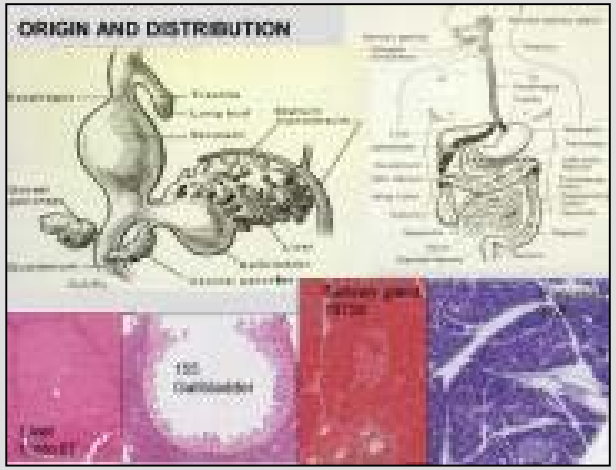
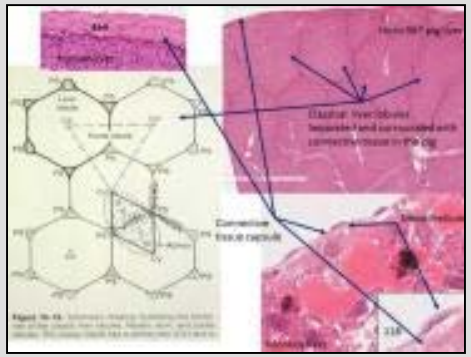
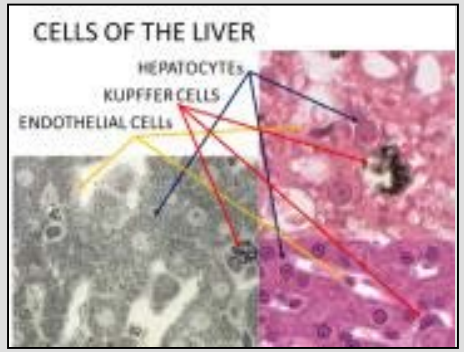
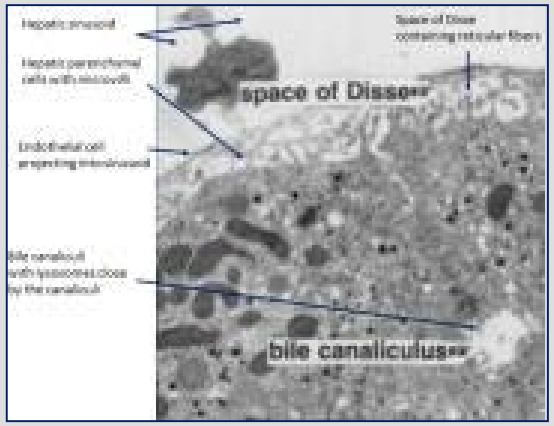
Medical School Histology Basics
Liver, gallbladder, salivary glands, and pancreas

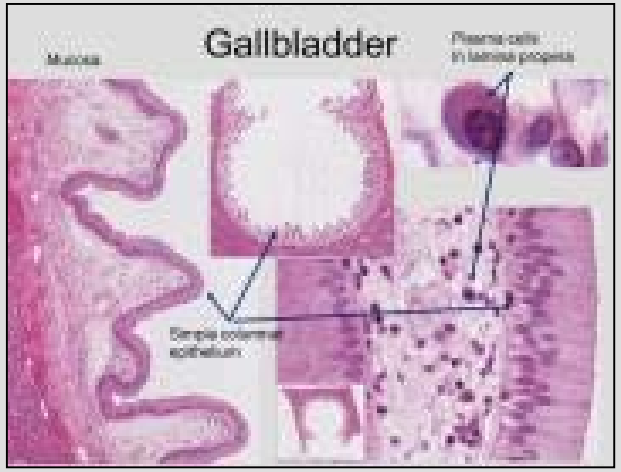
VIBS 243 lab

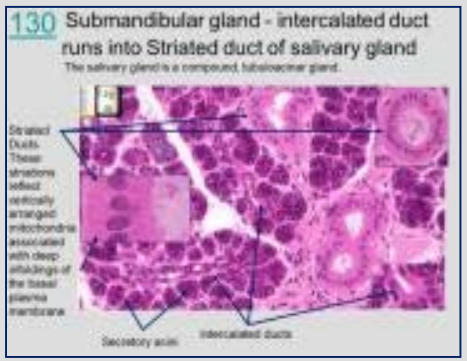


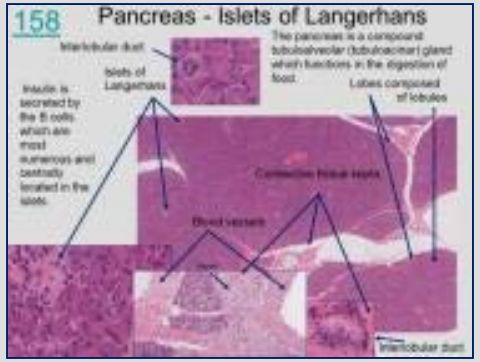


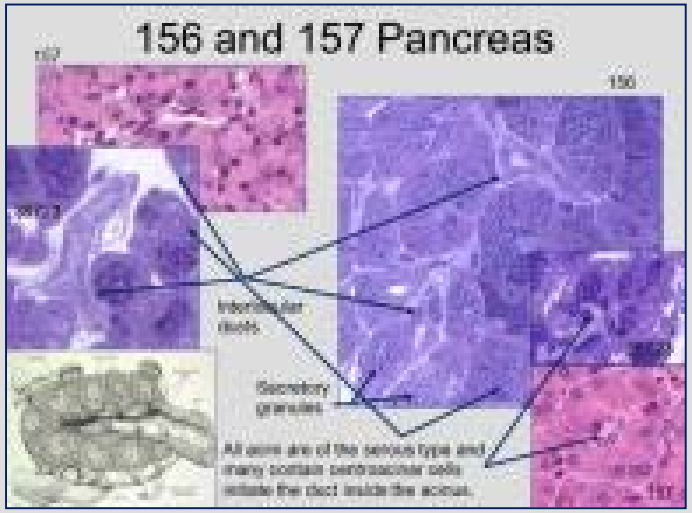






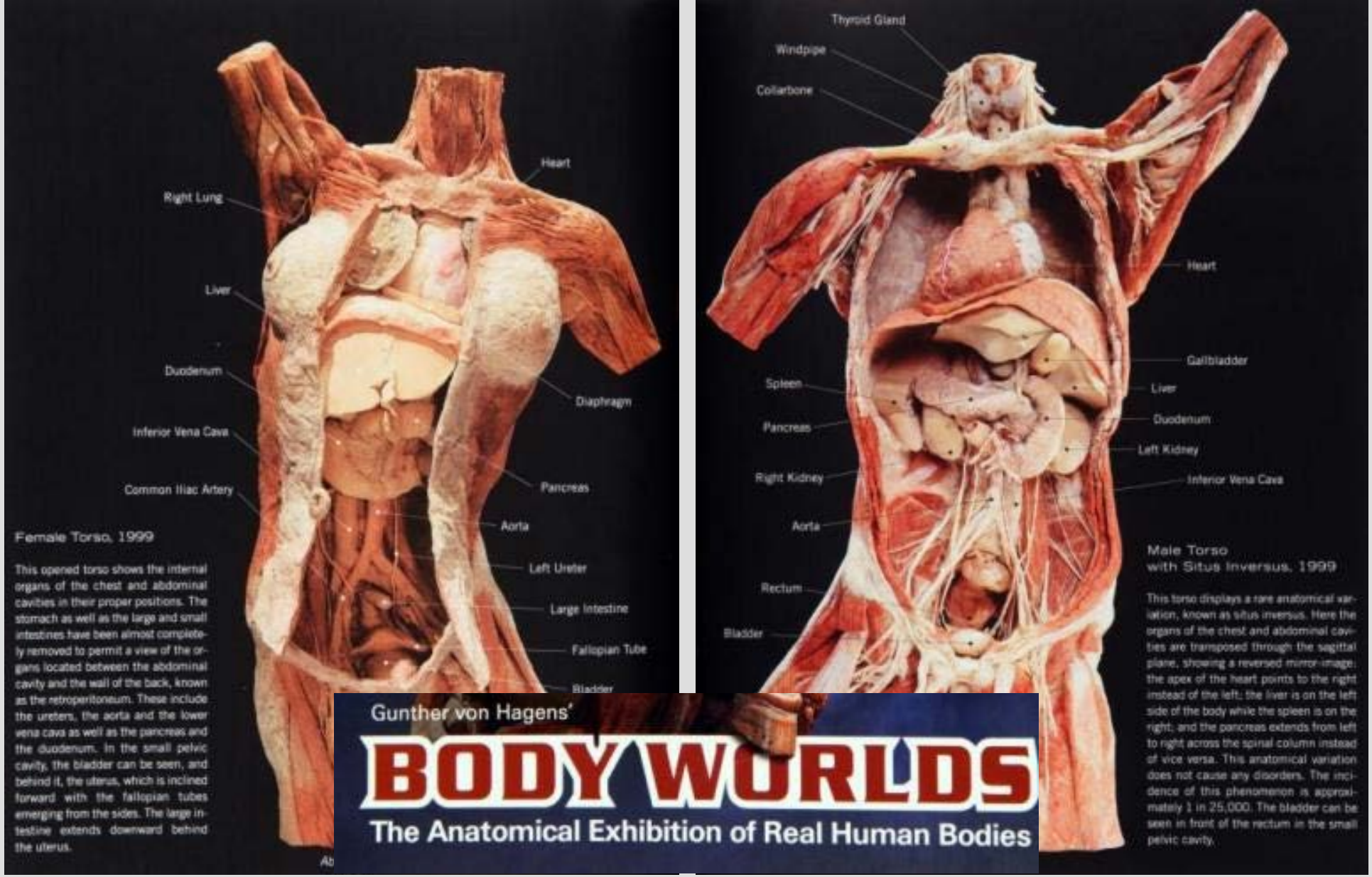






Larry Johnson Texas A&M University

Ref code
18


Heart
Right Lung
Liver
Duodenum
Diaphragm
Inferior Vena Cava
Common Iliac Artery
Pancreas
Aorta
Left Ureter
Large Intestine
Fallopian Tube
Bladder
Female Torso, 1999
This opened torso shows the internal organs of the chest and abdominal cavities in their proper positions. The stomach as well as the large and small intestines have been almost completely removed to permit a view of the organs located between the abdominal cavity and the wall of the back, known as the retroperitoneum. These include the ureters, the aorta and the lower vena cava as well as the pancreas and the duodenum. In the small pelvic cavity, the bladder can be seen, and behind it, the uterus, which is inclined forward with the fallopian tubes emerging from the sides. The large intestine extends downward behind the uterus.
Thyroid Gland
Windpipe
Collarbone
Heart
Gallbladder
Spleen
Liver
Pancreas
Duodenum
Left Kidney
Right Kidney
Inferior Vena Cava
Aorta
Rectum
Bladder
Male Torso
with Situs Inversus, 1999
This torso displays a rare anatomical variation, known as situs inversus. Here the organs of the chest and abdominal cavities are transposed through the sagittal plane, showing a reversed mirror-image: the apex of the heart points to the right instead of the left; the liver is on the left side of the body while the spleen is on the right; and the pancreas extends from left to right across the spinal column instead of vice versa. This anatomical variation does not cause any disorders. The incidence of this phenomenon is approximately 1 in 25,000. The bladder can be seen in front of the rectum in the small pelvic cavity.
Gunther von Hagens'
BODY WORLDS
The Anatomical Exhibition of Real Human Bodies

