

Lymphoid System



Lymphoid system

- Primary

- 1) Bone marrow

- 2) Thymus

- Secondary

- 1) Lymph nodes

- 2) Spleen

- 3) Nodules

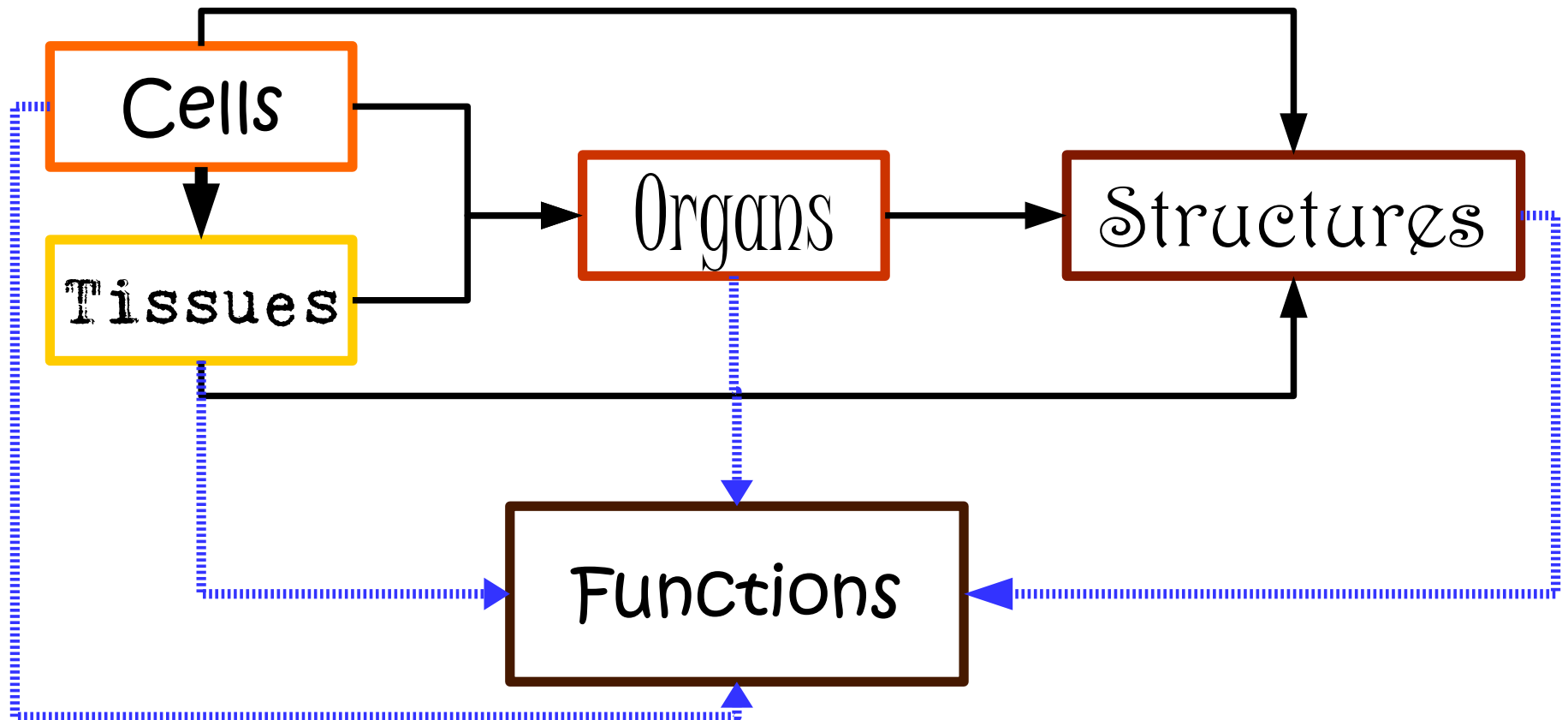
- 4) MALT

- 5) BALT

Lymphoid tissue

- Tissue/Organ
 - Lymph Nodule
 - Tonsils
 - Lymph Node
 - Thymus
 - Spleen
- Structures
 - Capsule?
 - Cortex-Medulla?
 - Germinal Centers?
 - Lobulation?
 - Cells?

what stuff could there be?



Slides: Lymphatic system

Slide 22: Lingual tonsil

Slide 62: Thymus

Slide 63: Palatine Tonsils

Slide 64: Spleen

Slide 65: Thoracic Duct

Slide 66: Lymph Node

Slide 75: Thoracic Duct

Goals: Lymphoid Tissues

1. Identify, describe and distinguish:
 - lymph nodules, tonsils, lymph nodes, thymus and spleen.
2. Explain flow of lymph & blood through the lymph node and spleen respectively.
3. Explain how the structure of the lymphoid organs facilitate their function.
4. Explain age related changes in the thymus.
5. Describe distribution, organisation and significance of MALT.
6. Differentiate between B- and T-cell regions.

Tasks: Lymphoid Tissues

1. Complete table comparing lymphoid tissues and organs.
2. Compare low magnification view of the lymphoid tissues and organs with diagrams of each.
3. Make own annotated diagram of each structure.
4. Complete the drawings for each slide in the practical workbook.
5. Connect the histological structures with the relevant macroscopic anatomy, physiology and pathology.

Tasks: Lymphoid system

1.List:

- Components of lymphoid system
- Purpose of each – keep in mind barrier concept
- Characteristic of each component
- Common to all components
- Blood/Lymph flow through each component

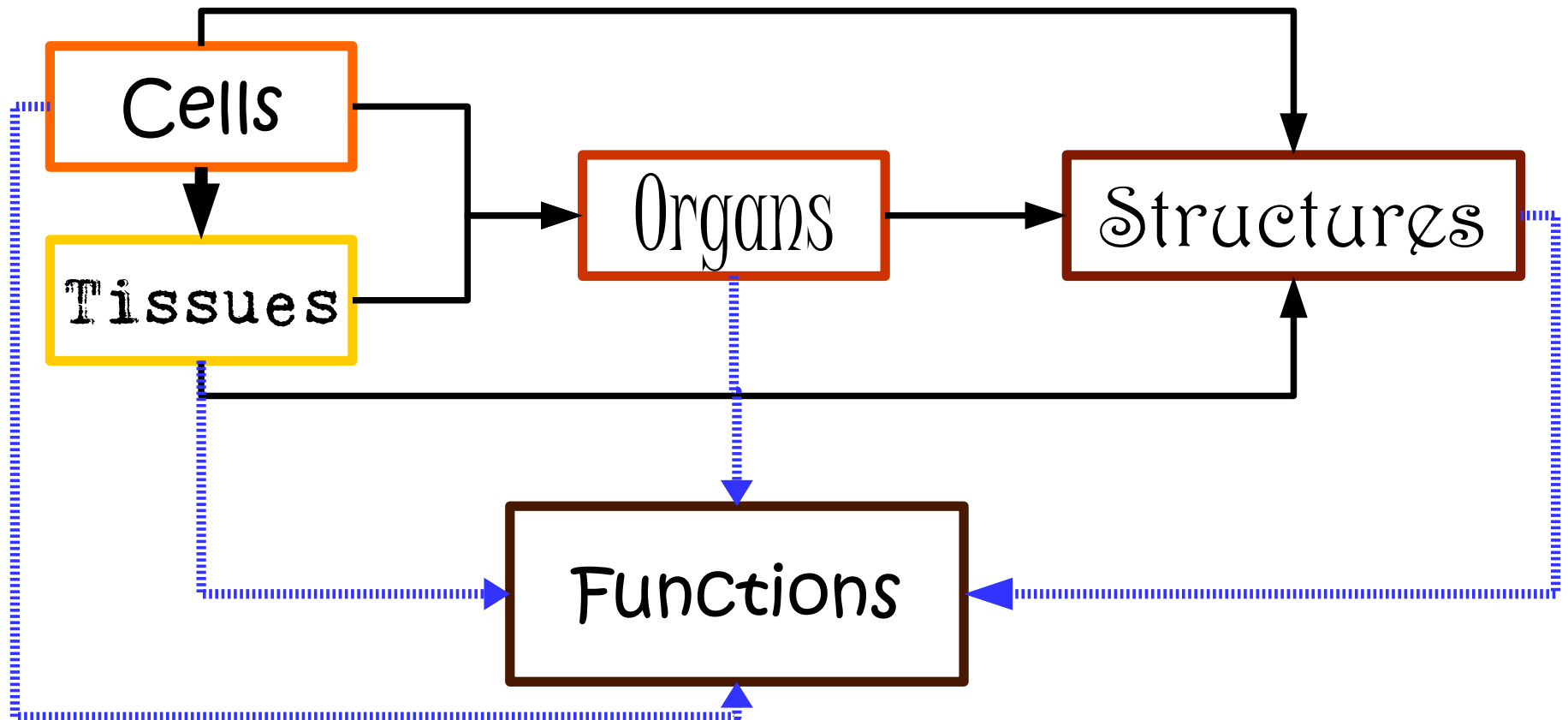
2.Complete the drawings for each slide in the practical workbook.

	Lymphoid system	Liver	Kidney
Structures			
Substances	List <u>all</u> substances moving through the structure.		
Paths	List the path these substances take through the structure.		
Slides	Correlate with the microscopic structure.		

Organisation of lymphoid system

- Nodular and diffuse accumulations
- Work together
- to defend
- against foreign elements

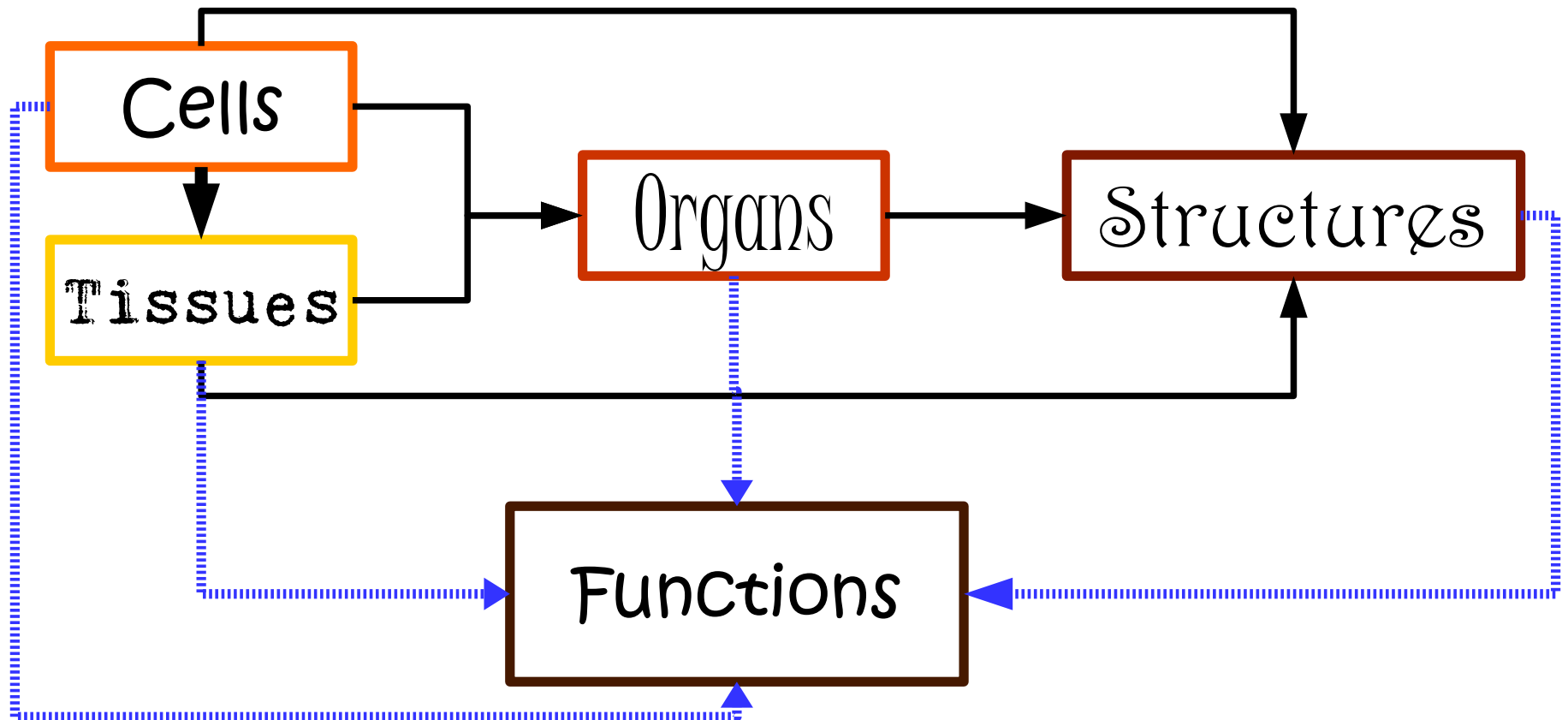
what stuff could there be?



Basis of defense

- Immune system
- Depends on action of 2 cells

what stuff could there be?

