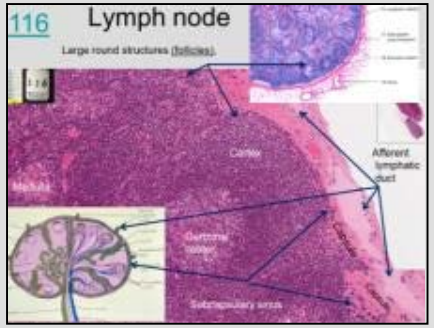
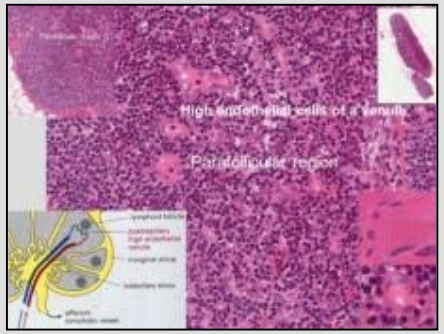
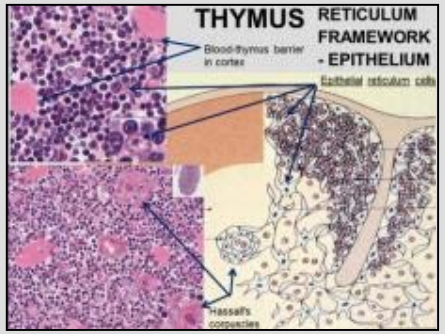
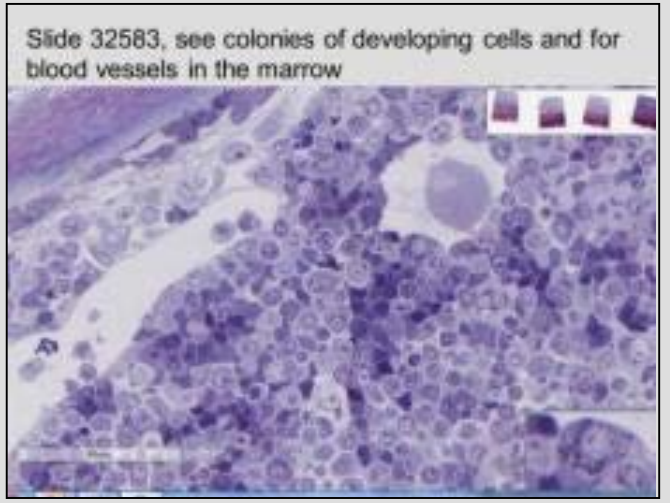
Medical School Histology Basics
Lymphoid System

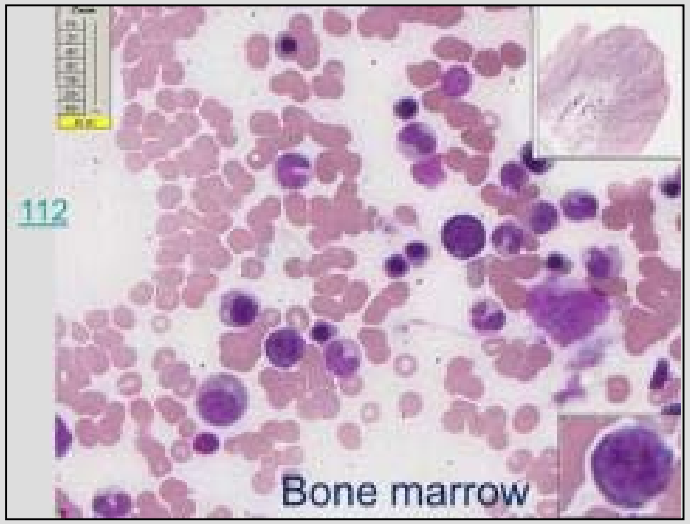
VIBS 243 lab

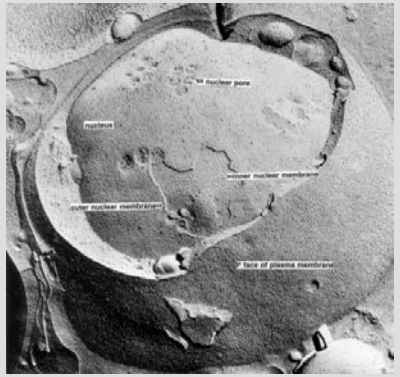


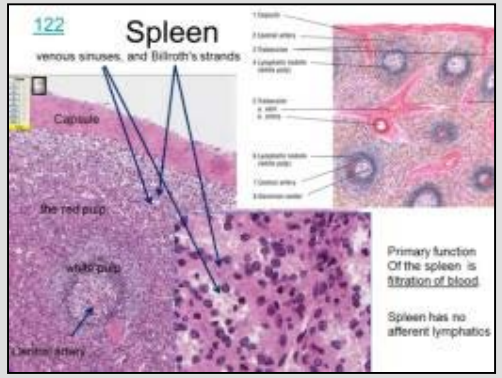










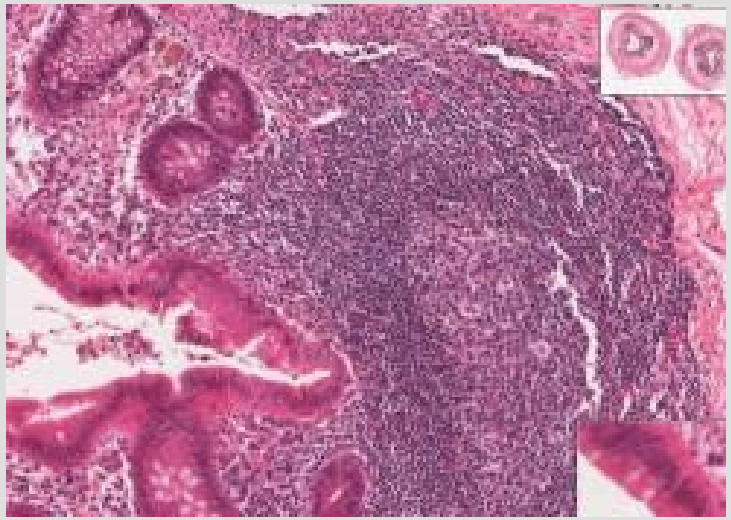


Larry Johnson Texas A&M University

EXAMPLES OF IMMUNE RESPONSE

- **REACTION AGAINST MICROORGANISMS: BACTERIA, VIRUSES, PARASITES**
- **REACTION AGAINST TUMOR CELLS**
- **ALLERGIC REACTIONS: HAY FEVER, POISON IVY**
- **AUTOIMMUNE REACTION: ARTHRITIS, TYPE I DIABETES**
- **GRAFT REJECTION**