Objectives

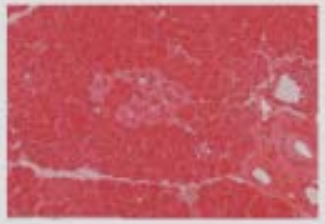
Ref code # 16

To understand the general organization of the accessory organs of the digestive system and how they contribute to obtaining metabolites necessary for growth and energy for the body.

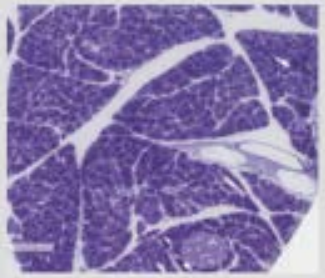
To learn the origin of these glands and how structural features of these glands contribute to their function in digestion and absorption of food stuffs

Liver
Histo
67

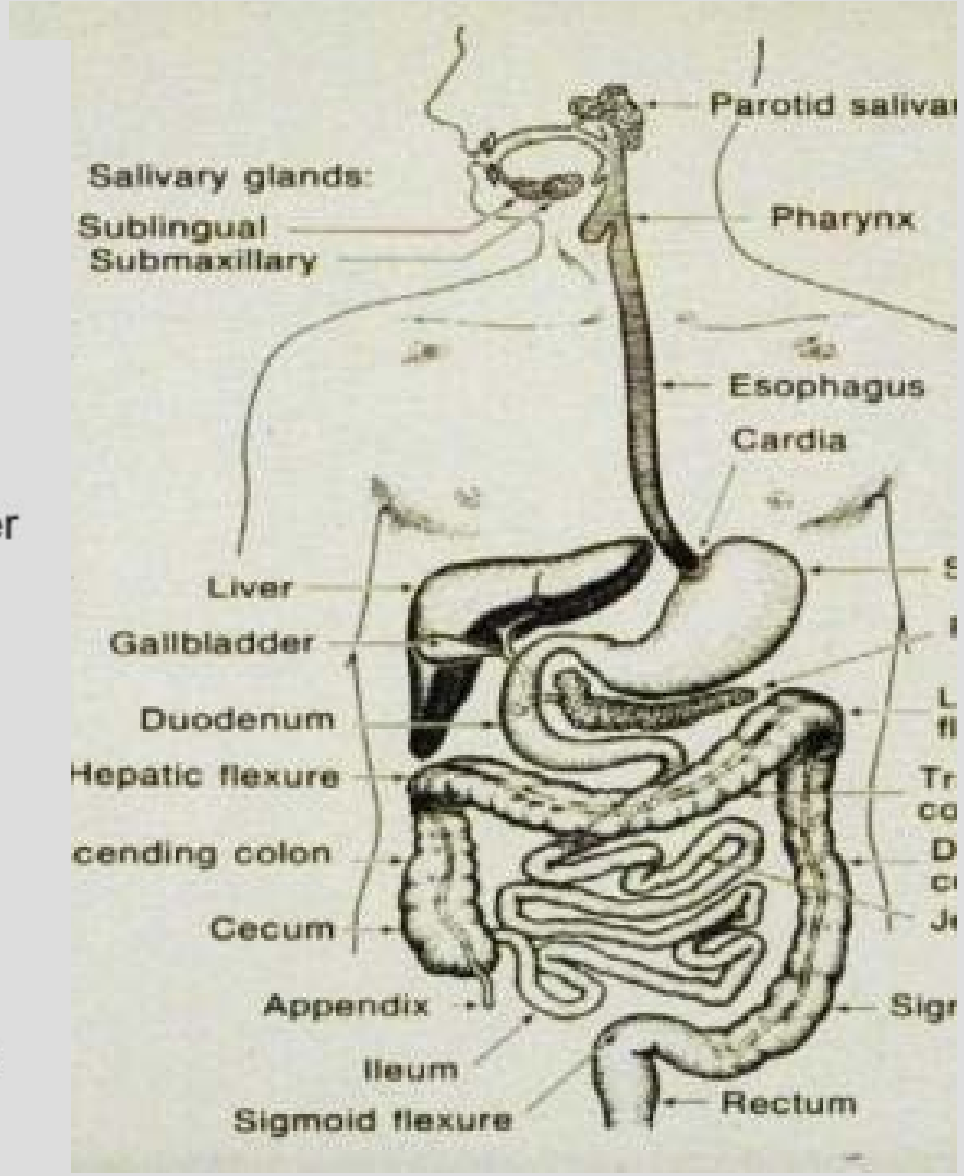
155
Gallbladder



Salivary
gland
19758



Pancreas
158



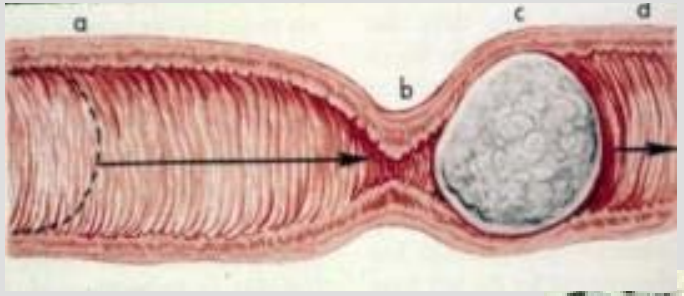
Function of the Digestive System

Ref code
4, 16

Role of liver, gall bladder, salivary glands, and pancreas

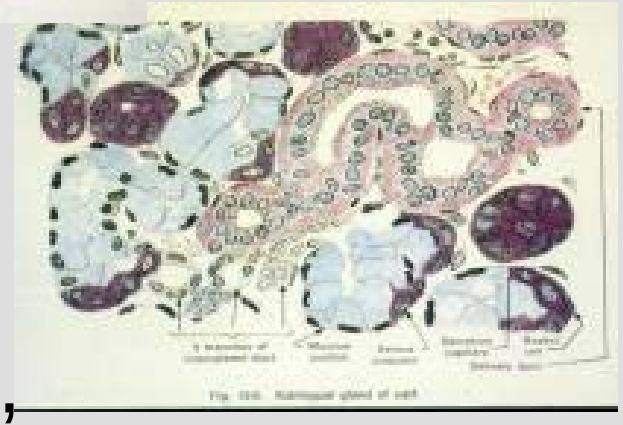
Movement of food

Salivary glands lubricates



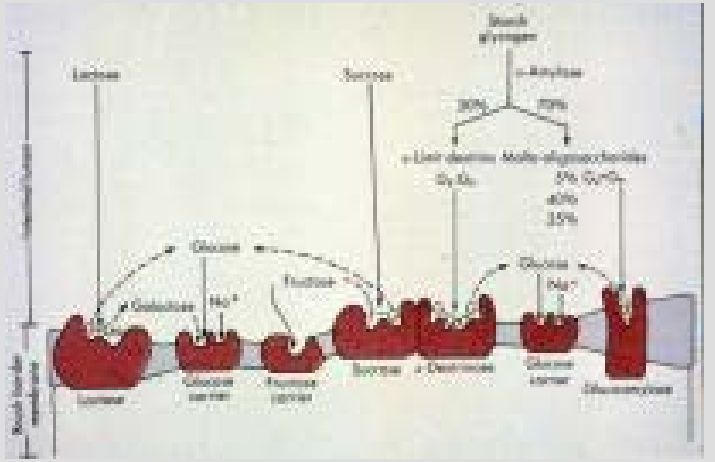
Secretion of digestive juices

Salivary glands and pancreas secretes digestive juices and liver secretes bile



Absorption of digested foods, water, and electrolytes

Liver stores nutrients and cleans the blood. Also, the accessory digestive organs contribute antibodies and antibacterial/viral growth substances.



ORIGIN AND DISTRIBUTION OF EPITHELIUM

Ref code # 4

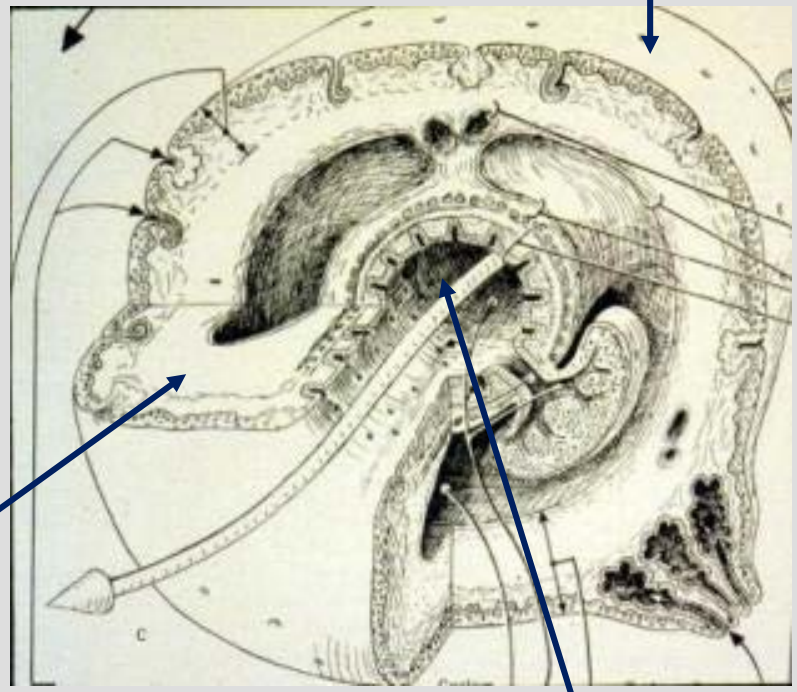
ECTODERM - EPIDERMIS OF SKIN AND EPITHELIUM OF CORNEA TOGETHER COVERS THE ENTIRE SURFACE OF THE BODY; SEBACEOUS AND MAMMARY GLANDS

