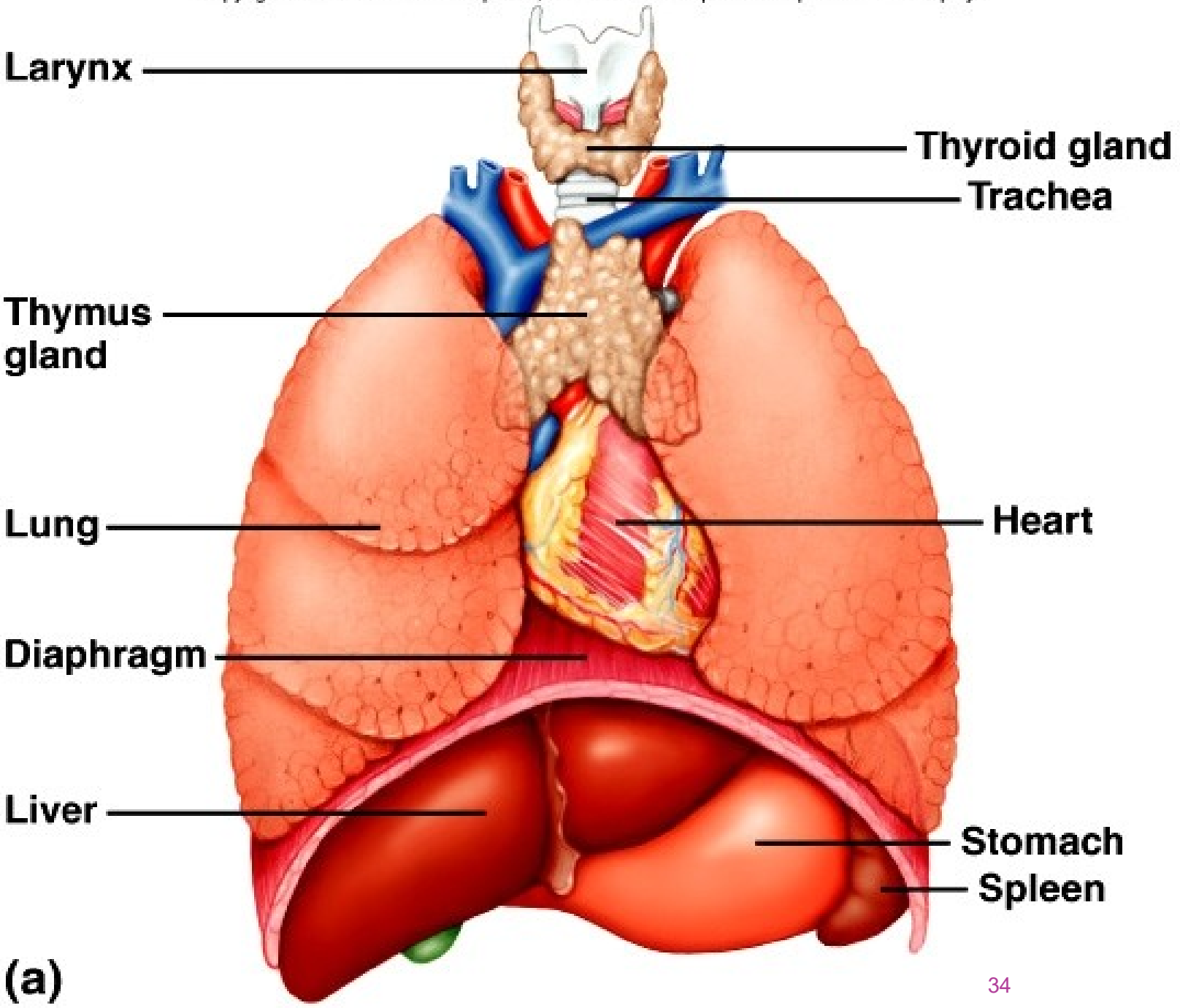
- Tonsils – lymphoid tissue under the mucous membranes of the throat
- palatine tonsils (sides of oropharynx)
- tubal tonsils (roof)
- pharyngeal tonsil (Adenoid) (roof)
- lingual tonsils (floor of oropharynx)
- First line of defense
- Tonsillectomy