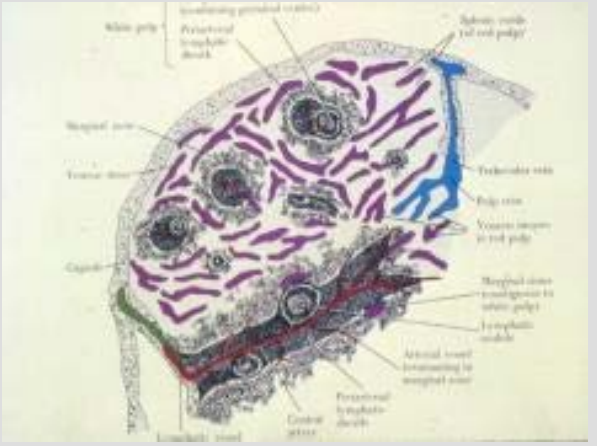
Appendix 32412



http://www.greenlifestyle.be

OBJECTIVES

Ref code
1

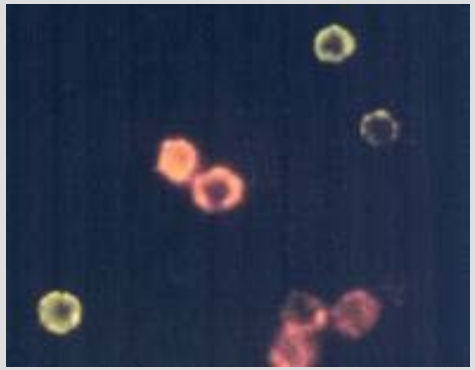


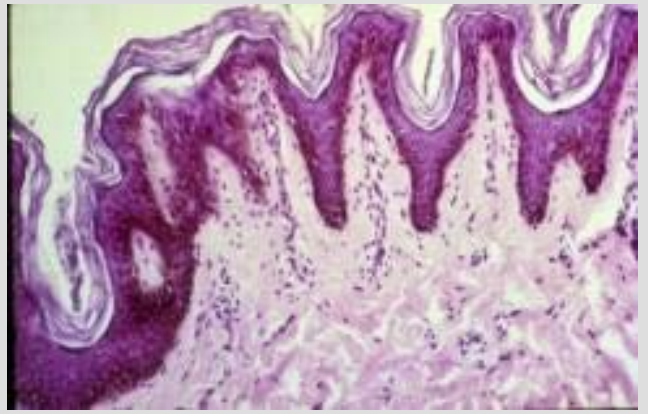
CELLULAR BASIS OF IMMUNITY

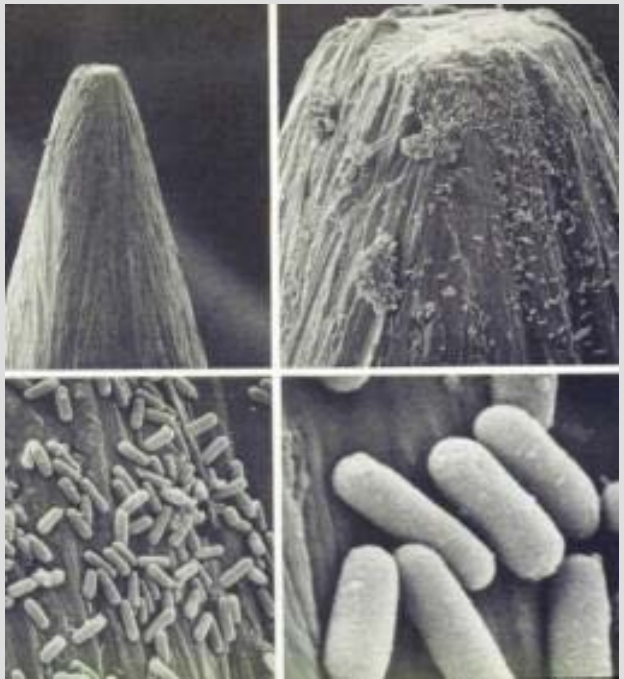
EFFECTORS OF RESPONSE

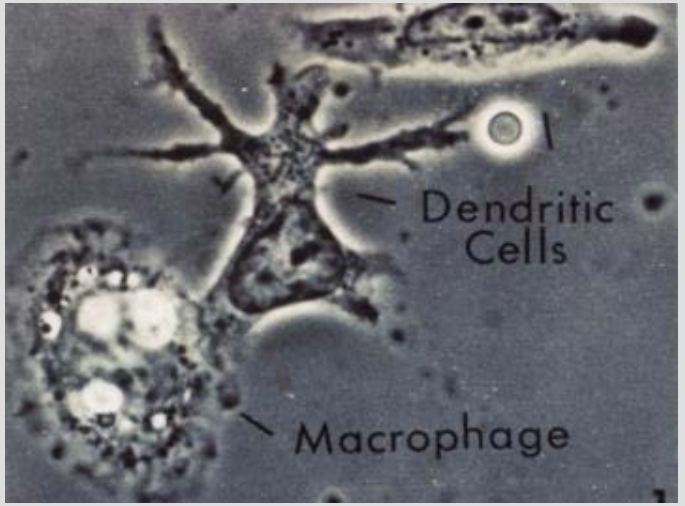
INDUCTION OF THE RESPONSE

ONTOGENY



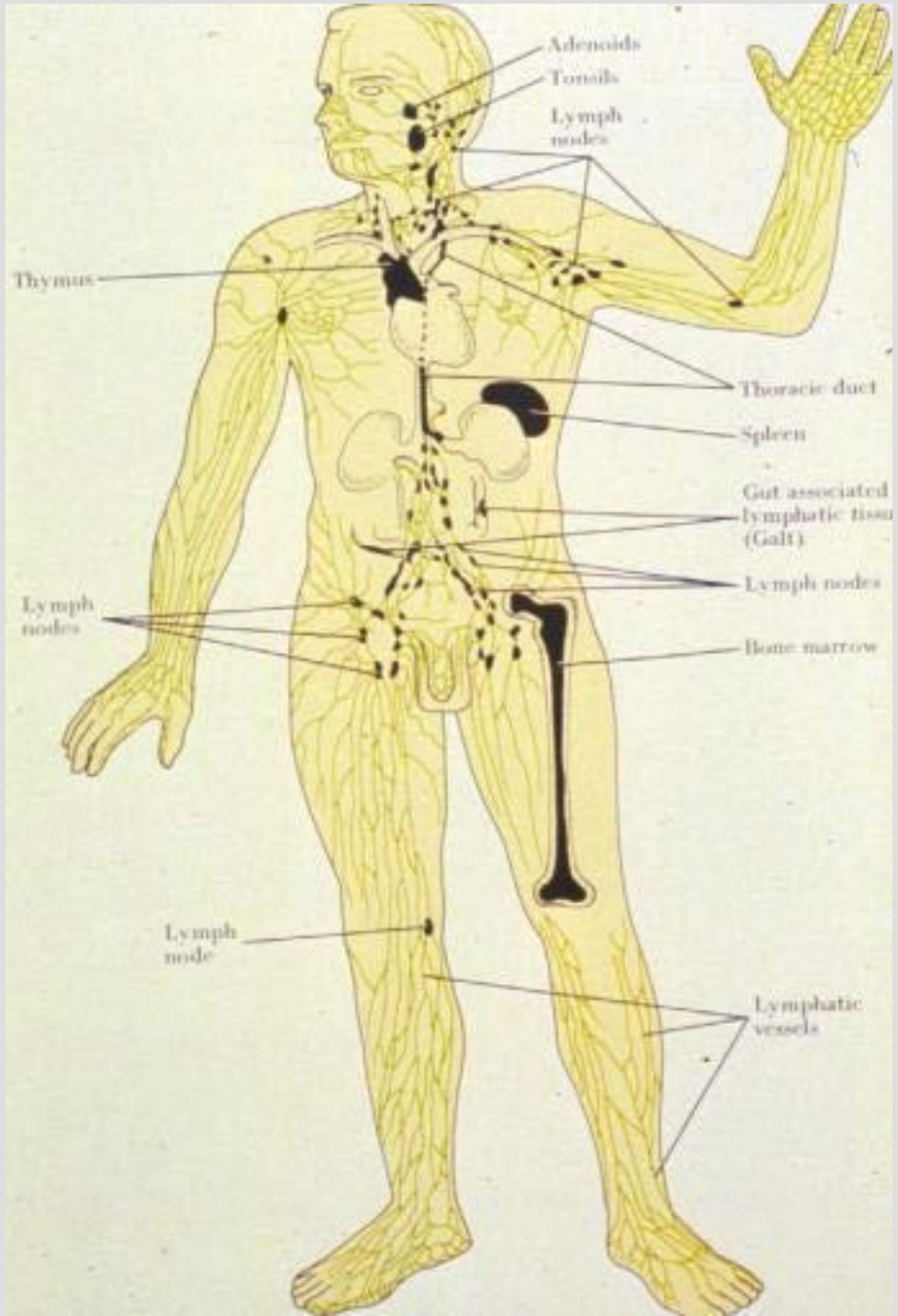






FUNCTIONS OF THE IMMUNE SYSTEM

- **PROTECTION AGAINST FOREIGN INVADERS INTO BODY**
- **PRODUCE / PROTECT GERM FREE ENVIRONMENT OF THE BODY**



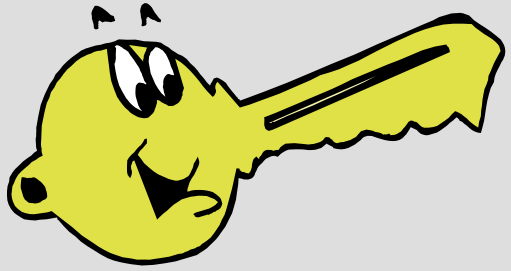
Three Key Steps of Combating Infections

Break the cycle of transmission

Kill the infectious agent

Increase host resistance

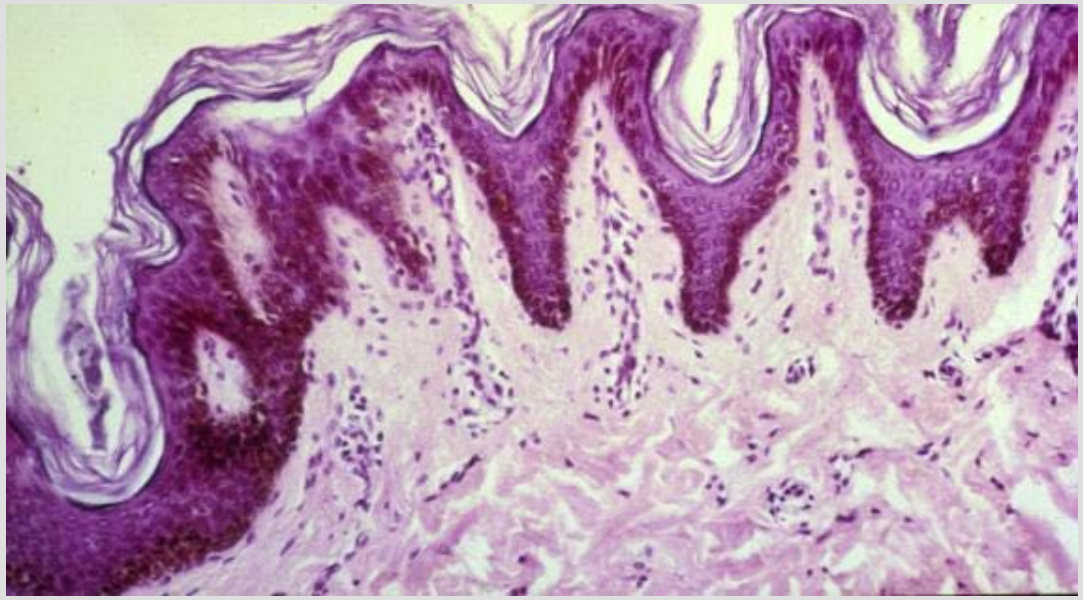
e.g., increase immunity of host

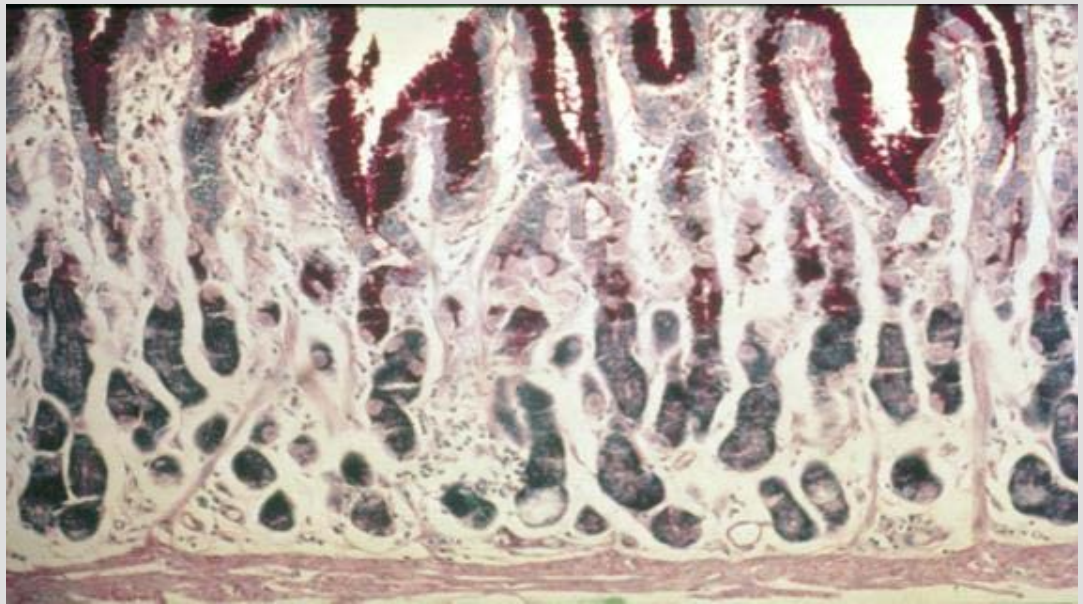


Lines of Defense

First Line: Physical Barrier

- **Skin: Stratum Cornium**
- **HCl In Stomach**
- **Mucus In Intestines**



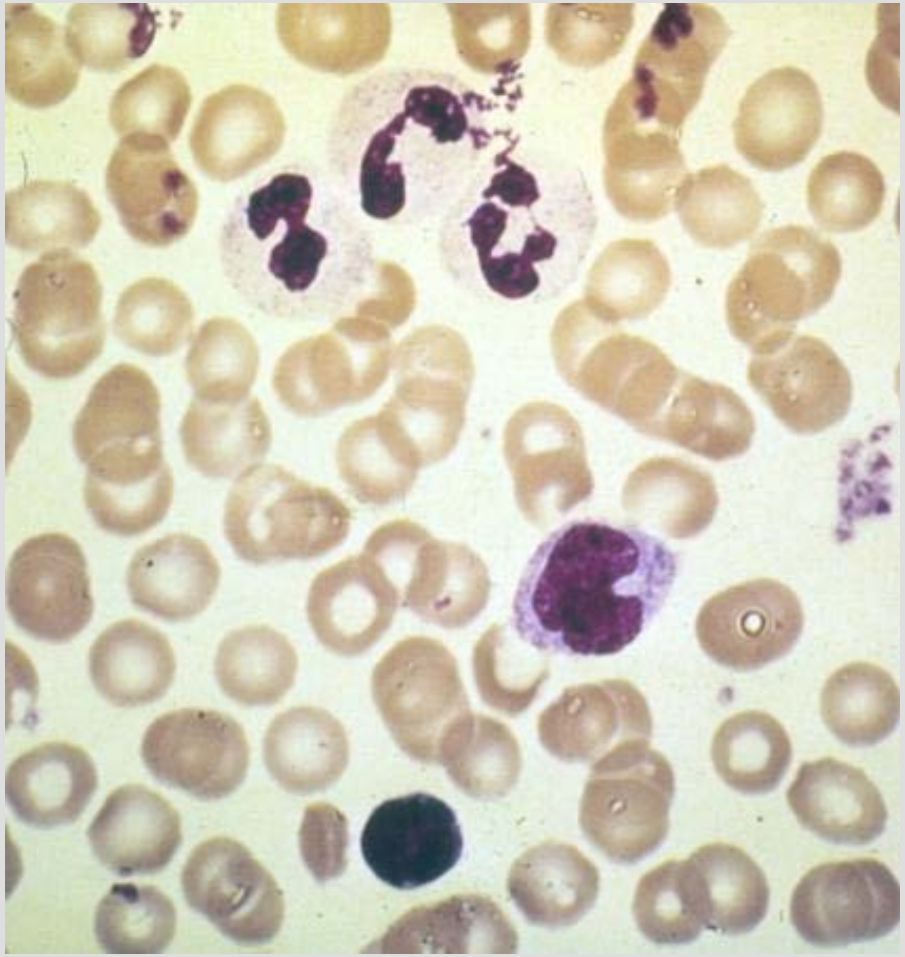


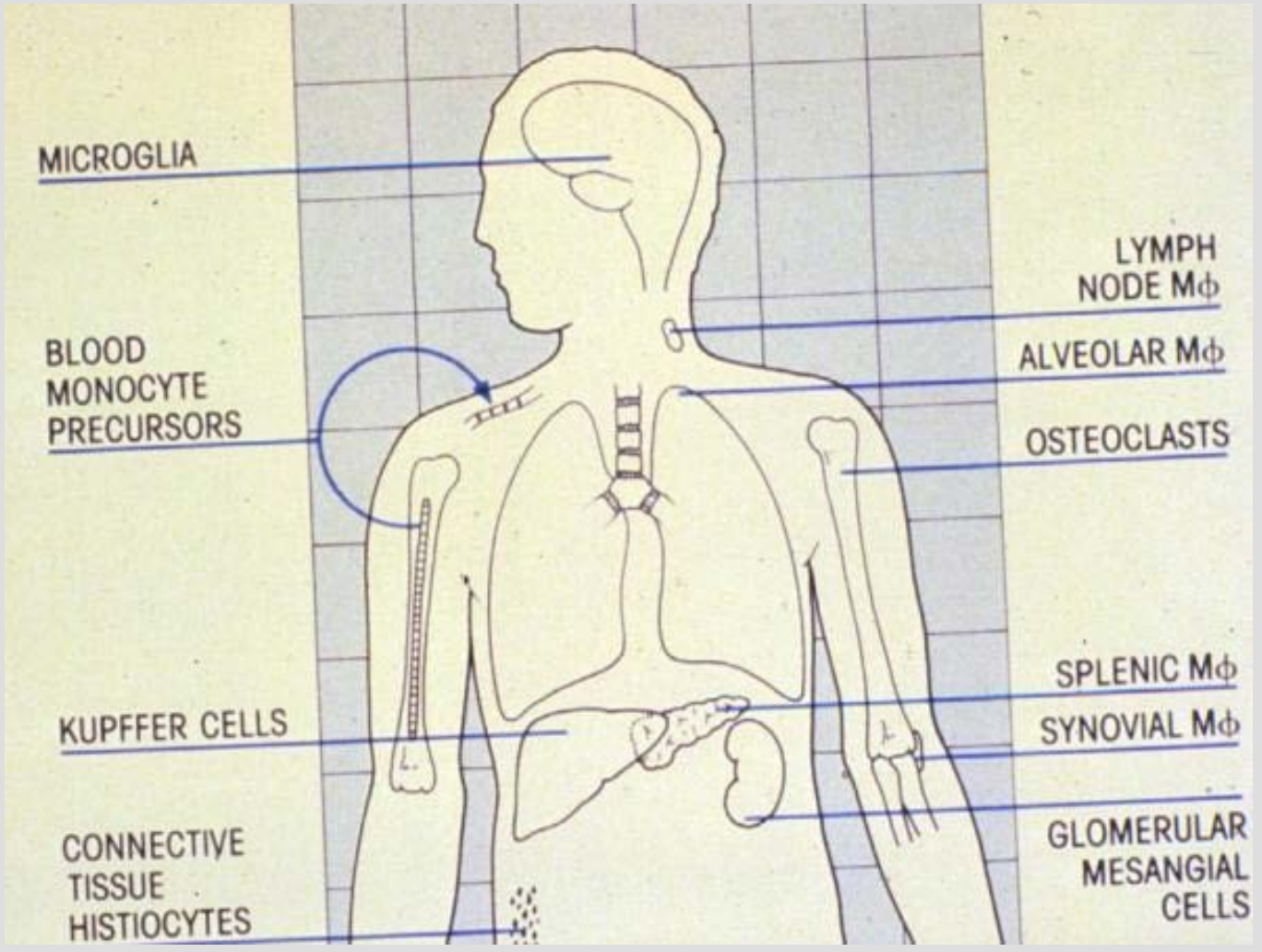
Break the cycle of transmission

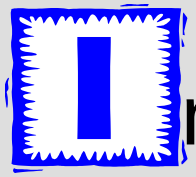
Lines of Defense

- **Second line: Phagocytes** at work
- **Neutrophils to** K **ill the infectious agent**

  Monocytes - macrophage







Increase host resistance

Characteristics of Immunity

Acquired - requires exposure to antigens

Specificity - response is unique to exposure

Memory - remembers previous exposure

Characteristics of Immunity

Acquired -

Must be developed

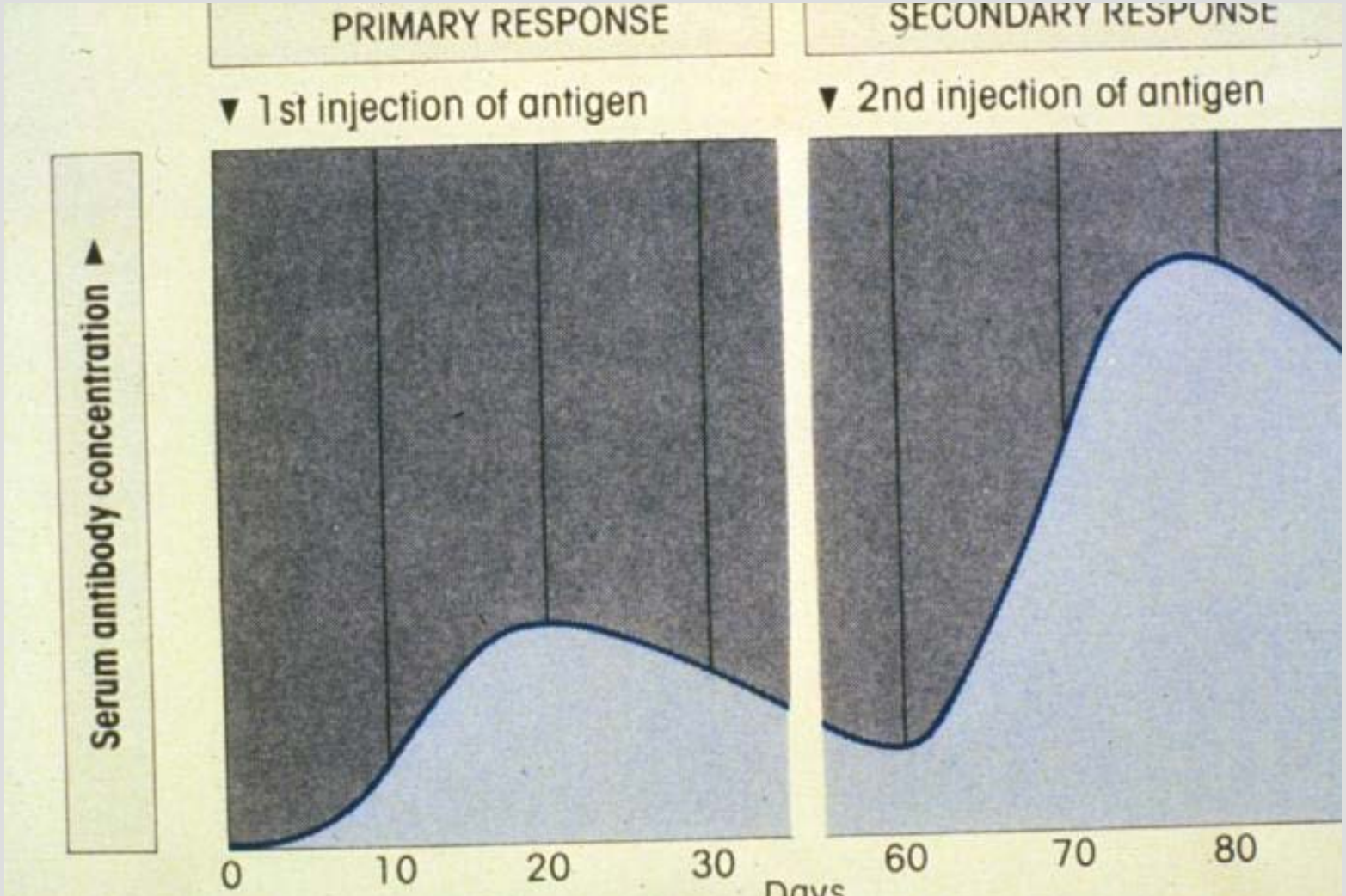
Specificity -

Antibodies made are specific to specific molecules on the antigen of exposure

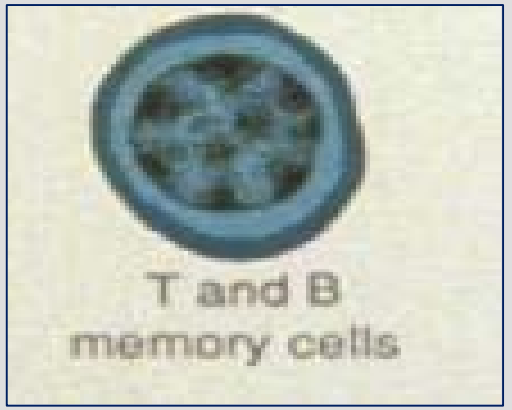
Characteristics of Immunity

Memory: quick second response

- **Long lived cells**

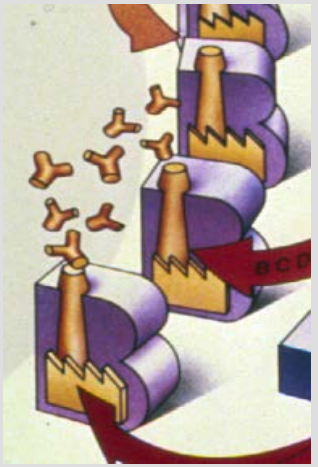


Memory of lymphocytes is the basis of immunization by vaccination. Your lymphocytes remember the antigen used in your vaccination and mounts a quick and enhanced response when the same antigen is presented again.

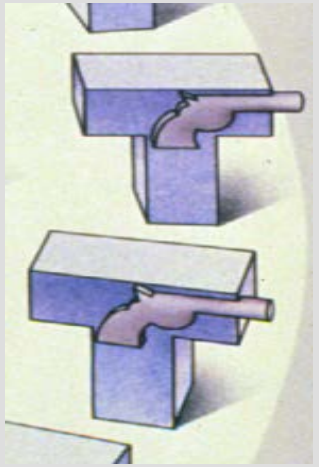


Types of Immune Response

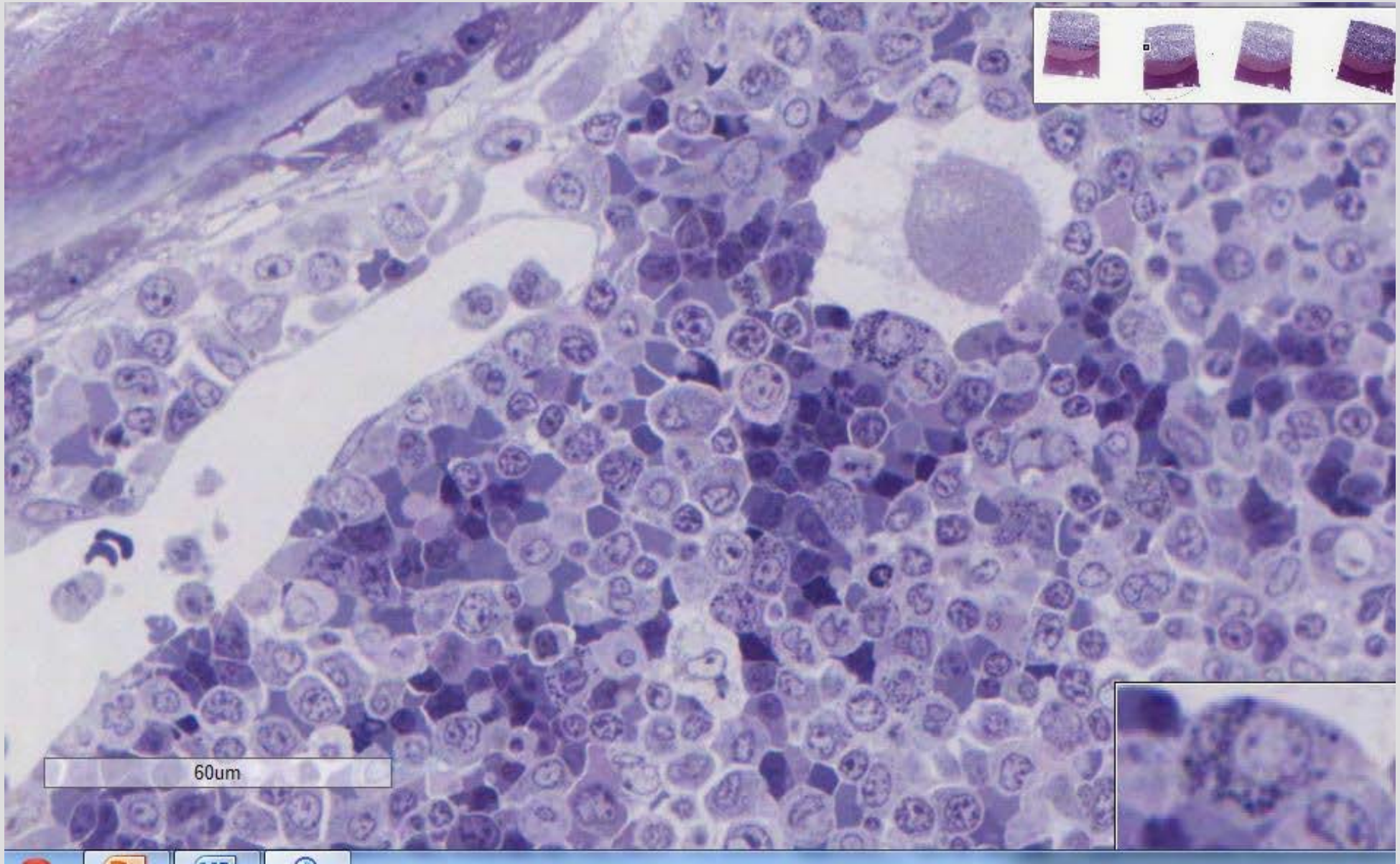
- **Antibody: mediated**
  - **Glycoproteins recognize and bind to antigens**

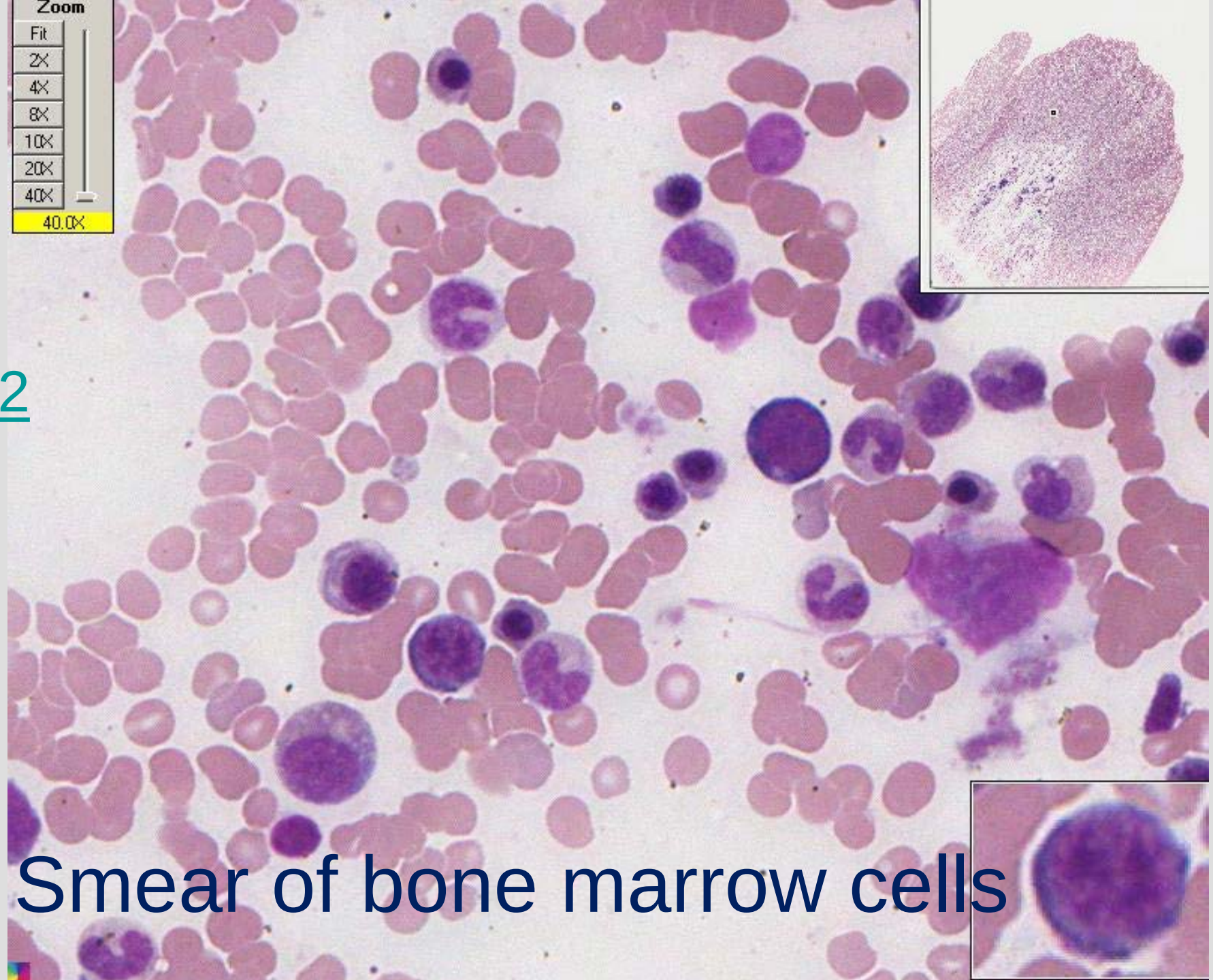


- **Cell: mediated**
  - **Specifically active cells recognize cell - bind antigens**



Slide 32583, see colonies of developing cells and for blood vessels in the bone marrow

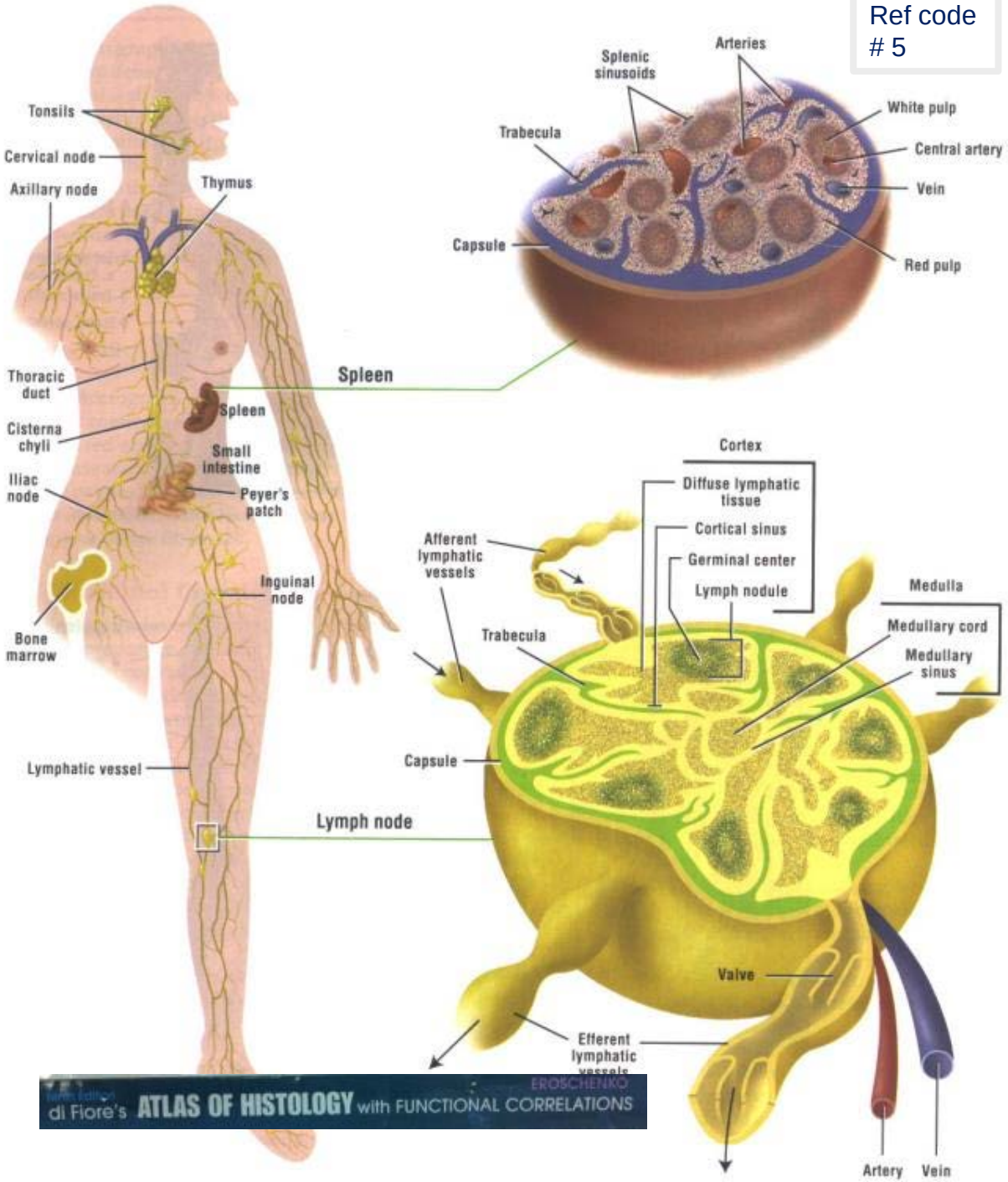


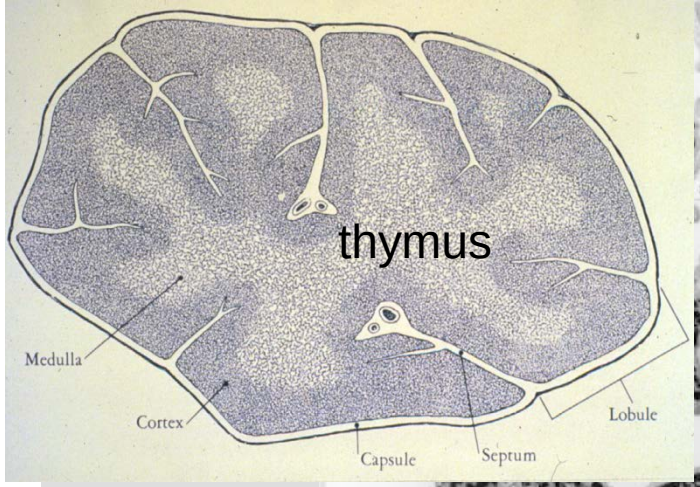


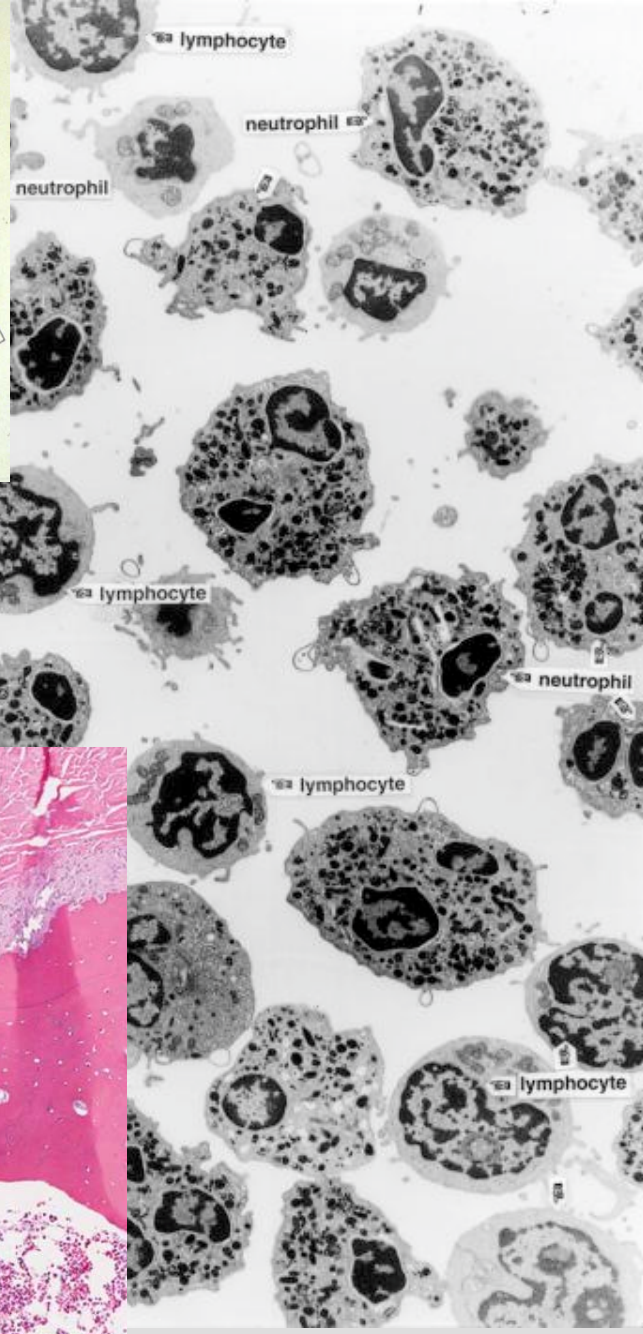
112

Smear of bone marrow cells

Ref code
5


Tonsils
Cervical node
Axillary node
Thymus
Thoracic duct
Spleen
Cisterna chyli
Small intestine
Iliac node
Peyer's patch
Inguinal node
Bone marrow
Lymphatic vessel
Lymph node
Splenic sinusoids
Arteries
White pulp
Trabecula
Central artery
Vein
Capsule
Red pulp
Spleen
Cortex
Diffuse lymphatic tissue
Cortical sinus
Germinal center
Lymph nodule
Afferent lymphatic vessels
Medulla
Medullary cord
Medullary sinus
Trabecula
Capsule
Valve
Efferent lymphatic vessels
Artery
Vein
di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS
EROSCHENKO