ENDODERM - ALIMENTARY TRACT, LIVER, PANCREAS, GASTRIC GLANDS, INTESTINAL GLANDS

- ENDOCRINE GLANDS - LOSE CONNECTION WITH SURFACE

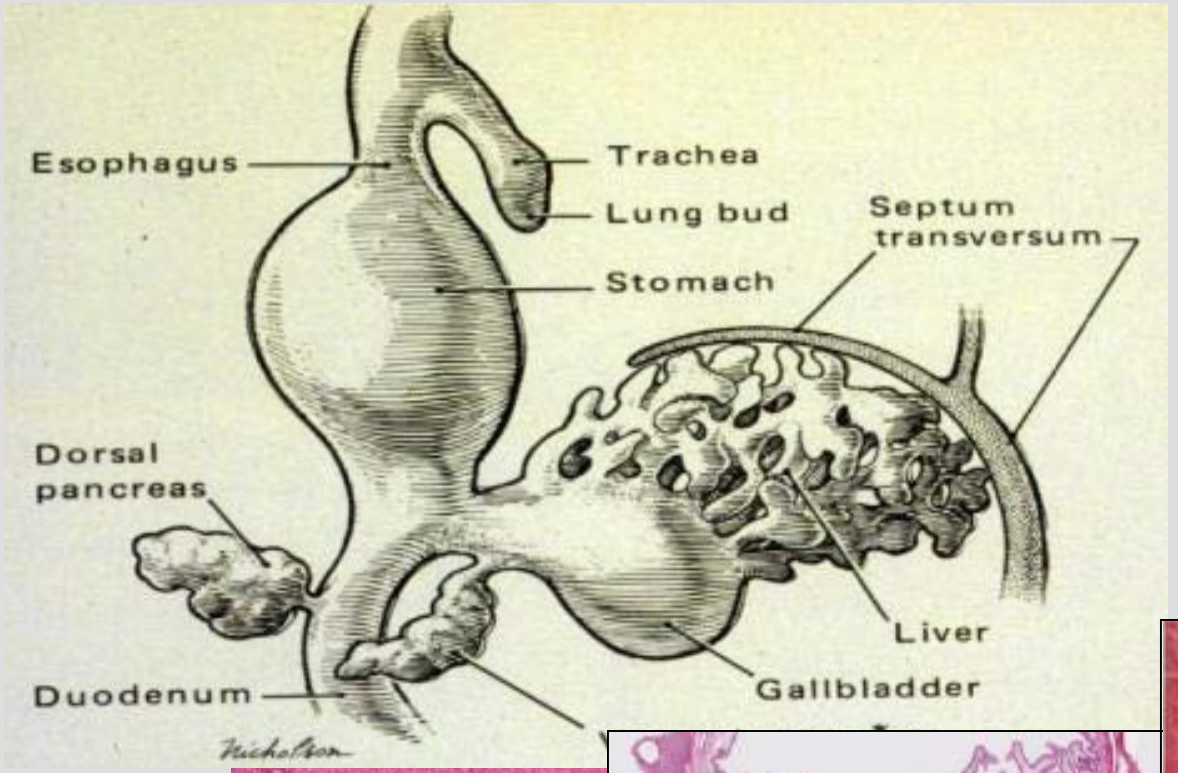
MESODERM

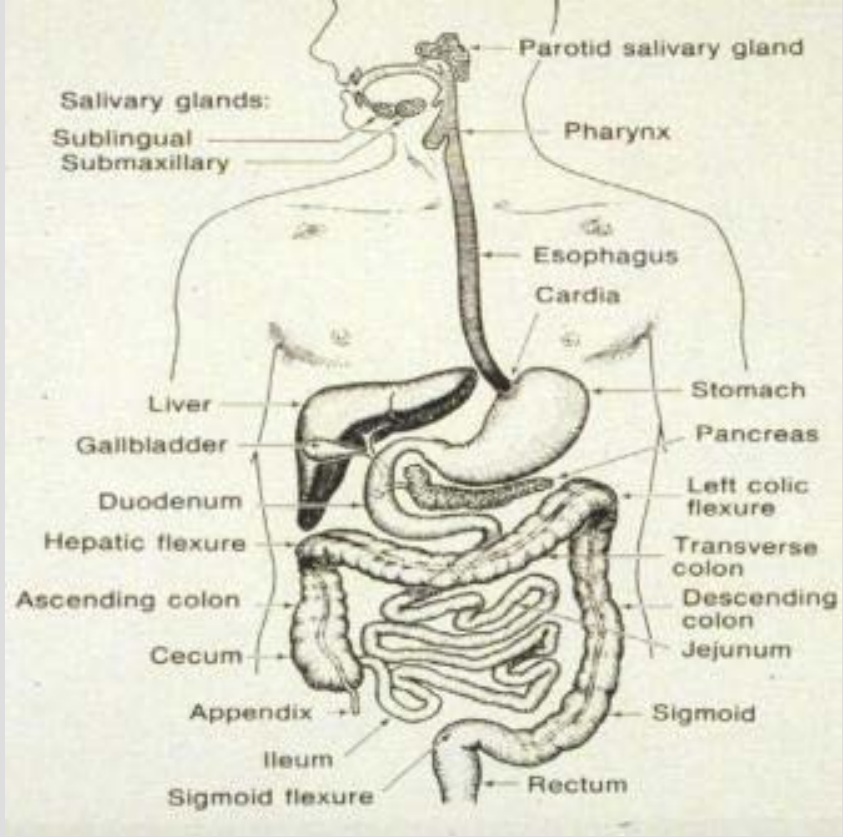
- ENDOTHELIUM - LINING OF BLOOD VESSELS
- MESOTHELIUM - LINING SEROUS CAVITIES

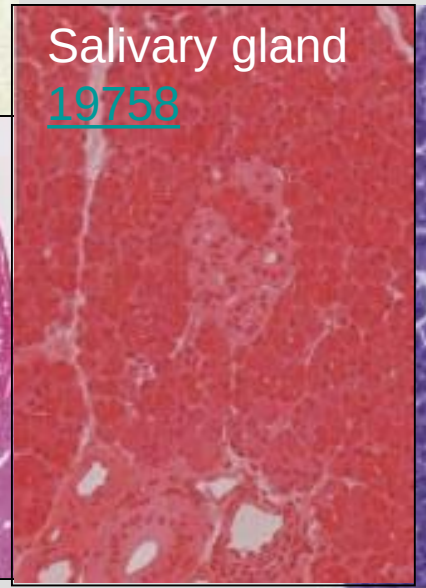


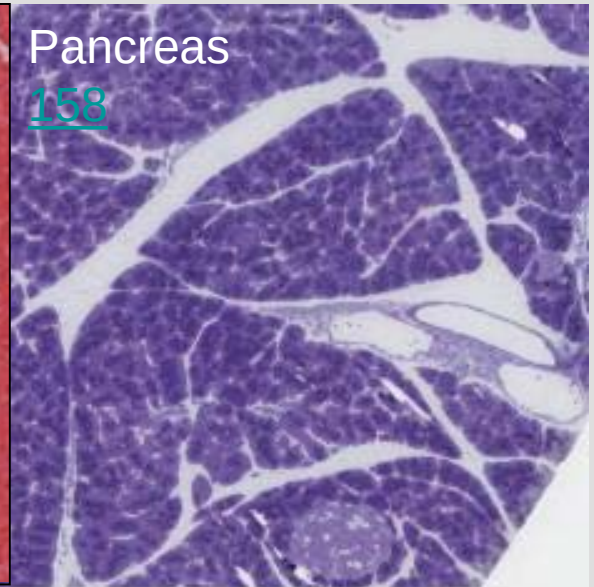
ORIGIN AND DISTRIBUTION OF EPITHELIUM con'd