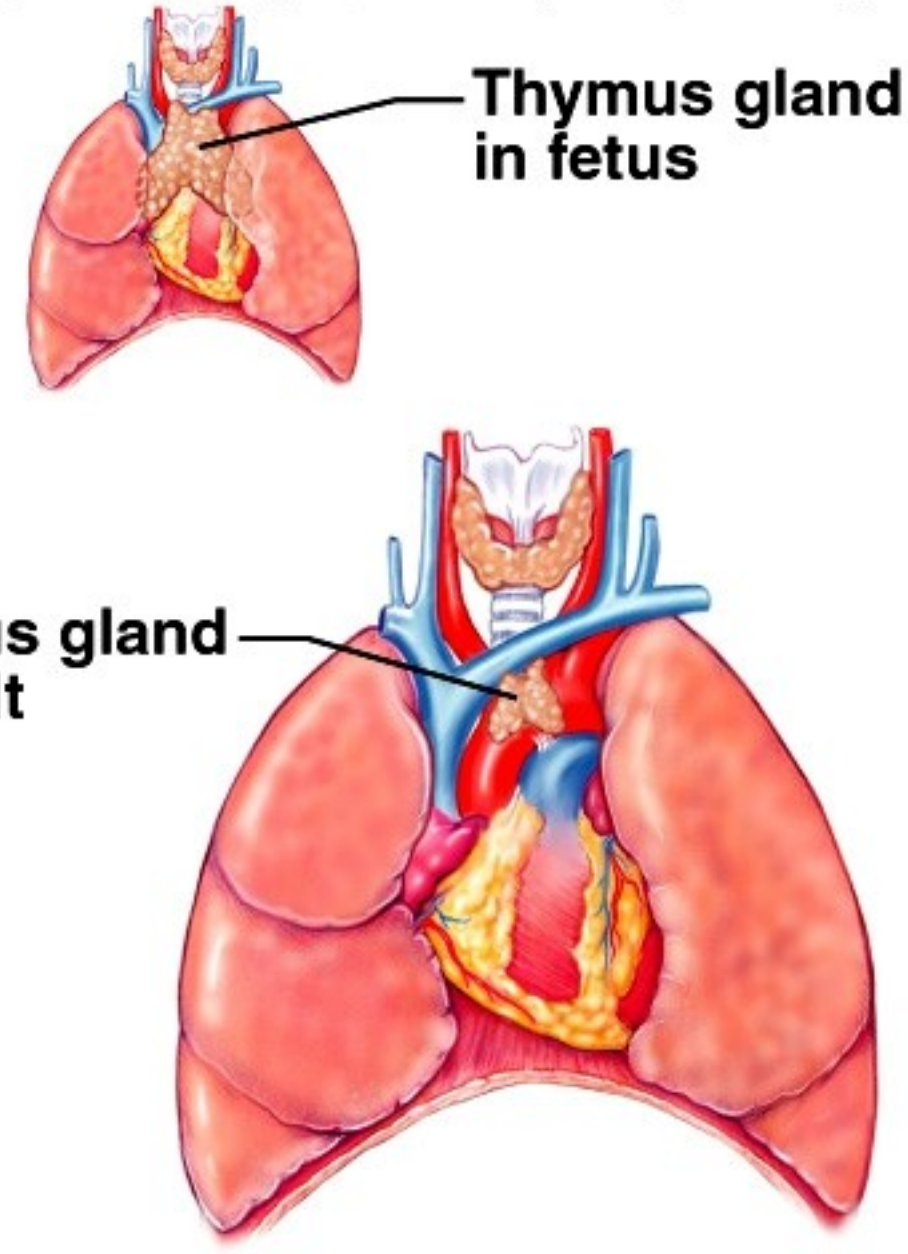
TONSILS



THYMUS GLAND

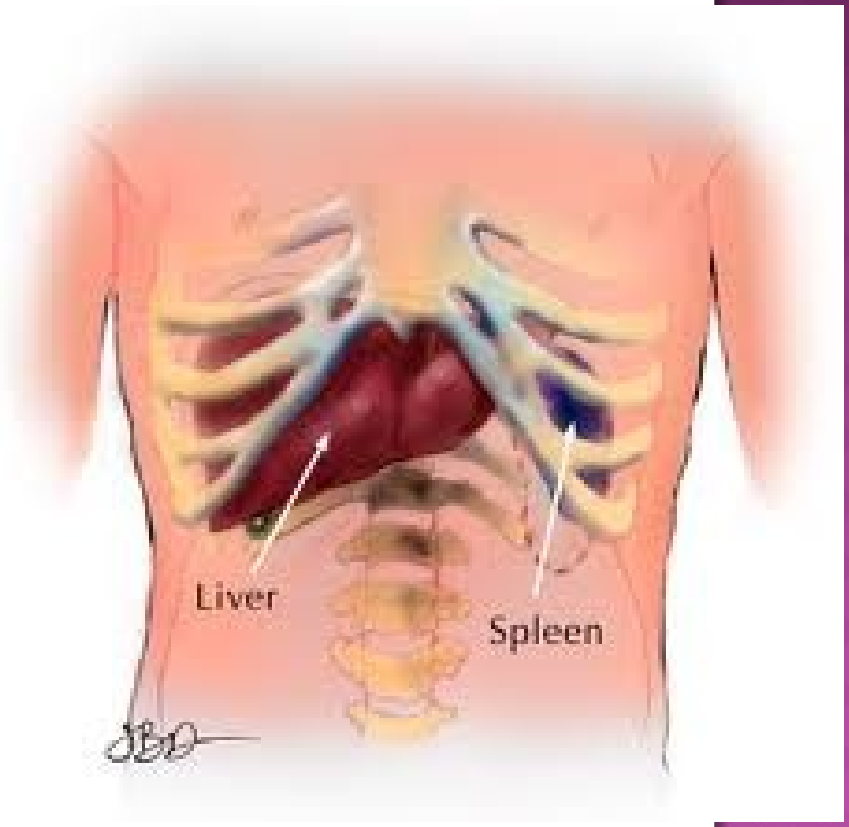
- in mediastinum above heart
- largest at age 10-12 then begins to atrophy
  - Pre - T cells come from bone marrow and develop into T cells in thymus
  - Mature T cells then go to other lymphatic tissues
- Thymus produces hormone thymosin
  - aids maturation of T cells elsewhere in body
  - In older adults, it decreases in size and is replaced with fat and connective tissues





SPLEEN

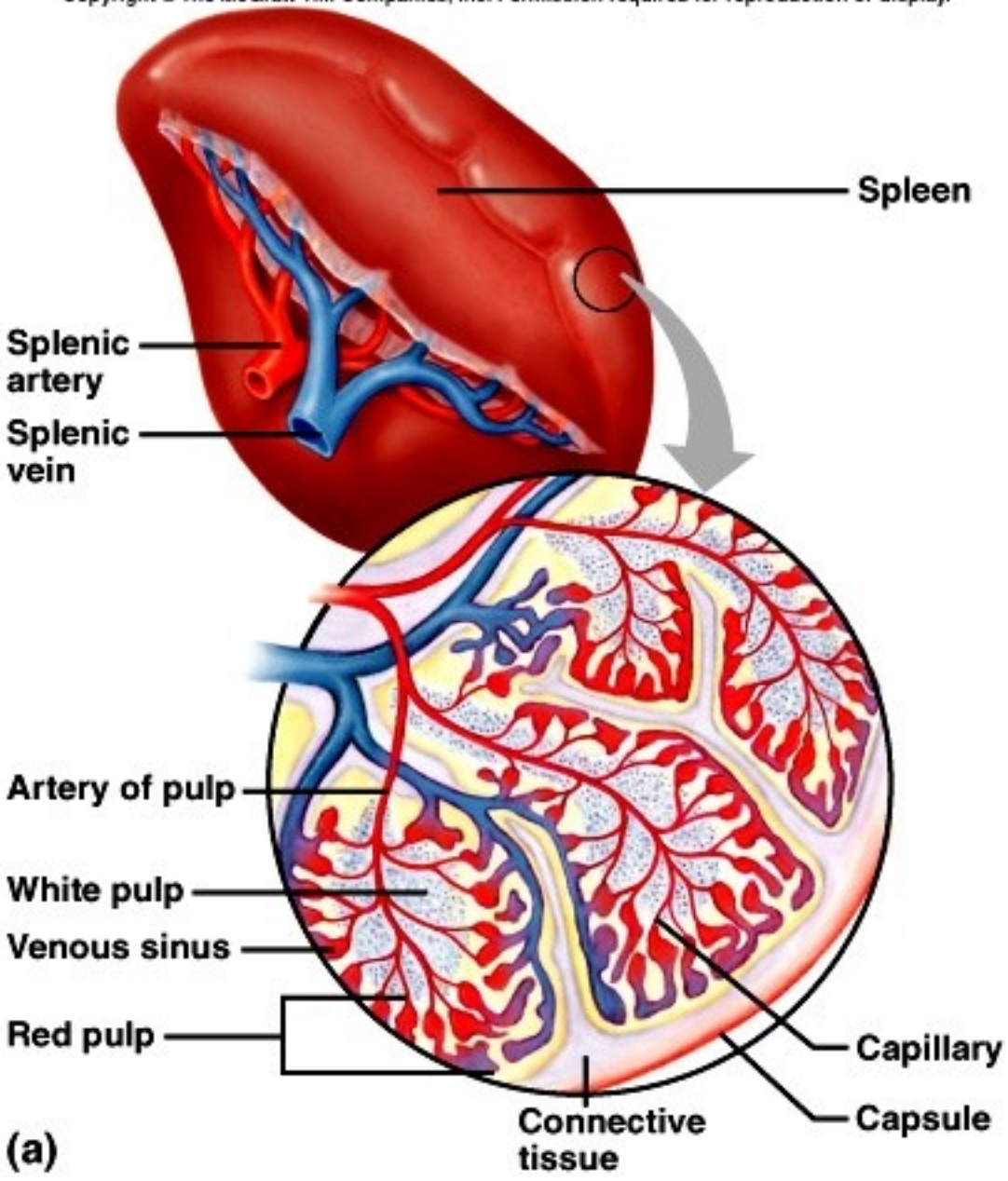
- Included in because play a role in defense system
- Largest lymphoid organ (12cm long)
- In upper left quadrant of abdomen



SPLEEN……..CON'T

- Has hilum and capsule like lymph nodes

- Sinuses has spleenic pulp
  - Red pulp suffused with blood
  - White pulp with lymphatic tissue covered by macrophages and lymphocytes

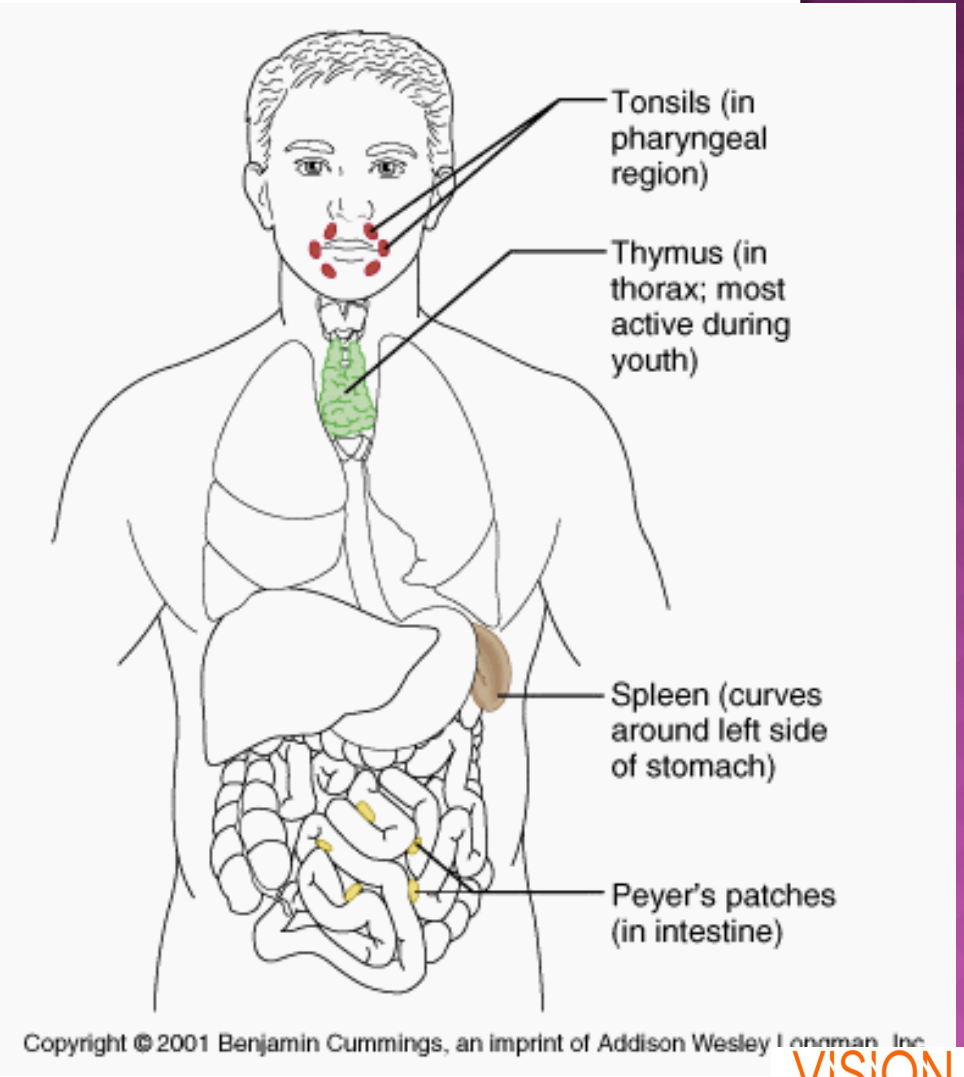


FUNCTIONS OF SPLEEN

- Blood formation
  - Produce all blood cells in fetus life
  - Only lymphocytes and monocytes after birth
- Blood filtration
  - Removes bacteria, particles, worn out RBCs and platelets (recycles iron)
- Store platelets
  - During hemorrhage, it will release into blood circulation

PEYER'S PATCHES

- Found in the wall of small intestines
- The macrophages destroy bacteria in the intestines and prevents them from infecting and penetrating the walls.