thymus
Medulla
Cortex
Capsule
Septum
Lobule


lymphocyte
neutrophil
neutrophil
lymphocyte
neutrophil
lymphocyte
lymphocyte


4 20
Bone marrow

Thymus

Ref code # 5

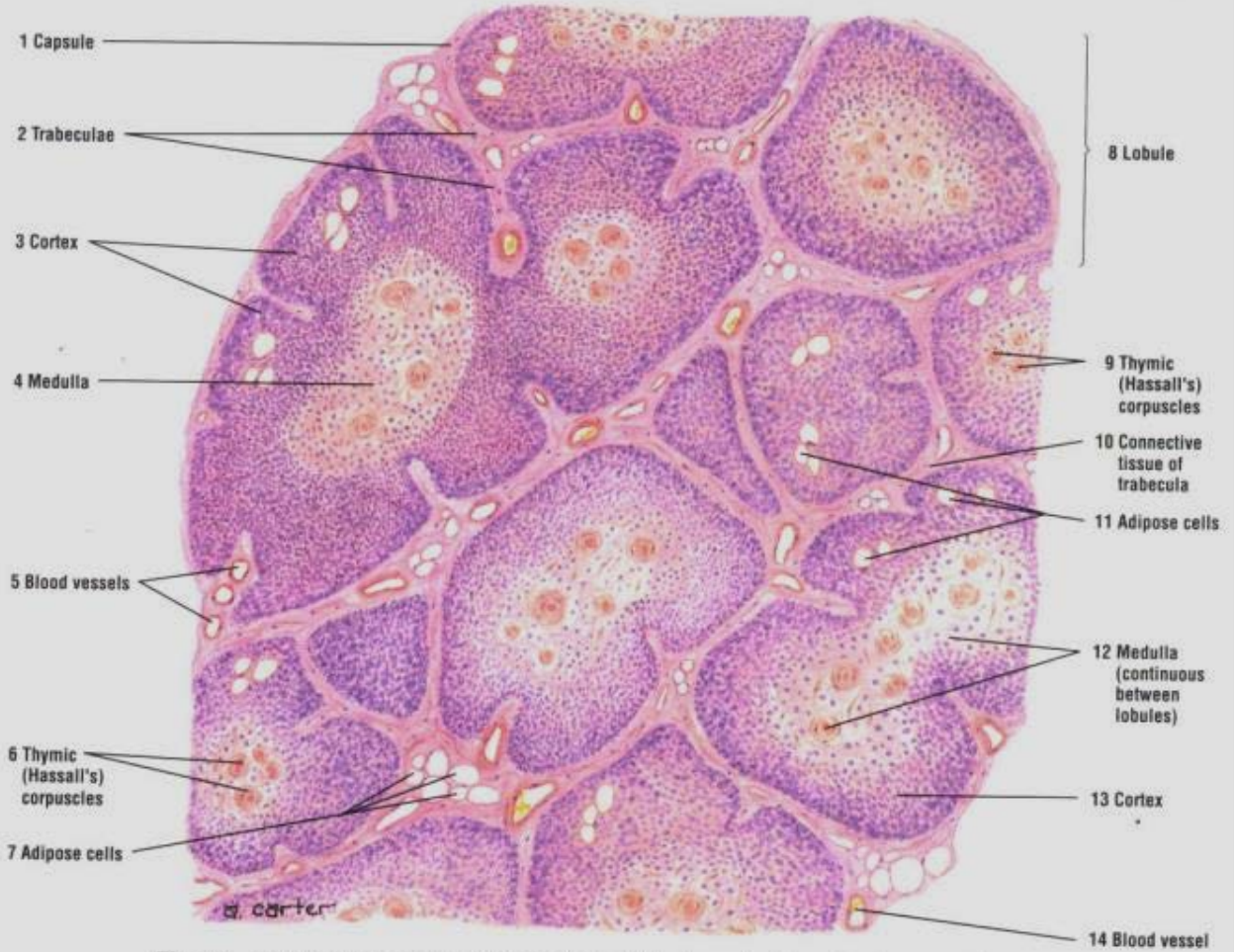


Fig. 8-6 Thymus Gland (panoramic view). Stain: hematoxylin-eosin. Low magnification.

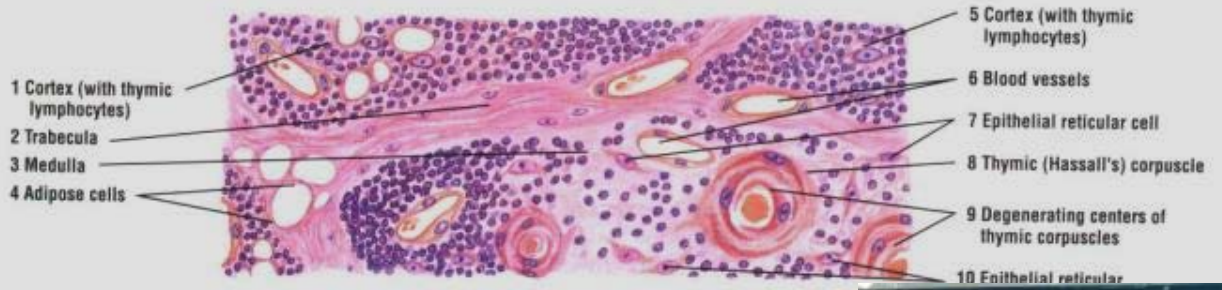
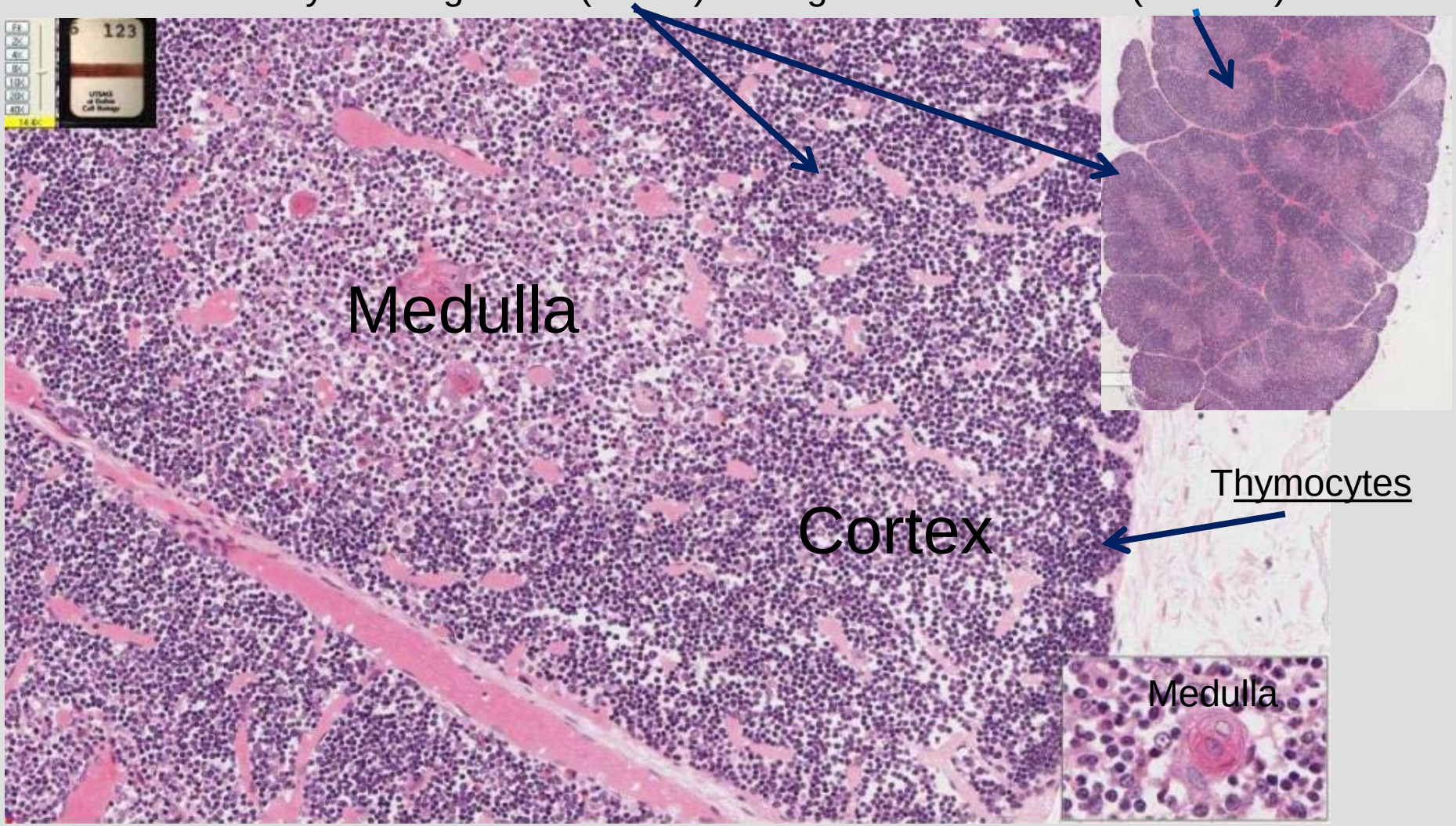


Fig. 8-7 Thymus Gland (sectional view). Stain: hematoxylin-eosin.

di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS

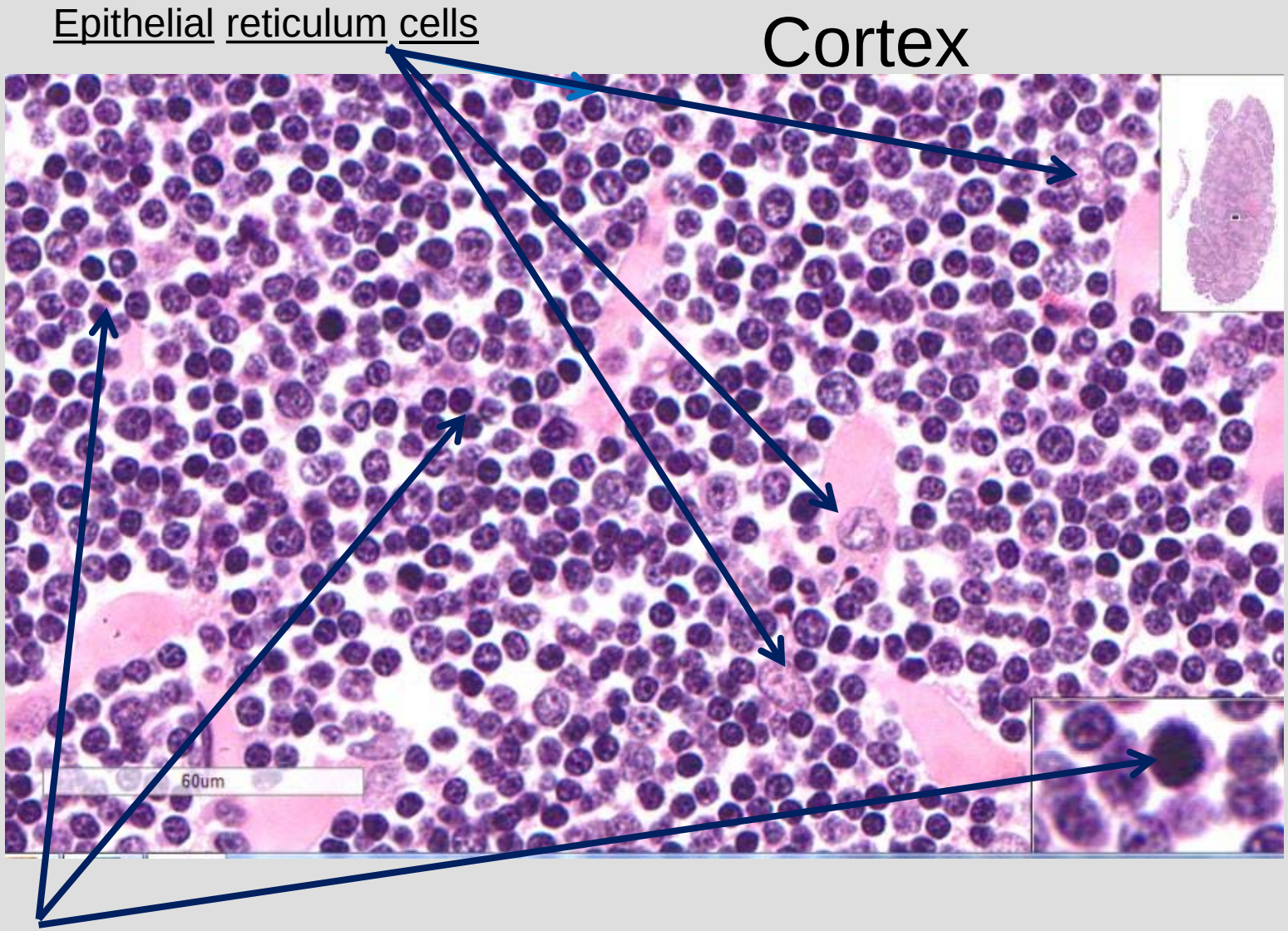
123 Thymus, newborn

Outer darkly staining areas (cortex) and lighter central areas (medulla).



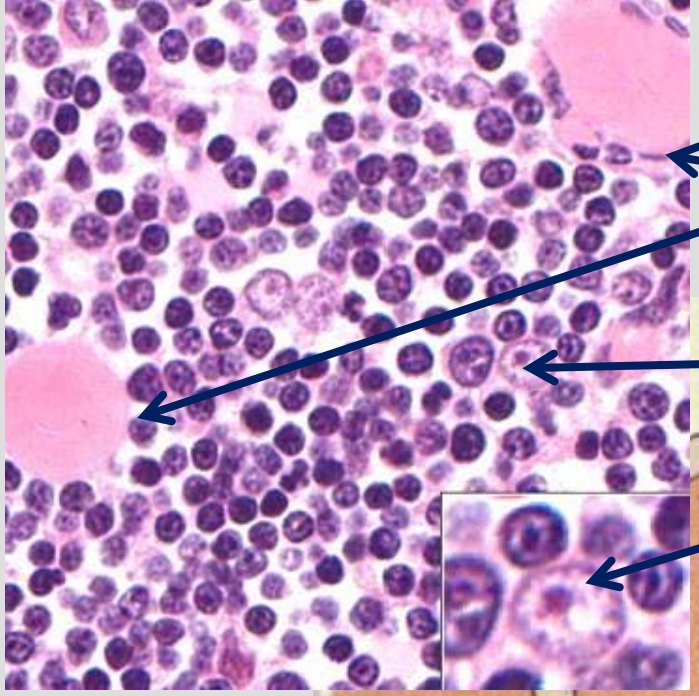
Continuous capillaries, sheathed by epithelial reticular cells around each, characterizes blood vessels in the thymus cortex and is responsible for the blood thymus barrier. Also there are no afferent lymphatics in the thymus.

123 Thymus, newborn



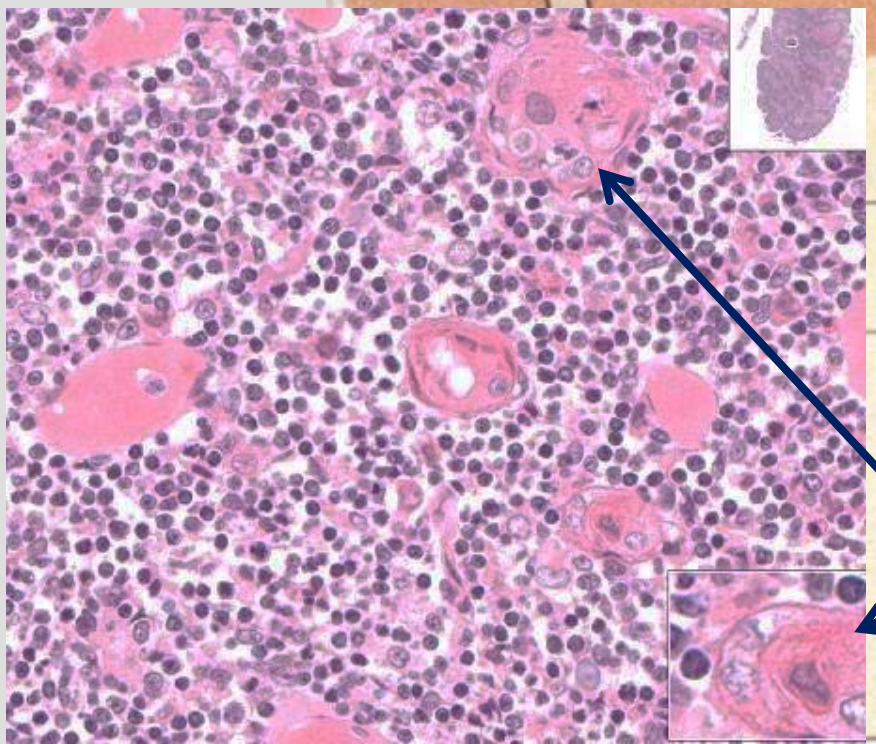
Mitotic figures frequently, which reflect the high proliferative rate of these cells.