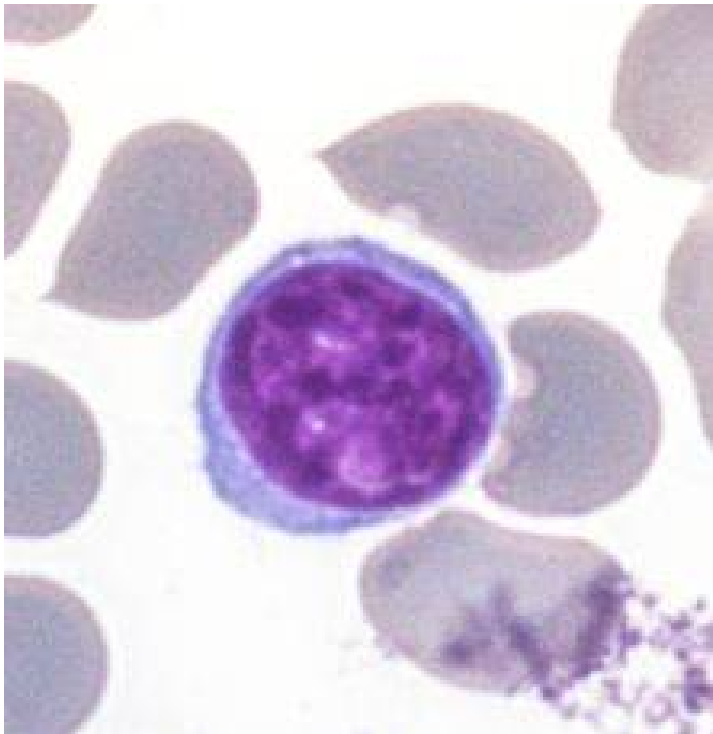


Basis of defense

- Immune system
- Depends on action of 2 cells
 - Lymphocytes
 - Macrophages

cells

- Lymphocytes
 - As seen in cells in Blood
- Macrophages
 - As seen in various organs



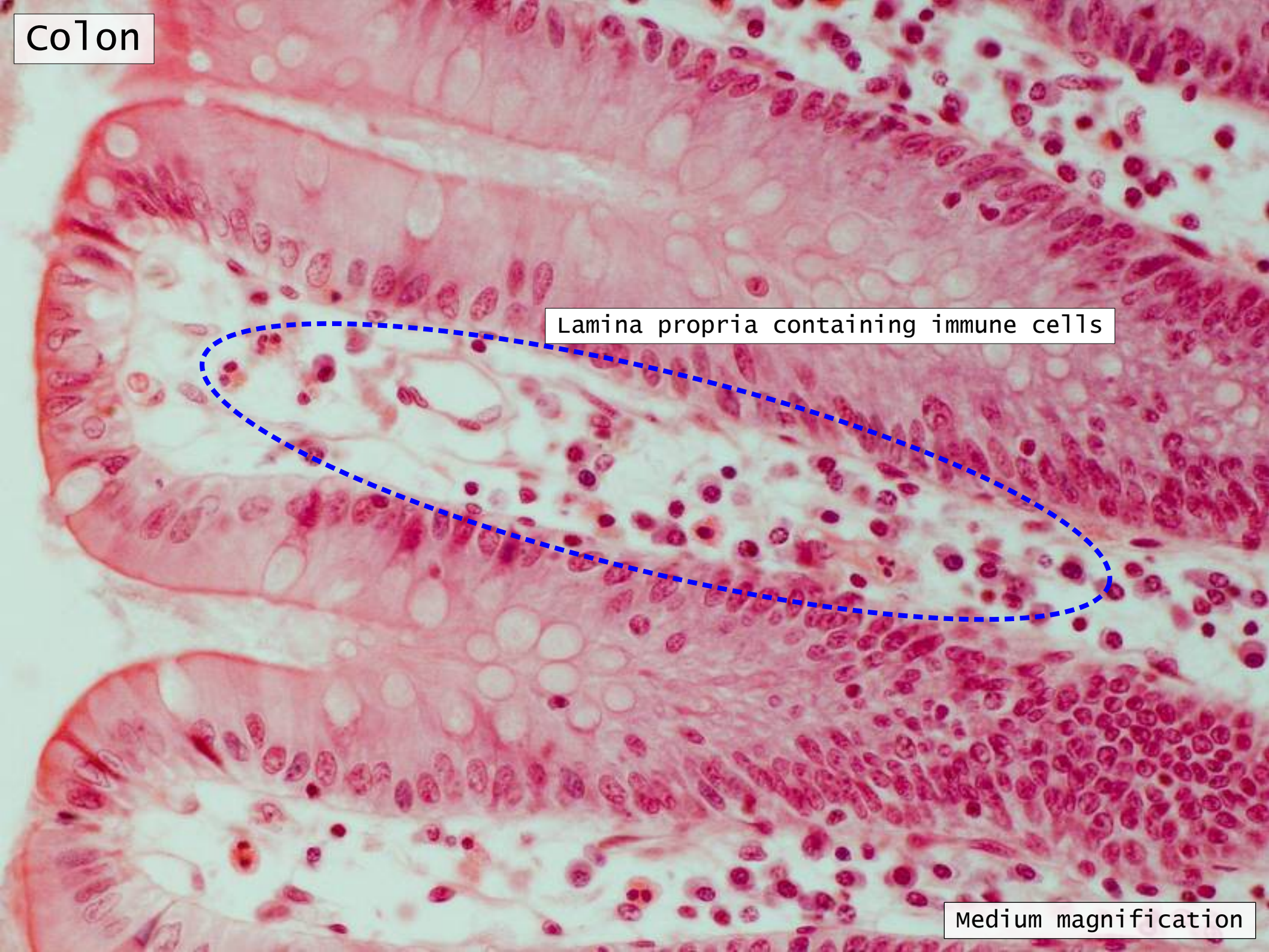
Diffuse lymphatic tissue

- Loose CT underlying epithelia
 - For example lamina propria of GIT
- Scatter clusters
 - Lymphoid cells/lymphatic nodules

Colon

Lamina propria containing immune cells

Medium magnification



Lymphatic nodules

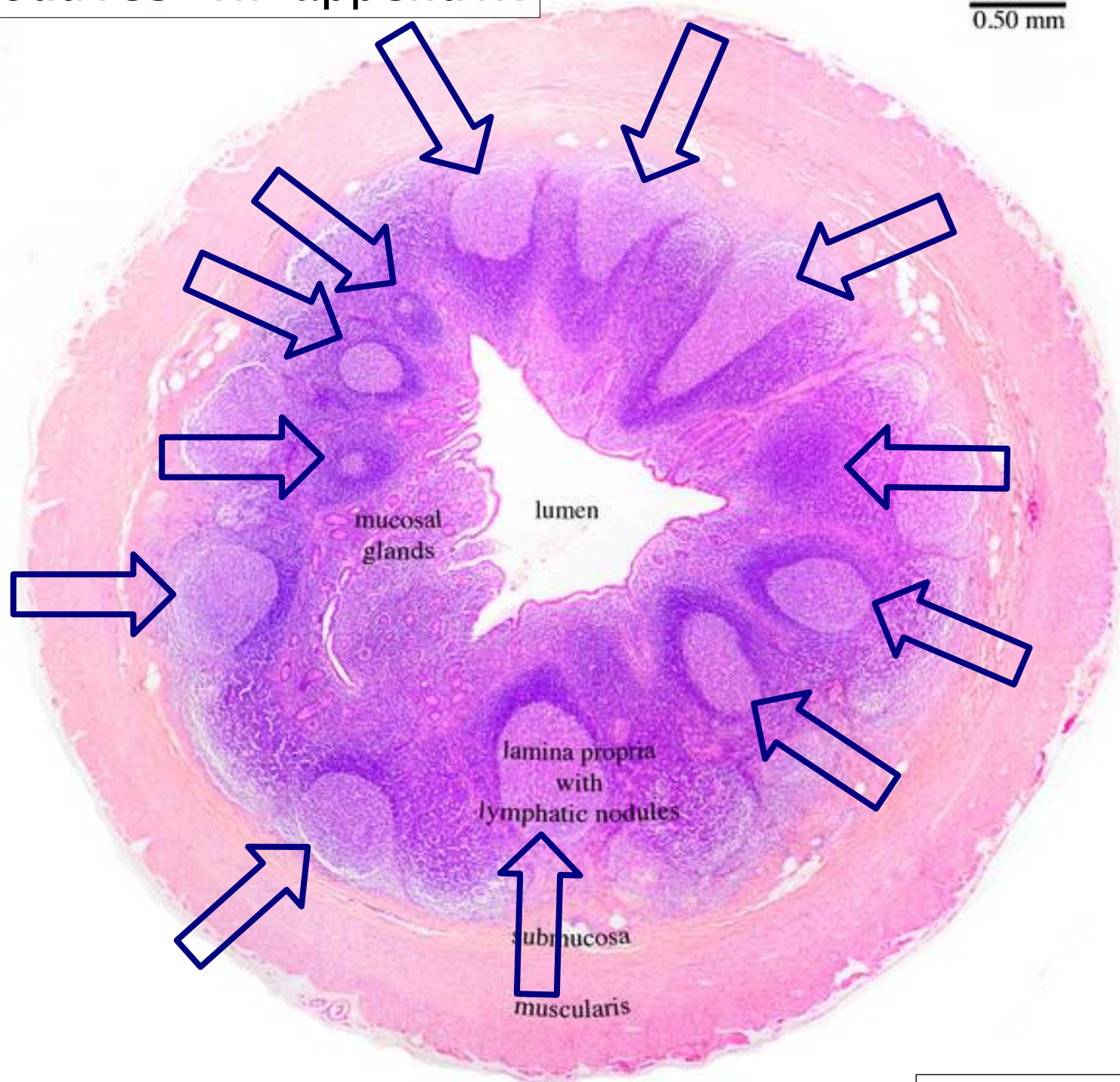
- Dense accumulations of lymphocytes
 - Mostly B cells
- Central light stained area
 - Germinal centre
 - Medium/large lymphocytes
 - Active cell division
 - Transformation B cells into plasma cells
- Peripheral dark region
 - Small newly formed lymphocytes

Lymph nodule

- Capsule = No
- Cortex-Medulla = No
- Germinal Centers?
 - Primary = No
 - Secondary = Yes
- Lobulation = No
- Cells = B, T, Fibroblasts, Macrophages