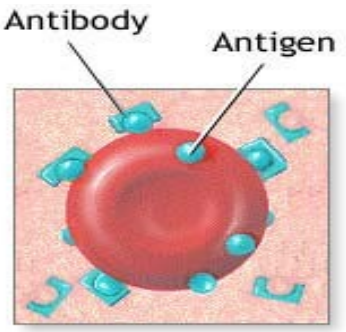


IMMUNE SYSTEM

- A biological structure and process within an organism that protects against disease.
- The mechanisms divided 2:
  - General - protect against many types of pathogens, providing innate (nonspecific) defense.
  - Specific – targeting certain pathogens (by specialiased lymphocytes)
- They function the same way regardless of the size and amount of the invader.

CHARACTERISTIC

- The immune system of the body has four key characteristics:
  - It can distinguish ‘self from non-self’.
  - It is specific- it responds to specific foreign cells.
  - It is diverse- it can recognise an estimated 10 million different antigens.
  - It has immunological memory-once you have met and responded to a pathogen, you can respond rapidly if you meet it again.

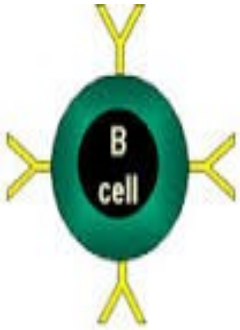


Red blood cell

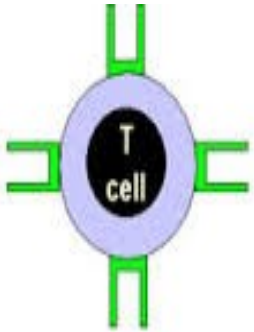
An antigen is a substance that induces the formation of antibodies because it is recognized by the immune system as a threat

LYMPHOCYTES

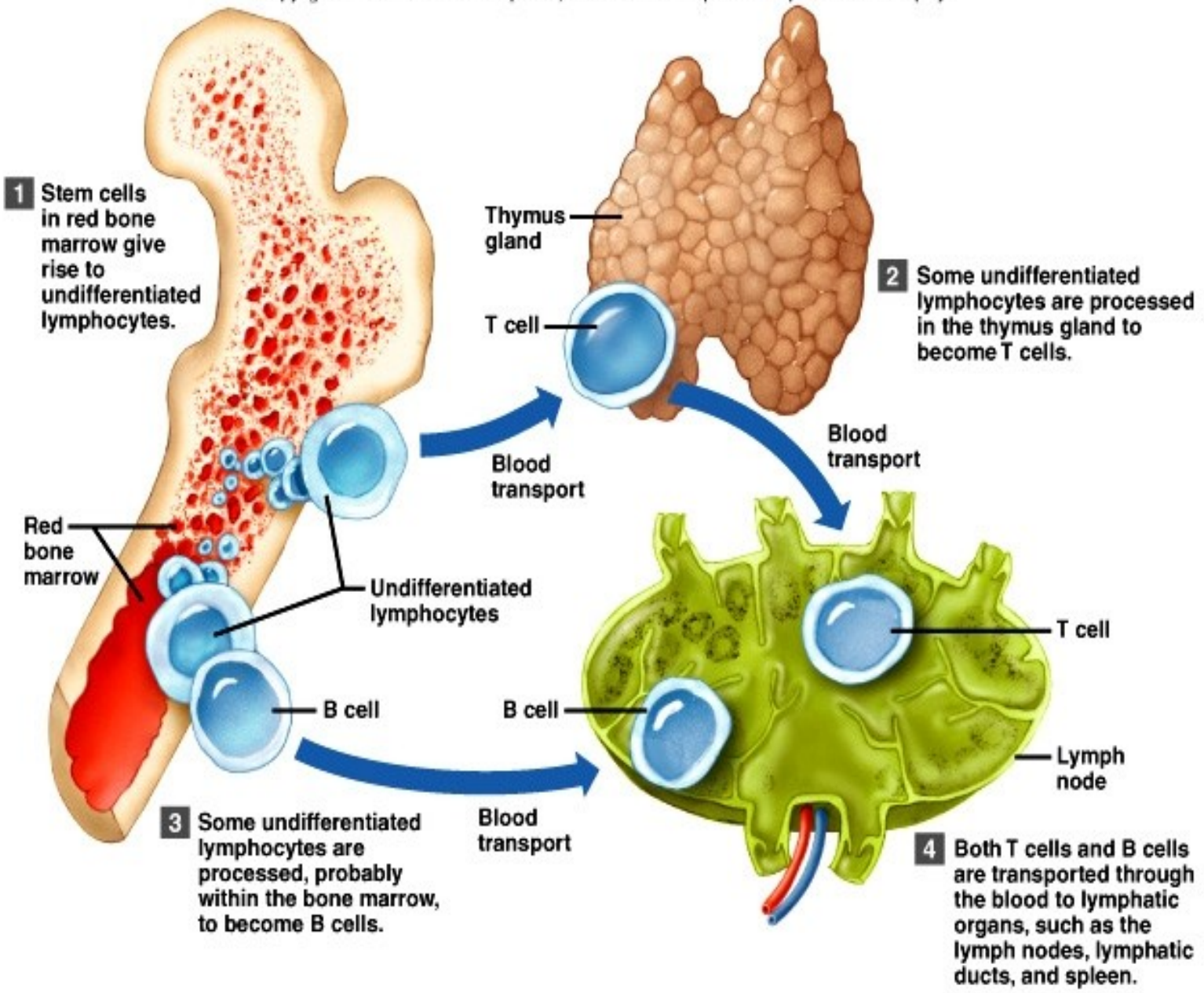
- Cell involved in immunity
- Manufactured in bone marrow with characteristic – large and single nucleus.
- Divided to 2 – T-lymphocytes
  - B-lymphocytes



B cell antigen receptors:
Surface Immunoglobulins
Two identical antigen recognition sites