THYMUS

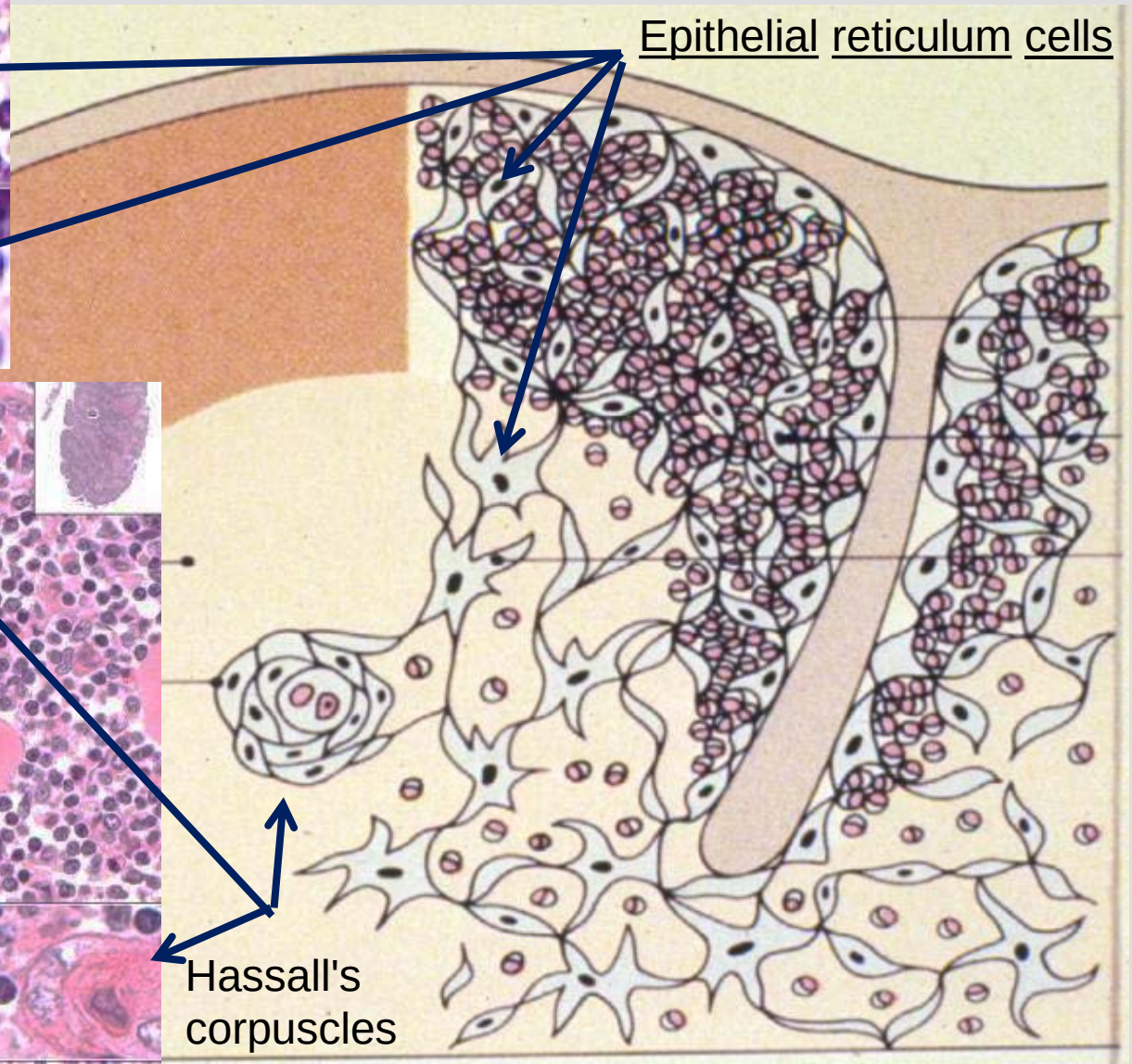


Blood-thymus barrier
in cortex

RETICULUM FRAMEWORK - EPITHELIUM



Hassall's
corpuscles



Epithelial reticulum cells

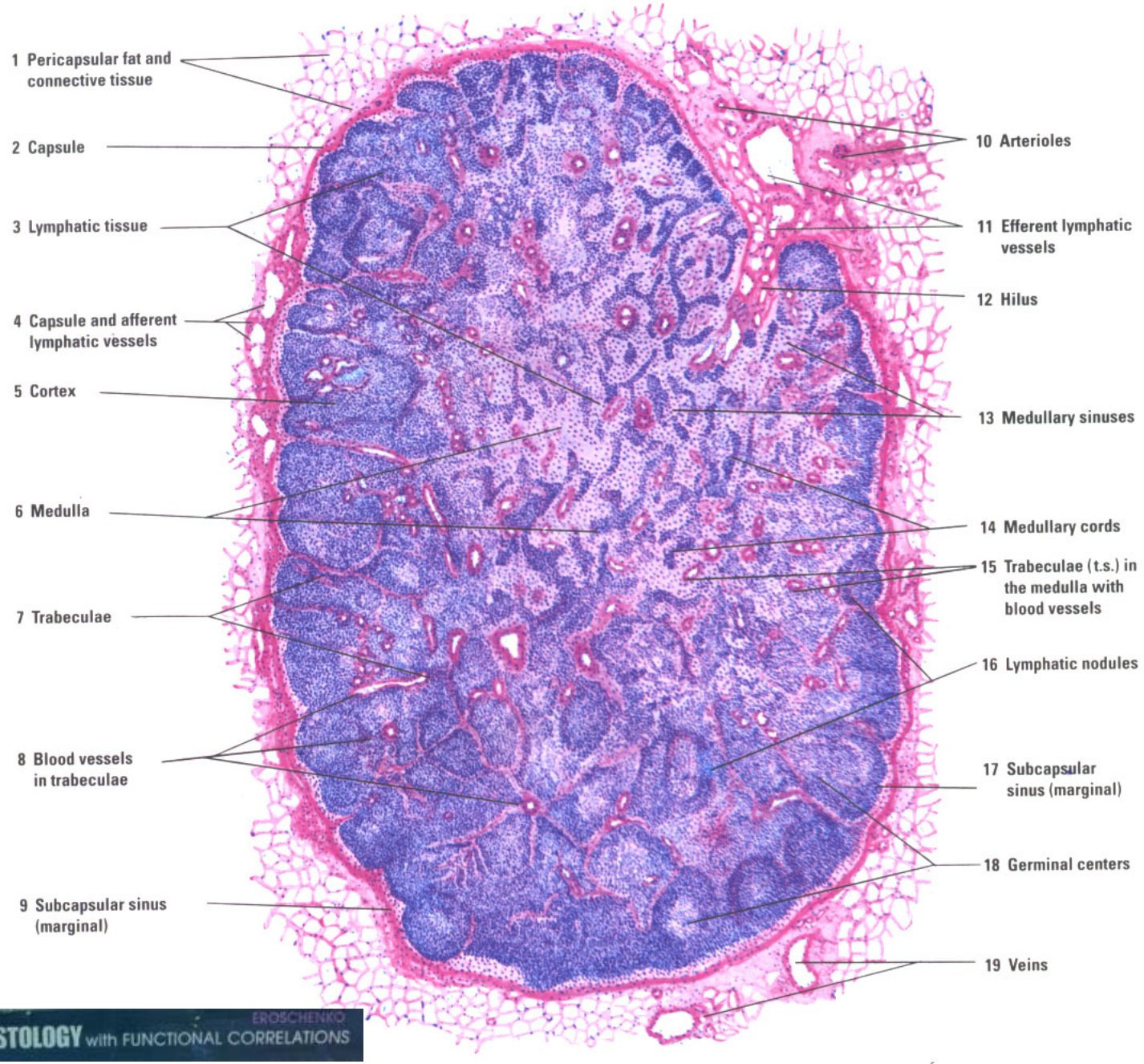
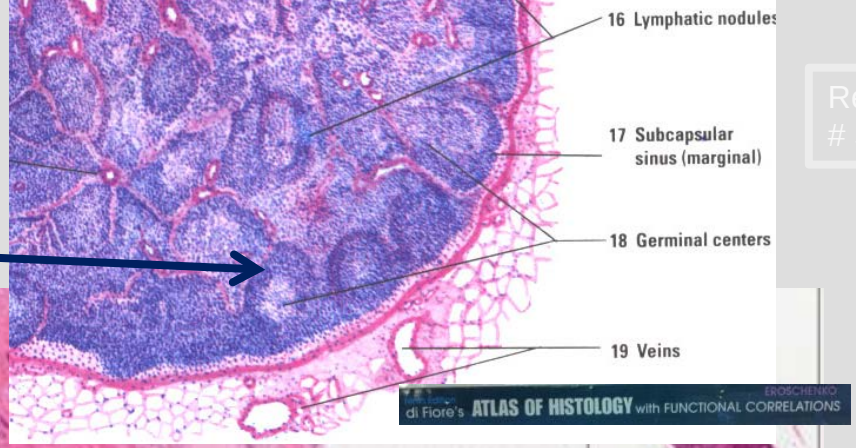


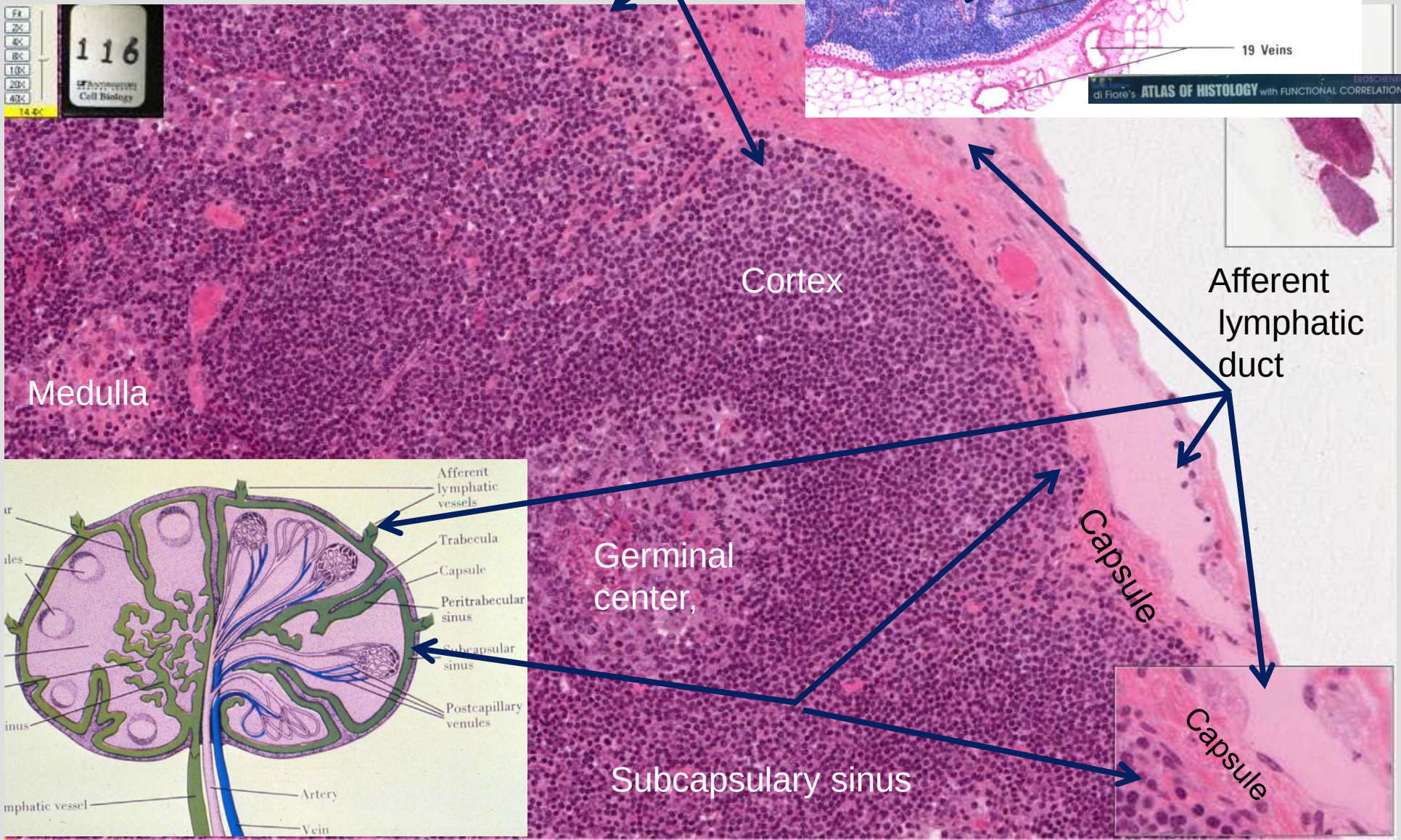
Fig. 8-1 Lymph Node (panoramic view). Stain: hematoxylin-eosin. Low magnification.

116 Lymph node

Ref code # 5, 6

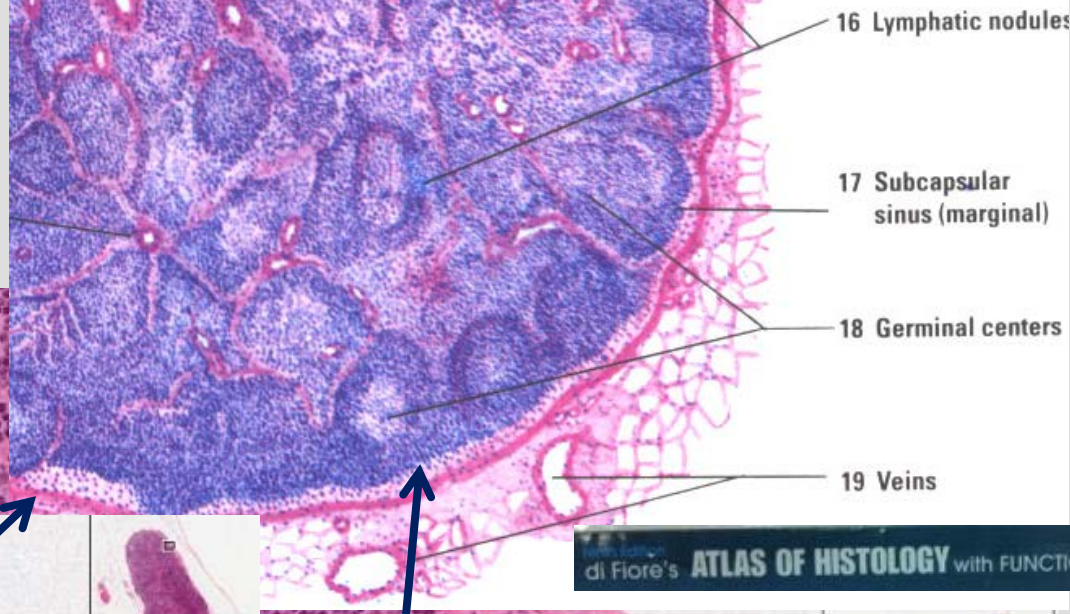
Large round structures (follicles),

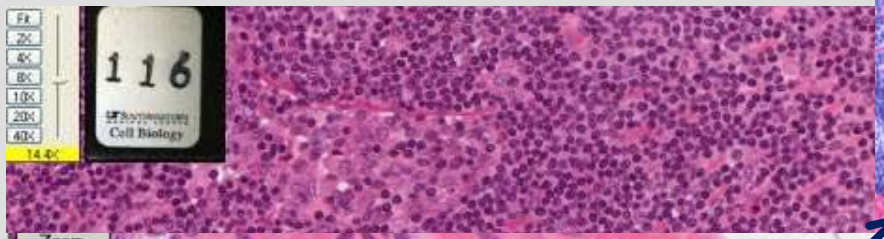


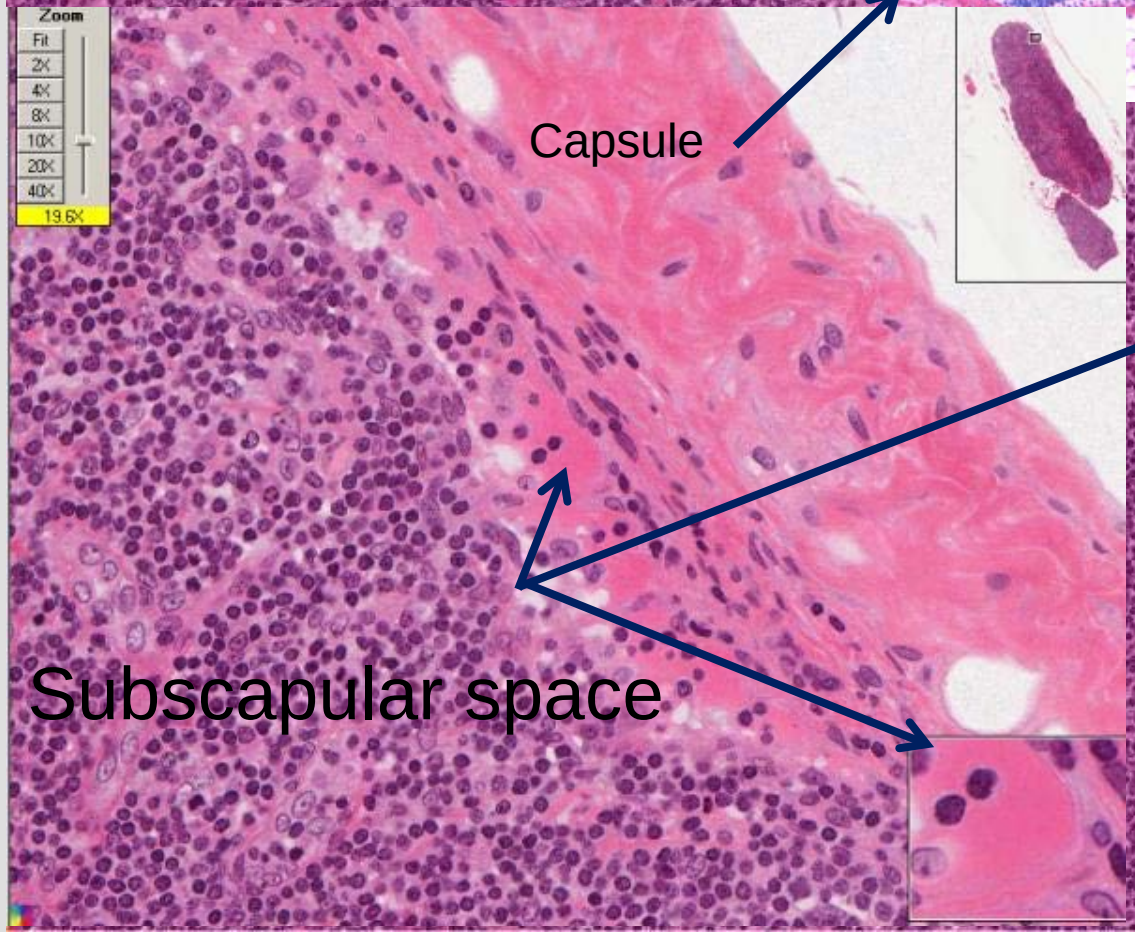


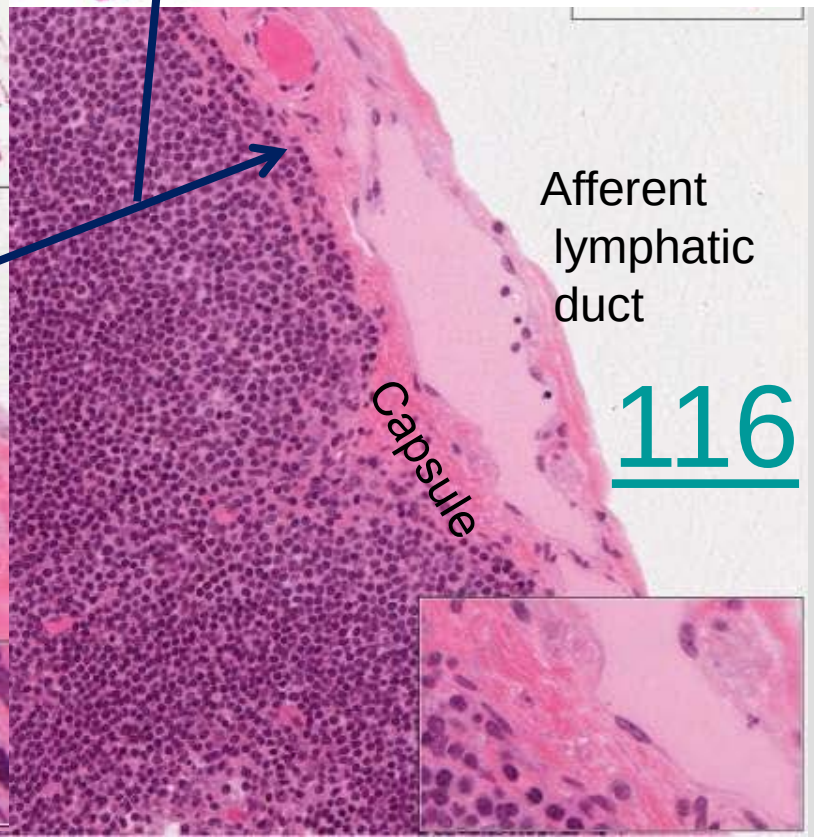
Lymph node

Ref code # 5



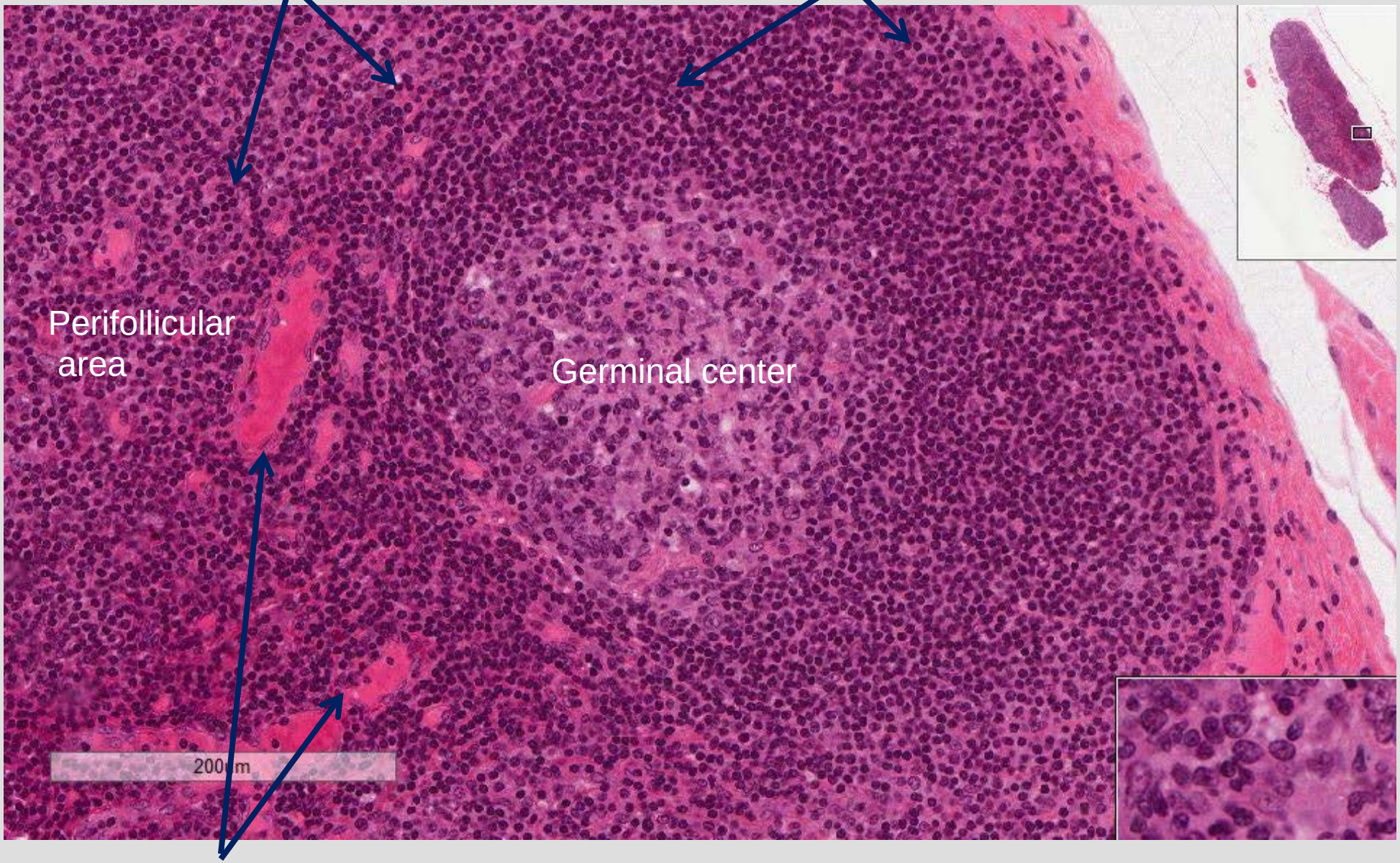




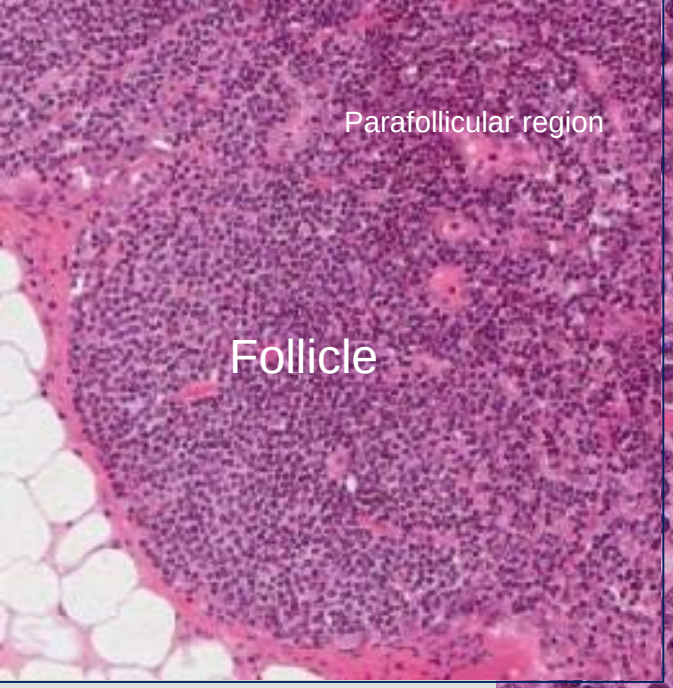


Predominantly T lymphocytes

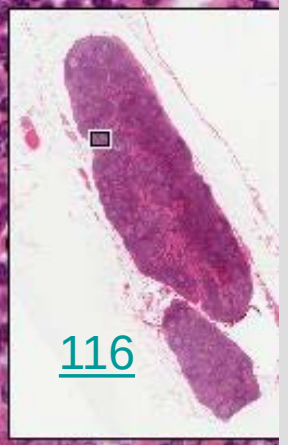
Predominantly B lymphocytes, around germinal center



High endothelial venules = sites where blood-borne lymphocytes enter the node.