Lymph nodules in appendix

0.50 mm



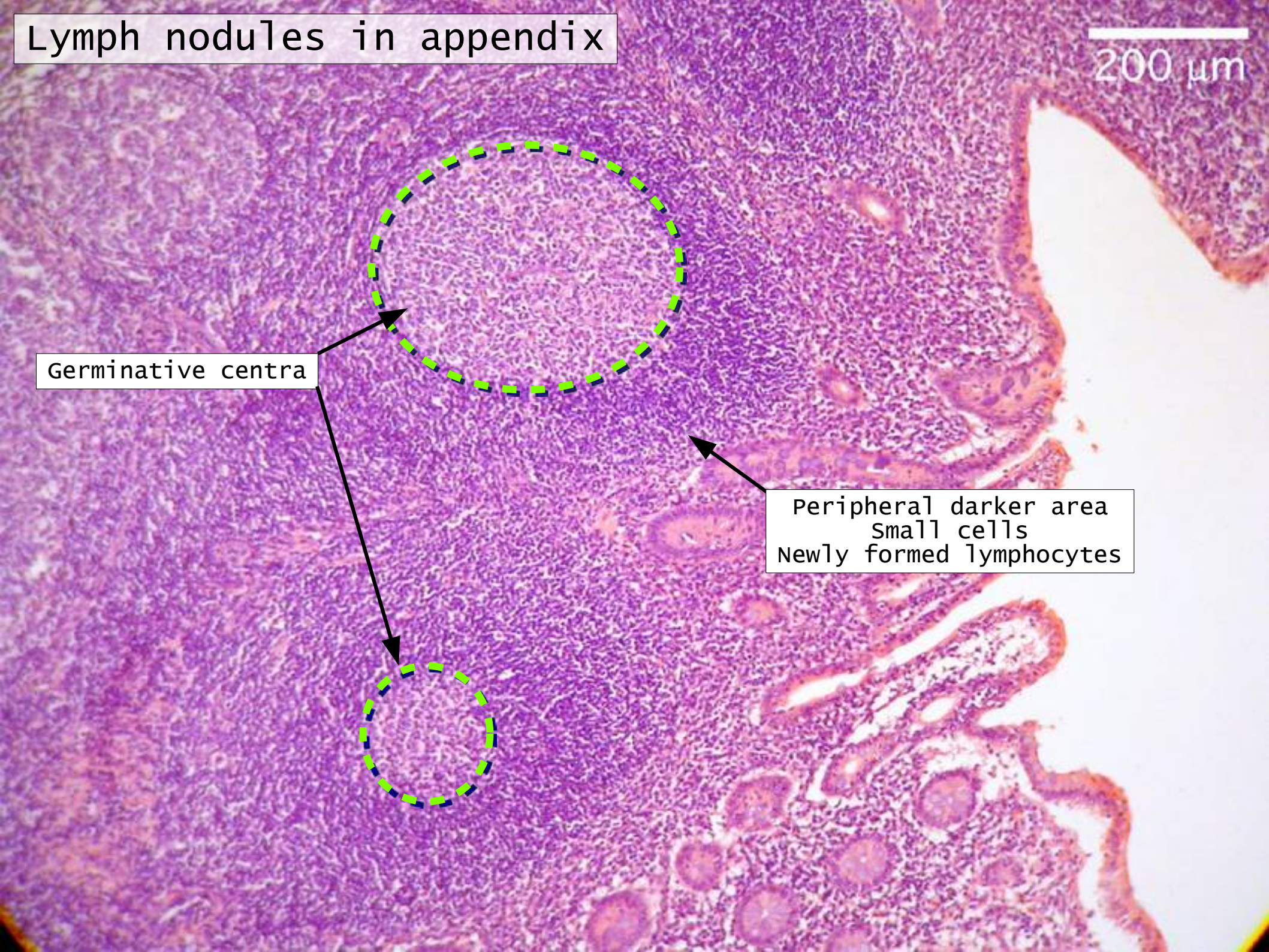
very low magnification

Lymph nodules in appendix

200 μm

Germinative centra

Peripheral darker area
Small cells
Newly formed lymphocytes



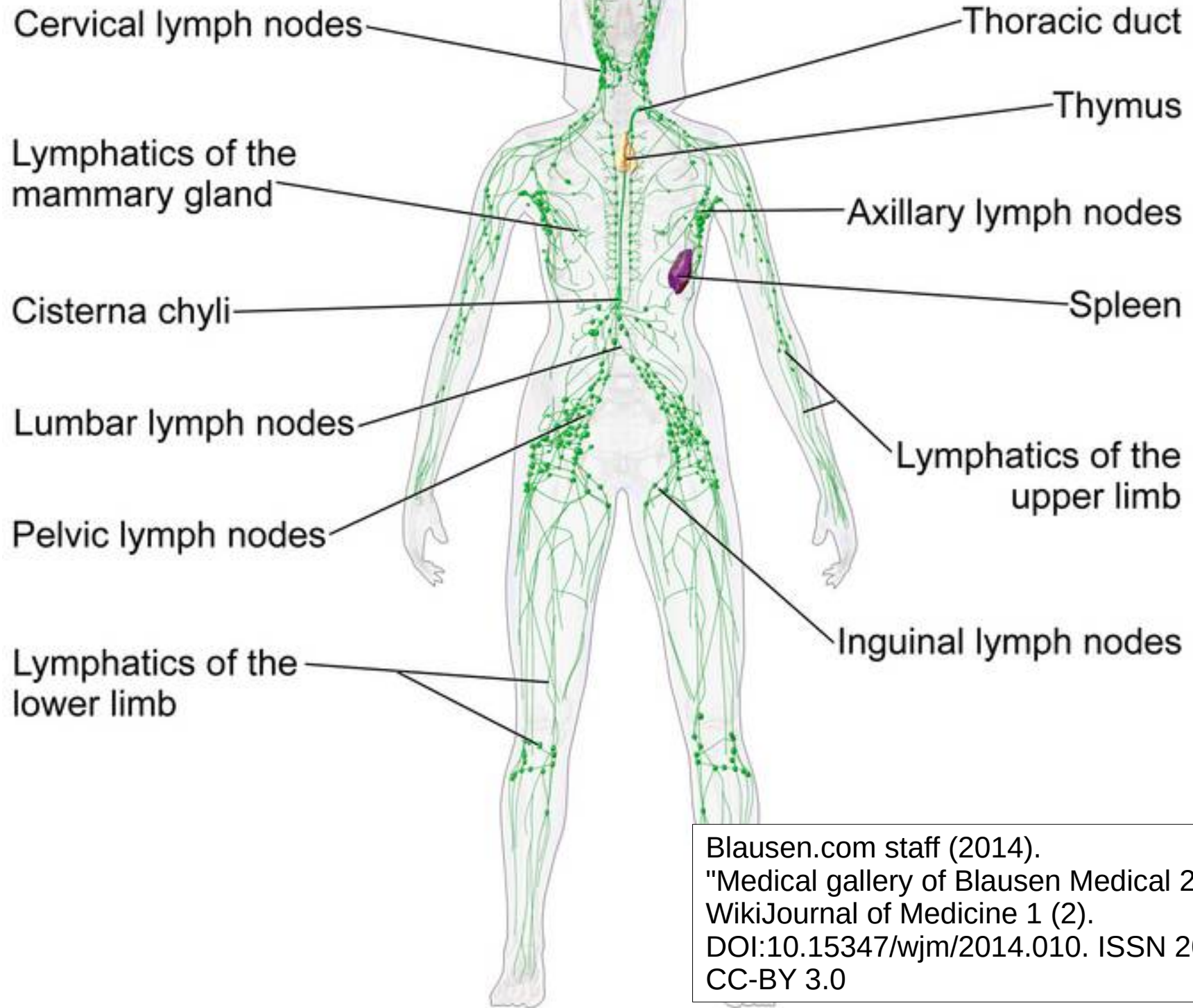
Lymph Node

Slide 66

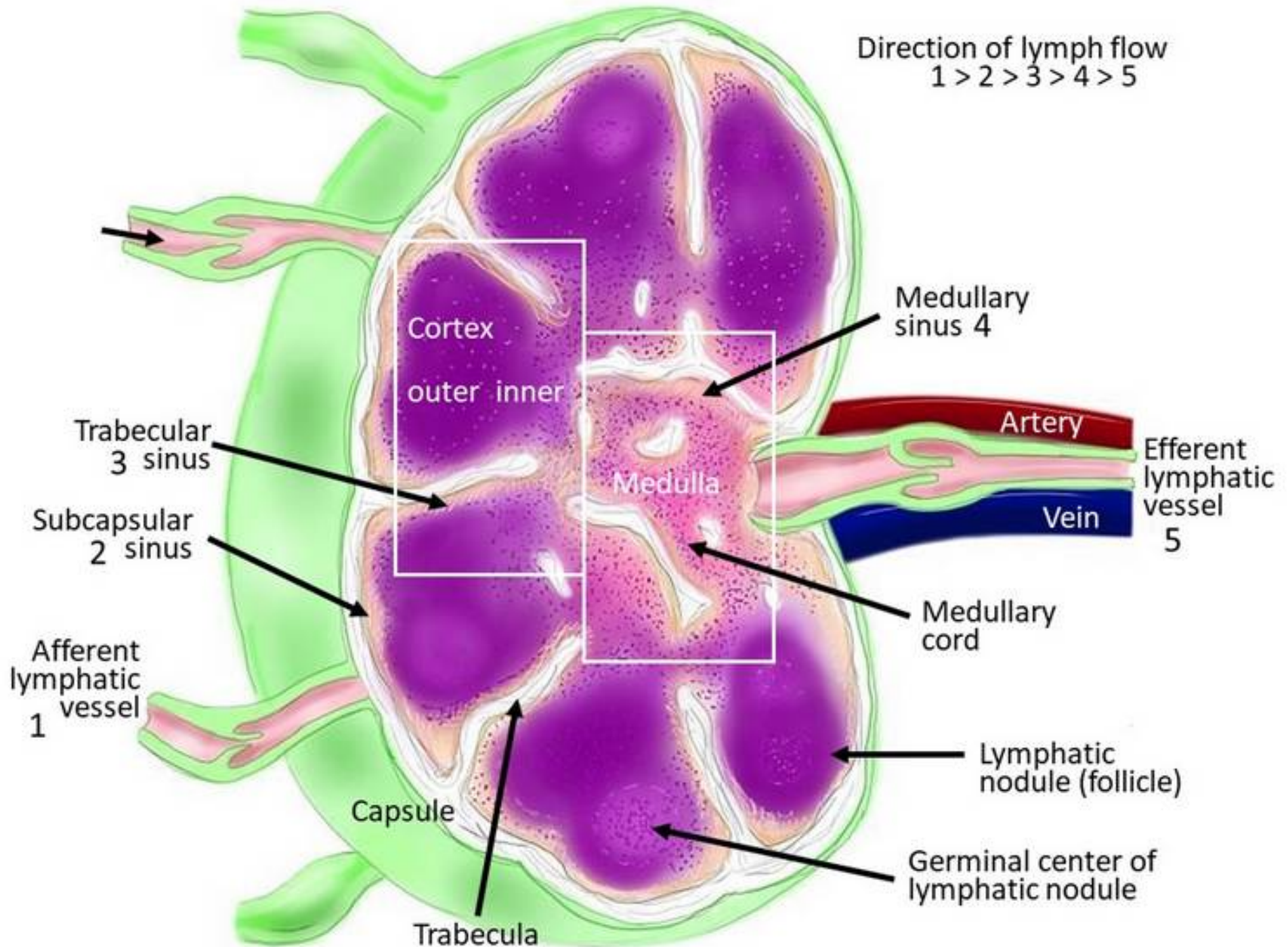
Lymph nodes

- Small encapsulated ovoid/kidney shaped
 - Alongside lymphatic vessels
 - Filter lymph
 - Produce lymphocytes
- Capsule surrounds entire node
- Divided into cortex & medulla
- Afferent lymph vessels – convex surface
- Efferent vessels – hilus
 - Hilus – artery, vein, lymph vessels

Lymphatic system



Blausen.com staff (2014).
"Medical gallery of Blausen Medical 2014".
WikiJournal of Medicine 1 (2).
DOI:10.15347/wjm/2014.010. ISSN 2002-4436
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Capsule

- Surrounded by adipose tissue
- Dense irregular CT with septae
- Convex aspect pierced by lymph vessels
- Lymph vessels has valves >>flow>>flow>>

Cortex

- Deep to capsule but absent at hilus
- Incompletely divided into compartments
- Compartments formed from CT septae from capsule
- Three parts
 - Lymphatic nodules
 - Sinusoids
 - Paracortex

Cortex

- Lymphatic nodules
 - Some with germinal centra
 - Mainly B lymphocytes some T lymphocytes
 - Antigen-presenting cells, macrophages, reticular cells
- Sinusoids
 - Endothelial lined spaces
 - Extend along capsule and trabeculae
 - Subcapsular and cortical sinuses
- Paracortex
 - Non-nodular T lymphocytes
 - Enter lymph node via postcapillary venules
 - Postcapillary venules = cuboidal shaped endothelium

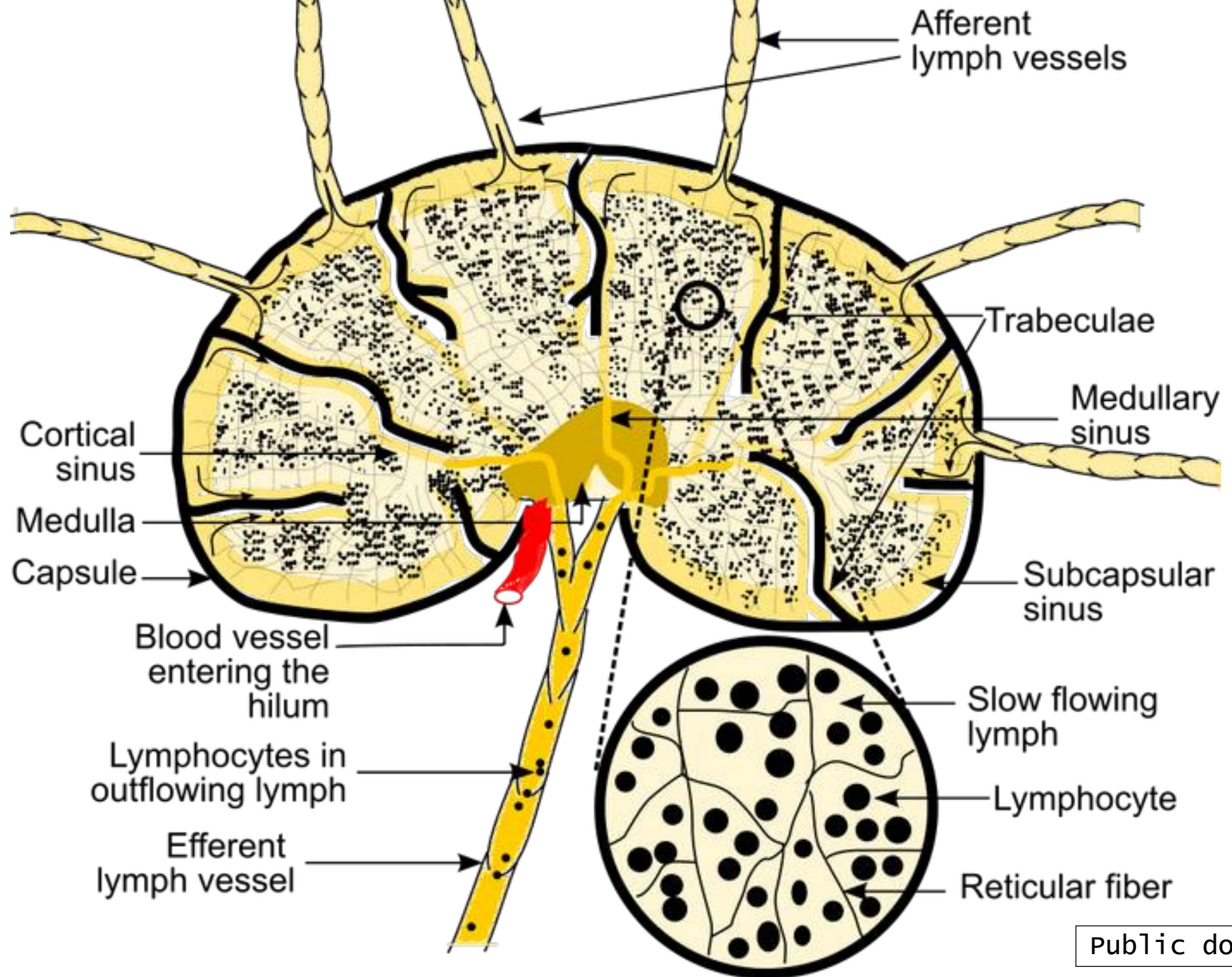
Medulla

- Surrounded by cortex except at hilus
- Consists of
 - Medullary sinusoids
 - Endothelial lined spaces
 - Contains reticular cells, macrophages
 - Receives lymph from cortical sinuses
 - Medullary cords
 - Lymphocytes & plasma cells
 - Migrated from medulla

Reticular fibres

- Network of fibres
- Constitute framework of lymph node
- Associated with capsule & trabeculae

Flow of lymph through lymph sinuses



Lymph node

- Capsule = Yes
- Cortex-Medulla = Yes
- Germinal Centers = Yes
- Lobulation = No, CT trabeculae
- Cells = B, T, Fibroblasts,
Macrophages, Plasma cells