T cell antigen receptors:
One antigen recognition site



LYMPHOCYTES

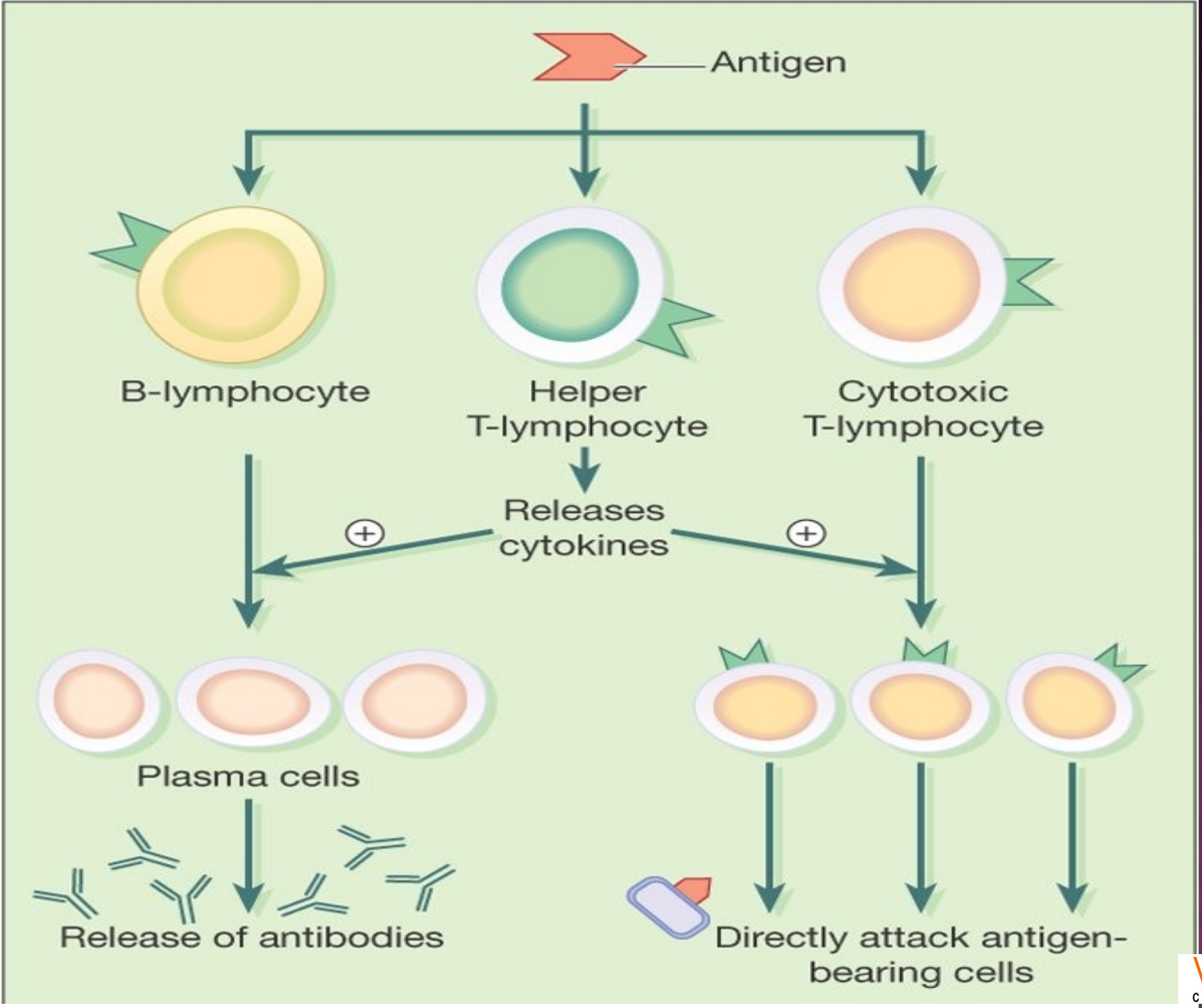
- **B cells**
  - Produced in bone marrow.
  - Role in **production of antibodies** (immunoglobulins) a protein designed to bind and cause destruction of an antigens.
  - Provide antibody-mediated immunity
  - Fixed in lymphoid tissue (spleen and lymph nodes)

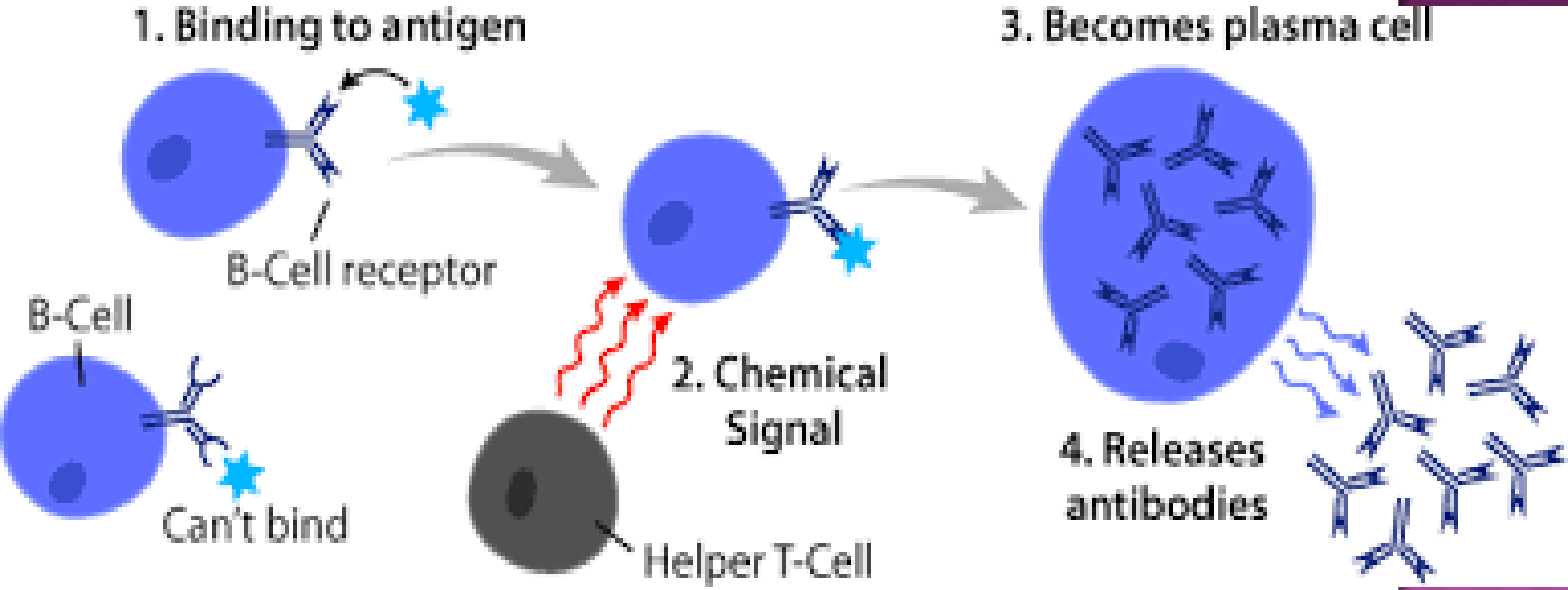
LYMPHOCYTES - B CELLS .....CON'T

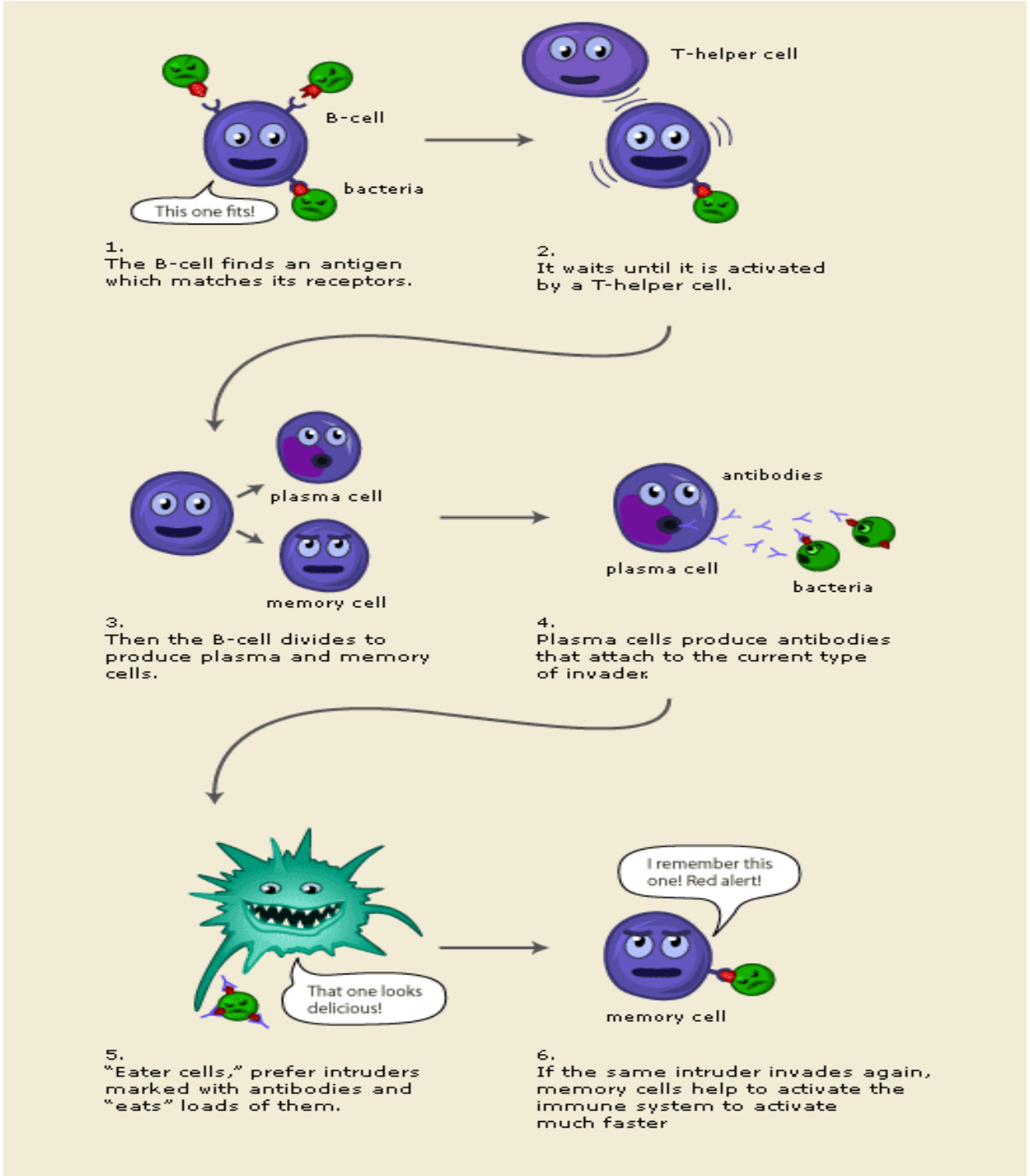
- **Recognize and bind antigen without** presented with antigen- presenting cell (APC).