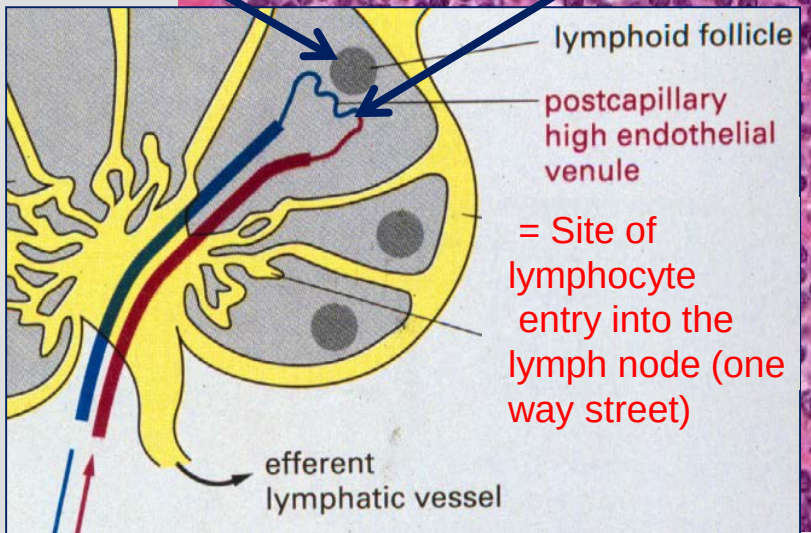


Parafollicular region



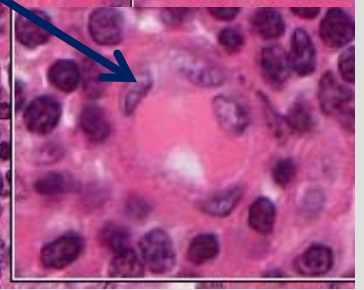
High endothelial venule

Part of follicle



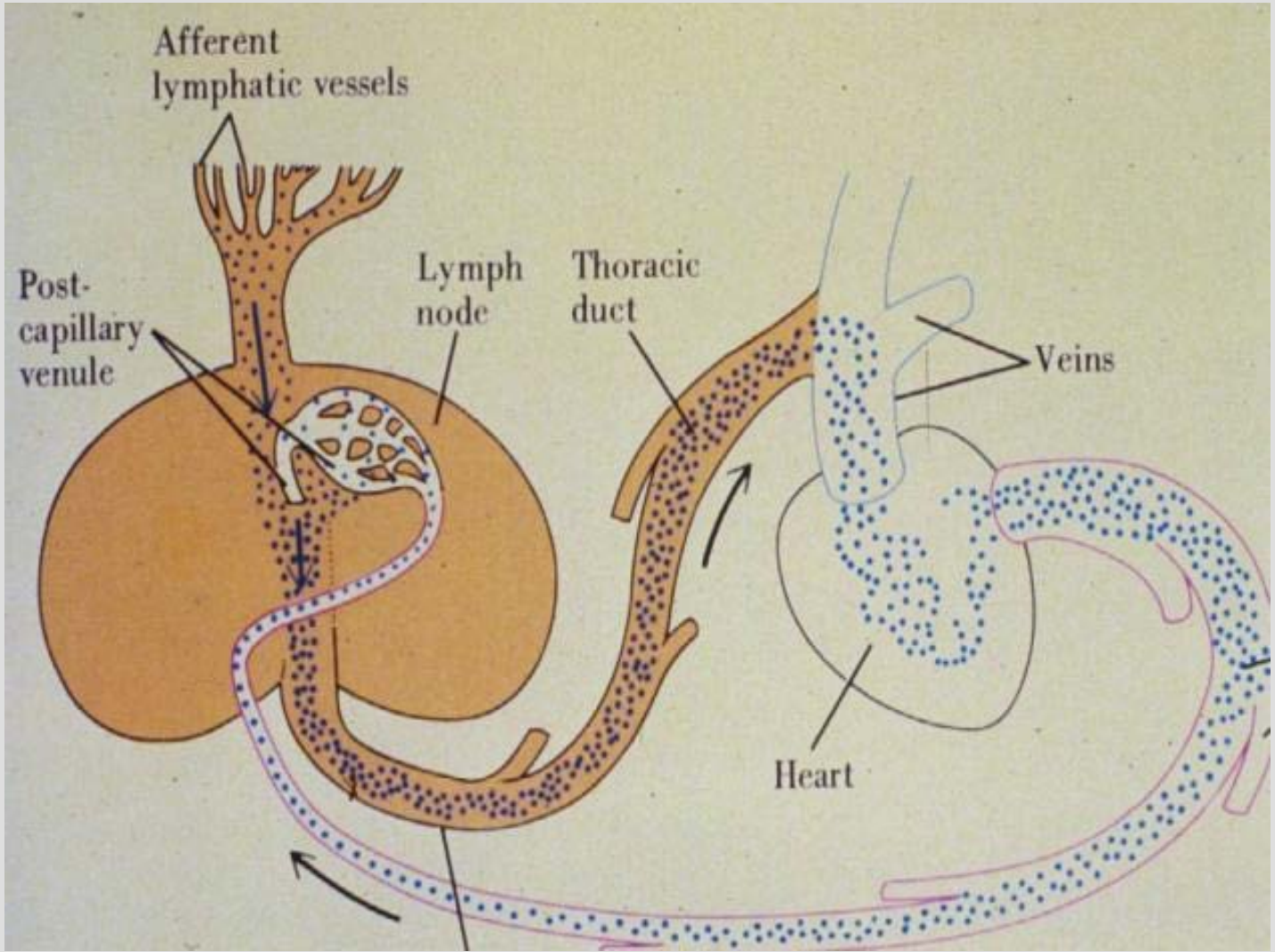
= Site of lymphocyte entry into the lymph node (one way street)

Typical flat endothelium

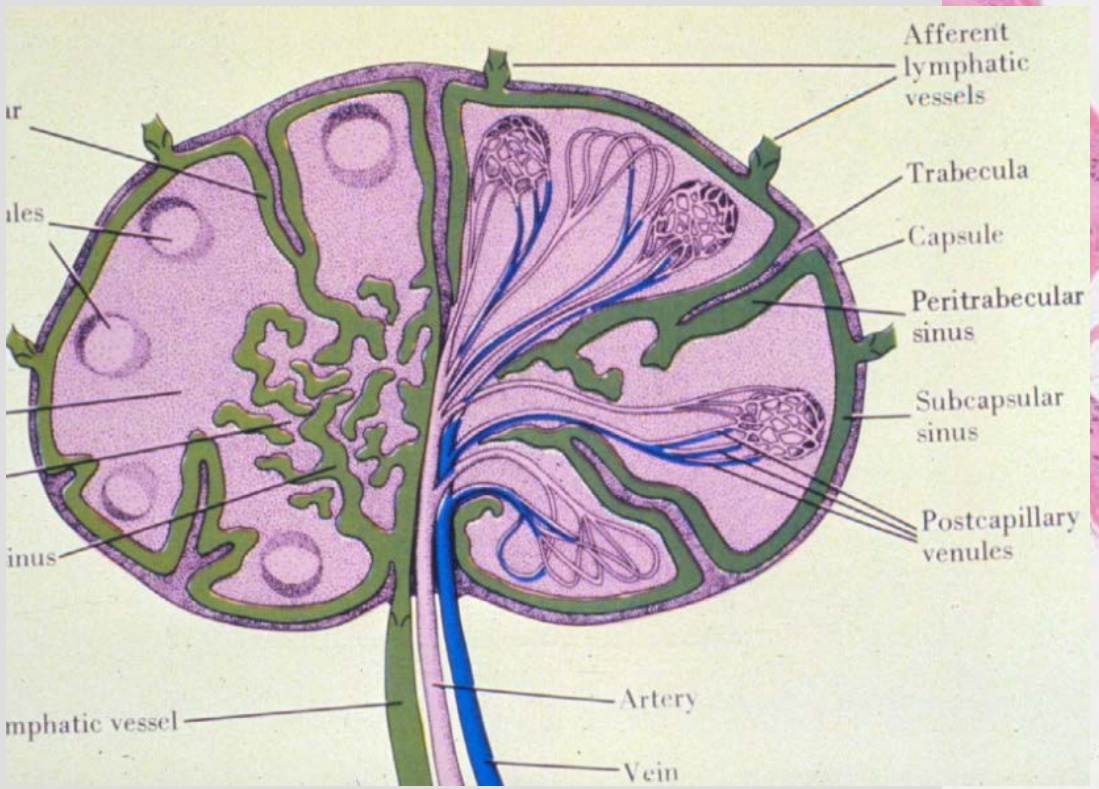


INDUCTION OF RESPONSE

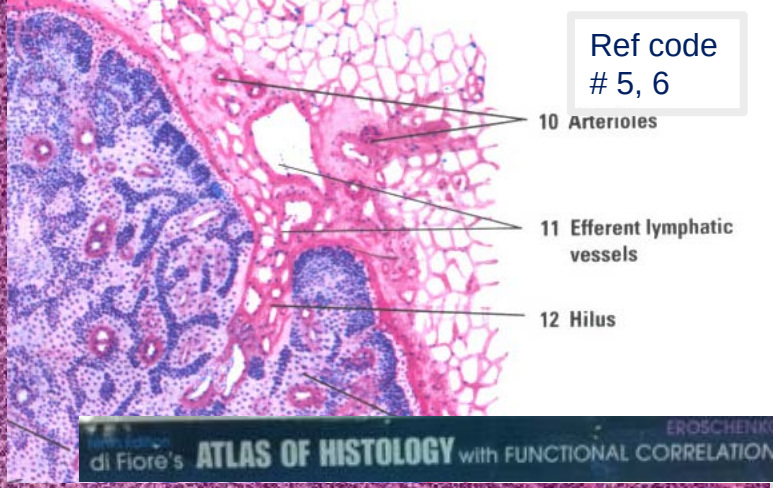
- **PERIPHERAL ORGAN NEEDED TO GET ANTIGEN AND RESPONSIVE CELL TO INTERACT**
  - **LYMPHOCYTE RECIRCULATING**
  - **APPROPRIATE CONTEXT**



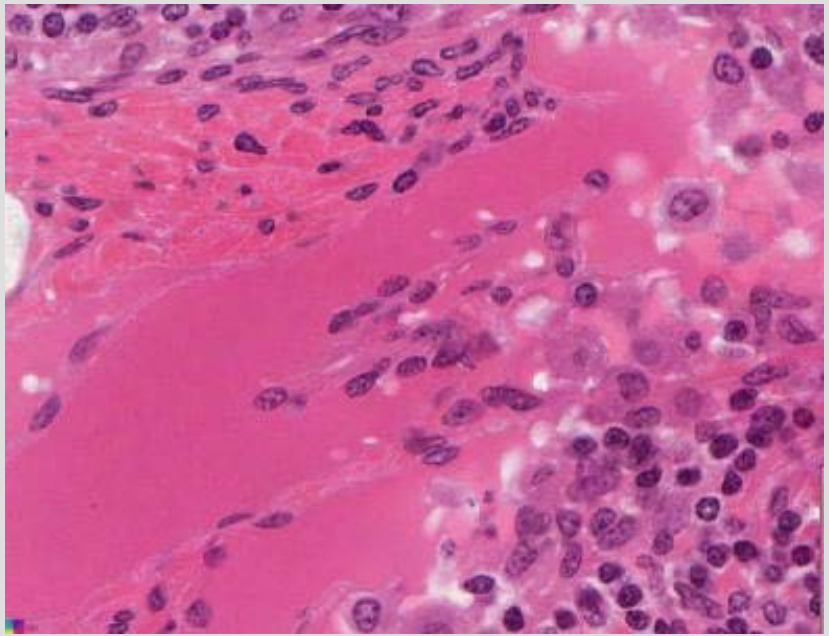
19754 Lymph sinus in lymph node



Ref code # 5, 6

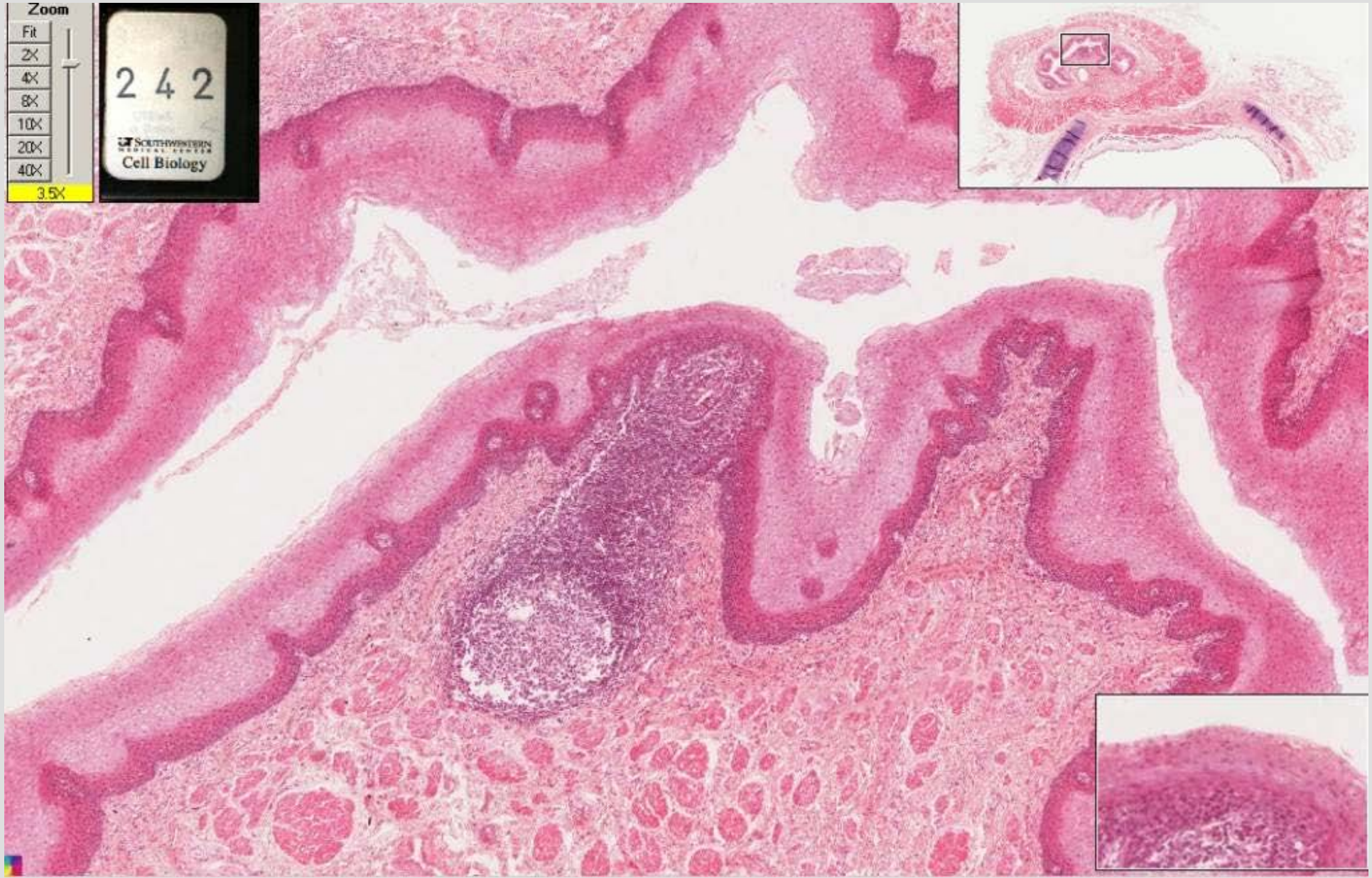


Parafollicular region



Efferent lymphatic duct?