Ref code # 14, 16





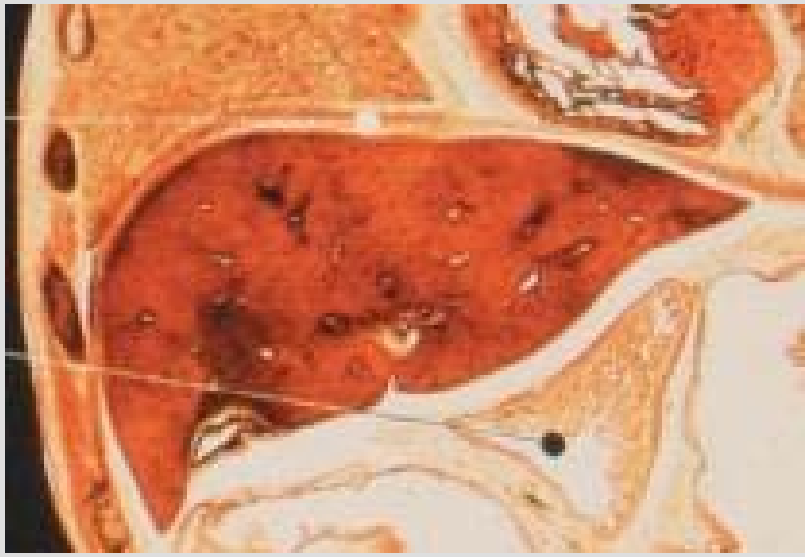


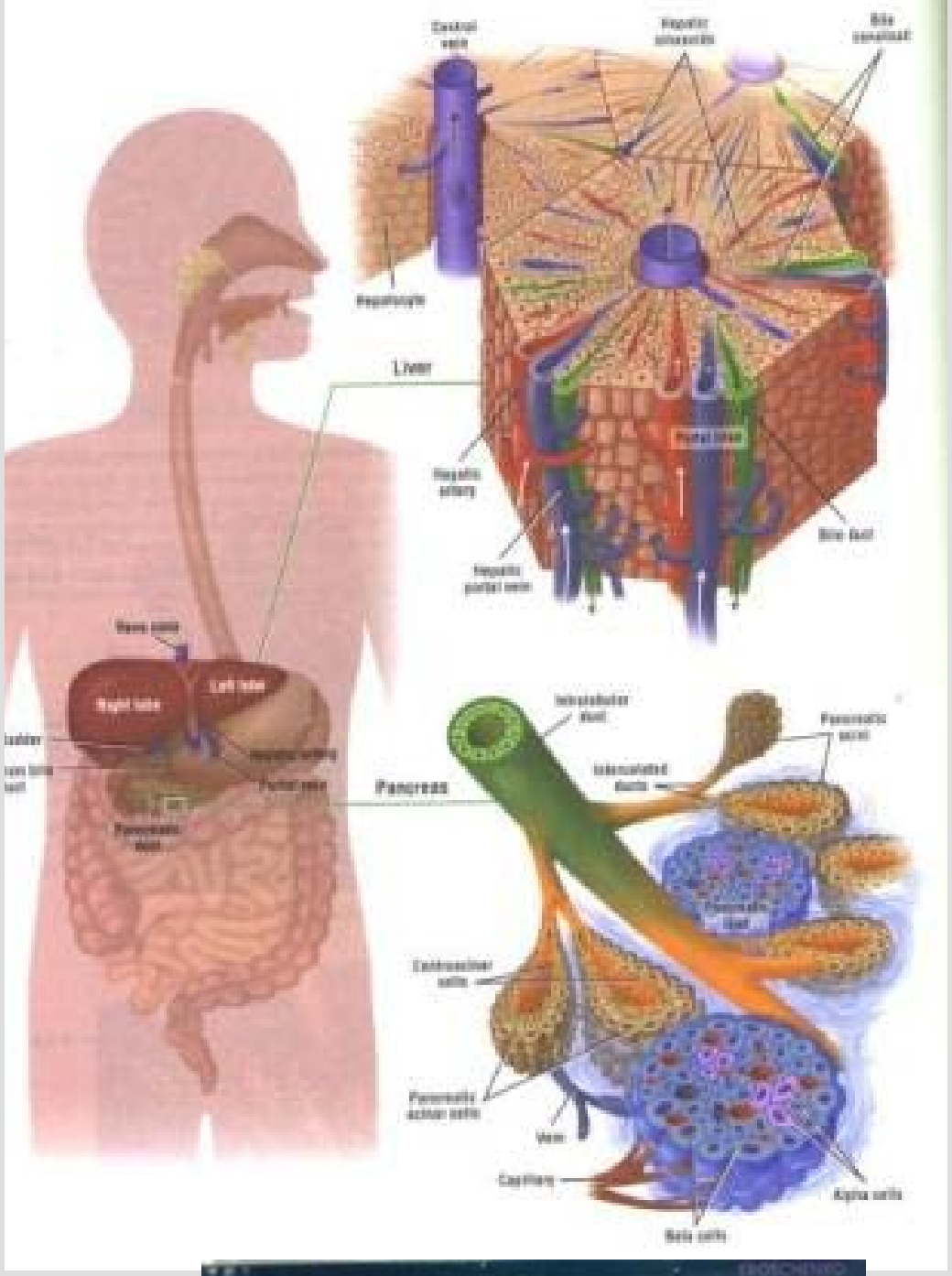


Ref code
18

LIVER FUNCTIONS

- Blood filtration - 1.2 x 107 Kupffer cells/g
- Blood storage - liver size and sinusoids expand
- Maintain normal blood glucose concentrations
- Metabolism and transport of lipids
- Secrete plasma proteins - blood clotting
- Nutritional metabolism and bile secretion
- Drug metabolism - drug tolerance
- Excretion of bilirubin - jaundice
- Secrete bile - emulsifying fats





di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS

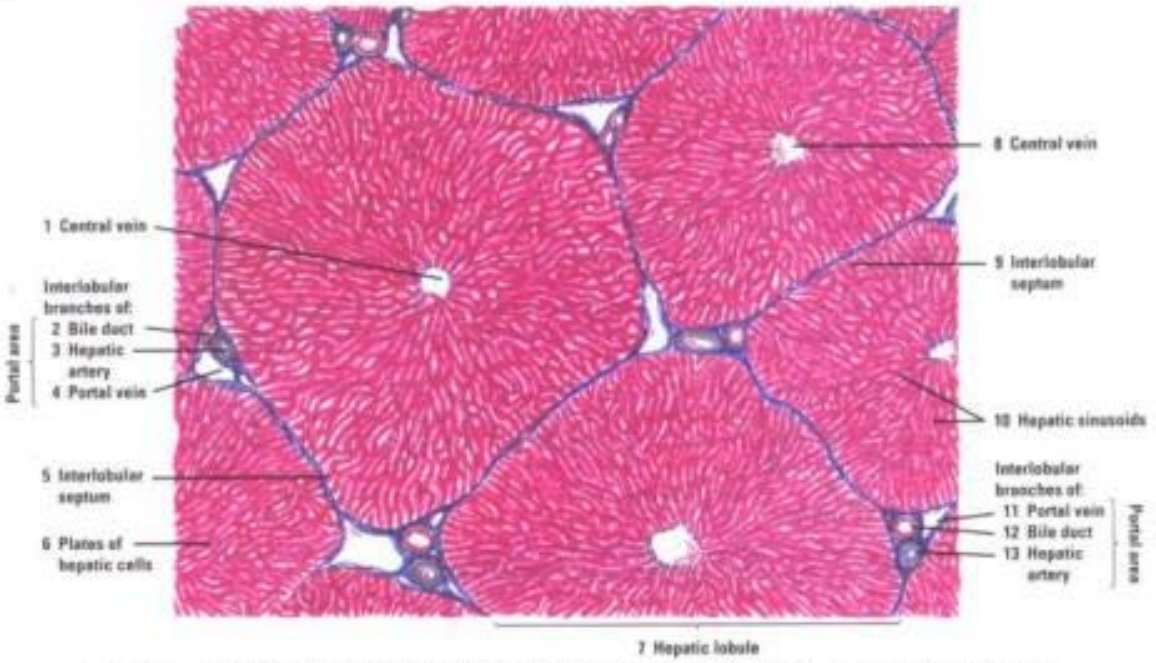
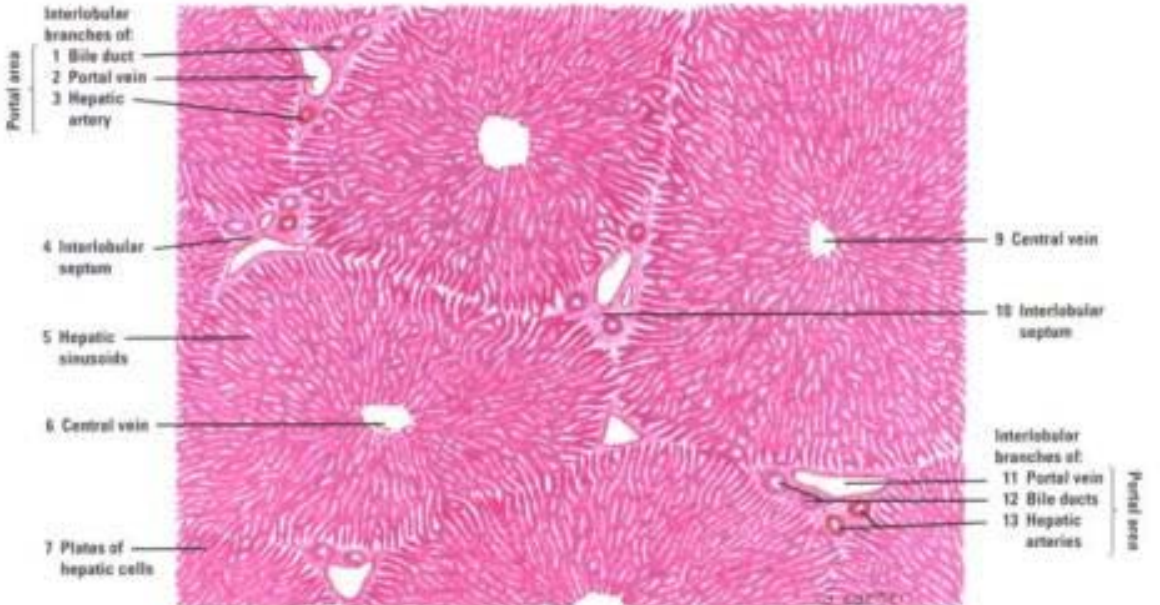


Fig. 13-1 Pig's Liver (panoramic view, transverse section). Stain: Mallory-azan. Low magnification.



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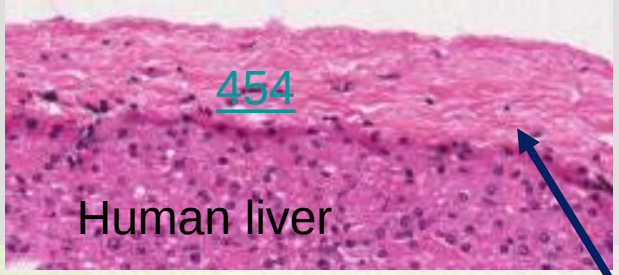