- On recognizing the antigen it will bound and with help from T- cell, **B-cell enlarges and divide (clonal through mitosis)**

- This is known as **Antibody- mediated (humoral) immunity**







LYMPHOCYTES

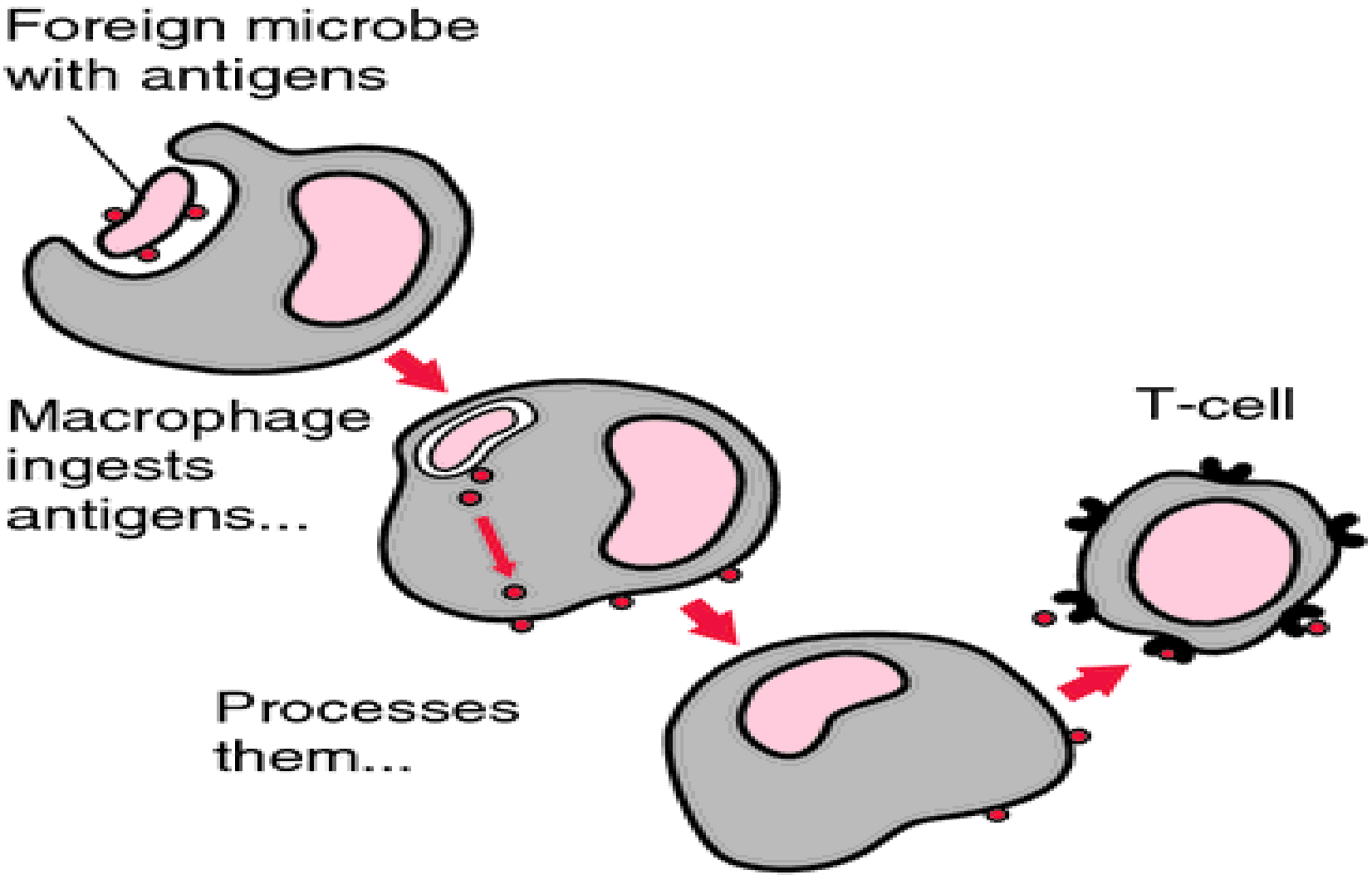
- **T cells**
  - Made in the bone marrow but mature and become active in the thymus gland with the help of thymosin hormone then released into circulation.

LYMPHOCYTES

- T- cell only **able to recognize the antigen** from outside **if it is presented with antigen-presenting cell (APC).**

- Eg: macrophages – they **engulf and digest it** then transport its antigenic to its cell membrane for T- cell recognization.

- This is also known as a **cell-mediated immunity.**


Foreign microbe with antigens
Macrophage ingests antigens…
Processes them…
T-cell
and presents them to the T-cell

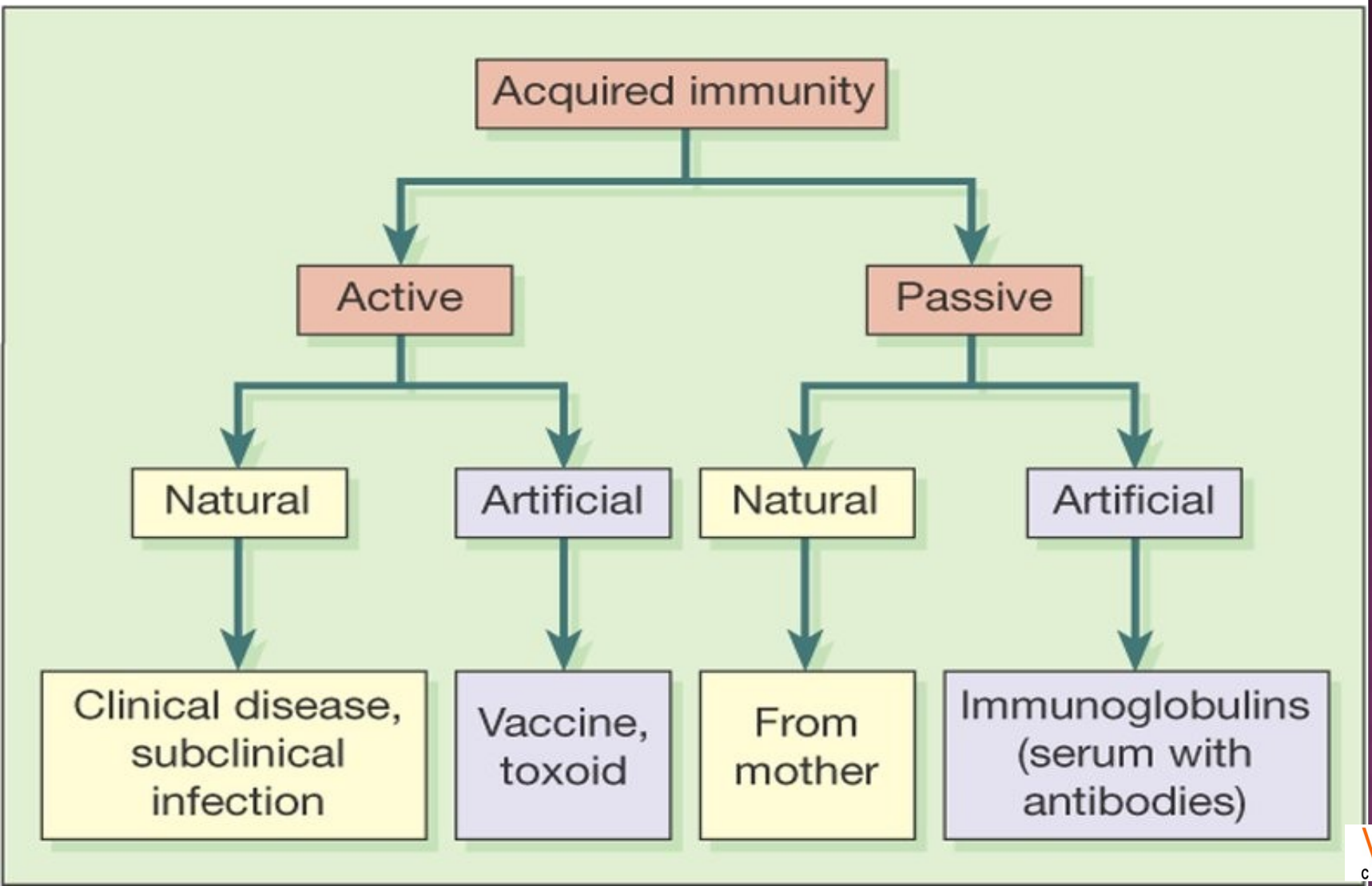
LYMPHOCYTES

- Both the T- and B-lymphocytes recognise and targets only one specific antigen – there is vast number of different T- and B- cell in the body.