Lymph node

CT Septa

Capsule

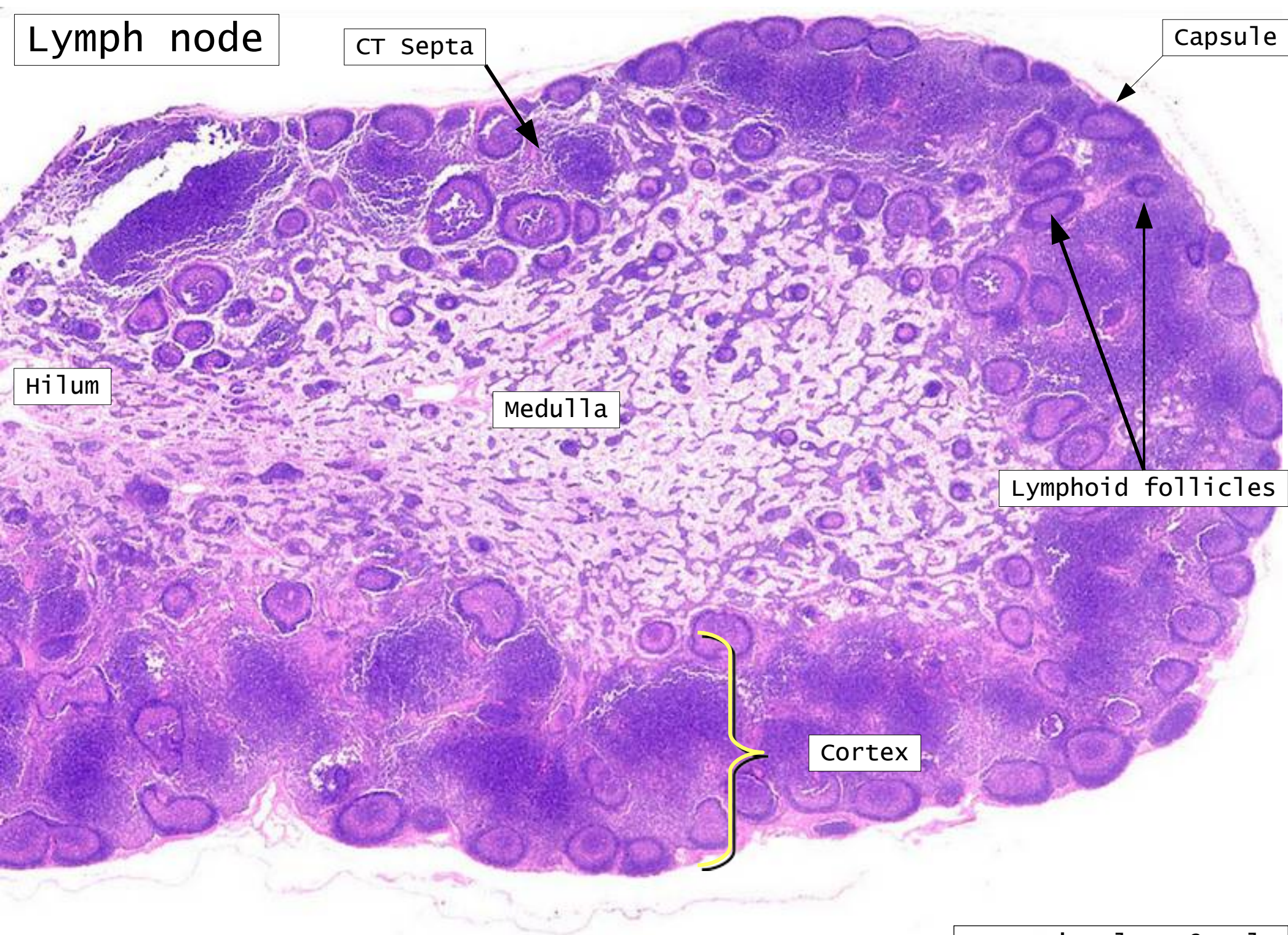
Hilum

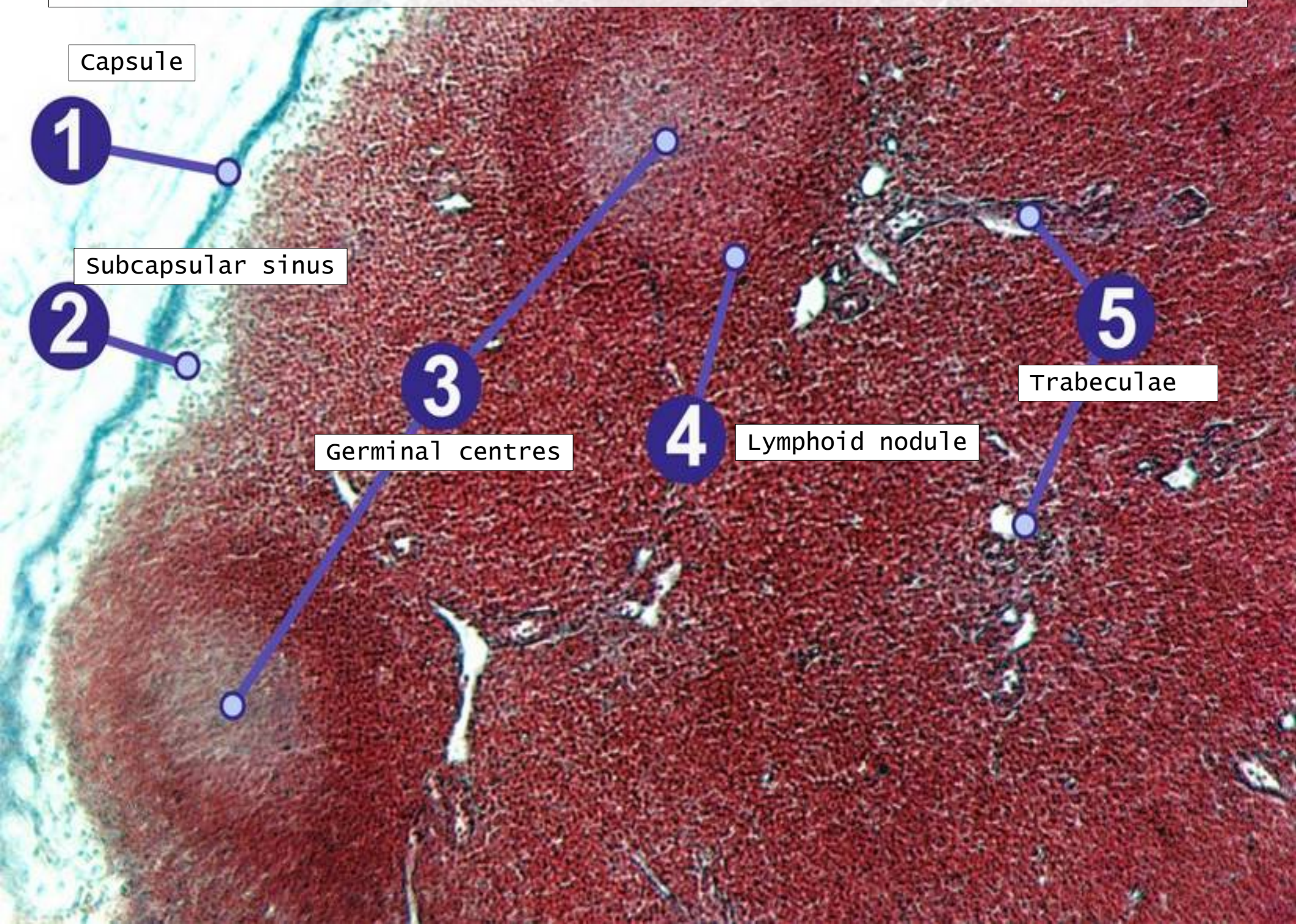
Medulla

Lymphoid follicles

Cortex

From Histology @ Yale





Thymus

slide 62

Thymus

- Located superior mediastinum
- Involute during puberty
- Two lobes
- Subdivided incomplete lobules
 - Surrounded by CT septae from CT capsule
 - Separated cortex & medulla
- No lymphatic nodules

Cortex 1/2

- Septa
 - Delicate collagen fibres from thin capsule
 - Incomplete around lobules
 - Contains arterioles from septae
 - Form capillary loops into cortex
- Epithelial reticular cells
 - Pale cells with large ovoid light staining nucleus & nucleolus
 - Processes **completely** surround cortex
 - Isolate cortex from CT septa & medulla
 - Blood-thymus barrier

Cortex 2/2

- T lymphocytes
 - Large numbers undergoing differentiation
- Medium & large lymphocytes
 - At periphery of cortex
- Maturing T cells
 - Migrate towards medulla for release
 - Most are phagocytosed by macrophages
- Vascularization
 - Continuous capillaries completely surrounded by reticular epithelial cells

Vascularization - cortex

- Continuous capillaries
- Surrounded by epithelial reticular cells
- Basal lamina of endothelium & reticular epithelial cells and macrophages
- Form blood-thymus barrier
- Macrophages stop antigens in vascular supply from reaching developing T cells

Blood-thymus barrier

- Continuous capillaries
- Basal lamina of endothelium
- Macrophages
- Basal lamina of REC
- Reticular epithelial cells

Medulla

- Cells
 - Mature T cells
 - Epithelial reticular cells
 - Forms Hassal's corpuscles
 - Various stages keratinization
 - Sometimes calcification
 - Increase with age
- Lymphocytes
 - Loosely packed
 - Appear lighter stained
- Medulla of lobules continuous

Epithelial reticular cells

- Pale cells
- Large ovoid light staining nucleus
- Often displays nucleolus
- Processes surrounds cortex
- Isolate cortex from CT septa & medulla

Lymphocytes

- T lymphocytes
 - Large numbers within cortex
 - In process of differentiation
- Medium & large lymphocytes
 - At periphery of cortex
 - Surrounded by reticular cells
 - Isolated
- Maturing T cells
 - Migrate towards medulla to be released
 - Most die in cortex
 - Phagocytosed by macrophages

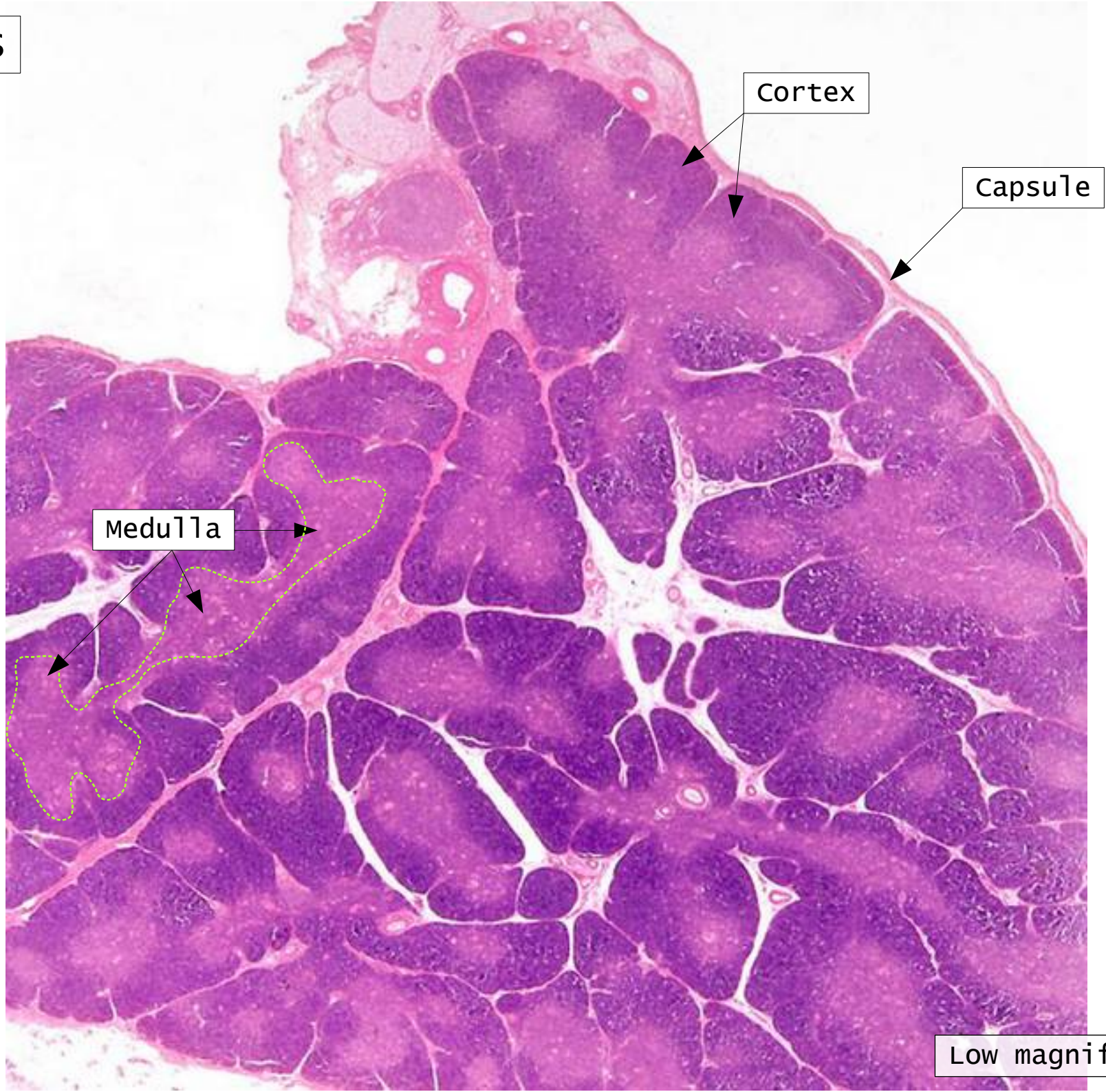
Vascularization - medulla

- Supplied by arterioles & venules
- No blood-thymus barrier
- T lymphocytes enter circulation
 - T lymphocytes exit thymus
 - Venules
 - Efferent lymphatic vessels

Thymus

- Capsule = Yes
- Cortex-Medulla = Yes
- Germinal Centers = No
- Lobulation = Cortex Yes
- Cells = Epithelial,
Hematopoietic, Accessory

Thymus



Hassall body

Epithelial reticular cells

very high magnification



Spleen

Slide 64

Spleen

- Largest lymphoid organ
- Intraperitoneal – covered peritoneum
- Functions
 - Filters blood
 - Stores RBC
 - Removed aged RBC
 - Site of proliferation B & T lymphocytes
 - Manufacture of antibodies
- No cortex or medulla
- Divided into red and white pulp