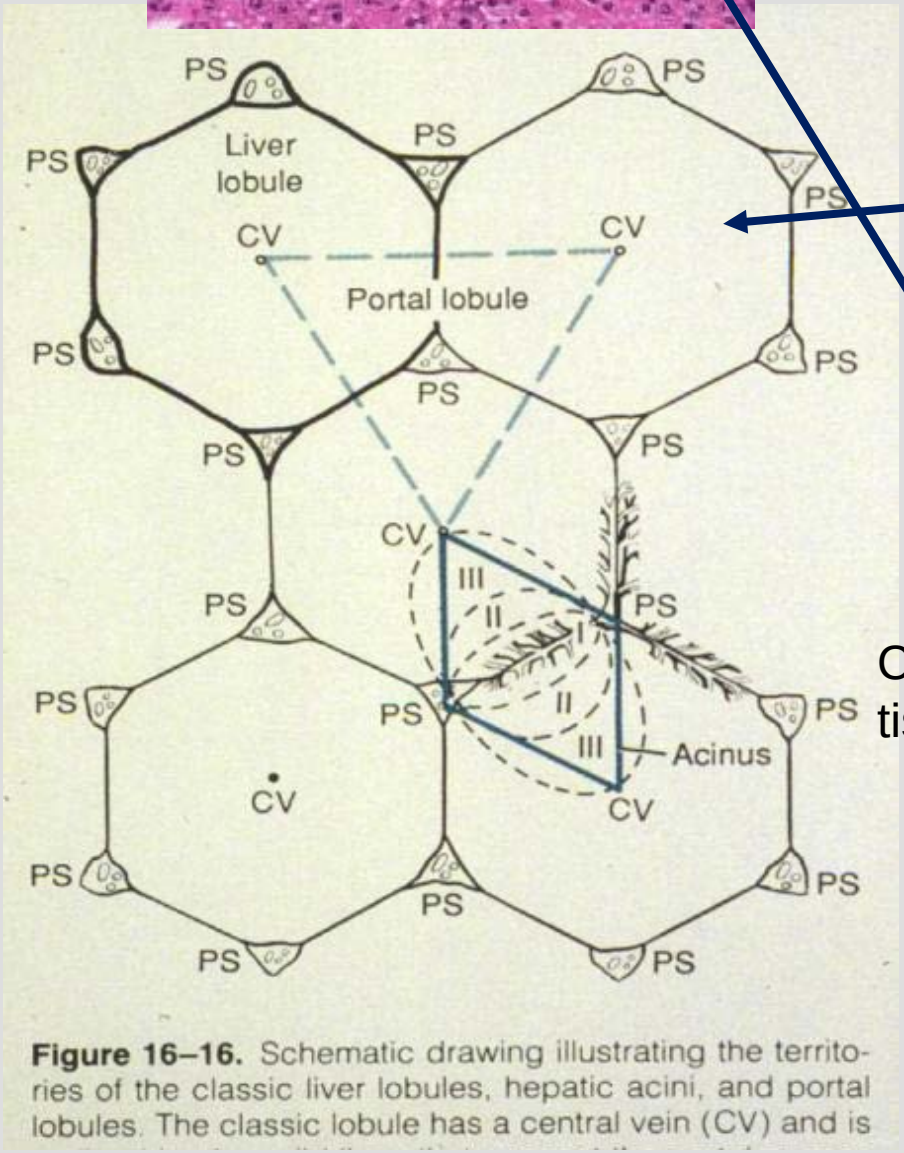
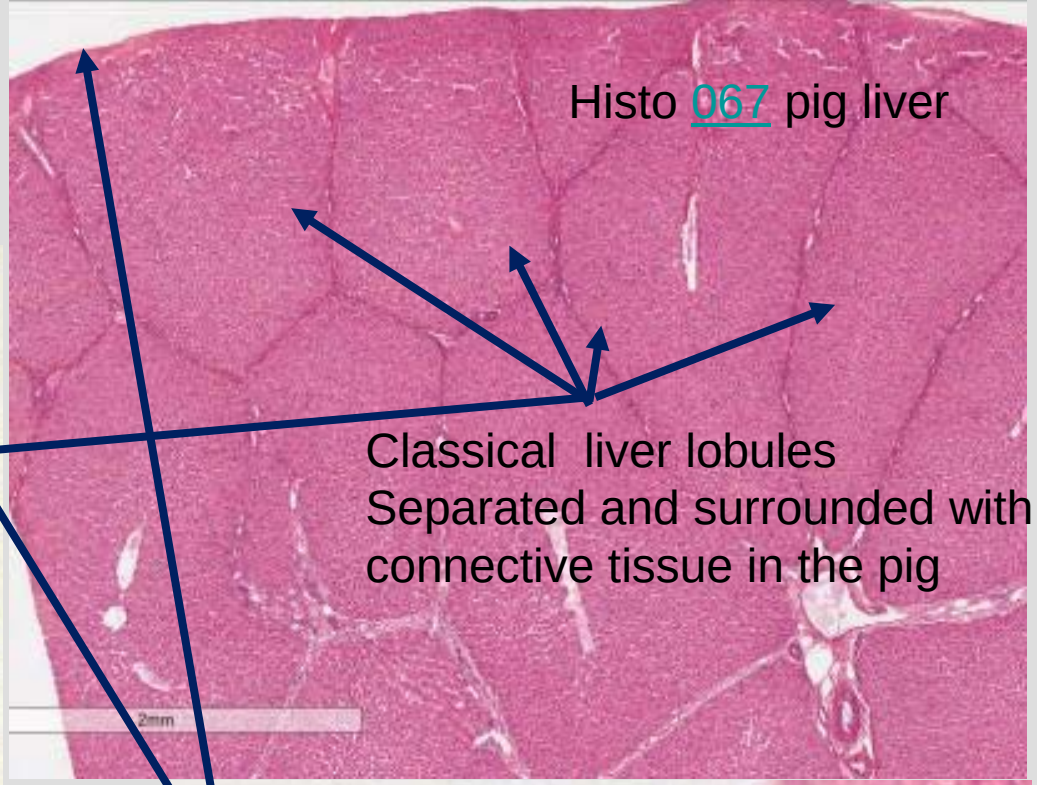
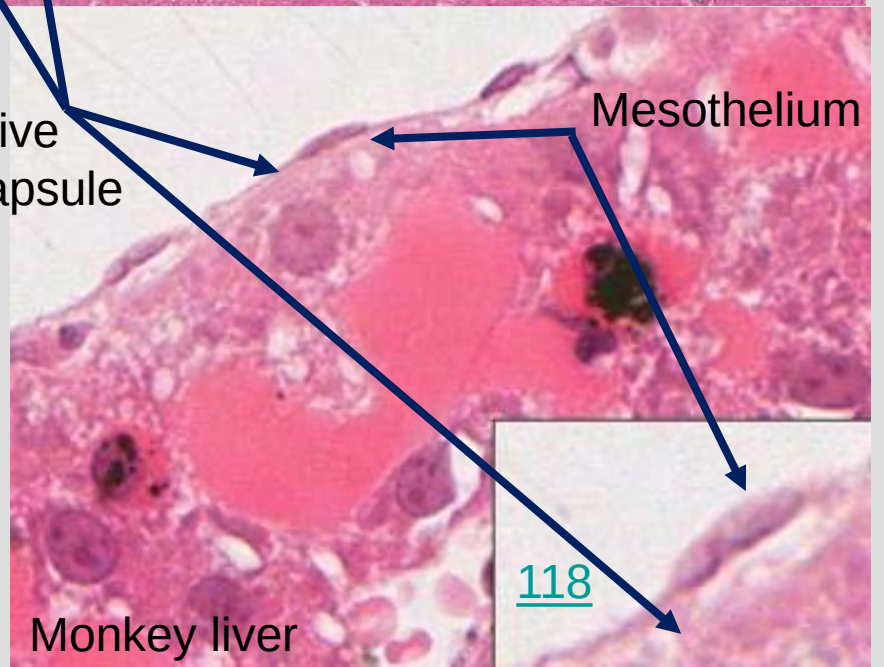