ANTIBODIES

- Are **special proteins** which is released into the circulation to help in combating infectious diseases.
- Functions:
  - Able to bind with pathogens
  - Agglutinate or clump the microorganisms together, prevent their spread through the body
  - Antigen-antibody complex is readily engulfed and digested by phagocytes
  - Antigen-antibody complex may stimulate other reactions within the body, such as destruction of the membrane of the antigen or release of histamine by the invaded cells, causing inflammation

ACQUIRED IMMUNITY



VACCINE

- An alternative approach to using drugs to treat a disease is to prevent it happening using immunisation.

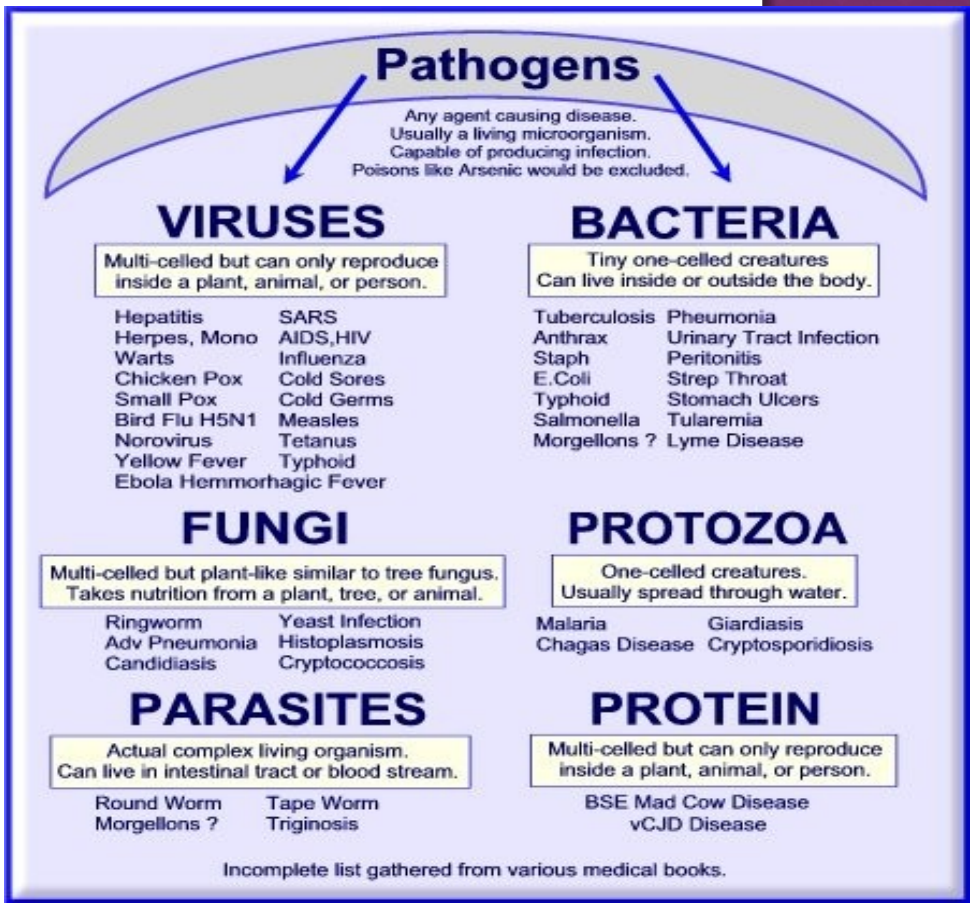
- Immunisation is the process of protecting people from infection by giving them passive or active artificial immunity.

VACCINE

- Diseases preventable by vaccination:
  - Anthrax
  - Cholera
  - Diphtheria
  - Hepatitis B
  - Measles
  - Mumps
  - Poliomyelitis
  - Smallpox
  - Tetanus
  - Tuberculosis
  - Typhoid
  - Whooping cough

BODY DEFENSES AGAINST INFECTION

- The presence and multiplication of a disease-causing agent, or pathogen, causes an infection.
- Pathogens include:
  - Bacteria
  - Protozoa
  - Spores of fungi
  - Viruses

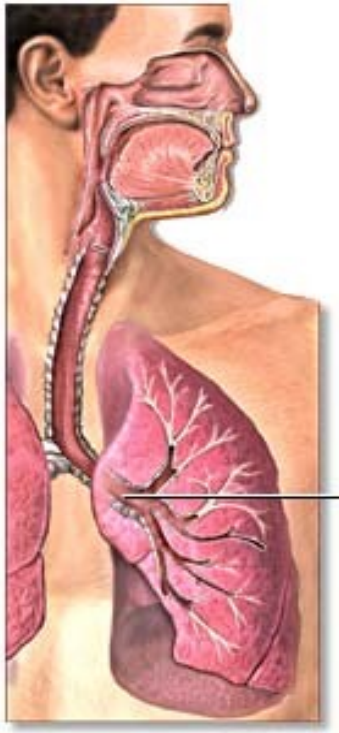


INNATE DEFENSE-BARRIERS FOR ENTRY

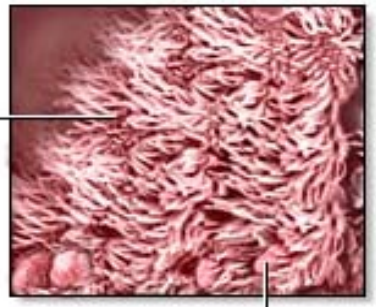
- Natural barriers breached before infection occur.
  - Epithelial defenses
    - Skin with sebum secretion and skin flora
    - Mucus production that protects the surfaces of the internal tubes and ducts (respiratory tract, gut, urinary and reproductive tracts)
    - Blood clotting to seal the open wound and to prevent the entry of any further pathogens

INNATE DEFENSE-BARRIERS FOR ENTRY

- Defences in the gut (intestine)
  - Digestive enzymes
  - Gastric juice
  - Gut flora
- Vomiting



Hair-like projections called cilia line the primary bronchus to remove microbes and debris from the interior of the lungs



Primary bronchus

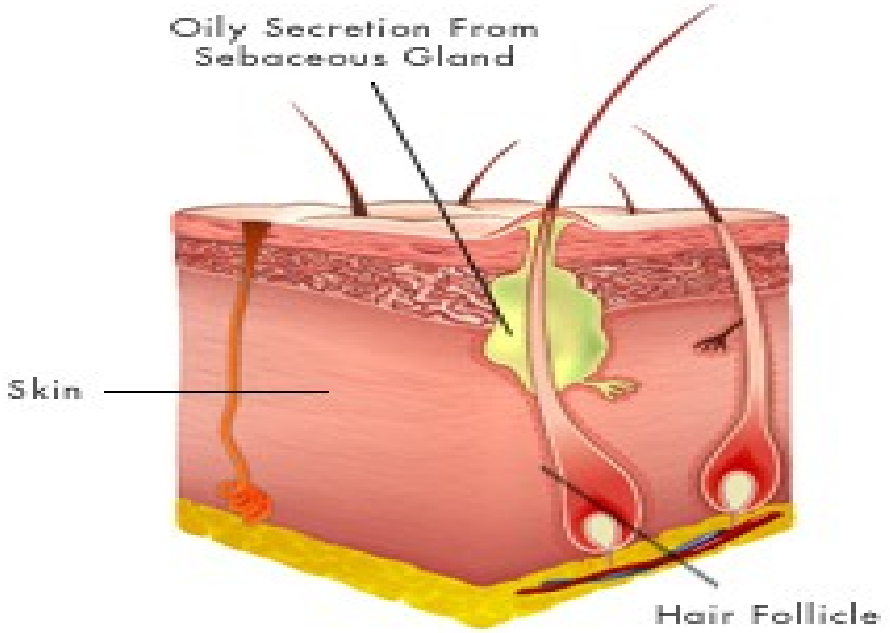
ADAM

Intestinal flora

(Microbial flora in the intestine)

Enterococcus faecalis AD101 strain Strain AD101 (Strain Coccus Newton)

Lactobacillus reuteri AD302 strain Strain AD302 (Strain Coccus Einstein)



Skin Flora

(Microbial flora in the skin)

Staphylococcus epidermidis

Propionibacterium acnes

VISION COLLEGE

Types of barriers that prevent the invasion of pathogenic microorganisms

- Physical barriers
- Chemical barriers
- Biological barriers

PHYSICAL BARRIERS

- Skin is a tough waterproof outer layer impregnated with keratin –

- prevents pathogens entry to the moist, blood-rich tissues where they could invade cells and easily grow to cause disease.