Nerves, blood & lymph vessels

- Enter and leave at hilus
- Afferent lymph vessels along convex surface

Capsule

- Dense irregular connective tissue
- With elastic fibers
- And smooth muscle cells
- Trabeculae
 - From capsule
 - Carry blood vessels and nerves
 - Attachment for reticular fibre network
 - Reticular fibres = framework of spleen

Vascularization

- Derived from splenic artery at hilus
- Trabecular arteries lead
- via trabeculae
- to splenic pulp
- On leaving trabeculae
 - Surrounded by sheath of lymphocytes
 - Penetrate lymphatic nodules
 - called central arteries

Arteries

- Central arteries
- Branch but maintain lymphatic shield
- Leave white pulp to form
- Penicillar arteries
 - Pulp arterioles
 - Sheathed arterioles
 - Terminal arterial capillaries
- Terminal arterial capillaries
 - Drain into splenic sinusoids
 - Or terminate into red pulp
 - Drained by pulp veins

white pulp

- All the diffuse and nodular lymphoid tissue of the spleen
- Includes
 - central artery
 - sheath of lymphocytes
 - lymphatic nodules
- Periarterial lymphatic sheath is primarily T lymphocytes
- Macrophages also present in white pulp
- And antigen-presenting cells

Marginal zone

- Region between red & white pulp
- Receive capillary loops from central artery
- Drain into sinusoids at periphery of lymphatic nodule
- Contains phagocytic macrophages & antigen-presenting cells
- Site where T & B lymphocytes enter spleen

Red pulp

- Interconnected network of sinusoids
- Supported by loose reticular tissue
 - Splenic cords or cords of Billroth
- Sinusoids
- Unusual
 - Endothelial cells long & fusiform
 - Large intercellular spaces
 - Thick discontinuous basal lamina
 - Supported by reticular fibres

Sinusoids

- Long fusiform endothelial cells
- Large intercellular spaces
- Outside endothelium circumferential "ribs" of collagen fibres
- "Ribs" discontinuous basal lamina
- Supported by reticular fibres

Splenic cords

- Contains
 - Plasma cells
 - Reticular cells
 - Blood cells
 - Macrophages
- Processes of macrophages enter lumen of sinusoids through intercellular spaces

Red & white pulp

- white pulp
 - Produce & grow immune & blood cells
- Red pulp
 - Filter blood
 - Antigens
 - Microorganisms
 - Old RBC

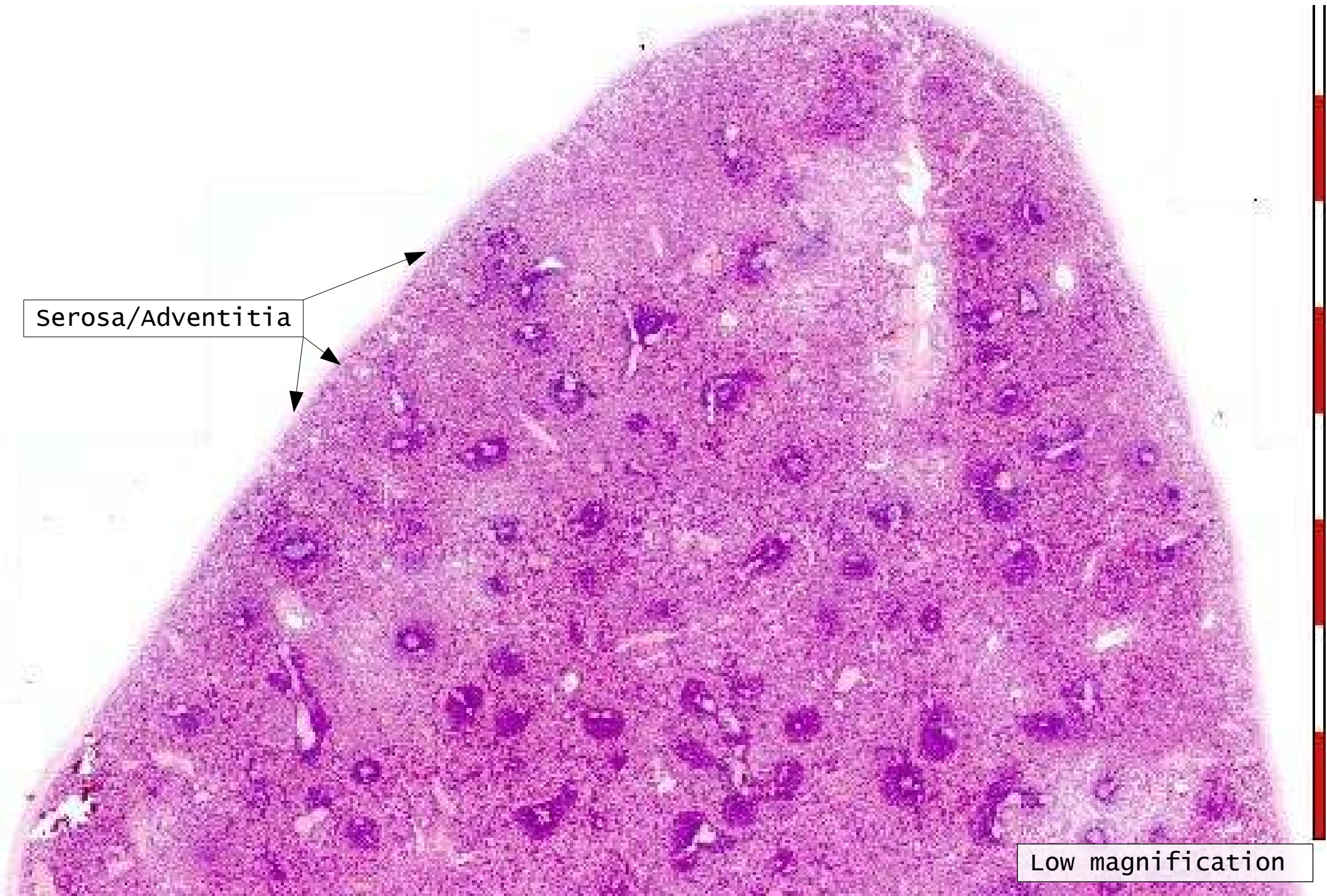
Spleen

- Capsule = Yes + Serosa+Mesothelium
- Cortex-Medulla = No
- Germinal Centres = Yes
- Lobulation = No, CT trabeculae
- Cells = RBC, Platelets, T, B, macrophages

Spleen

Serosa/Adventitia

Low magnification



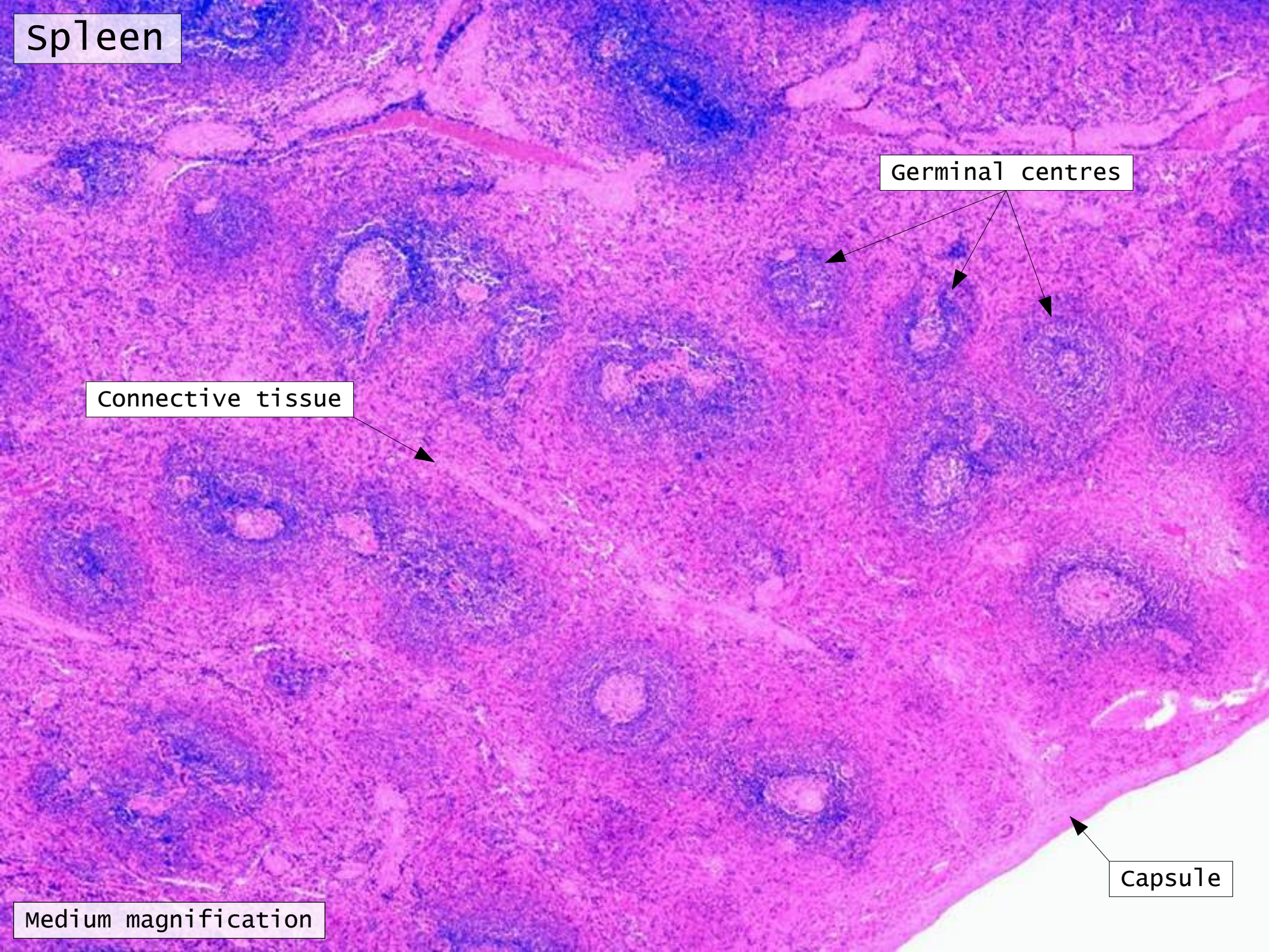
Spleen

Germinal centres

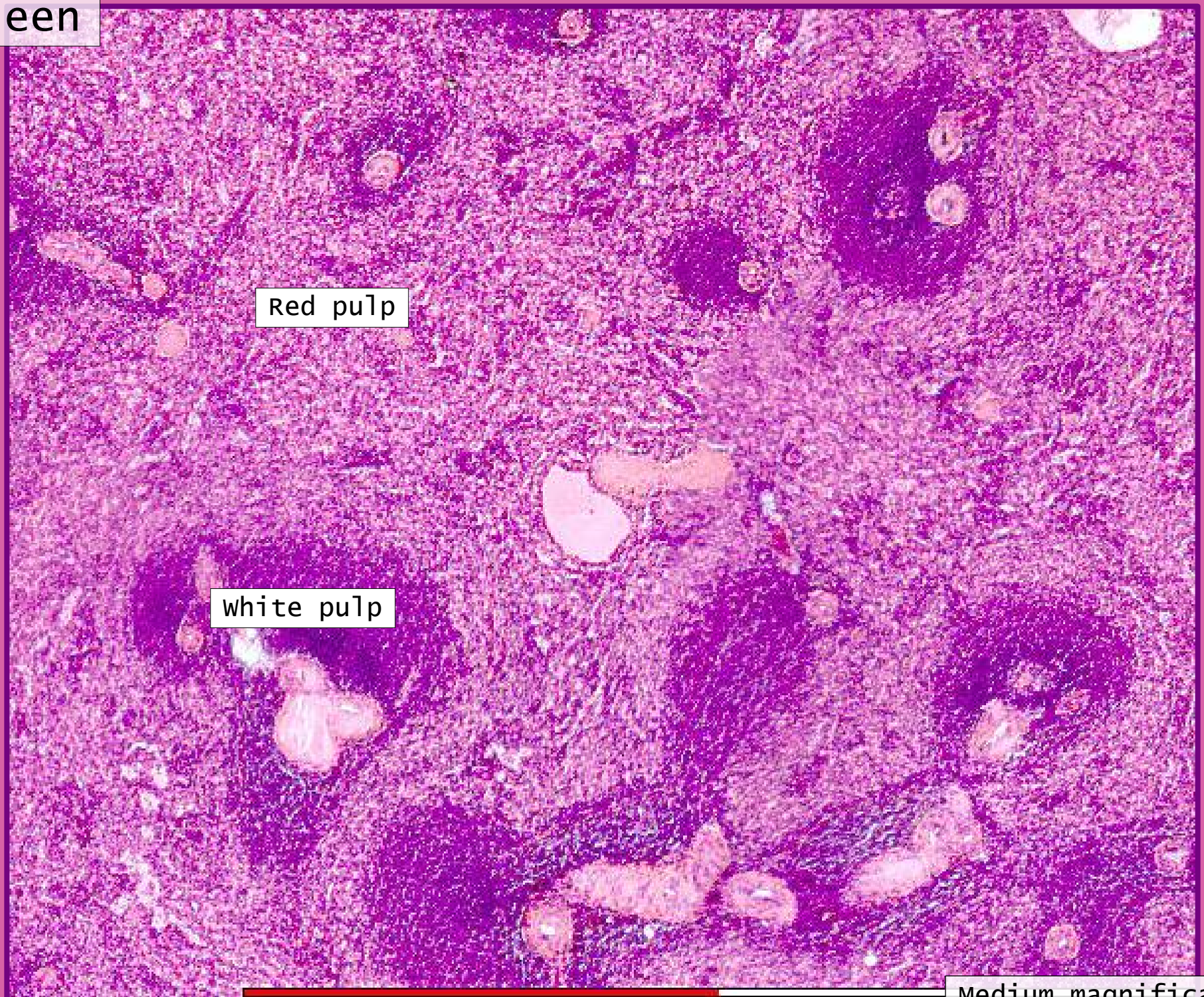
Connective tissue

Capsule

Medium magnification



Spleen



Red pulp

white pulp

Medium magnification

Tonsils

- Palatine tonsils – slide 63
- Lingual tonsils – slide 22
- Pharyngeal tonsils – no slide