Figure 16–16. Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is



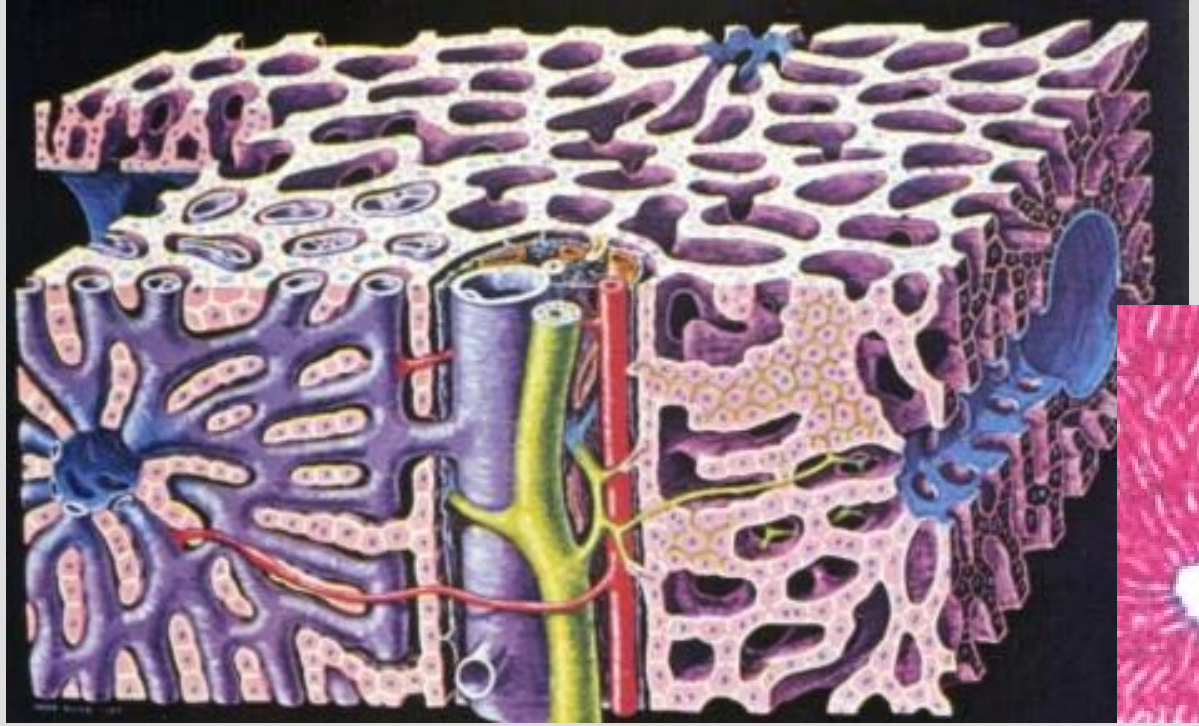
Connective tissue capsule

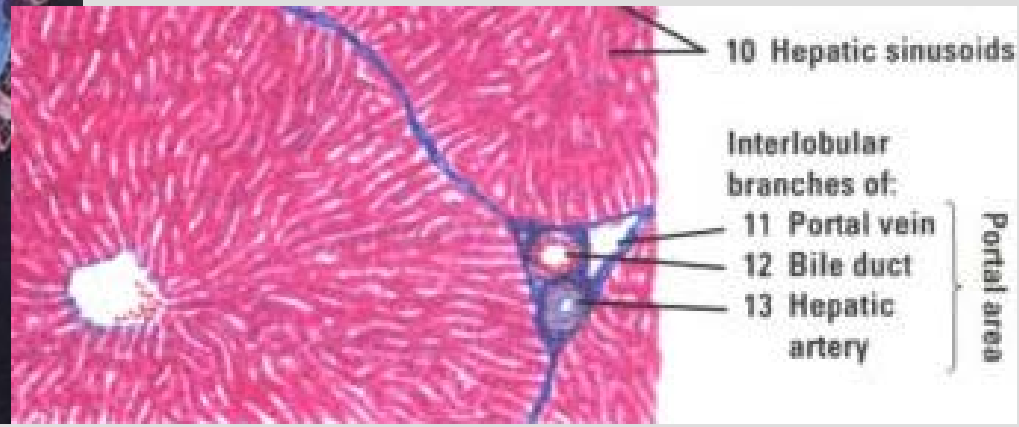


Ref code # 12

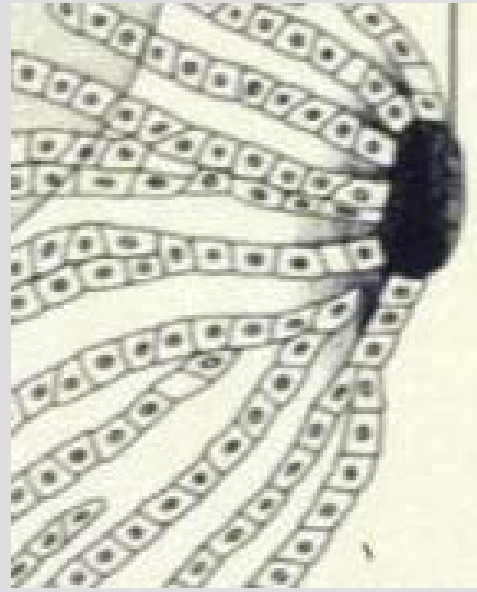
Liver

Ref code
4, 5, 6

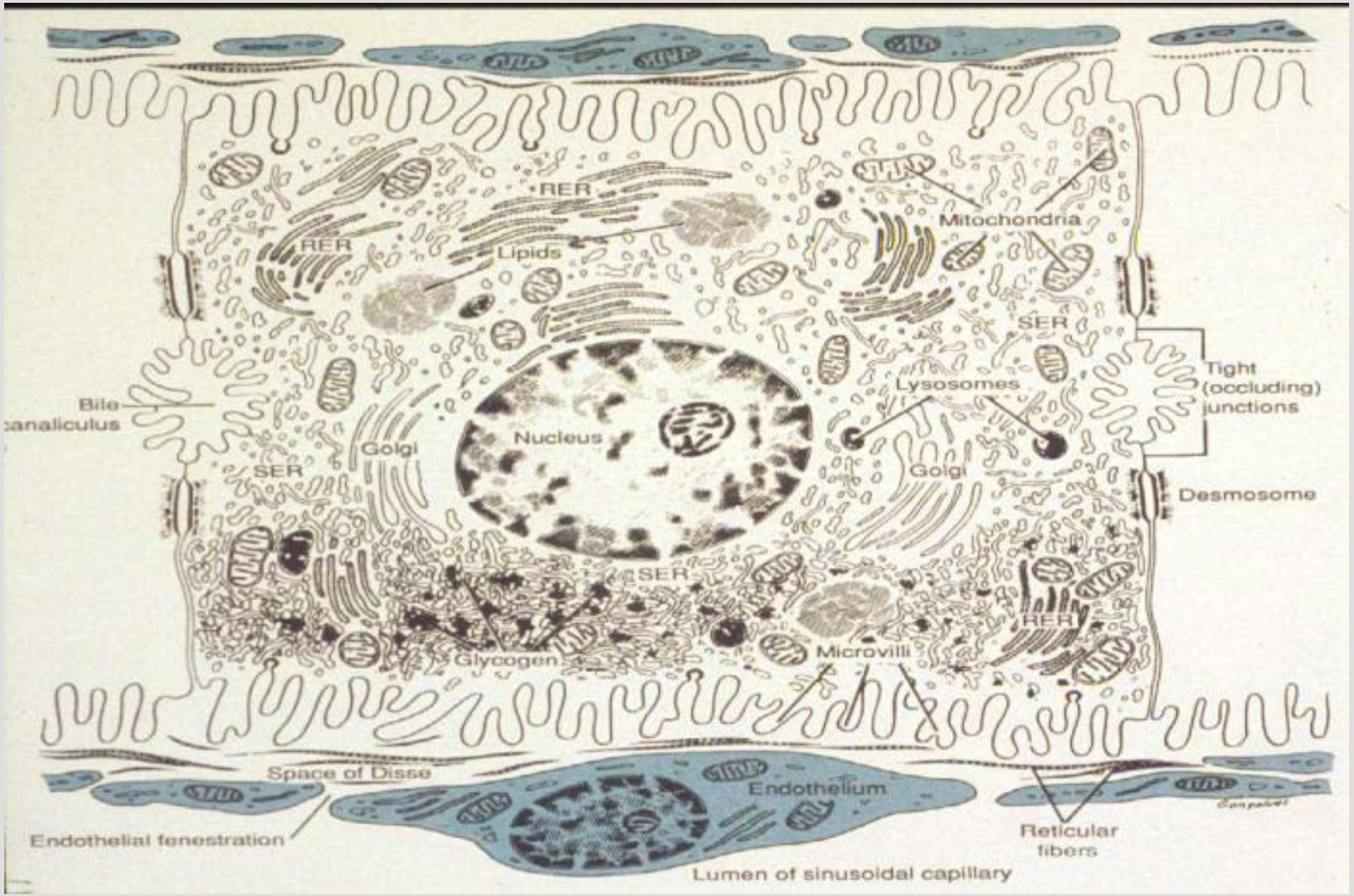




The hepatocyte functions as an endocrine-like cell (e.g., secretion of glucose and plasma proteins directly into the blood vascular system) and as an exocrine cell (e.g., secretion of bile into the bile canaliculi). This dual export of secretory products by a single cell requires a unique cellular arrangement in the liver in order to separate and compartmentalize the exocrine and endocrine-like products. Hepatocytes are arranged in fenestrated, anastomosing plates of one cell thick. Also each hepatocyte may have as many as four areas of access to the lumen.



Landscape of the Hepatocyte – Four Luminal Regions (two blood and two bile)



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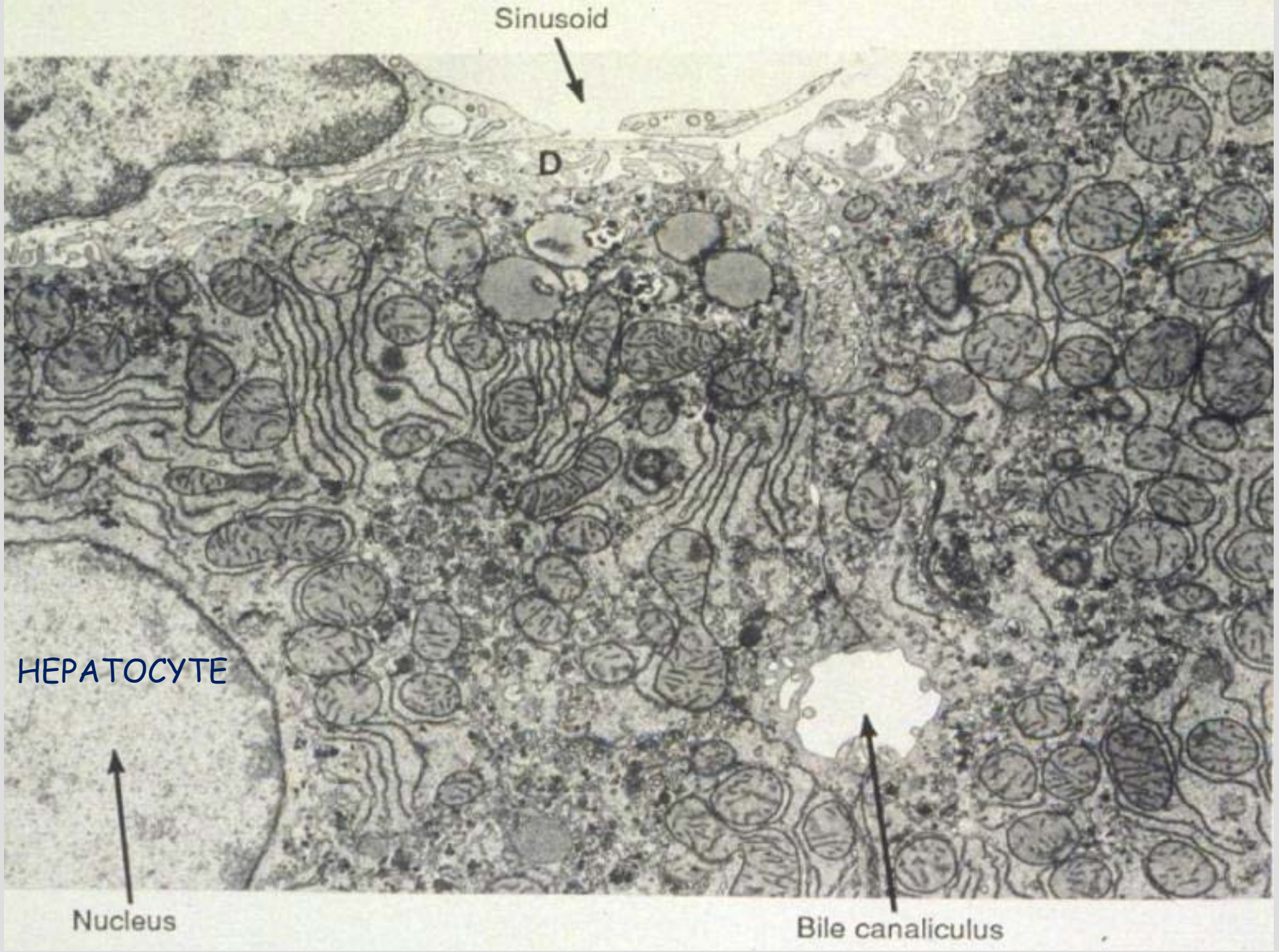