- Mucus forms a sticky layer which acts as a physical barrier to the entry of pathogens (inner layer of respiratory tract and gut)

CHEMICAL BARRIERS

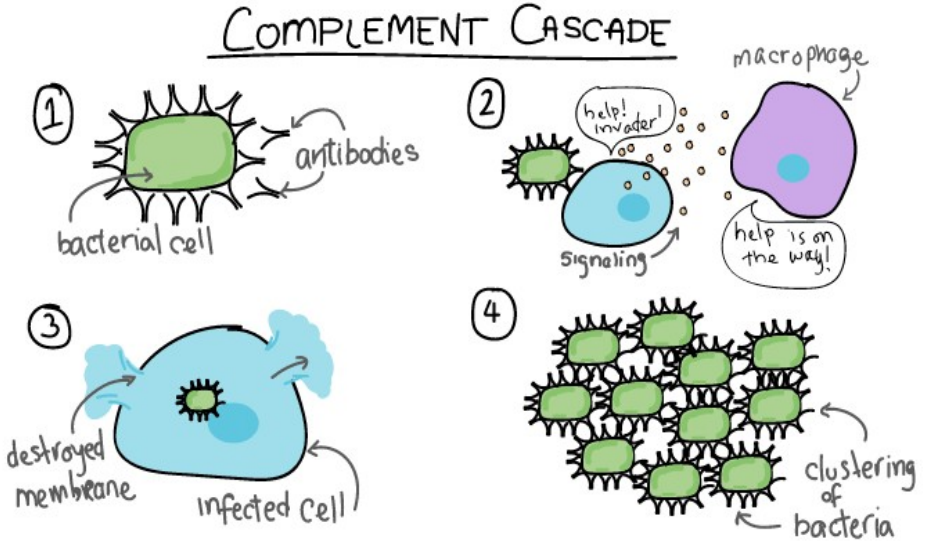
- Sebum is a layer of oil on top of the skin that contains chemicals which inhibit the growth of pathogenic bacteria (support the growth of the natural healthy skin bacteria).
- Acid (Hydrochloric acids + pepsin)in the stomach has a low pH and acts as barrier to most pathogens which are destroyed if they are ingested.

BIOLOGICAL BARRIERS

- Skin and gut flora- healthy bacteria growing on the surface
  - they outcompete pathogens and prevent them gaining entry to the body.
- Lysozymes are enzymes found in mucus and tears that break down bacterial cell walls and kill them before they can infect the tissues.
- The vomiting reflex ejects bacteria and viruses from the body before an infection can spread far.

NON-SPECIFIC RESPONSES

- The following responses are non-specific (similar response for all diseases regardless of the particular pathogens that invade into the body).
  - Inflammation
  - Fever
  - Interferon
  - Lysozyme action
  - Phagocytosis
  - Complement



VISION COLLEGE

INFLAMMATION

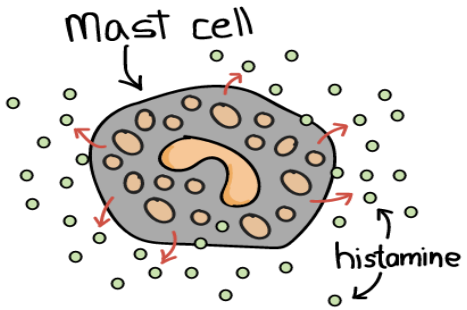
- Is a nonspecific, defensive response of the body to tissue damage.
- Causes:
  - Pathogen
  - Abrasions
  - Chemical irritations
  - Distortion / disturbances of cell
- Sign and symptoms:
  - Redness
  - Pain
  - Heat
  - Swelling

INFLAMMATION

- Three basic stages:
  - Vasodilatation and increased permeability of the blood vessels
  - Emigration (movement) phagocytes
  - Tissue repair

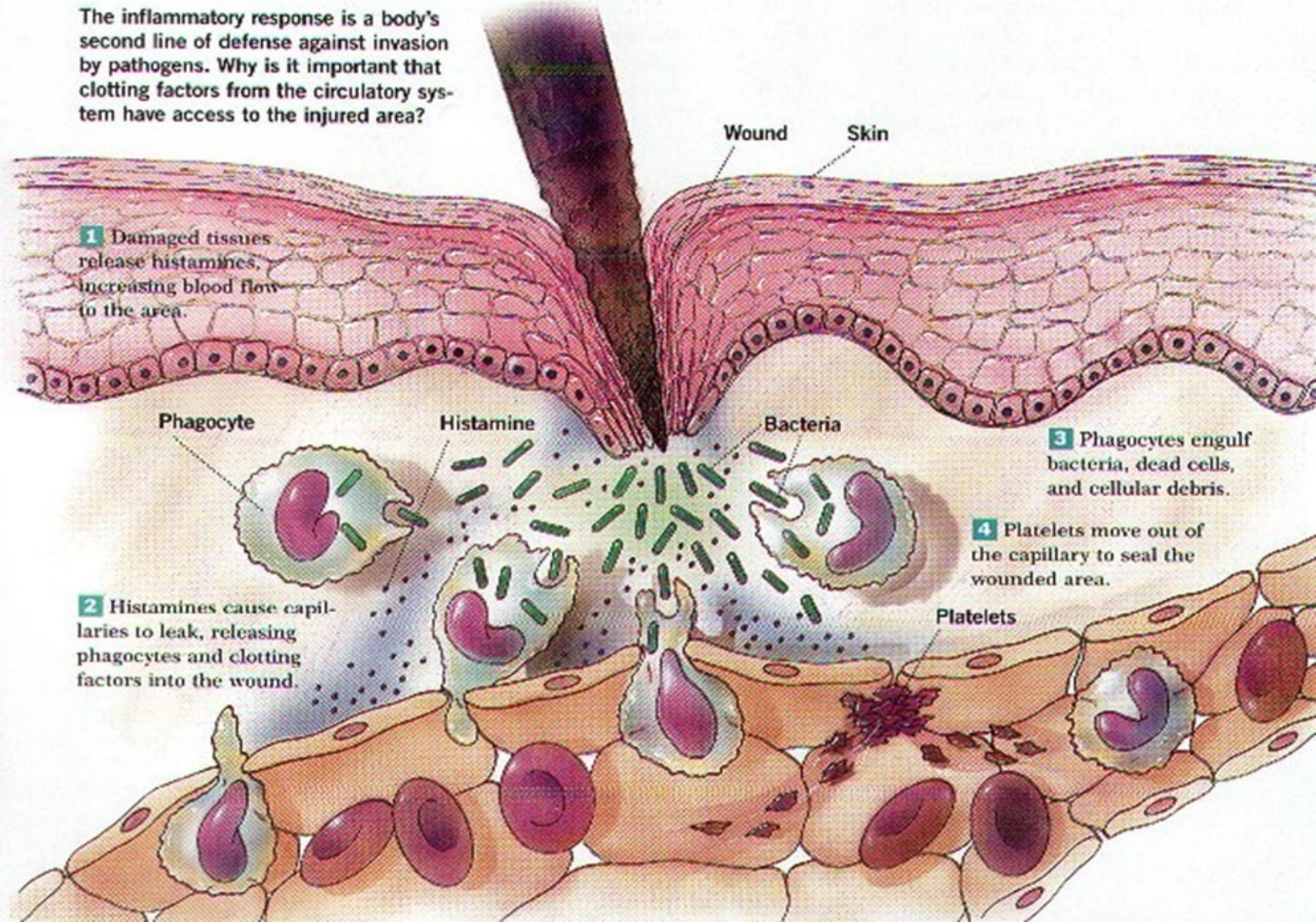
INFLAMMATION

- Happen through localized infections (cut)
- mast cell + WBC released histamines
- blood vessels (arterioles) dilate → heat + redness (reduces efficiency of pathogens reproductions)
- histamines cause capillaries wall permeable/ leaky → increase blood flow to the area (injured site)
- plasma, WBC + Antibodies leak
- tissue repair → pain + swelling.



Steps of the Inflammatory Response

The inflammatory response is a body's second line of defense against invasion by pathogens. Why is it important that clotting factors from the circulatory system have access to the injured area?



INFLAMMATION

- Acute - sudden onset and of short duration (days to a few weeks).

- Chronic - slow onset and of longer duration.

(could be due to acute or primary –slow onset)

FEVER

- Abnormally high body temperature that occurs because the hypothalamic thermostat is reset.
- Caused by infections and inflammations.
- Over toxin from micro will increase body temperature that will trigger release of cytokines from the macrophages.
- **Hypothalamus set body temperature high** (help body combat the infection) – high temperature reduces ability of bacterial reproduce & increase working of specific immune response.

LYSOZYME ACTION

- Lysozymes are **enzymes that can destroy bacterial cell walls** by catalysing the hydrolysis of peptidoglycan molecules.