Tonsils

- Capsule = Strat Sq Epithelium
- Cortex-Medulla = No
- Germinal Centers = Yes
- Lobulation = Infolding from SSE+CT
- Cells = M, B, T-cells

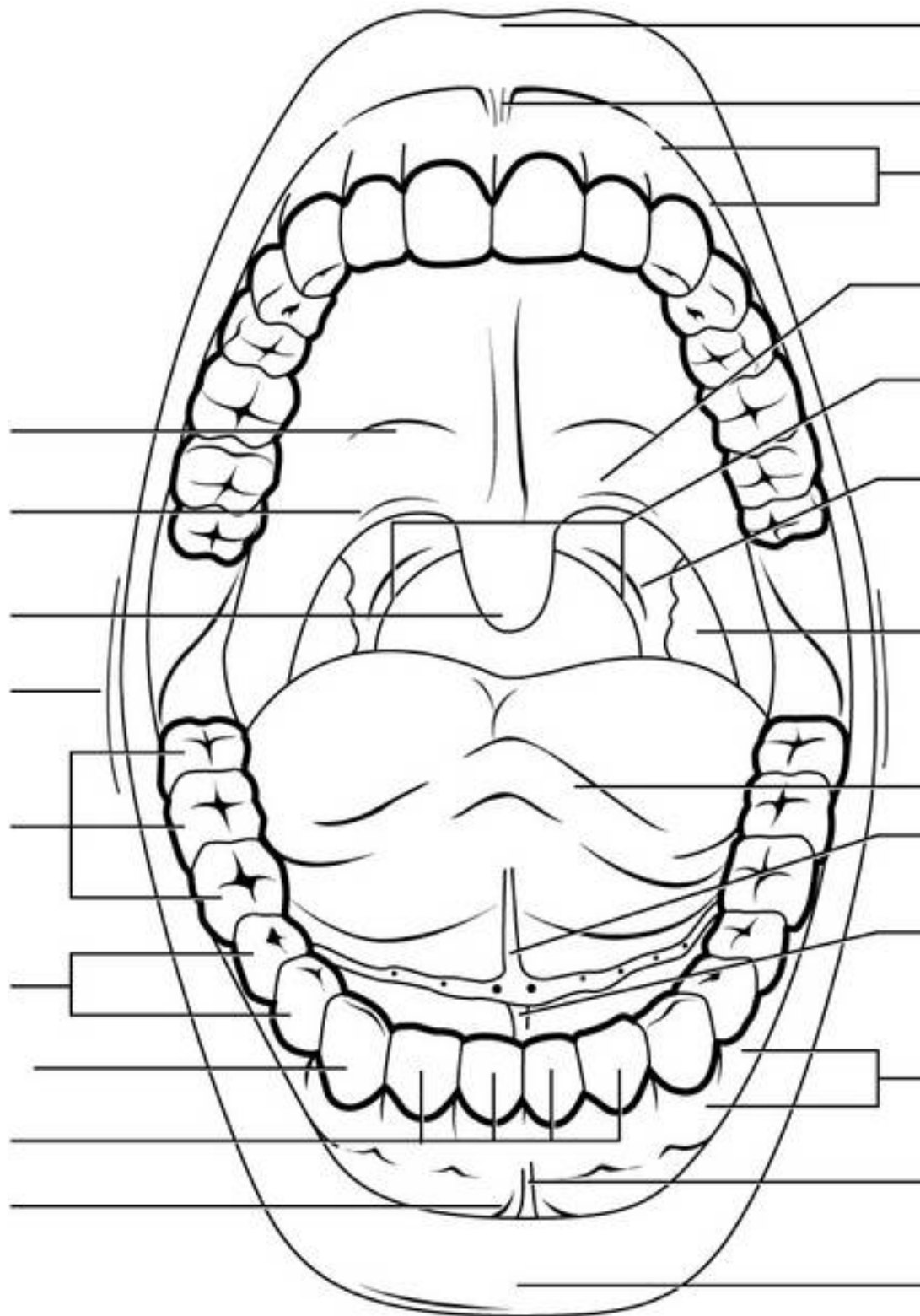
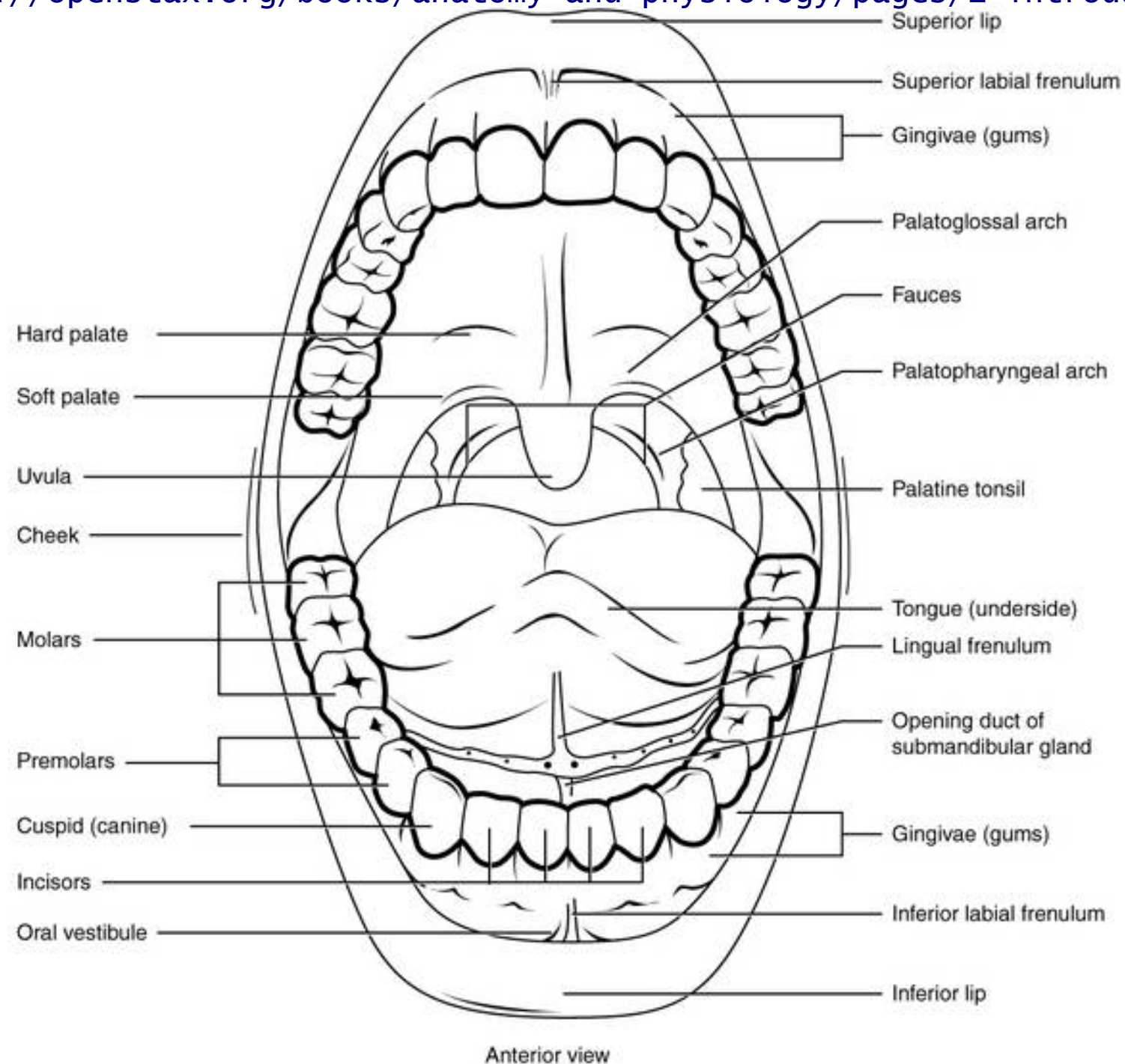


Figure 23.7 Mouth The mouth includes the lips, tongue, palate, gums, and teeth;
Anatomy and Physiology 25 April 2013; OpenStax; Creative Commons Attribution
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<https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>