Ref code
12

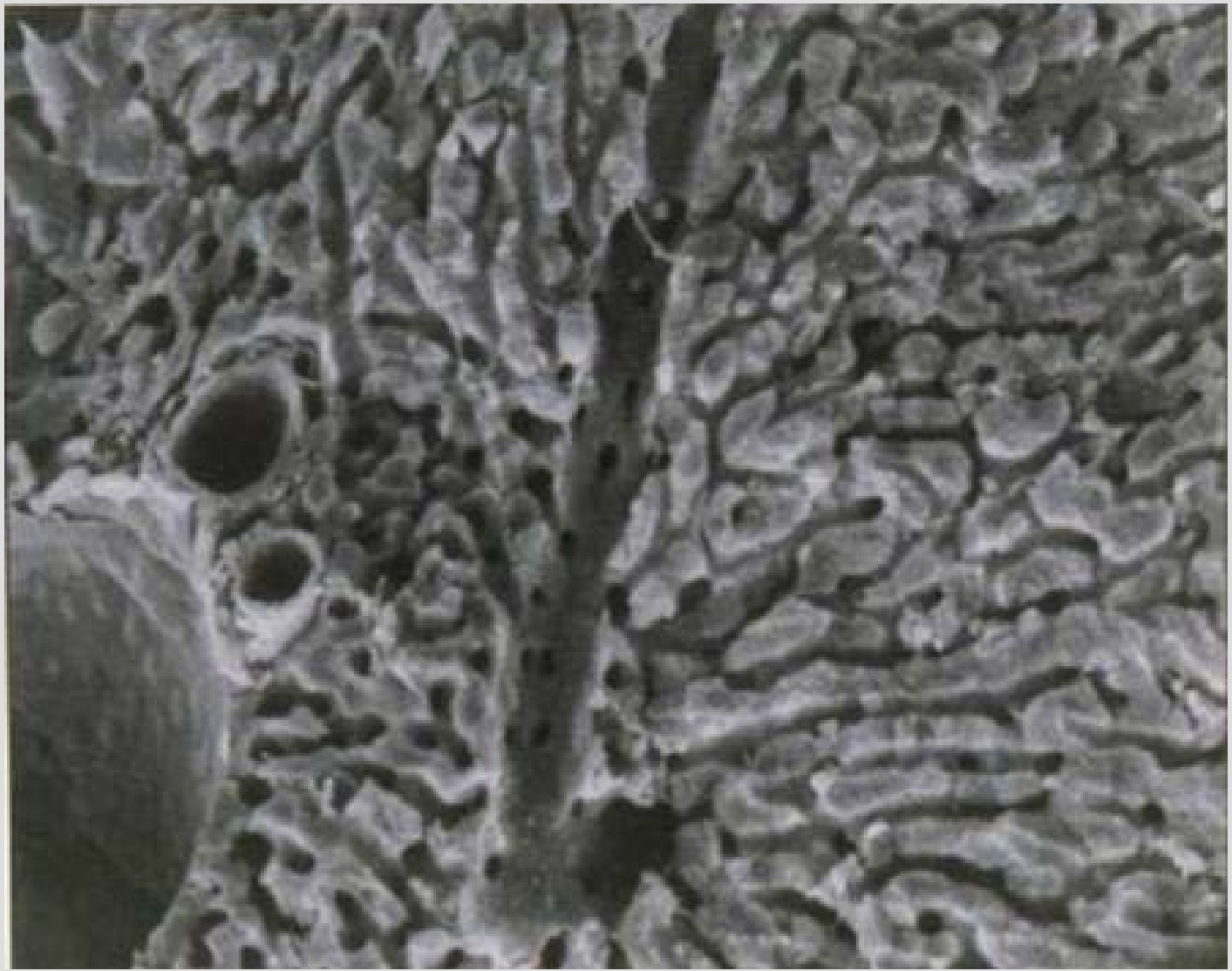
Ref code
2

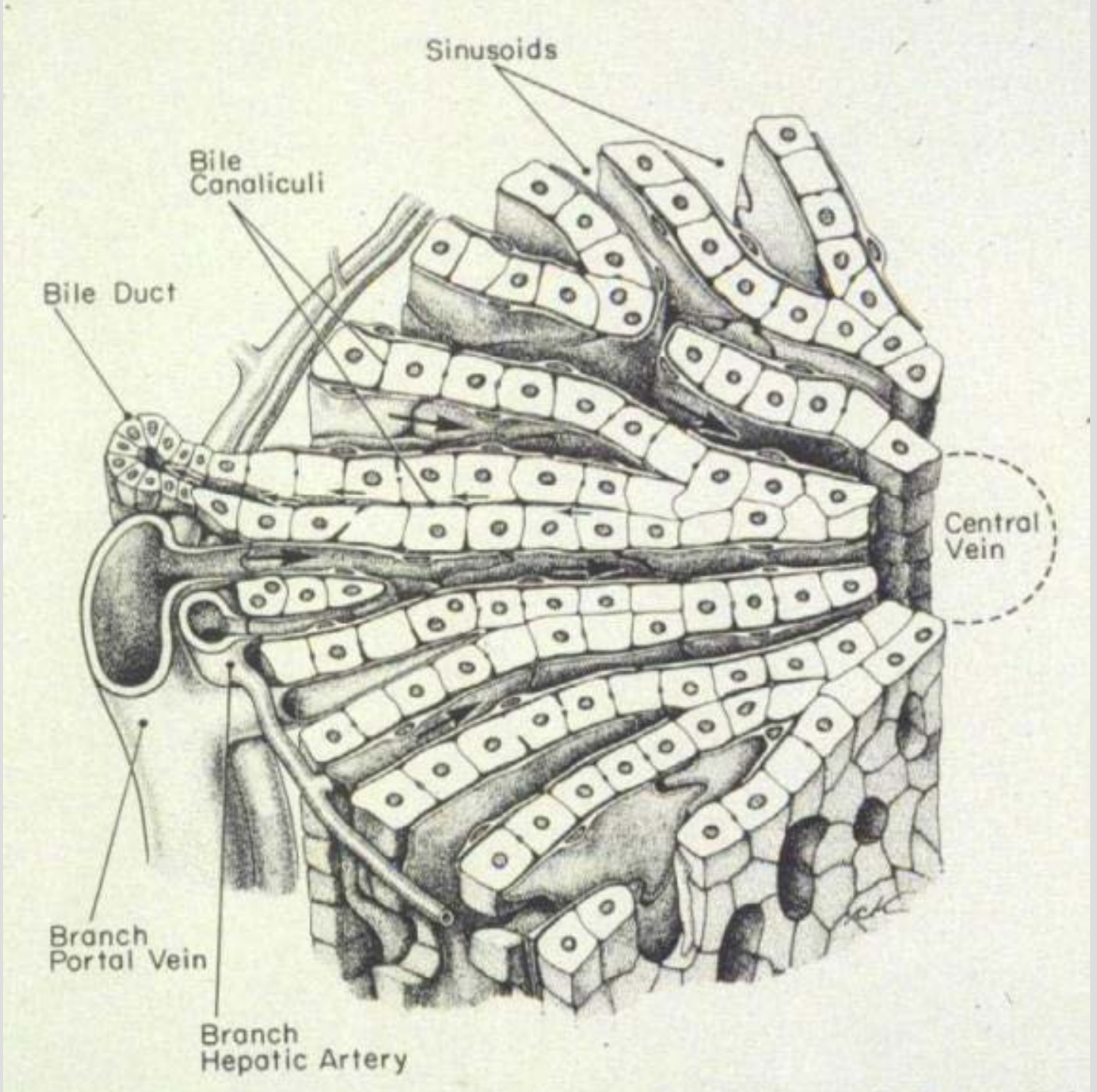
LIVER FUNCTION - LARGEST GLAND

EXOCRINE - BILE ACIDS, BILIRUBIN

ENDOCRINE - ALBUMIN, FIBRINOGEN,

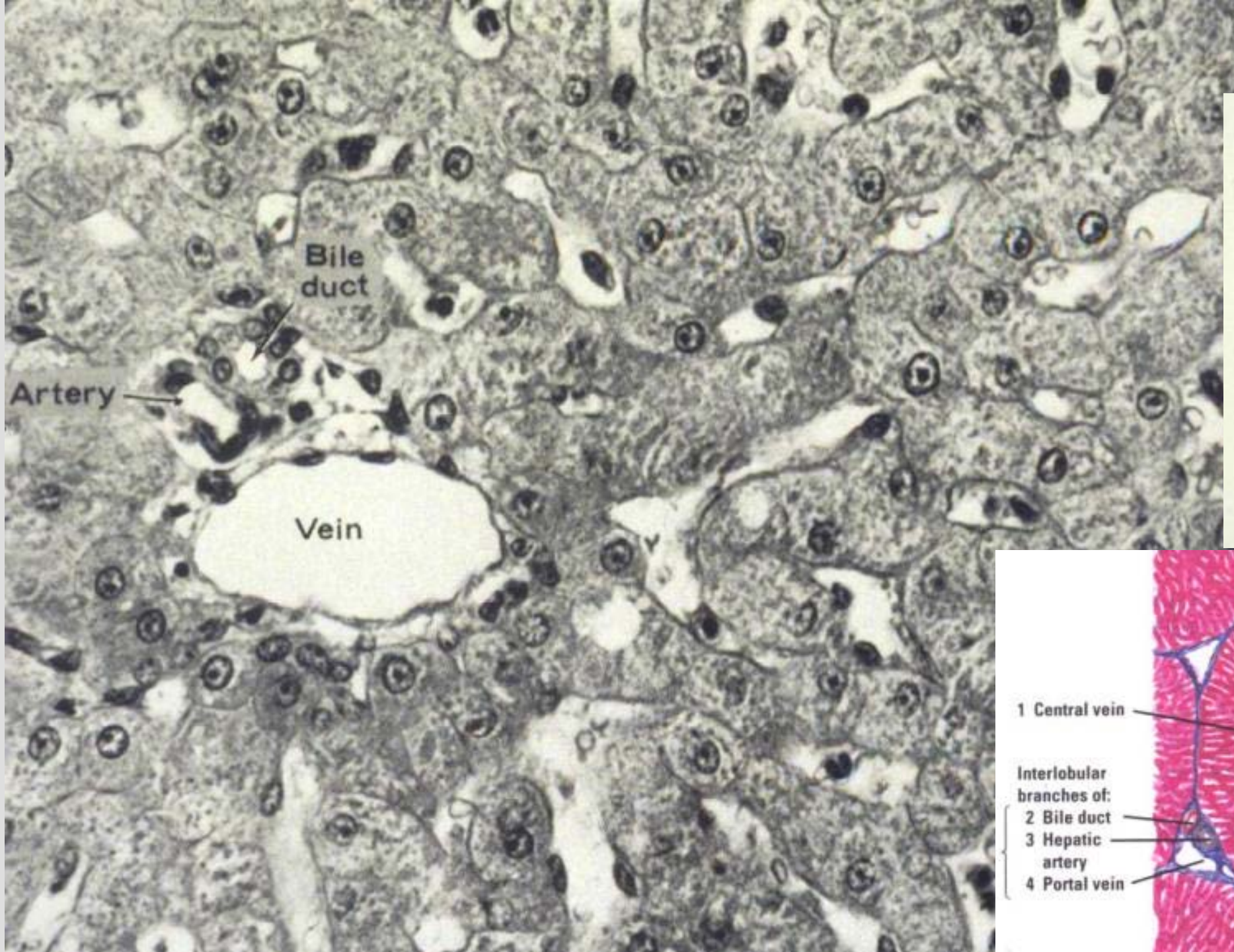
ETC.