- Effective against Gram-positive bacteria.

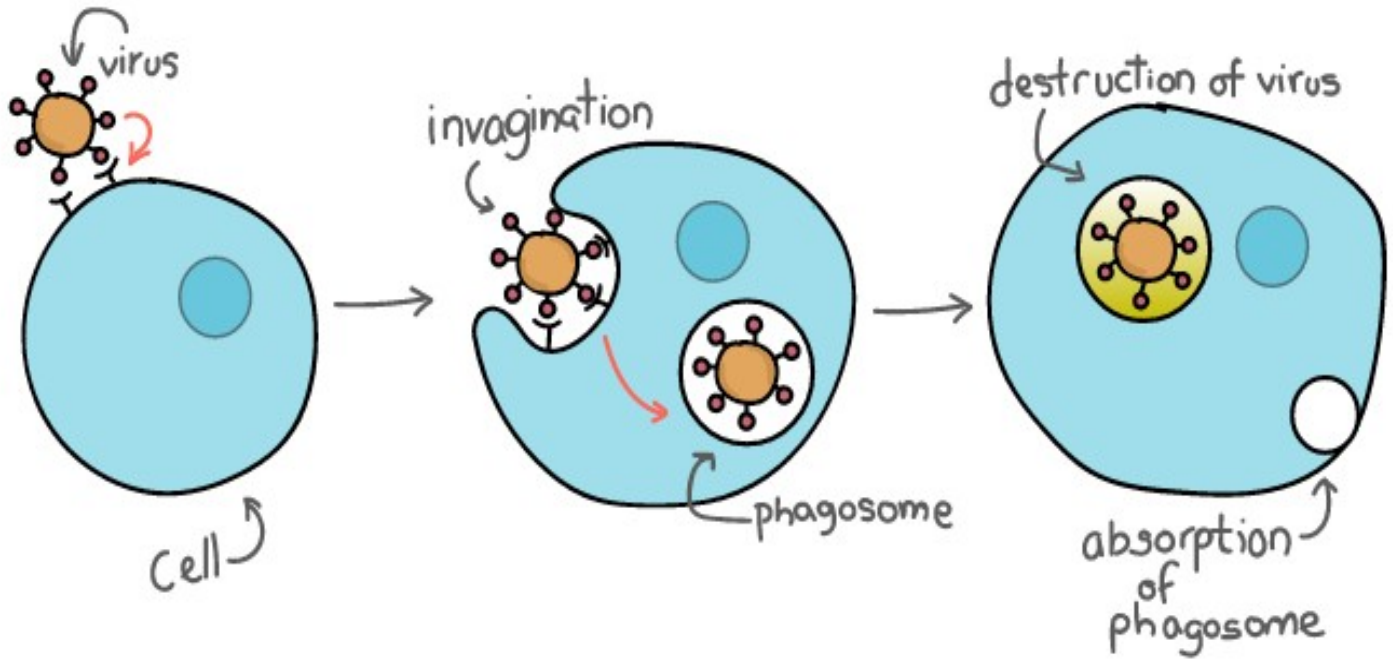
- Lysozymes are present in the mucus lines the respiratory system, the GIT, the urinary, reproductive tracts,tears and saliva to destroy bacterials can infect the eyes.

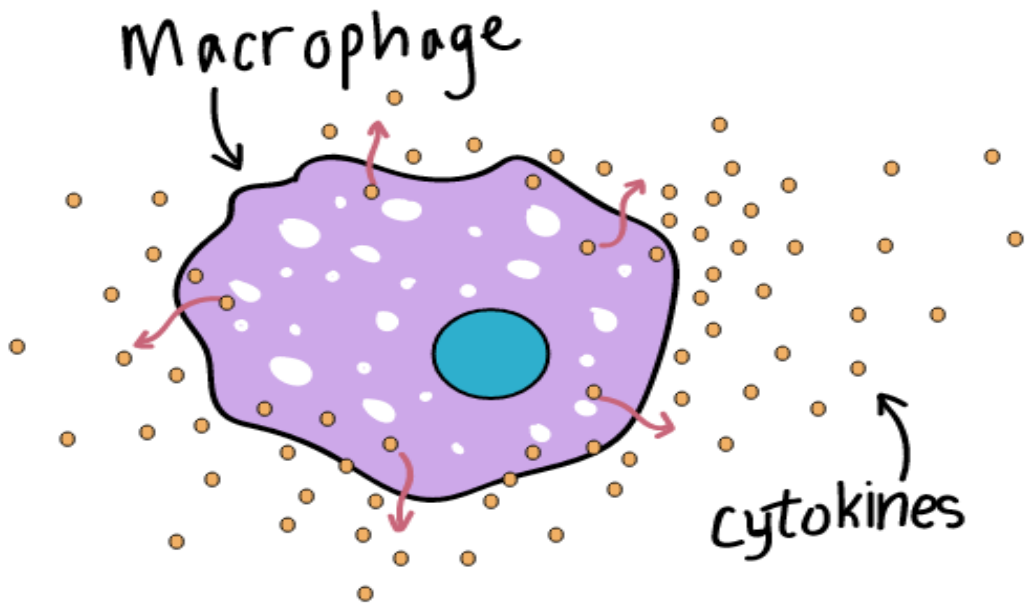
PHAGOCYTOSIS

- Two types of white blood cells, neutrophils and monocytes (which become macrophages) are able to **engulf, digest and destroy bacteria** or other foreign material, including any of the body's own cells that are damaged.

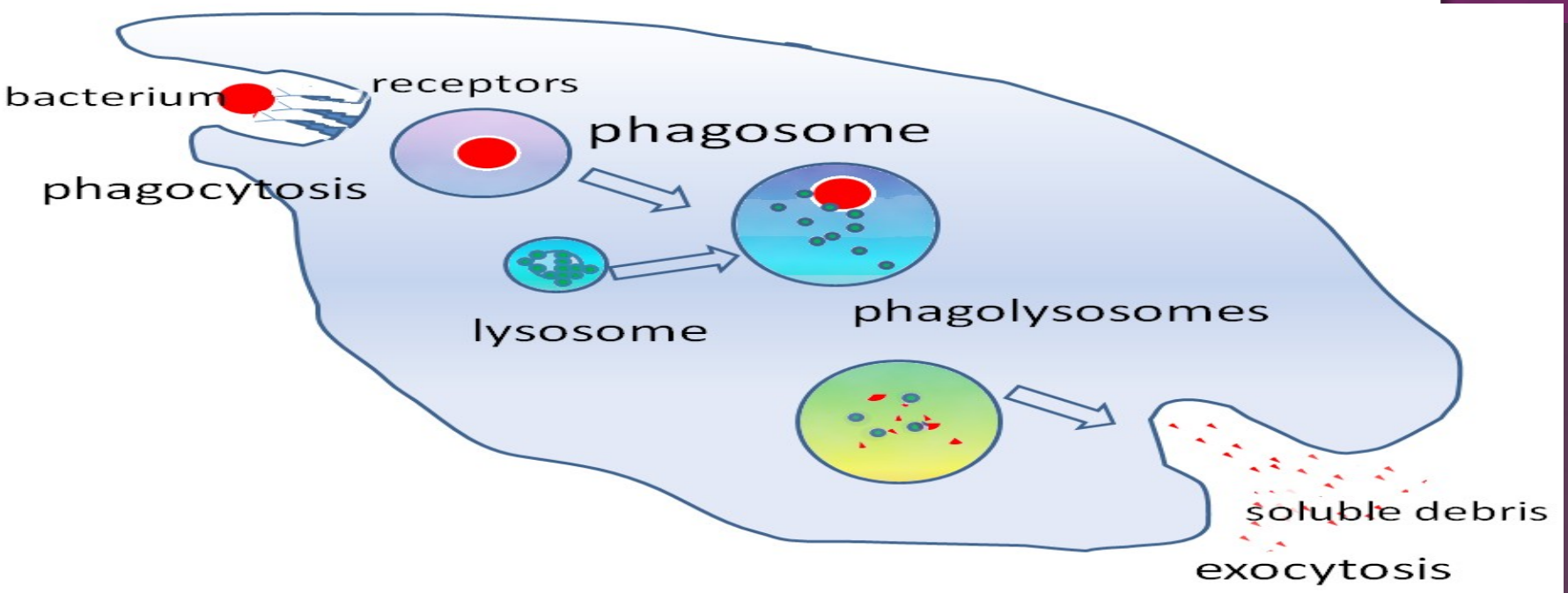
- Phagocytes = neutrophils and macrophage

- Phagocytes accumulate at the site of an infection to attack the invading pathogens.


virus
invagination
destruction of virus
cell
phagosome
absorption of phagosome


Macrophage
cytokines

PHAGOCYTOSIS




Thank You!