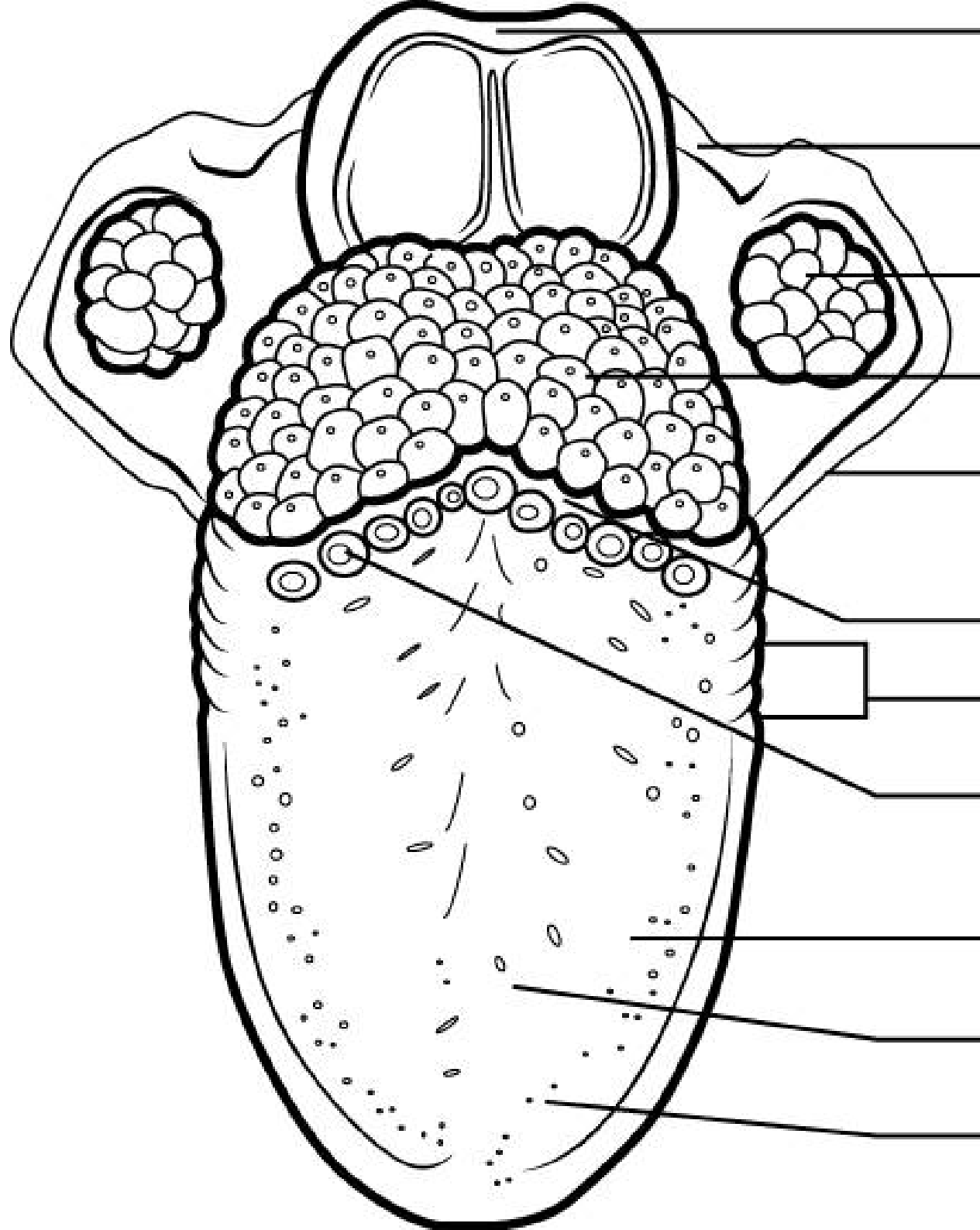
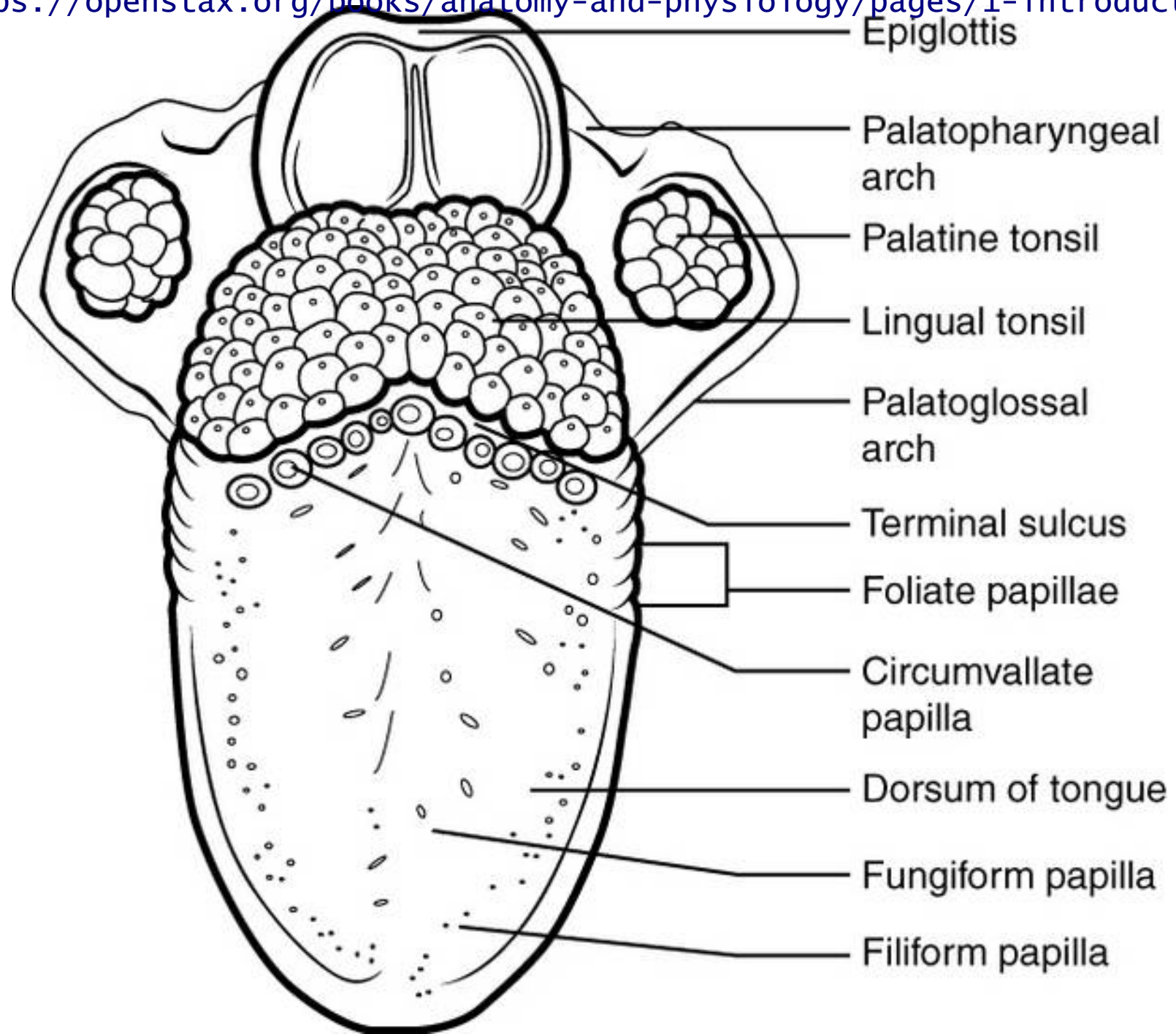
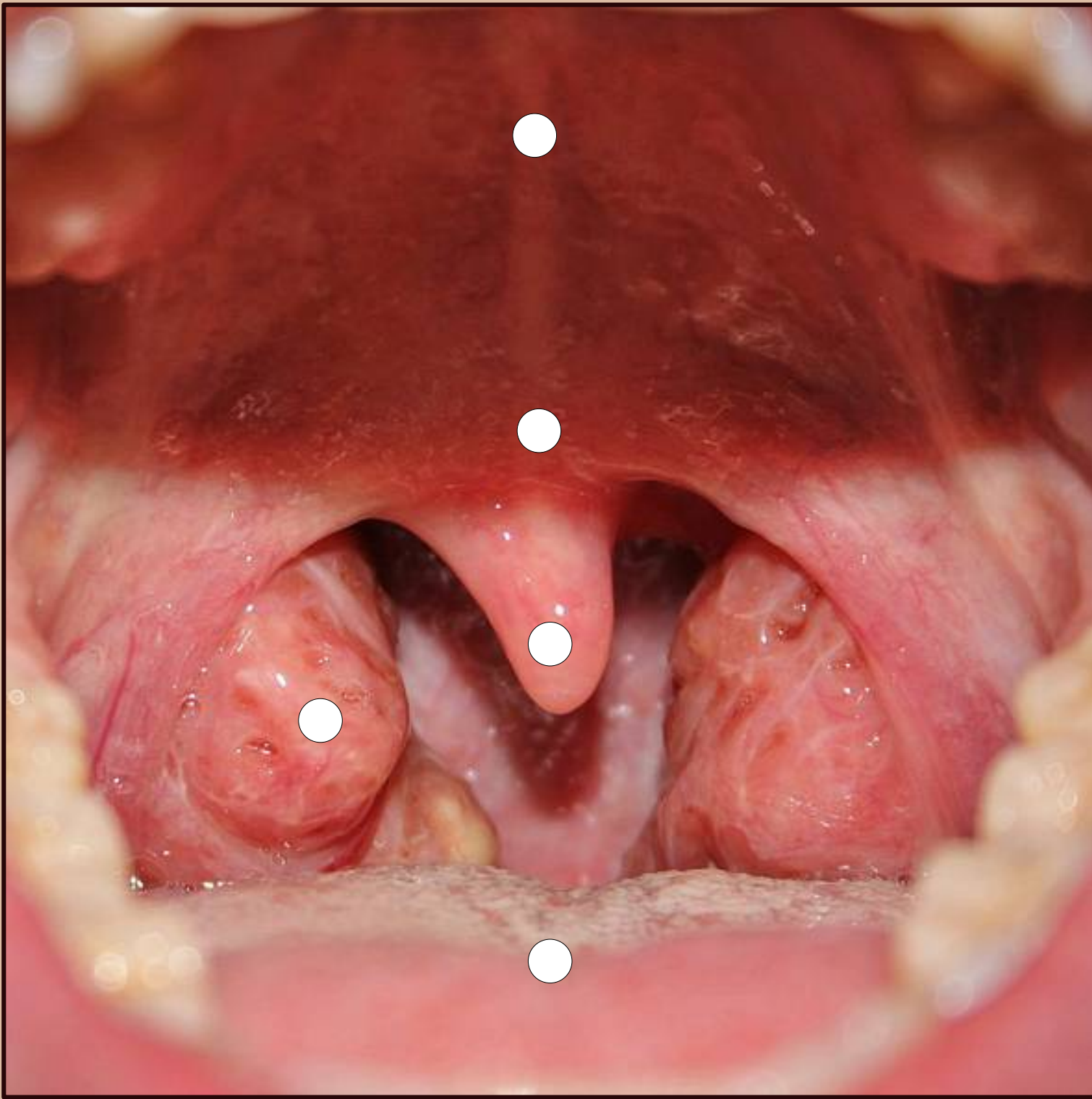


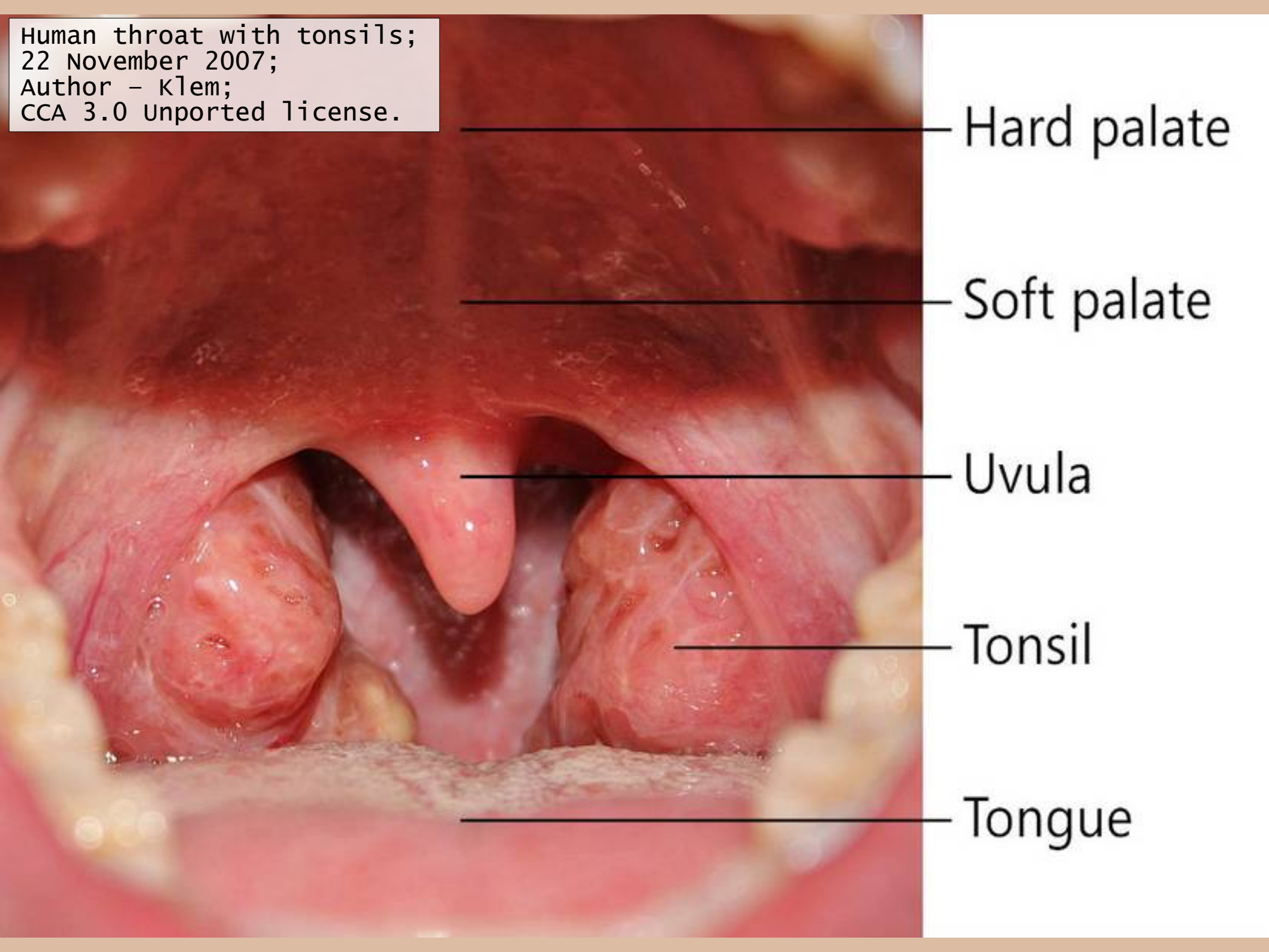
Figure 23.8 Tongue This superior view of the tongue shows the locations and types of lingual papillae; Anatomy and Physiology 25 April 2013; OpenStax; Creative Commons Attribution License 4.0;

<https://openstax.org/books/anatomy-and-physiology/pages/1-introduction>





Human throat with tonsils;
22 November 2007;
Author - Klem;
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Hard palate

Soft palate

Uvula

Tonsil

Tongue

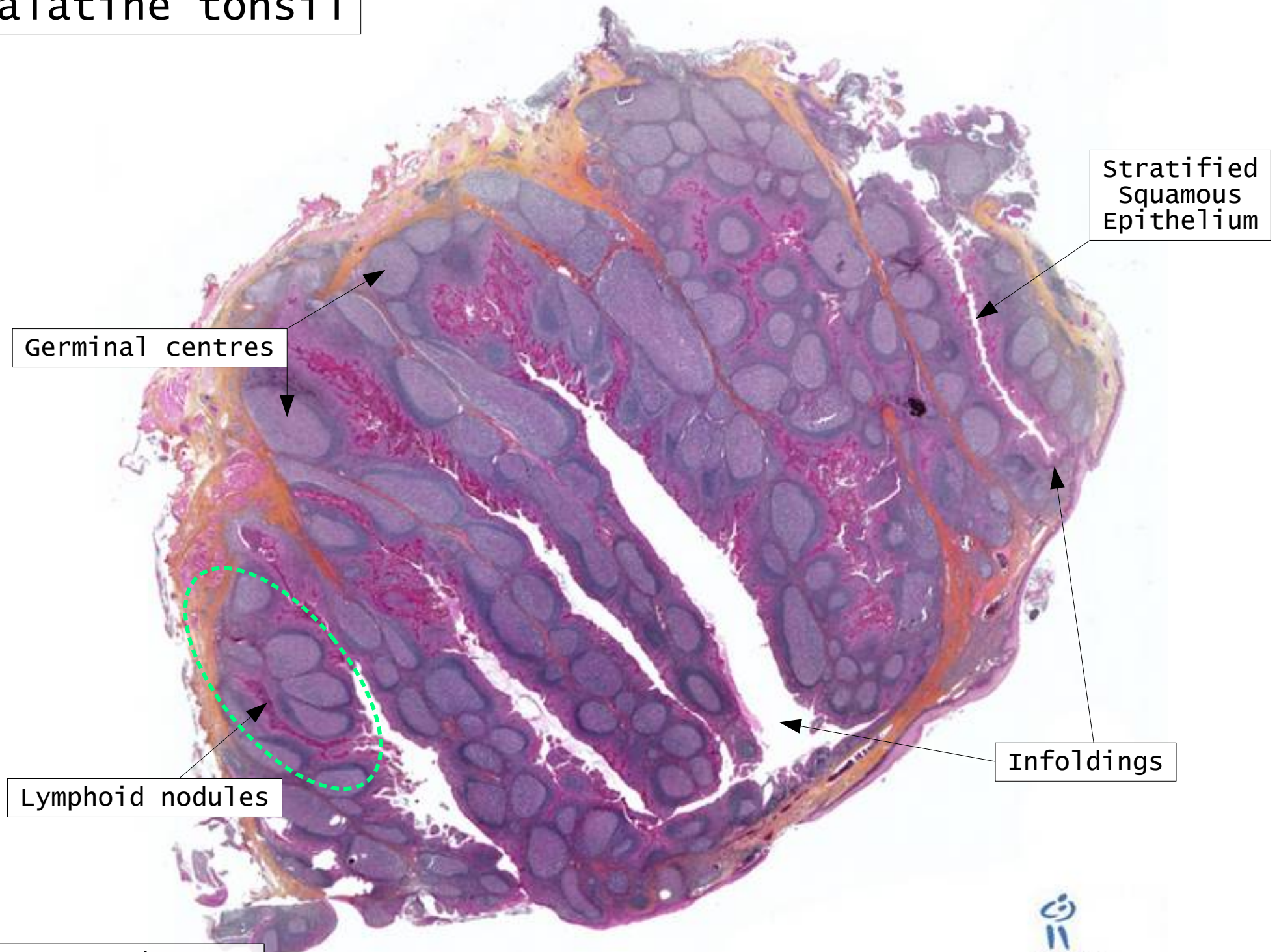
Palatine Tonsils

slide 63

Palatine tonsils

- Lymphatic aggregates
- Located between
 - Palatopharyngeal
 - Palatoglossal arches
- Crypts
 - Deep infoldings of stratified squamous epithelium
 - Contain debris
- Lymphatic nodules with germinal centers
- CT capsule around deep aspect
- Associated mucous glands
 - Does not open in crypts