242 Esophagus and trachea, monkey



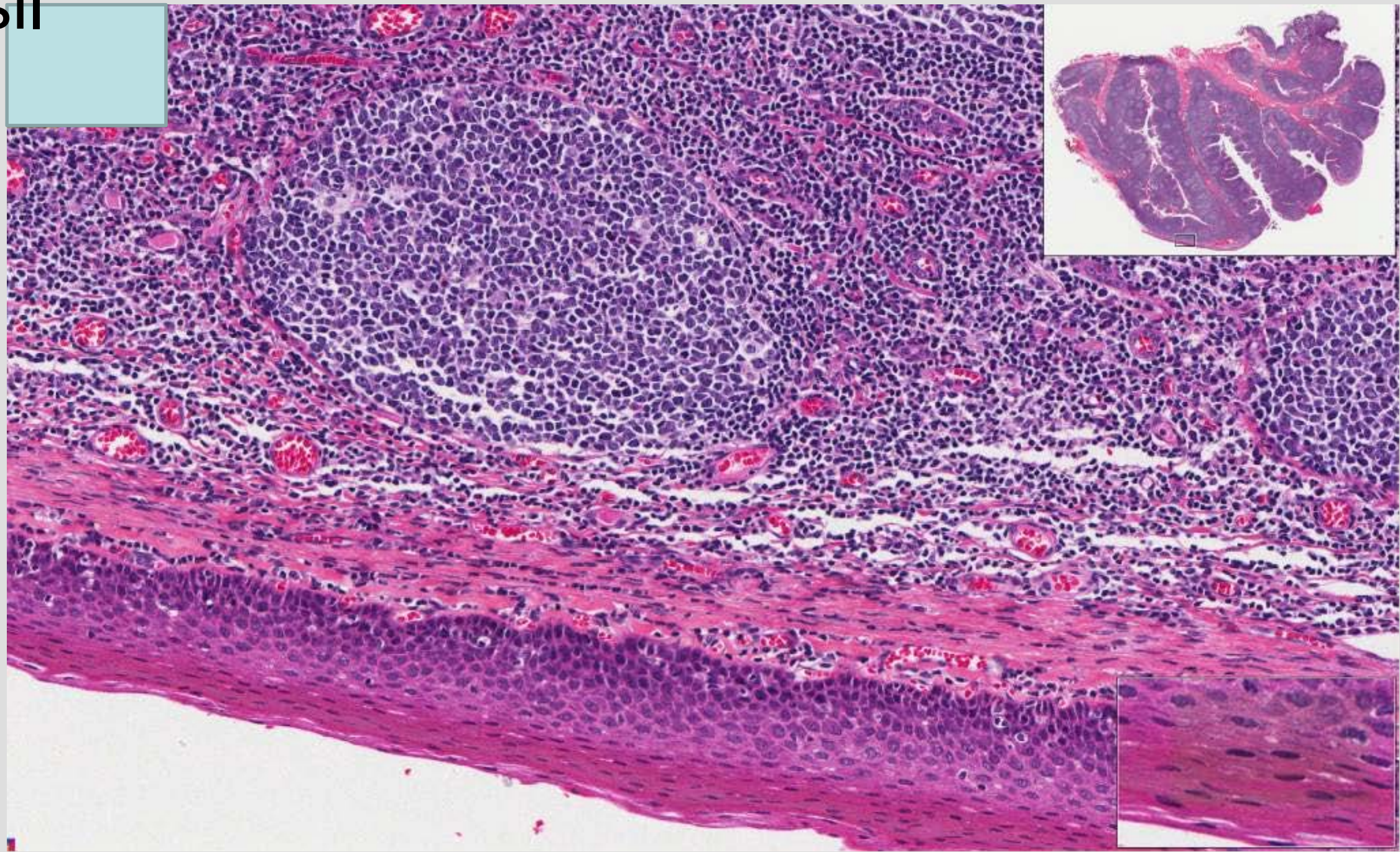
Tonsil

Ref code
5

Fig. 8-5 Palatine Tonsil. Stain: hemato

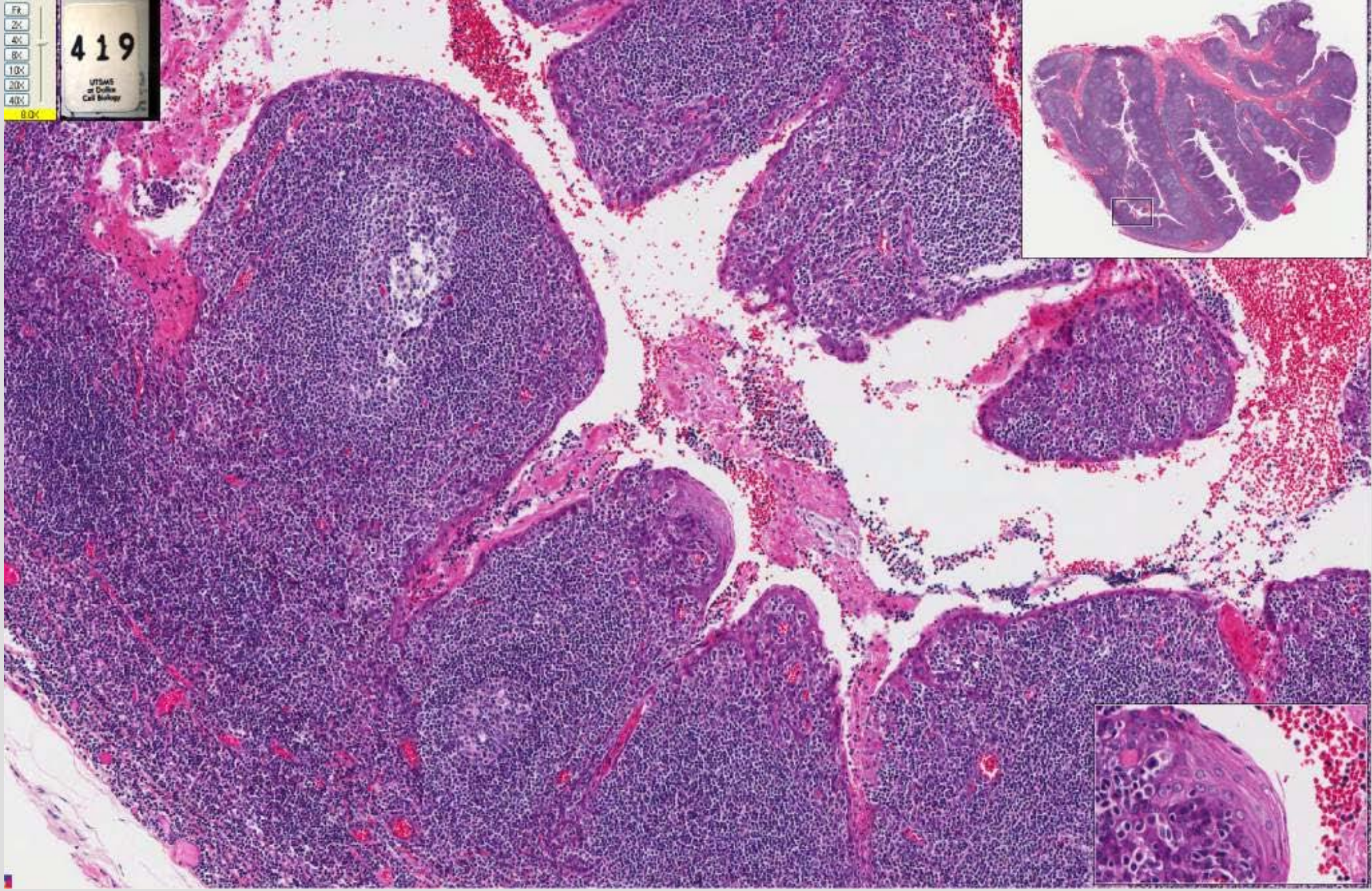
Tonsil

419

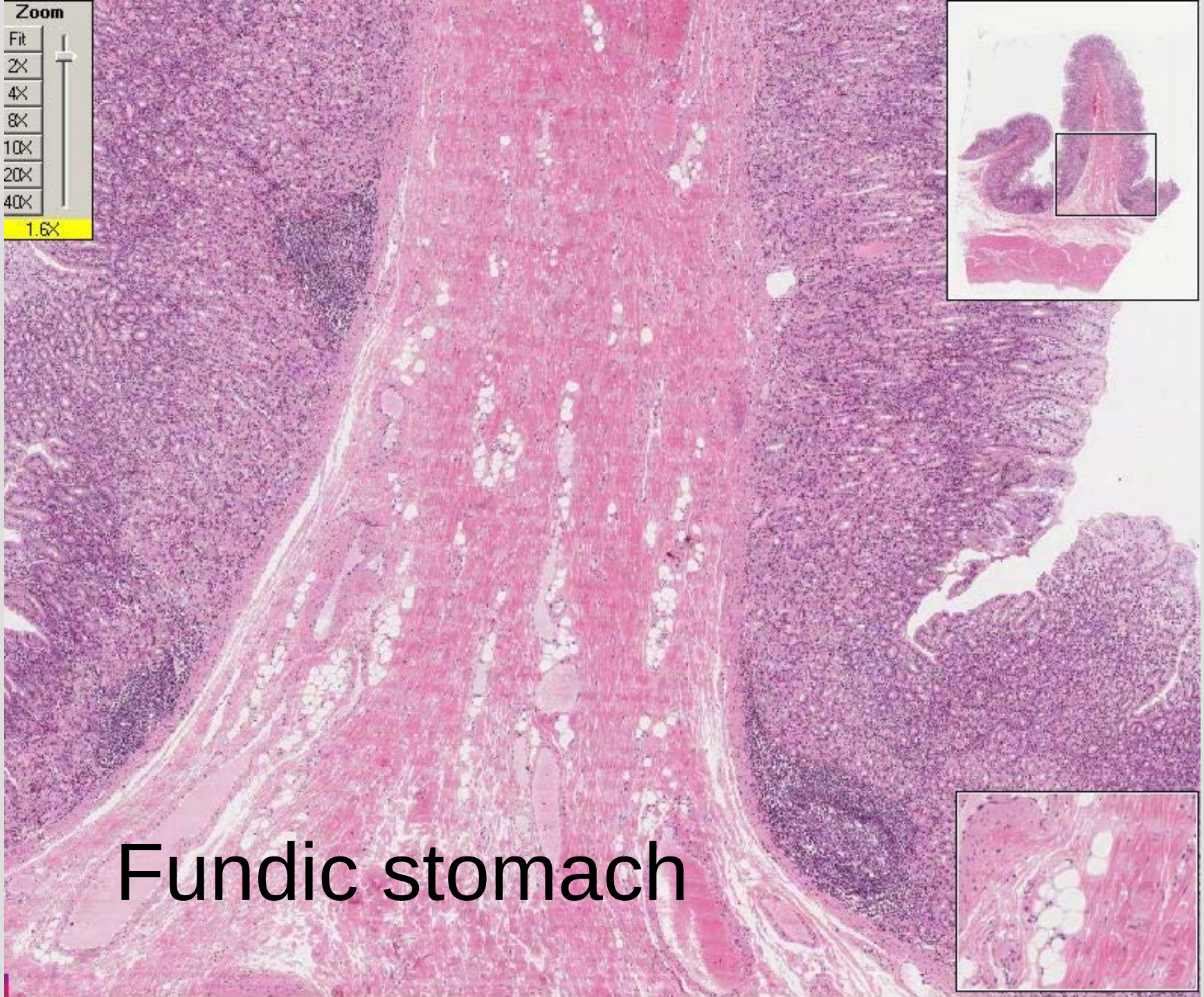


Tonsil

419

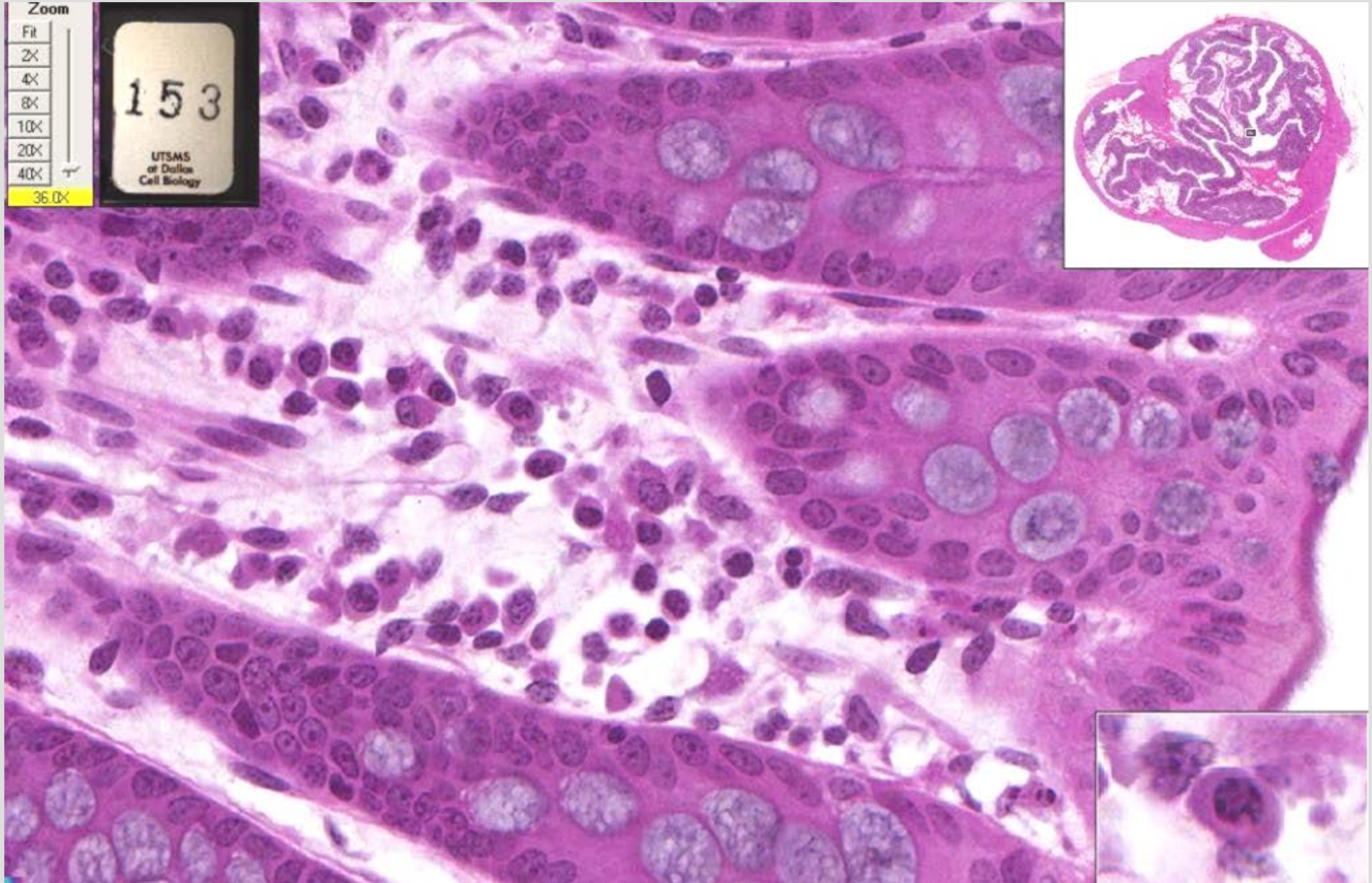


145

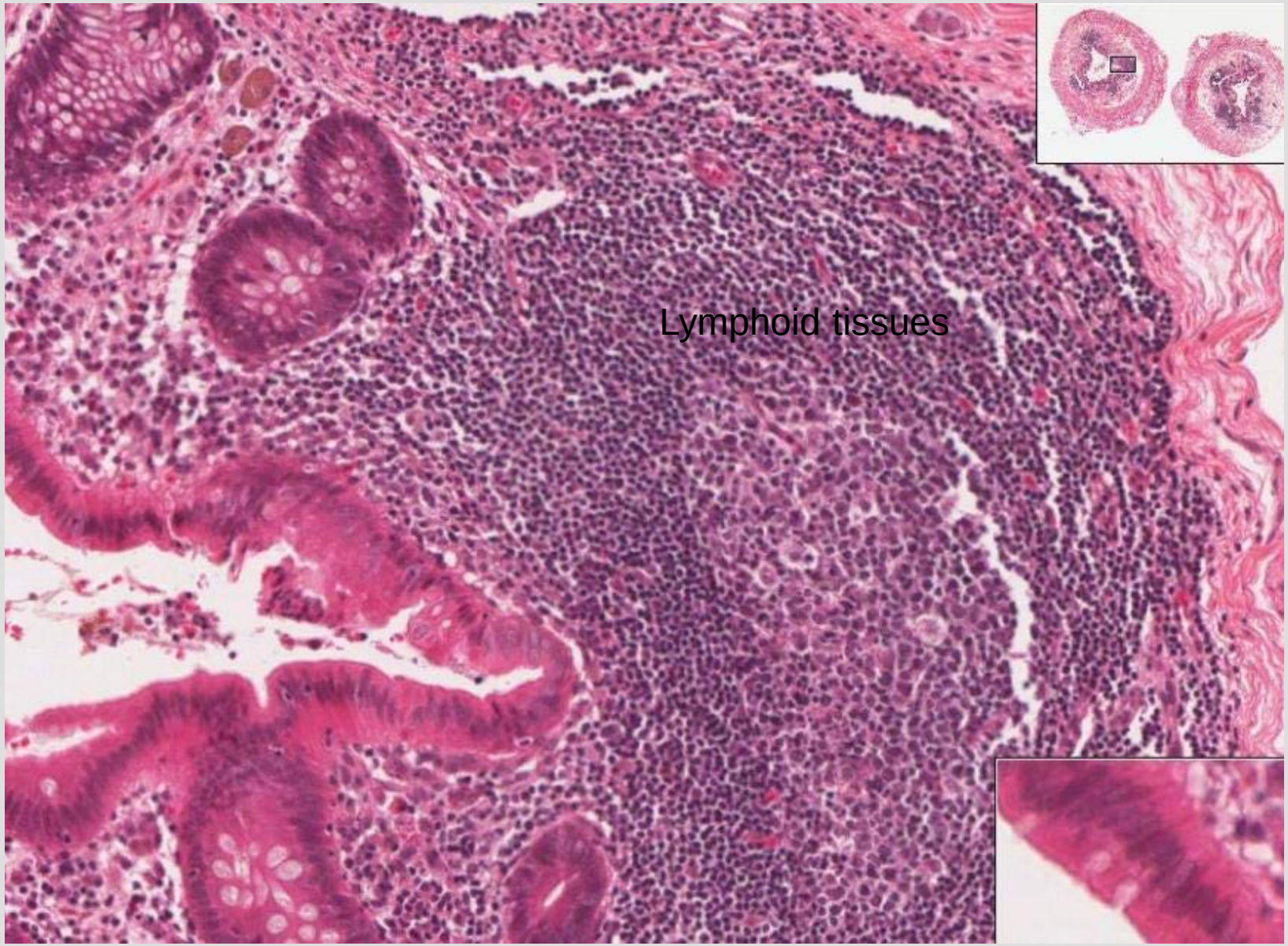


Fundic stomach

153 Plasma cells large intestine in Colon, monkey



- Appendix (Slide 32412). 32412



Lymphoid tissues are important in the defense against ingested micro-organisms

Spleen

Ref code # 5

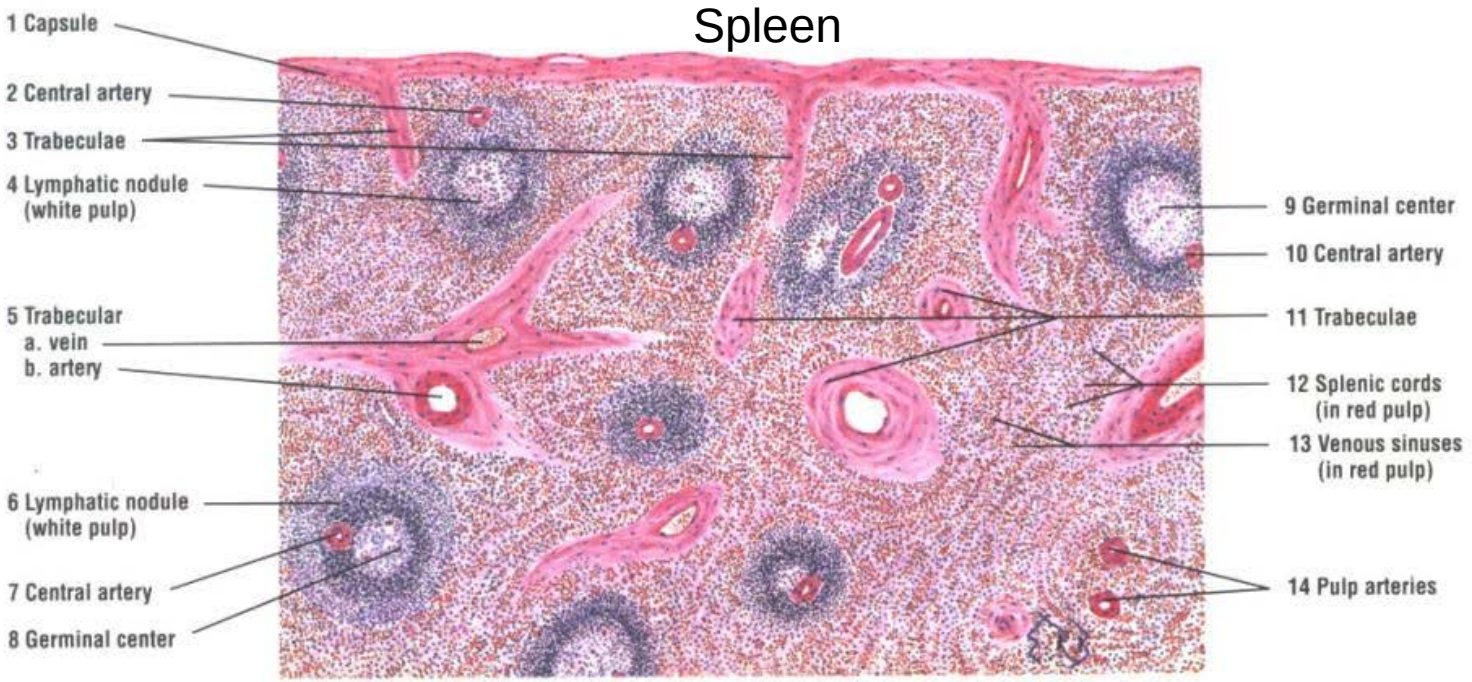
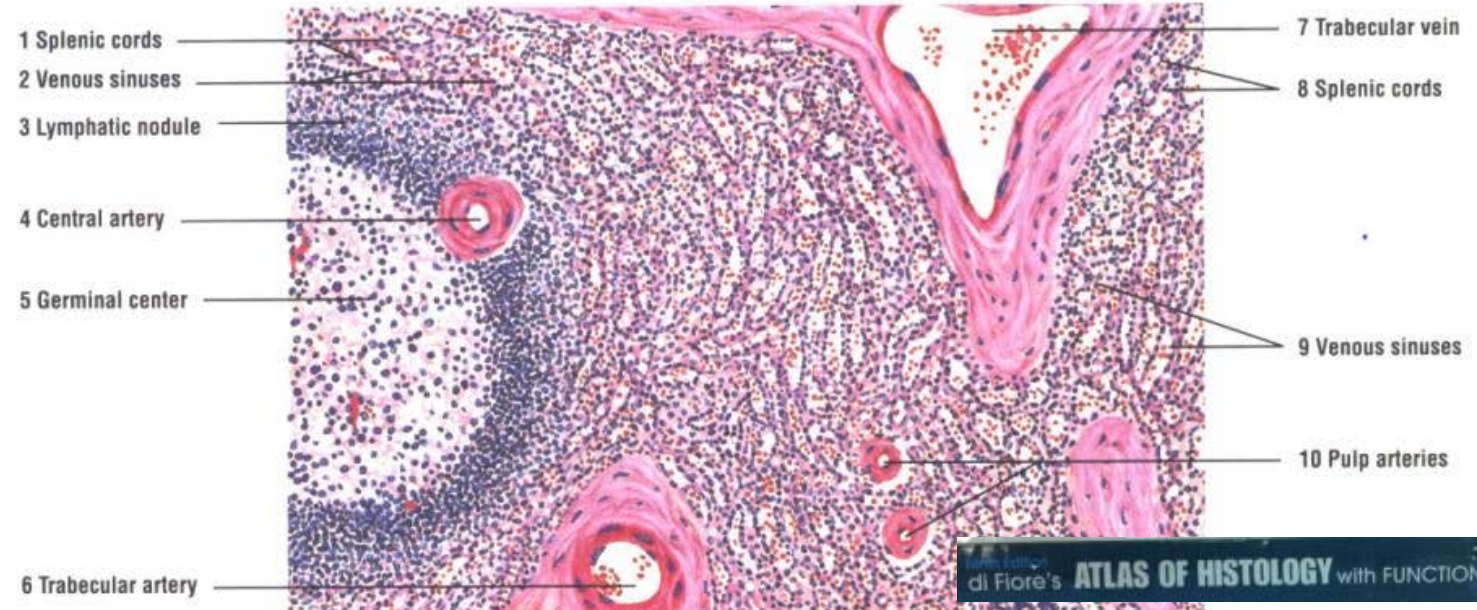
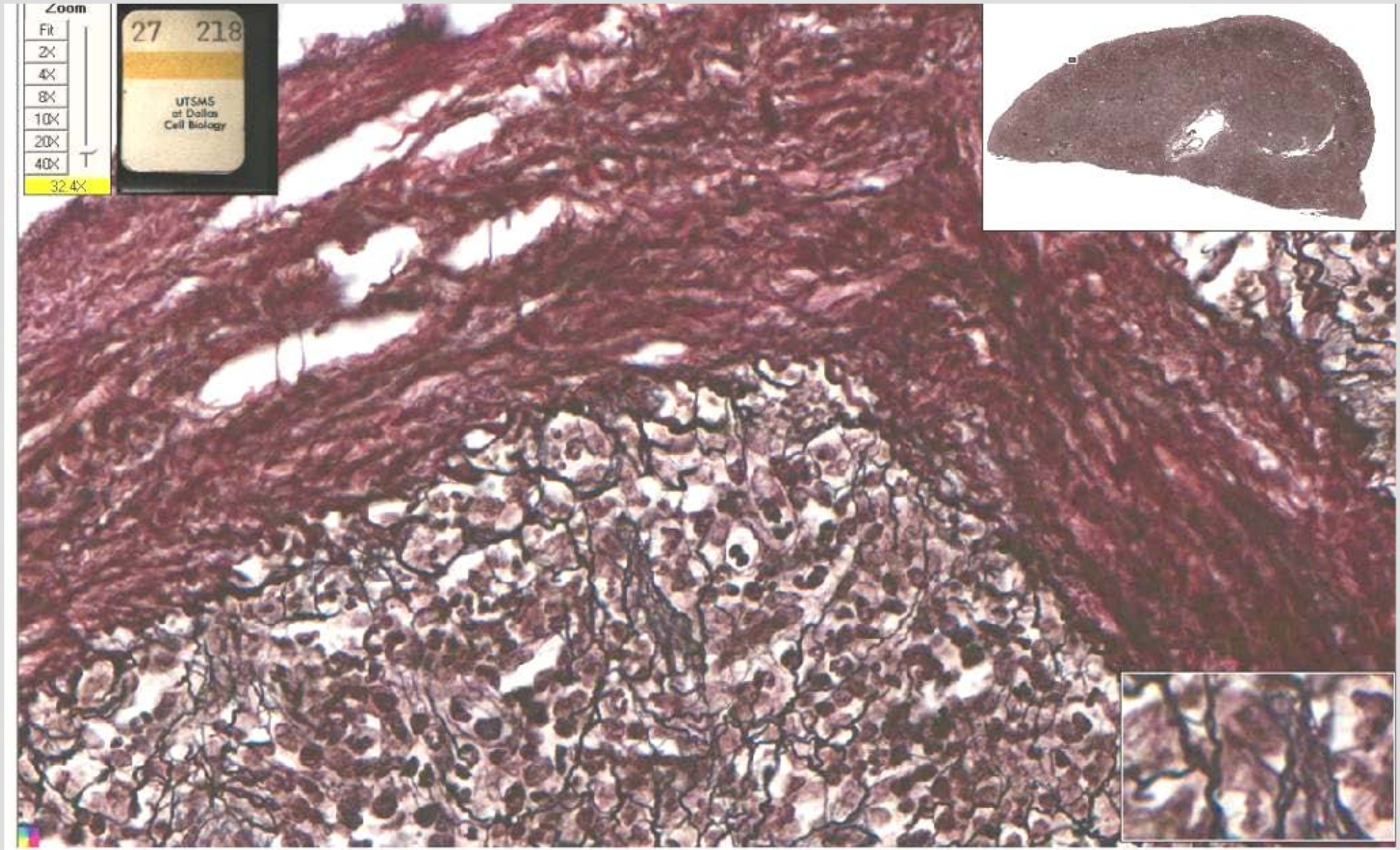


Fig. 8-8 Spleen (panoramic view). Stain: hematoxylin-eosin. Low magnification.