Palatine tonsil



Lingual tonsil

slide 22

Lingual tonsils

- Located posterior third tongue
- Covered by stratified squamous epithelium
- Epithelium forms deep crypts
- Crypts contain cellular debris
- Mucous glands
 - Open in base of crypts
 - wash out cellular debris

Lingual tonsil



Low magnification

Lingual tonsil

Stratified
Squamous
Epithelium

High magnification



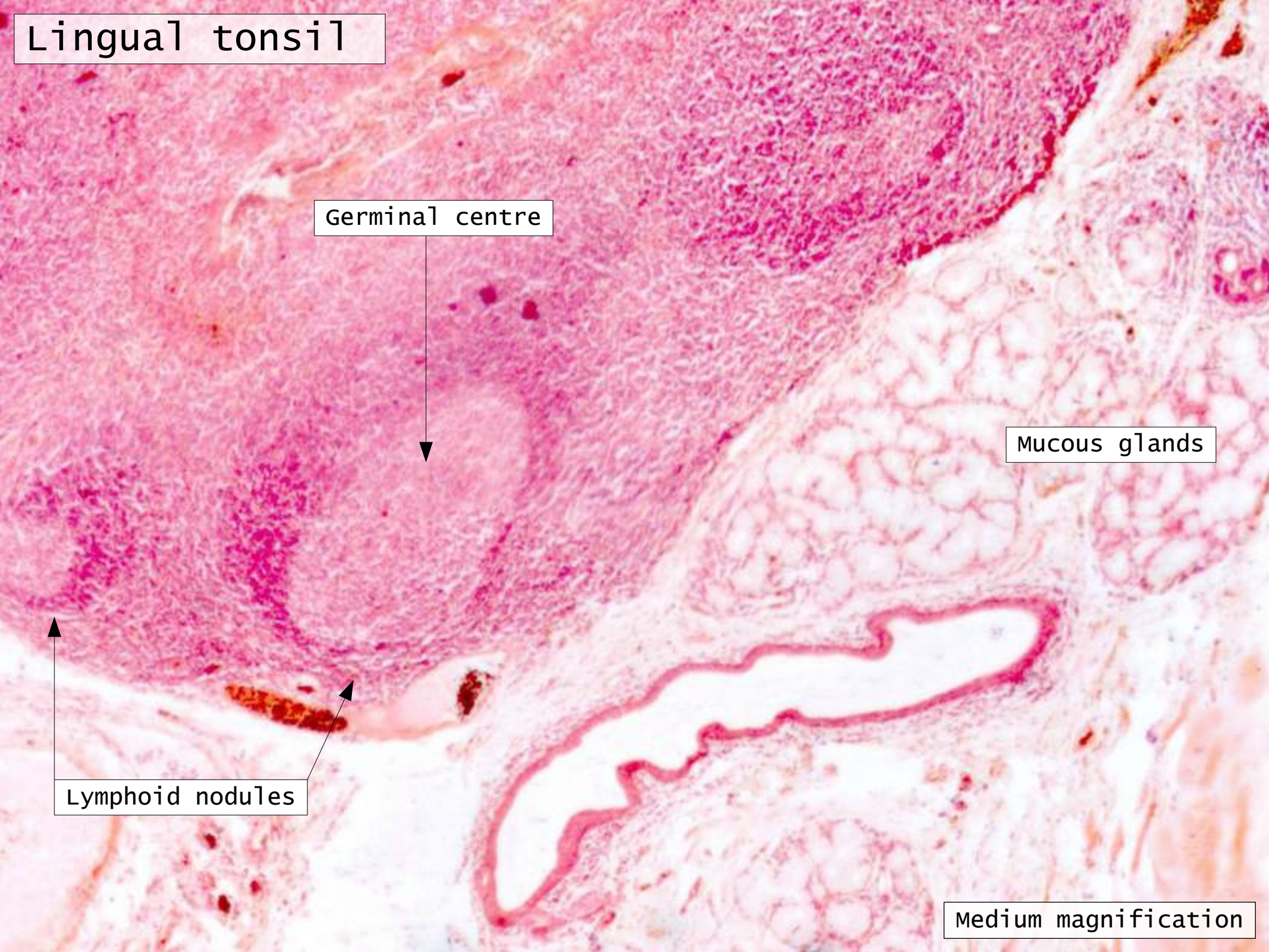
Lingual tonsil

Germinal centre

Mucous glands

Lymphoid nodules

Medium magnification



Small vein



High magnification

Pharyngeal tonsil

No slide

Pharyngeal tonsil

- Located posterior wall nasopharynx
- Covered by pseudostratified ciliated columnar epithelium
- Several folds in epithelium
- Seromucous glands open in folds

Ductus thoracicus

slides 65 & 75

Lymphatic vascular system

- Vessels in CT
- Collects excess tissue fluid (lymph)
- Return lymph to venous system
- Drains most tissues except nervous system & bone marrow

Lymphatic vessels

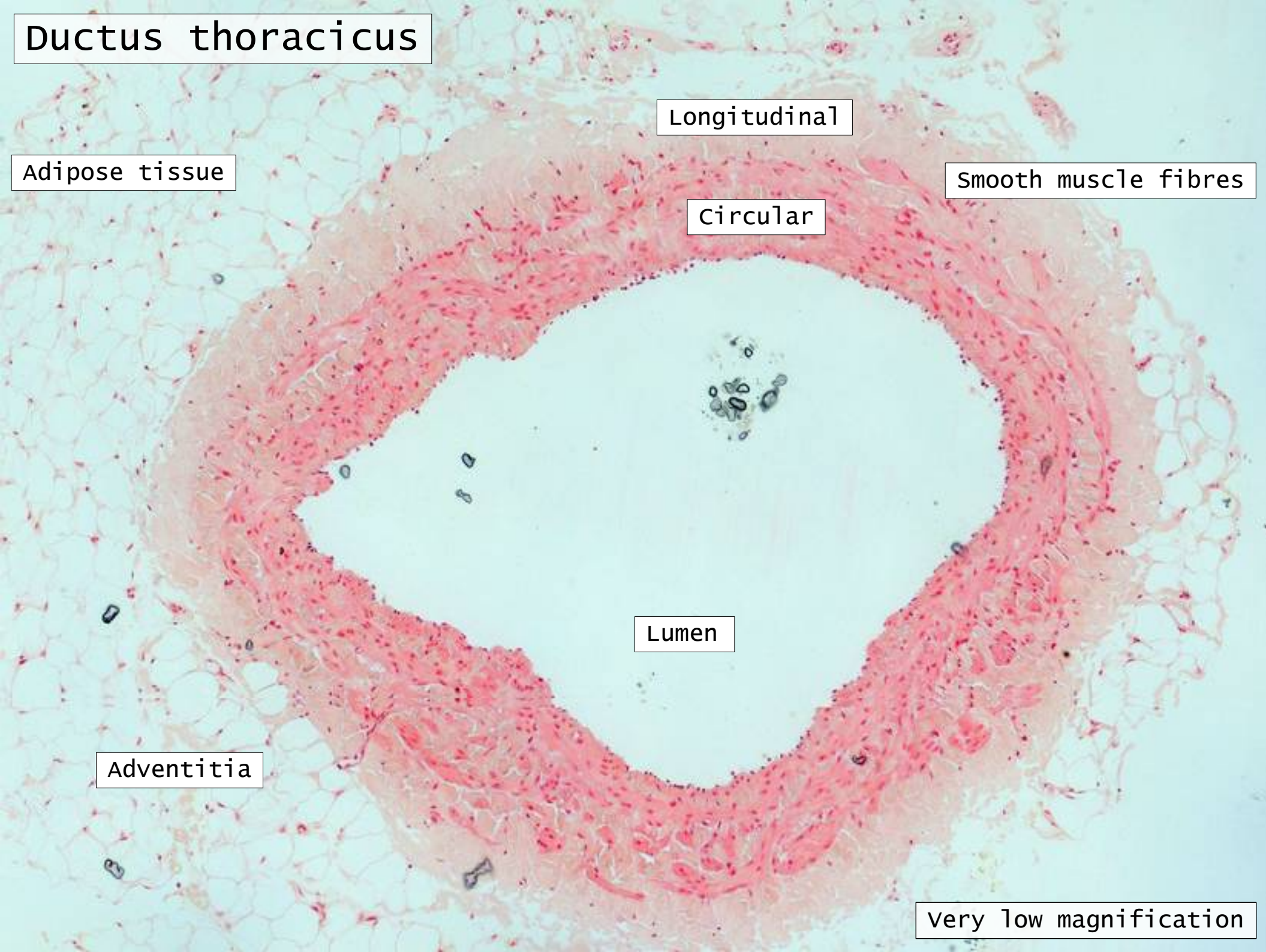
- Lymphatic capillaries
 - Thin walled vessels starts as blind-ended channels
 - Single layer endothelial cells
 - Sparse basal lamina
- Large lymphatic vessels
 - Similar to venules but larger lumen
 - Flow controlled by valves
 - Route through lymph nodes
- Lymphatic ducts
 - Morphology similar to veins
 - Longitudinal + Circular layer smooth muscle cells
 - Poorly defined adventitia with vasa vasorum & nerves

Ductus thoracicus



very low magnification

Ductus thoracicus



Longitudinal

Adipose tissue

Smooth muscle fibres

Circular

Lumen

Adventitia

very low magnification

Ductus thoracicus

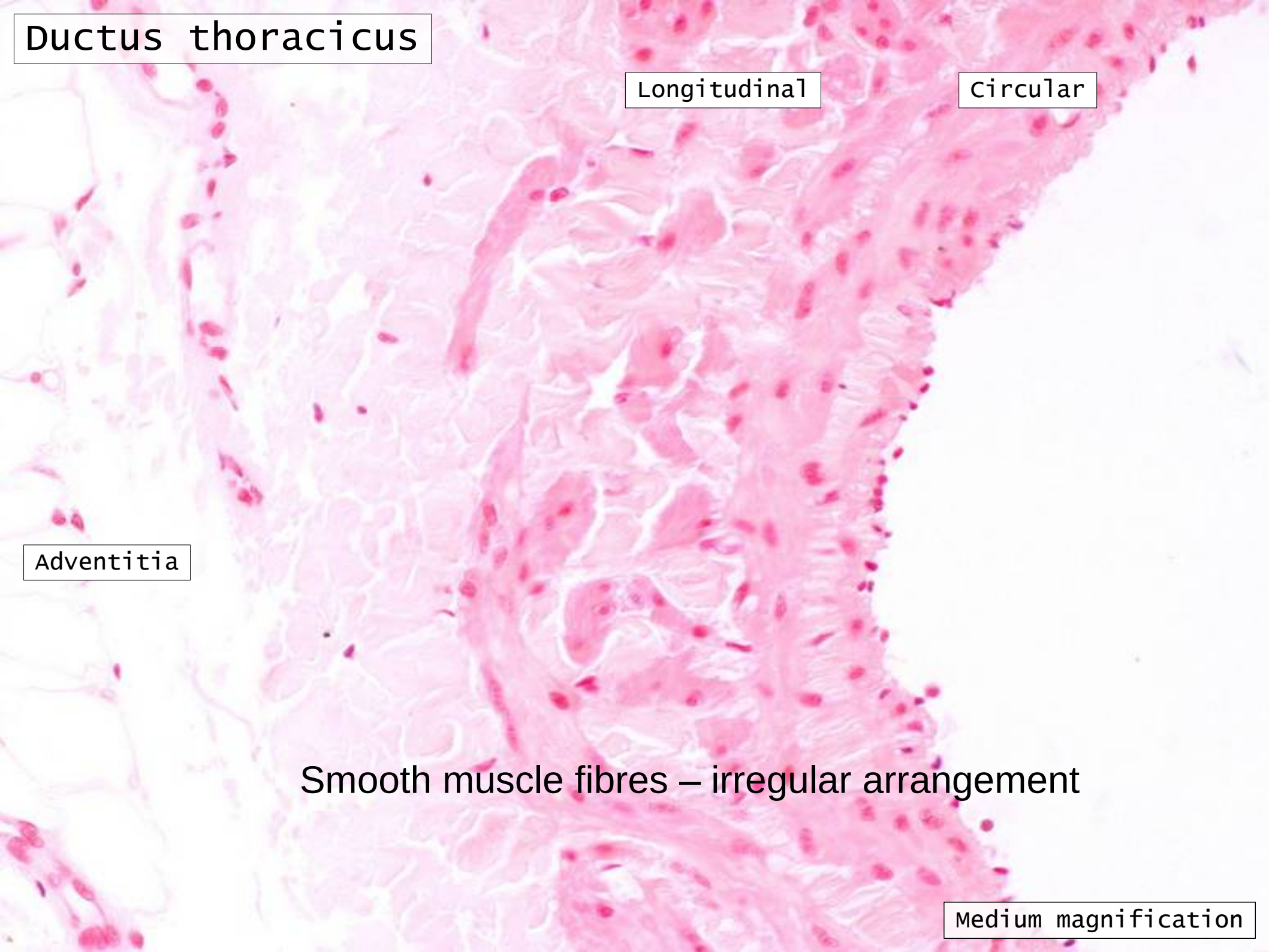
Longitudinal

Circular

Adventitia

Smooth muscle fibres – irregular arrangement

Medium magnification



Ductus thoracicus

Elastic fibres

Medium magnification