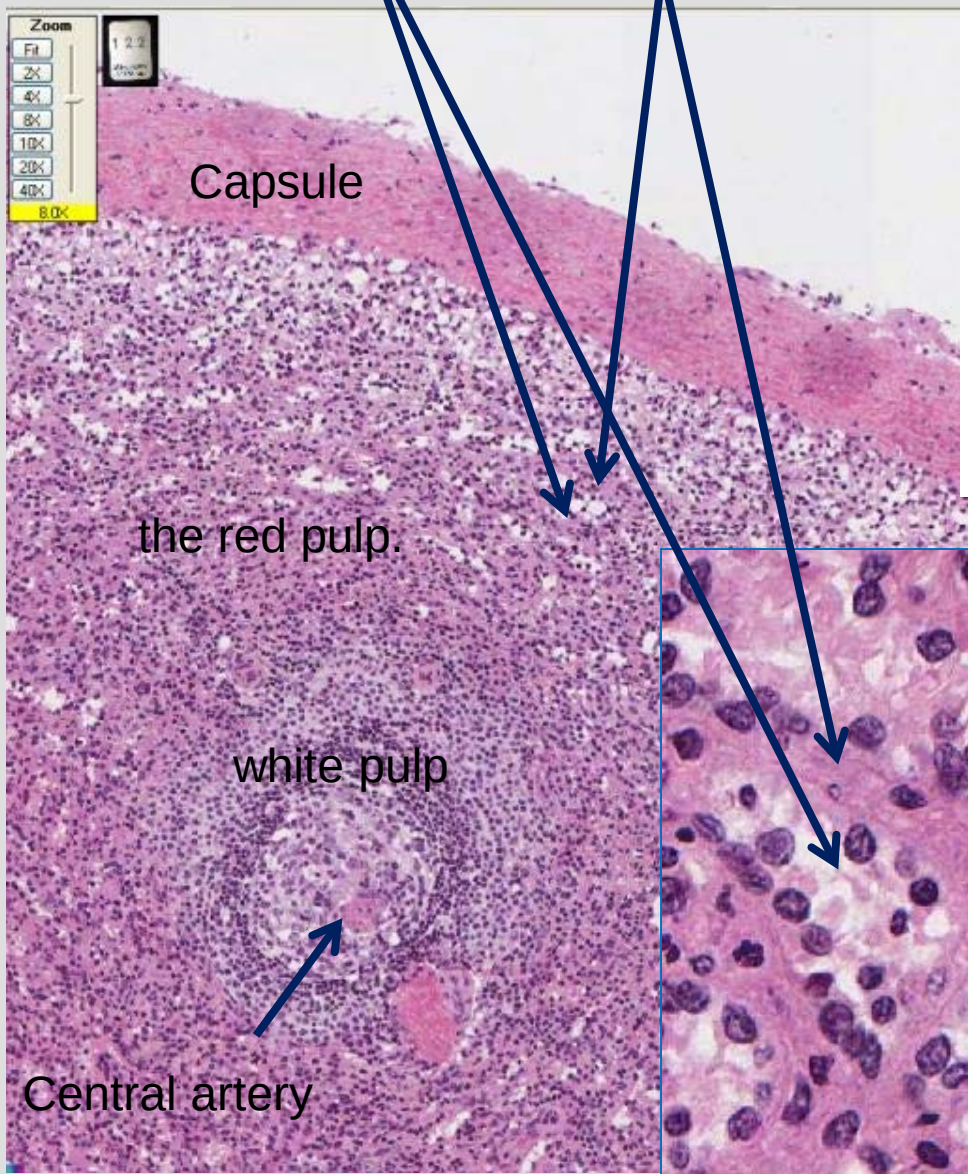
218 Spleen (reticulum stain)- capsule and reticulum fibers

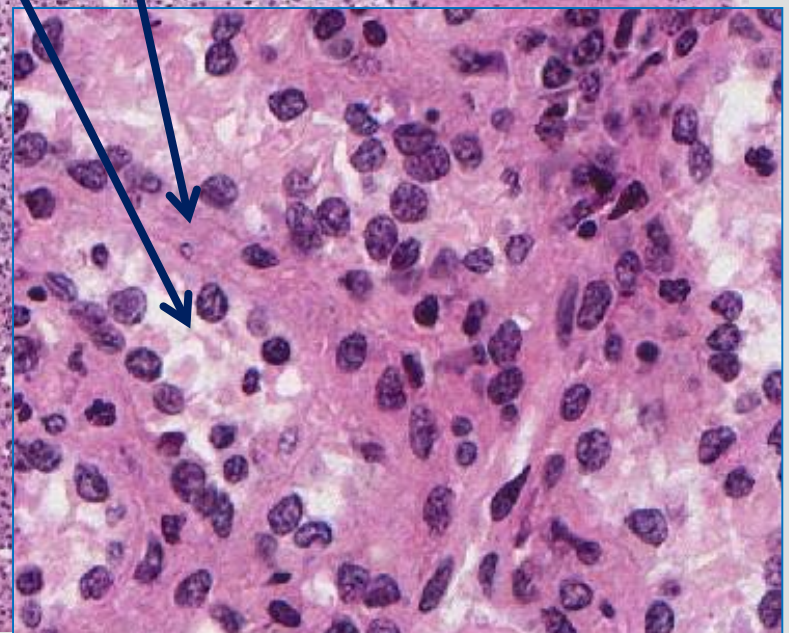


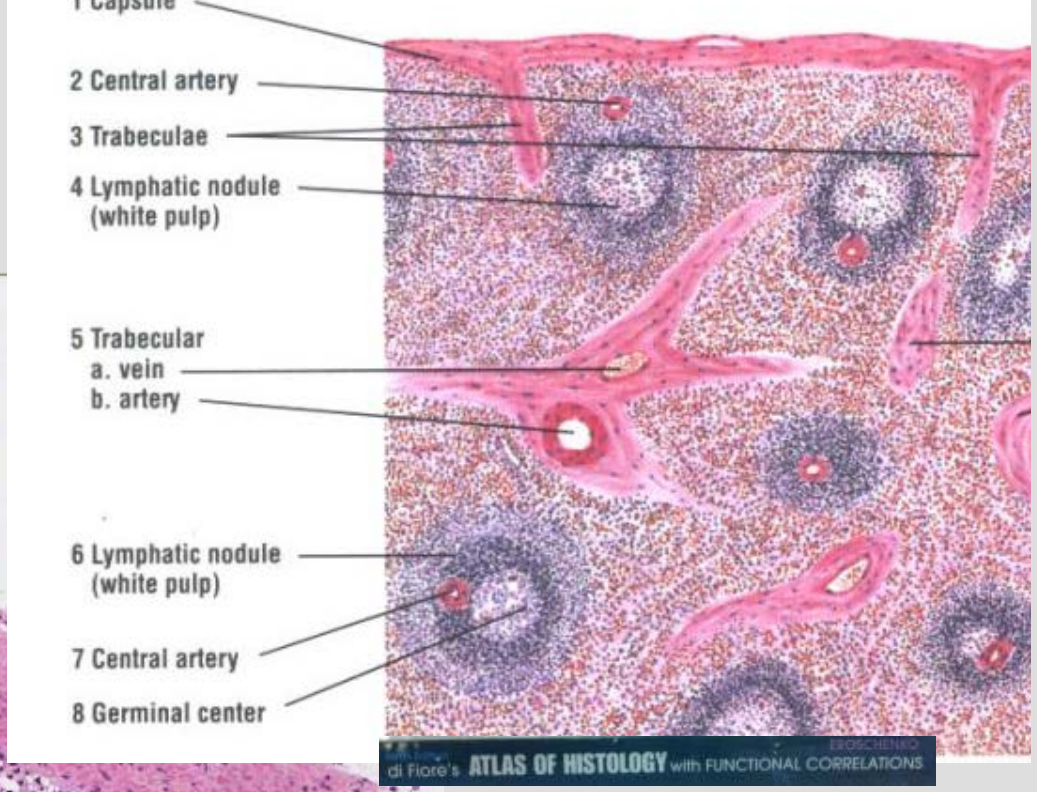
122

Spleen

Venous sinuses, and Billroth's strands





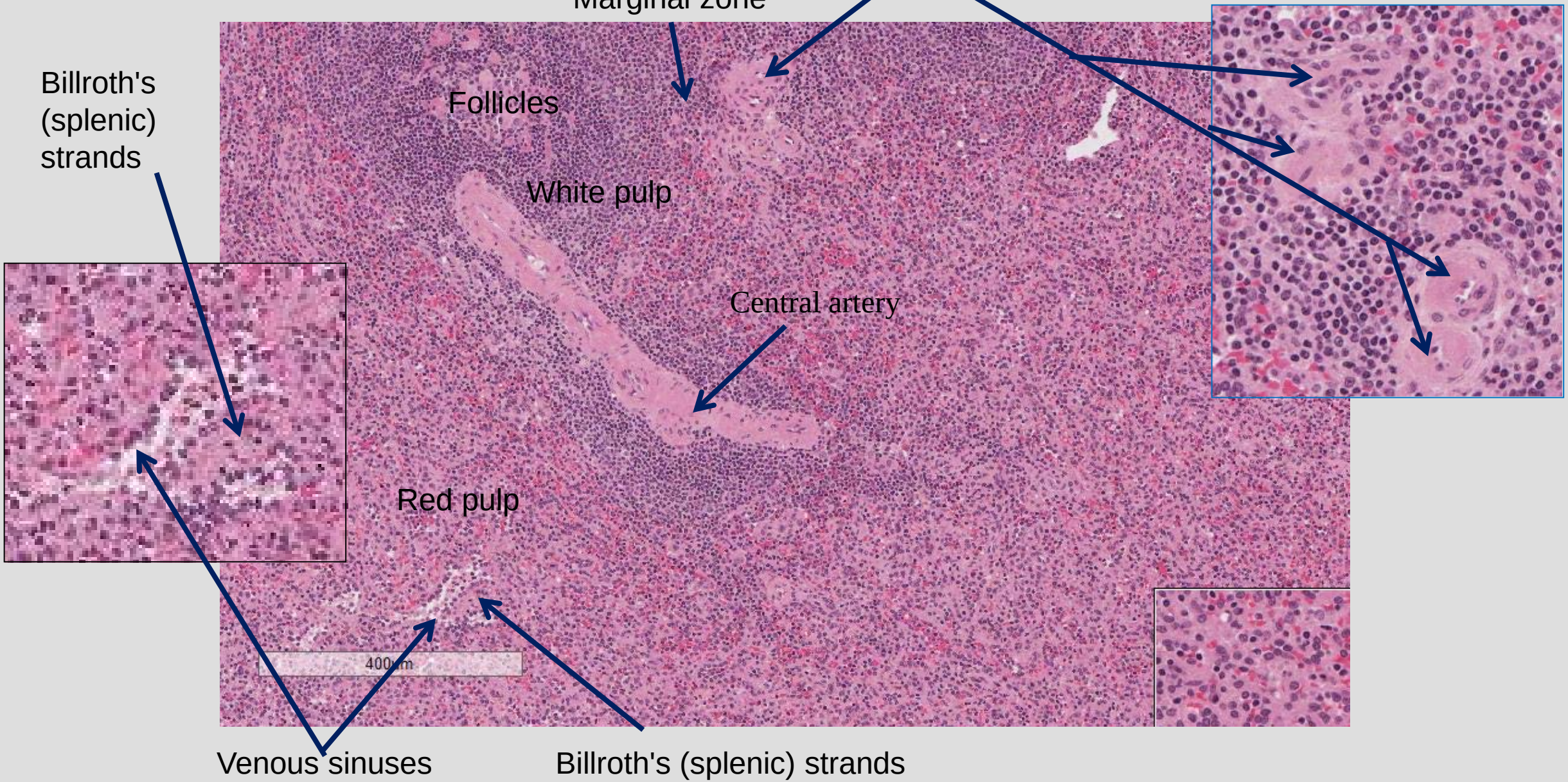


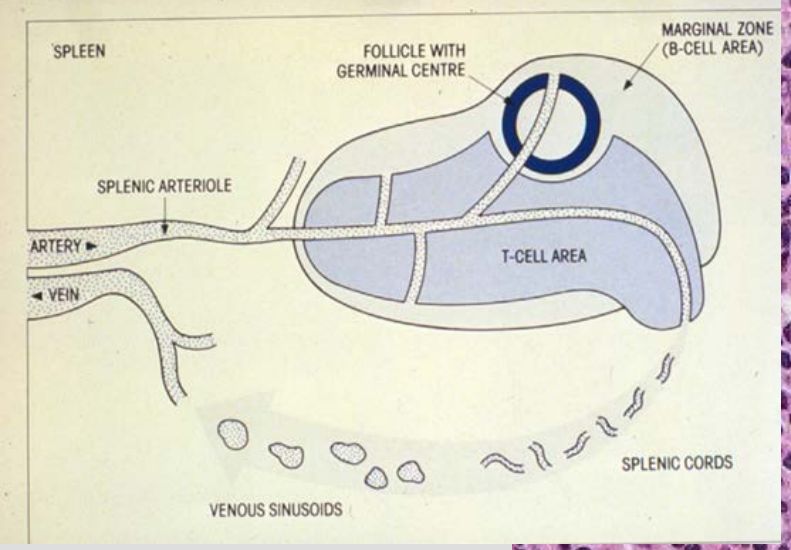
Ref code # 5

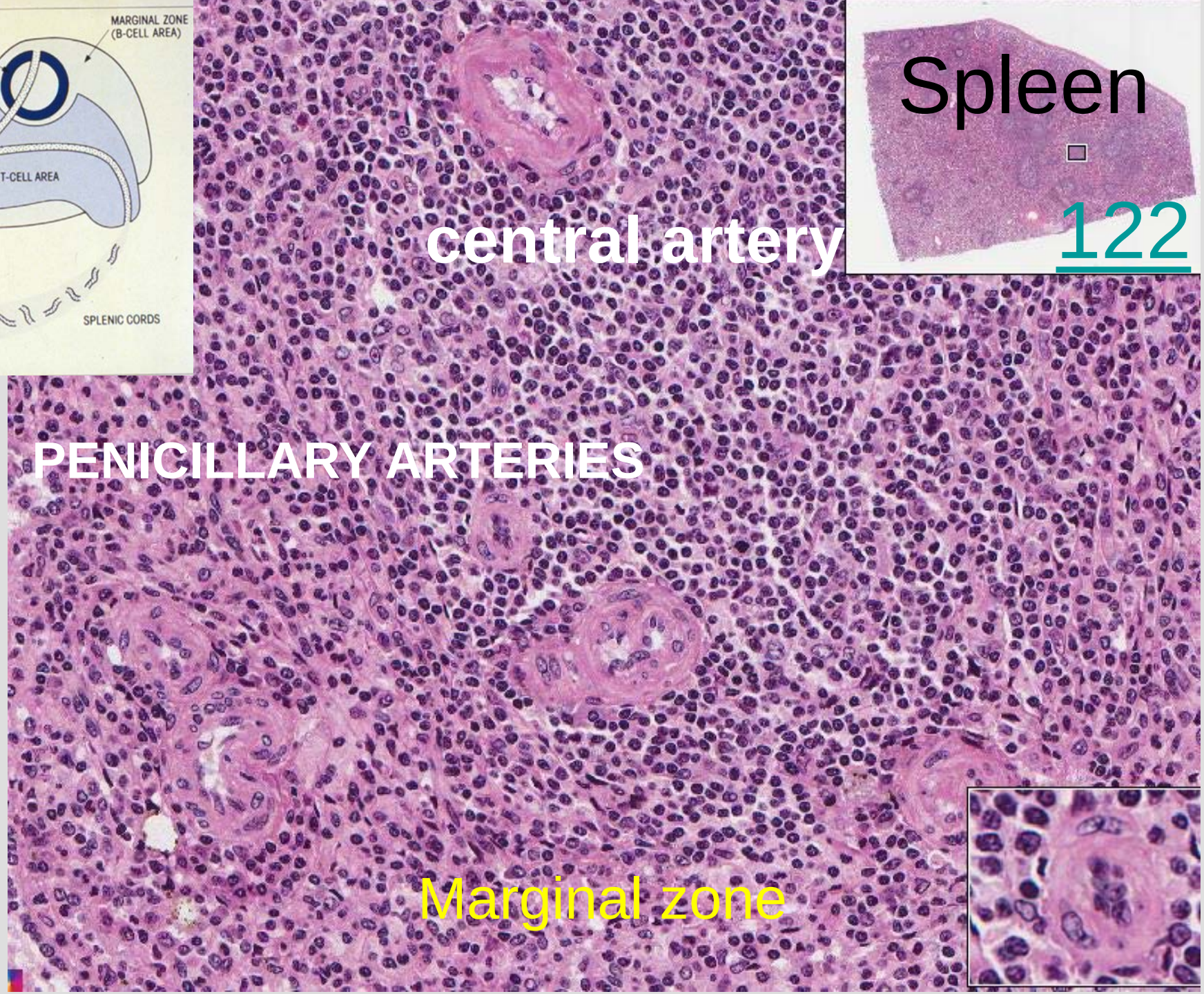
Primary function Of the spleen is <u>filtration of blood</u>.

Spleen has no afferent lymphatics

117 Spleen


Penicillar arteries in marginal zone
Marginal zone
Billroth's (splenic) strands
Follicles
White pulp
Central artery
Red pulp
400µm
Venous sinuses
Billroth's (splenic) strands

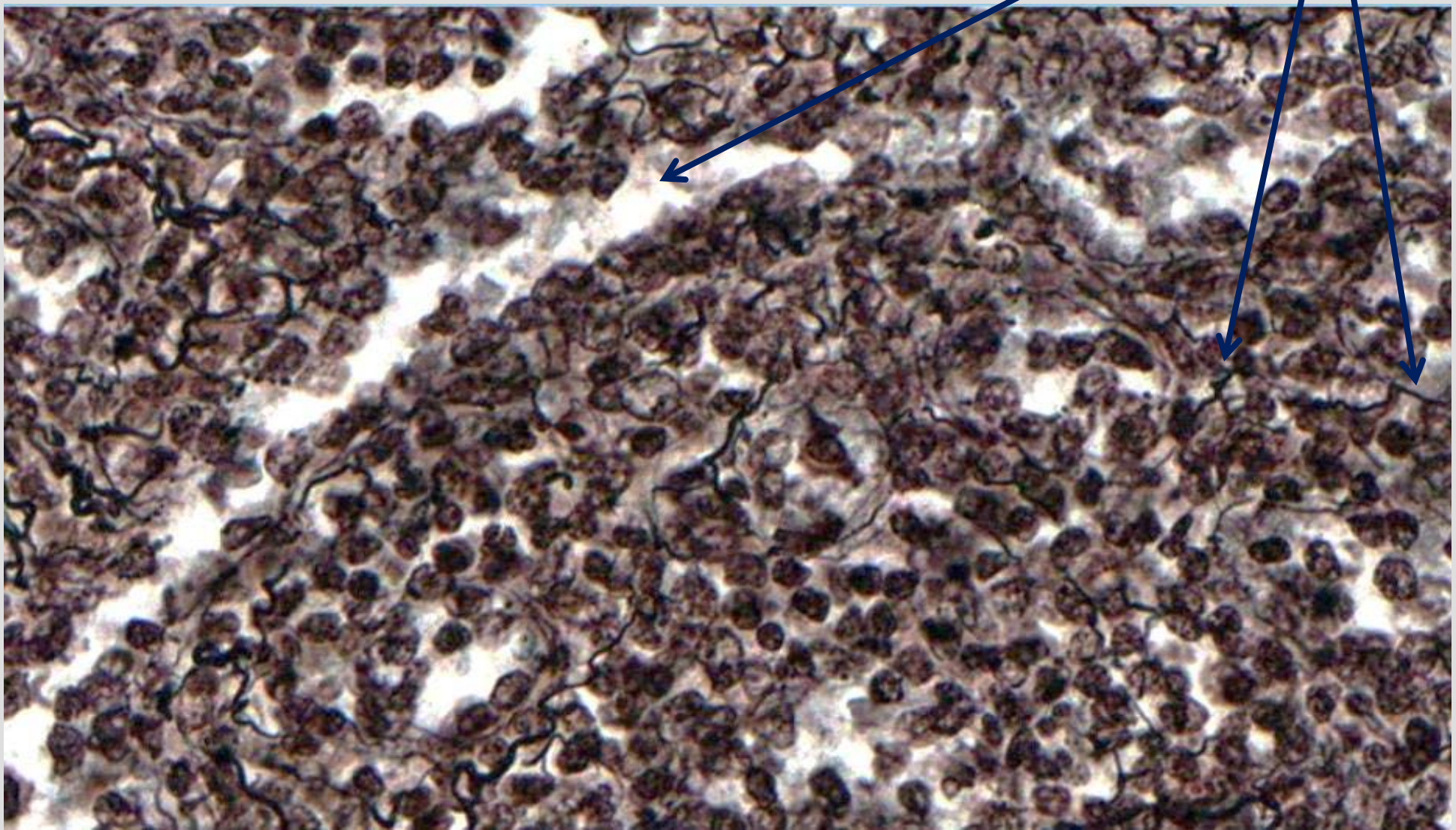

SPLEEN
FOLLICLE WITH GERMINAL CENTRE
MARGINAL ZONE (B-CELL AREA)
SPLENIC ARTERIOLE
ARTERY
VEIN
T-CELL AREA
SPLENIC CORDS
VENOUS SINUSOIDS


central artery
PENICILLARY ARTERIES
Marginal zone

Spleen
122

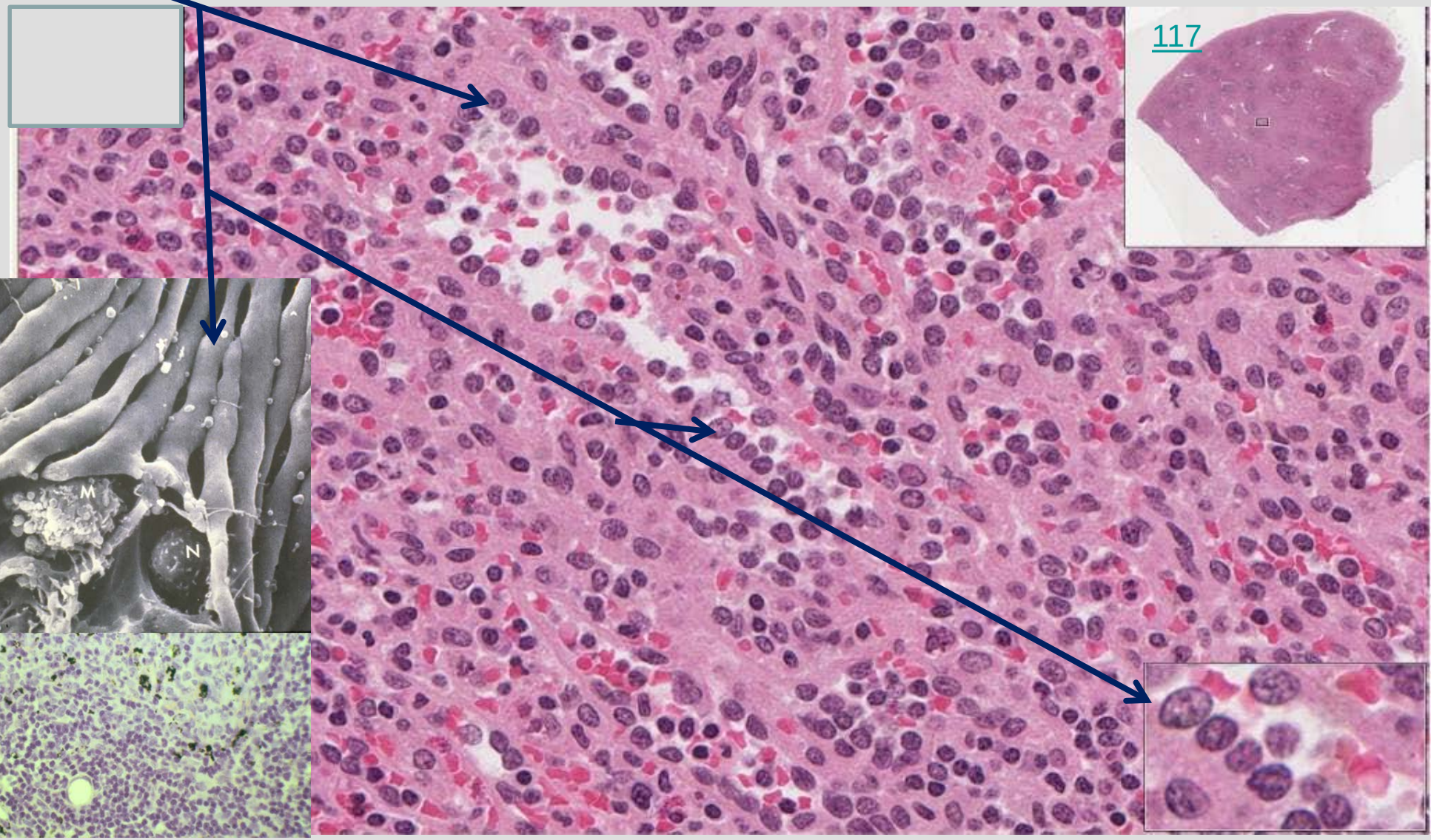
218

Spleen (reticulum stain)- reticulum fibers in strands between venous (blood) sinus



Spleen #19752

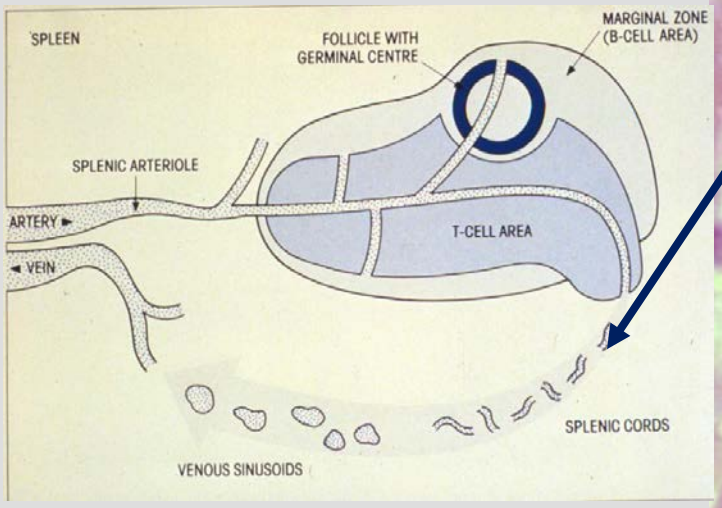
Litteral cells of spleenic venule

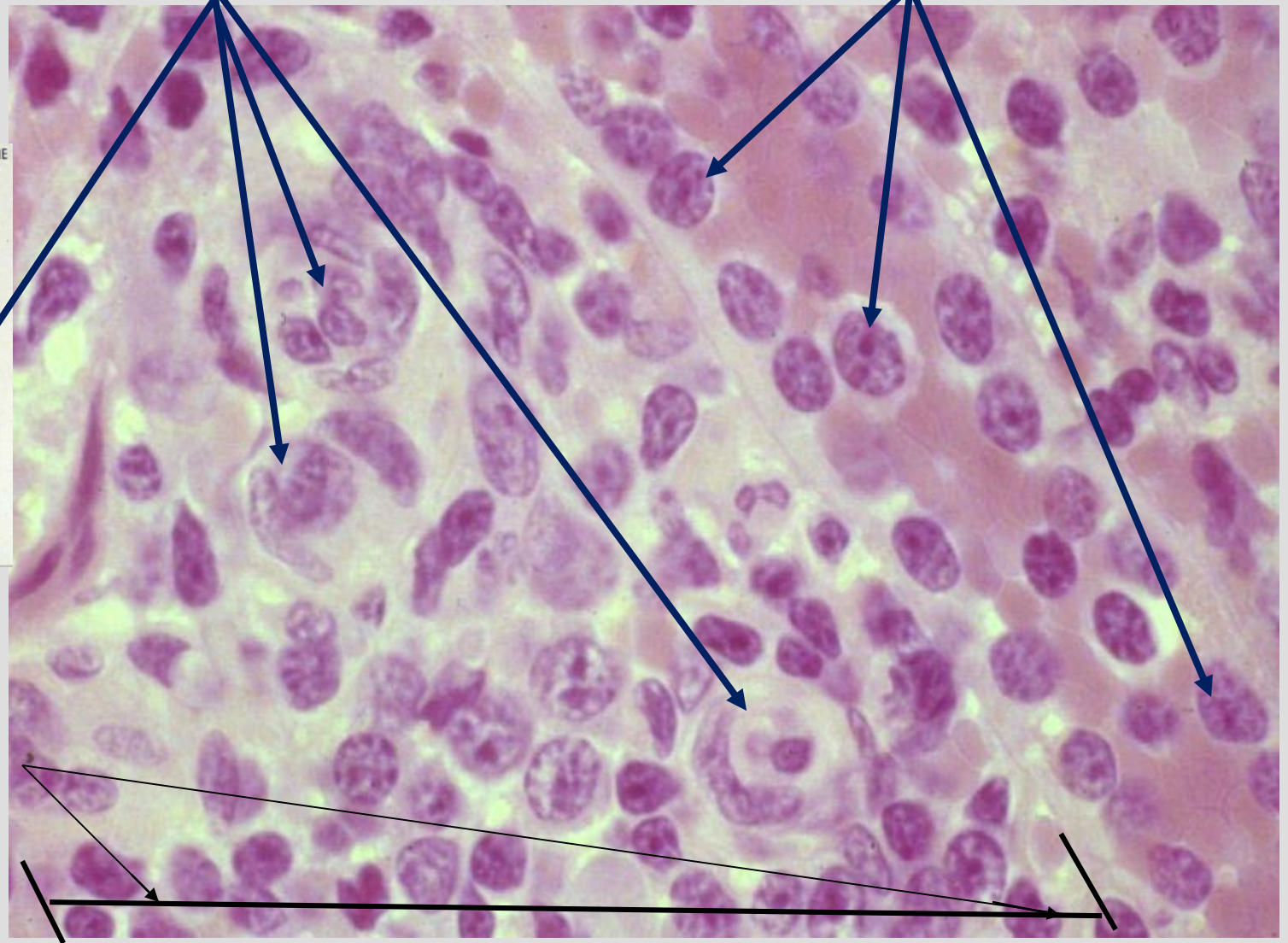


Spleen

Penicillar arteries

Littoral cells: picket-fence type endothelial cells of vascular sinus





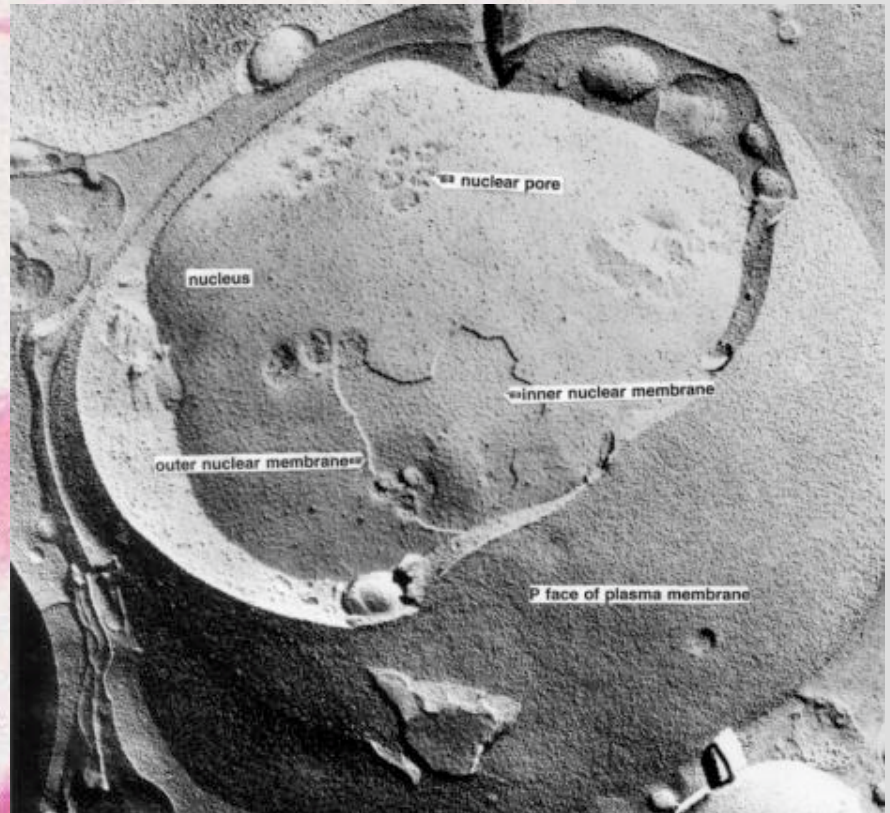
Billroth's strand or spleenic strand

19761

Bone marrow

Lymphocyte is a main player of immune response

Blood
in vessel

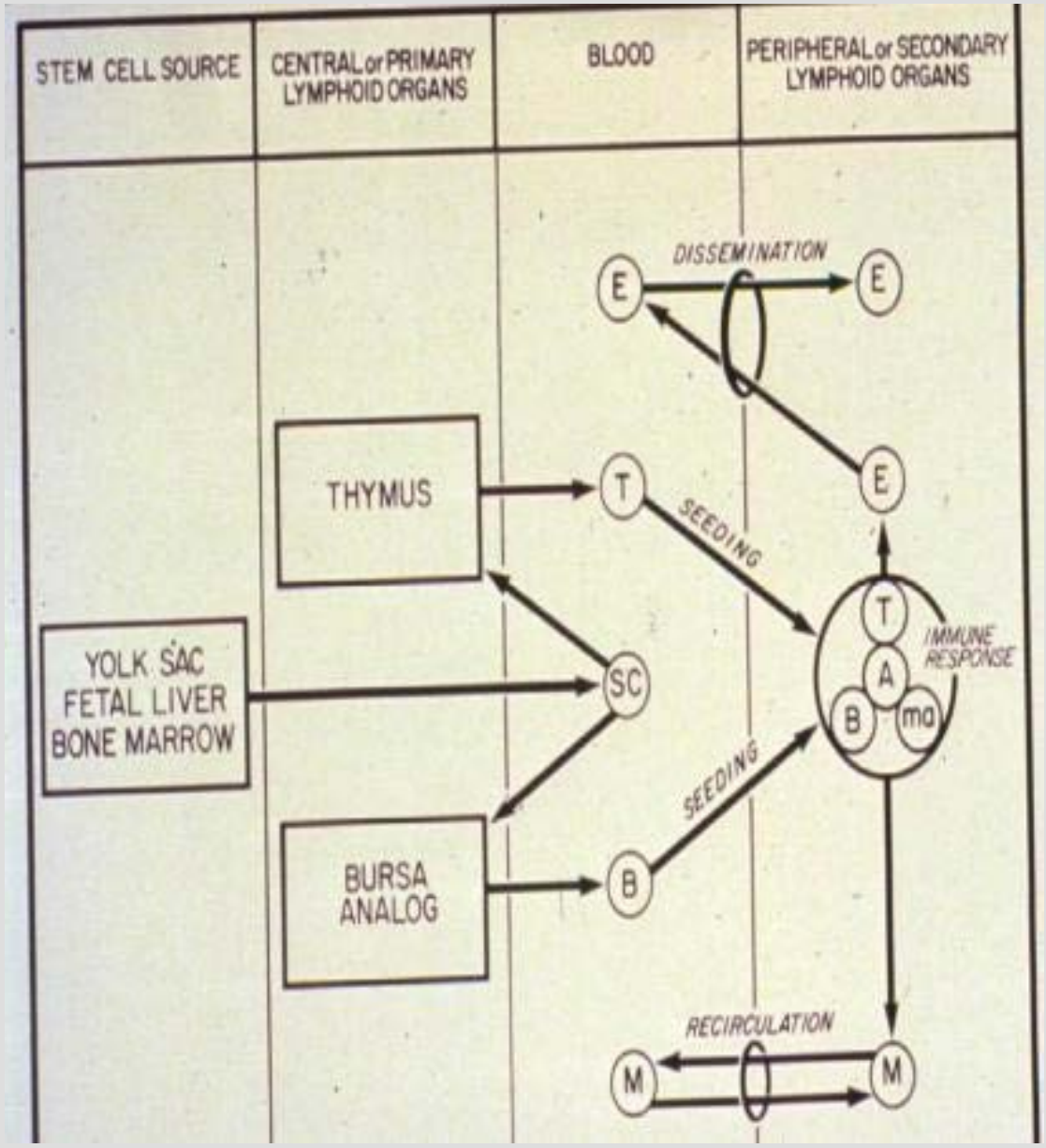


Life Cycle of Lymphocytes

Fetal organs
Bone marrow

Primary lymphoid organs
(Antigen independent development)
- **Thymus – T lymphocytes**
- **Bone marrow - B lymphocytes**

Secondary lymphoid organs
(Antigen dependent development)
- **Lymph nodes**
- **Lymphoid nodules**
- **Spleen**

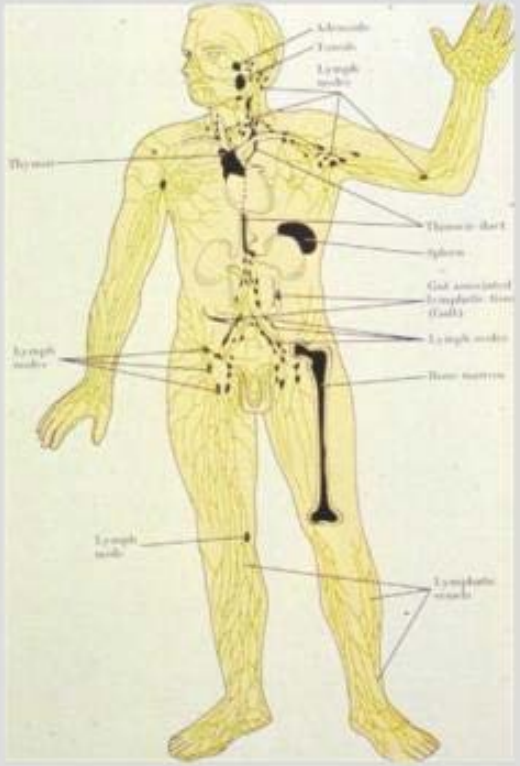


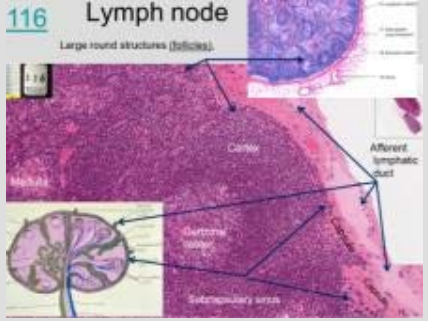
In summary

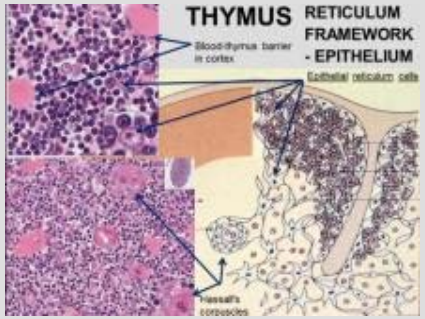
Ref code # 5, 6

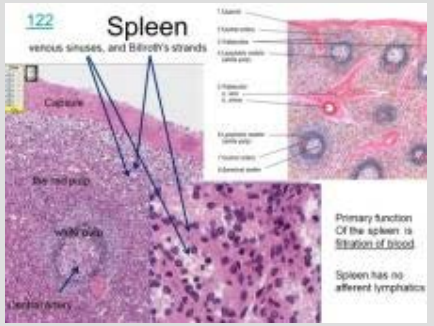
FUNCTIONS OF THE IMMUNE SYSTEM

- PROTECTION AGAINST FOREIGN INVADERS INTO BODY
- PRODUCE / PROTECT GERM FREE ENVIRONMENT OF THE BODY









Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

1. Alberts, et al., 1989. Molecular Biology of the Cell. 2nd Edition. Garland Publishing, Inc. New York. ISBN 0-8240-3695-6.
2. Alberts, et al., 1994. Molecular Biology of the Cell. 3nd Edition. Garland Publishing, Inc. New York. ISBN 0-8153-1619-4.
3. Bloom, W. and Fawcett, D.W., 1968. A Textbook of Histology. 9th Edition. W.B. Saunders Company. Philadelphia. Library of Congress #67-17445.
4. Elias, H. et al., 1978. Histology and Human Microanatomy. A Wiley Medical Publication. John Wiley & Sons, New York. ISBN 0-471-04929-8.
5. Eroschenko, V. 2000. Di Fiore's Atlas of Histology with Functional Correlations. 9th Edition. Lippincott Williams & Wilkins. Philadelphia. ISBN 0- 7817-2676-X.
6. Fawcett, D.W., 1986. Bloom and Fawcett. A Textbook of Histology. 11th Edition. W.B. Saunders Company. Philadelphia. ISBN 0-7216-1729-8.
7. Fawcett, D.W., 1986. Bloom and Fawcett. A Textbook of Histology. 12th Edition. Chapman and Hall. New York. ISBN 0-412-04691-1.
8. Guyton, A.C. 1971. Textbook of Medical Physiology. 4th Edition. W.B. Saunders Company. Philadelphia. Library of Congress # 74-118589.
9. Ham, A.W. 1974. Histology. 7th Edition. J.B. Lippincott Company. Philadelphia. ISBN 0-397-52062-X.
10. Ham, A.W. and Cormack, D.H. 1979. Histology. 8th Edition. J.B. Lippincott Co. Philadelphia. ISBN 0-397-52089-1.
11. Junqueria, et al., 1995. Basic Histology. 8th Edition. Appleton and Lange. Norwalk, Connecticut. ISBN 08385-0567-8.
12. Junqueira, et al., 1998. Basic Histology. 9th Edition. Appleton and Lange. Stamford, Connecticut. ISBN 0-8385-0590-2.
13. Knobil, E. et al. 1988. The Physiology of Reproduction. Volume 1. Raven Press. New York. ISBN 0-88167-281-5.
14. Langley, et al., 1974. Dynamic Anatomy and Physiology. 4th Edition. McGraw-Hill Book Company. New York. ISBN 0-07-036274-2.
15. Mescher, A.L., 2010. Junqueira's Basic Histology Text and Atlas. 12th Edition. McGraw Hill Medical. New York. ISBN 978-0-07-160431-4.
16. Tuttle, W.W. and Schottelius, B.A. 1969. Textbook of Physiology. 16th Edition. The C.V. Mosby Company. Saint Louis. Library of Congress # 75- 89848.
17. Varner, D. et al. 1991. Diseases and Management of Breeding Stallions. American Veterinary Publications. Goleta, California. ISBN 0-939674-33-5.
18. Von Hagens, Gunther and A.Whalley, 2007. Body Worlds – The Anatomical Exhibition of Real Human Bodies. ISBN 978-3-937256-04-7
19. Weiss, L. 1983. Histology: Cell and Tissue Biology. 5th Edition. Elsevier Biomedical. New York. ISBN 0-444-00716-4.
20. Weiss, L. and Greep, R. 1977. Histology. 4th Edition. McGraw-Hill Book Company. New York. ISBN 0-07-069091-X.

Questions on the lymphoid system

1. The main purpose(s) of lymphocyte traffic, the circulation of lymphocytes throughout the body, is:

a. to place the responsible lymphocytes in the region of specific antigens
b. to stimulate lymphocyte growth through meiosis
c. to clean out the lymphatics ducts
d. a and b
e. a, b, and c

2. The function(s) of the spleen include:

a. clean the blood of particulate matter
b. to remove worn red blood cells
c. to remove ribosomes from reticulocytes
d. a and b
e. a, b, and c

3. Which lymphatic organ(s) contain(s) penicilliary arteries or both afferent and efferent lymphatic vessels?

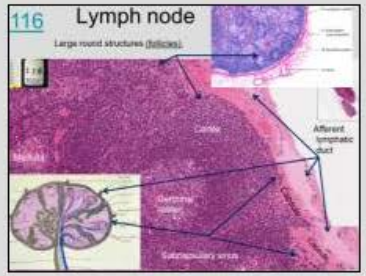
a. lymph node
b. spleen
c. thymus
d. a and b
e. a, b, and c

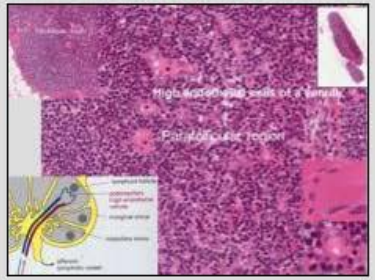
Park near Liberty Hill, TX

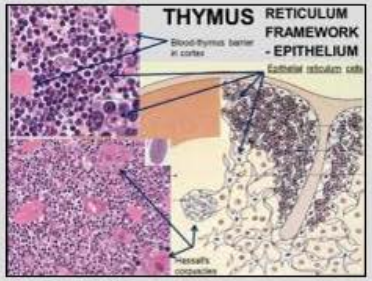
The end of

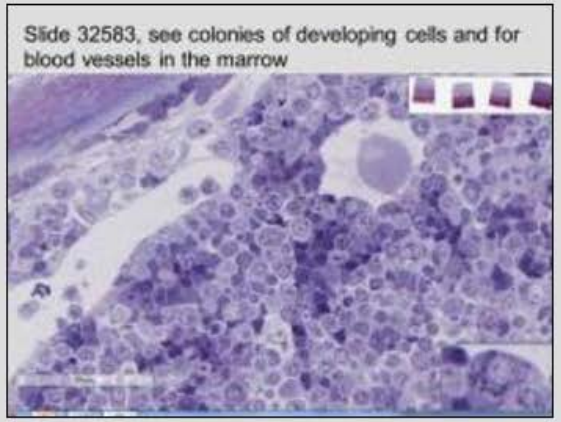
Medical School Histology Basics
Lymphoid System

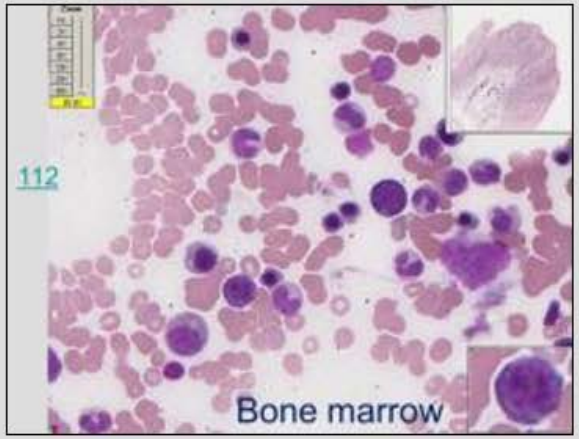
VIBS 243 lab

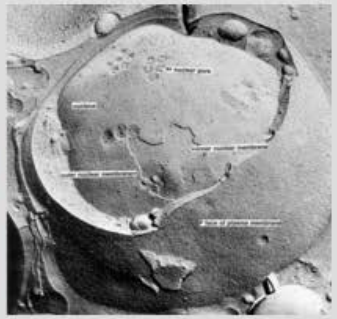


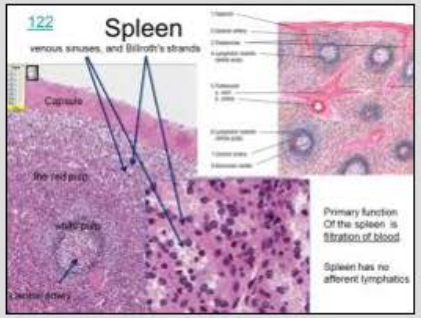












Larry Johnson Texas A&M University