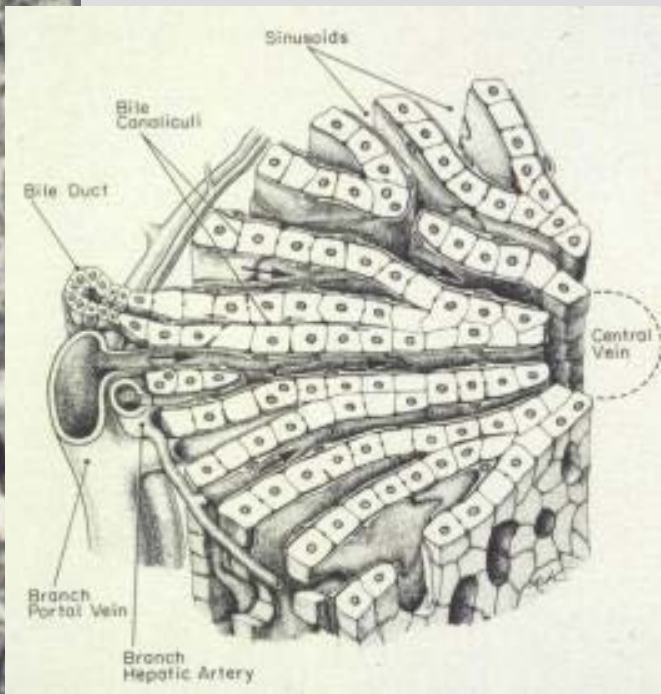


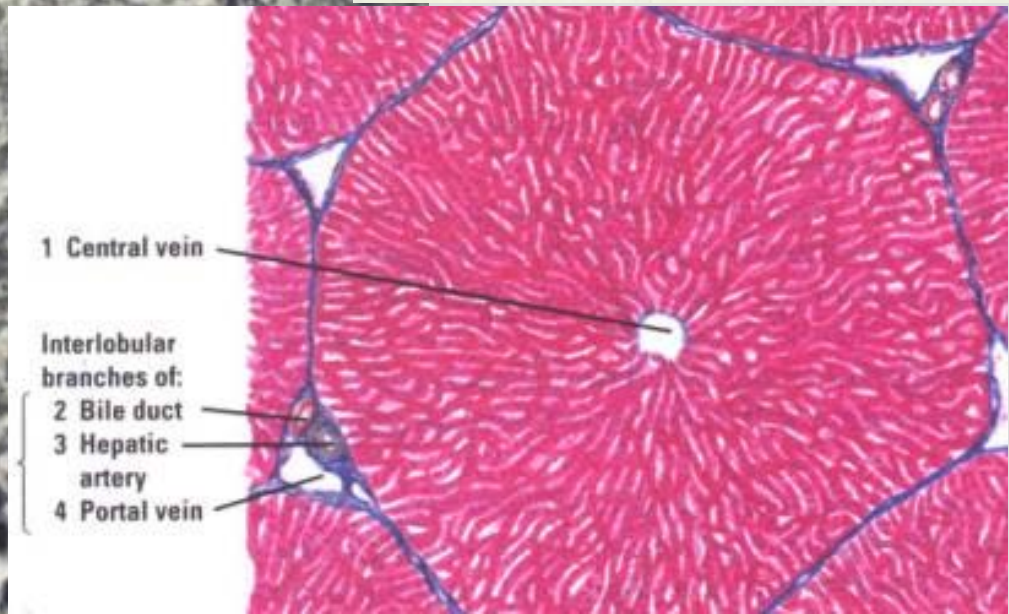

Sinusoids
Bile
Canaliculi
Bile Duct
Central
Vein
Branch
Portal Vein
Branch
Hepatic Artery

Ref code
6

Ref code
5, 6, 7


Bile duct
Artery
Vein

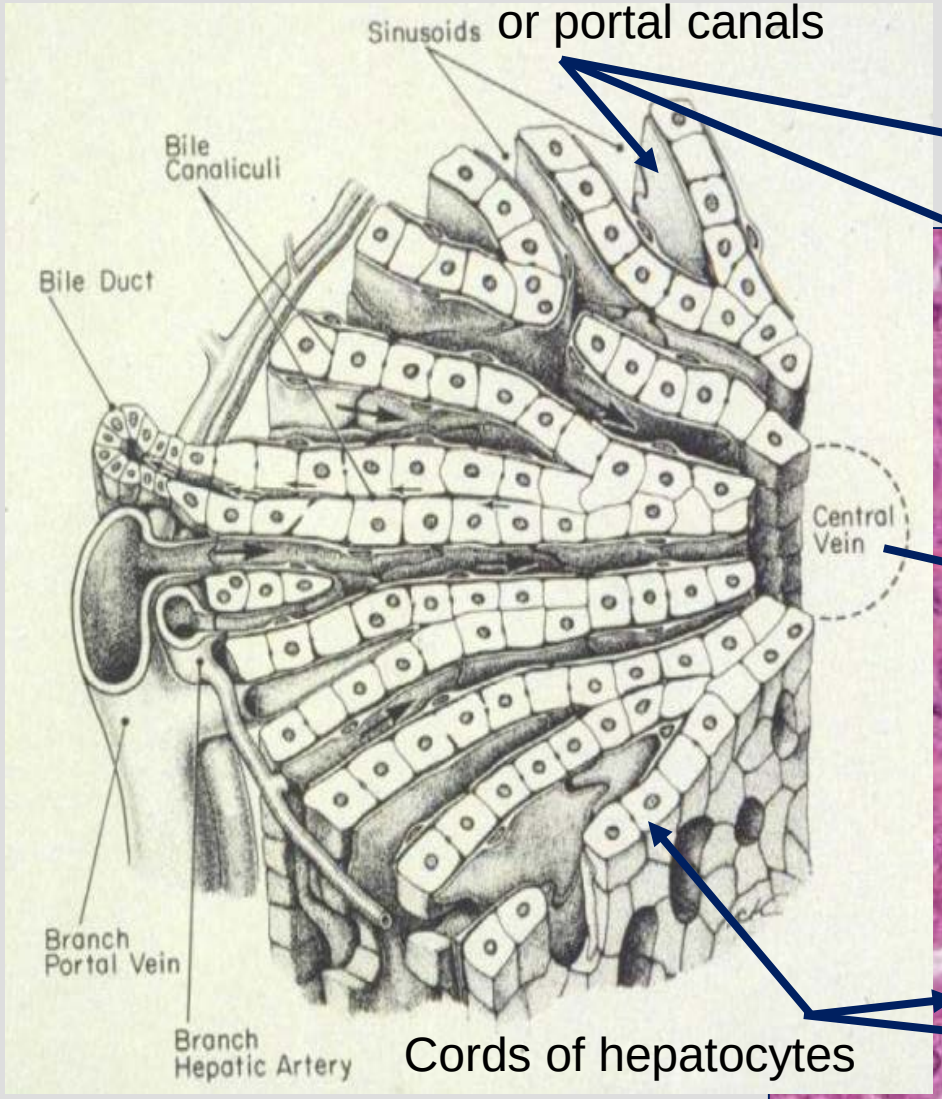

Sinusoids
Bile Canaliculi
Bile Duct
Central Vein
Branch Portal Vein
Branch Hepatic Artery

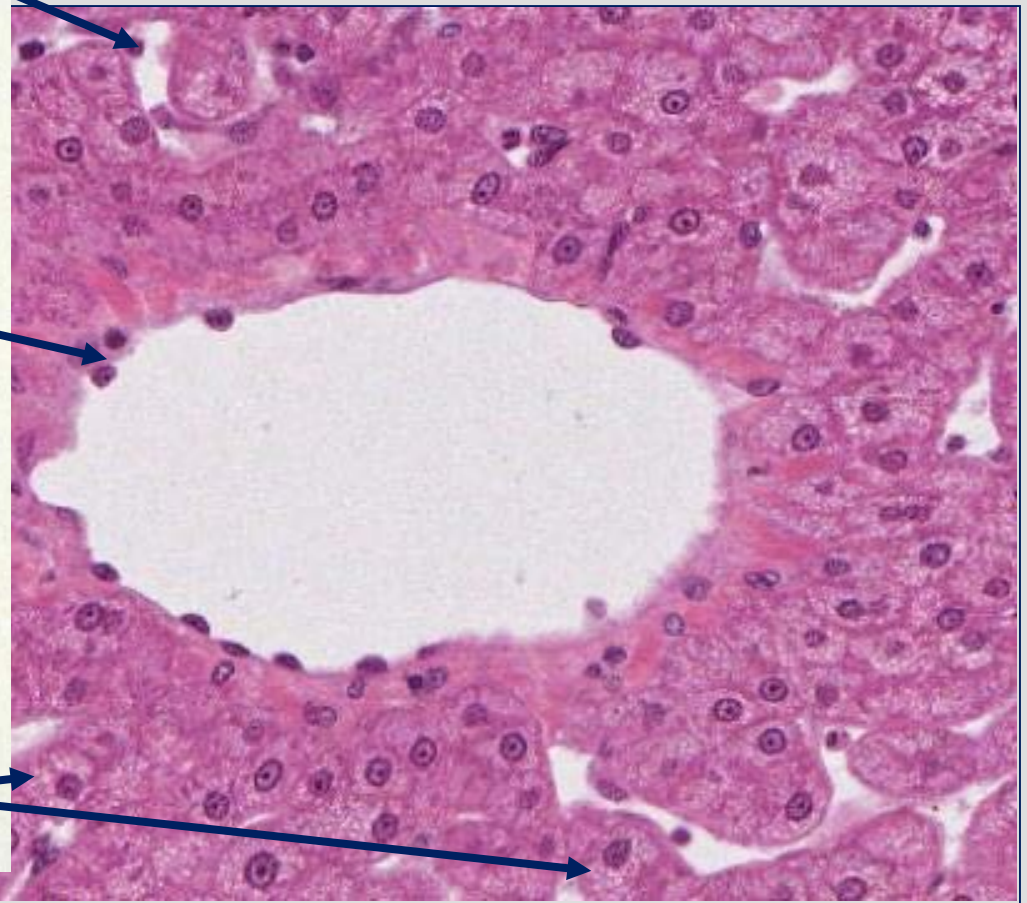

1 Central vein
Interlobular branches of:
2 Bile duct
3 Hepatic artery
4 Portal vein

Liver

Portal radicles containing:
A bile duct
Branch of portal vein,
Branch of hepatic artery
Lymphatic vessel (usually)
or portal canals

155



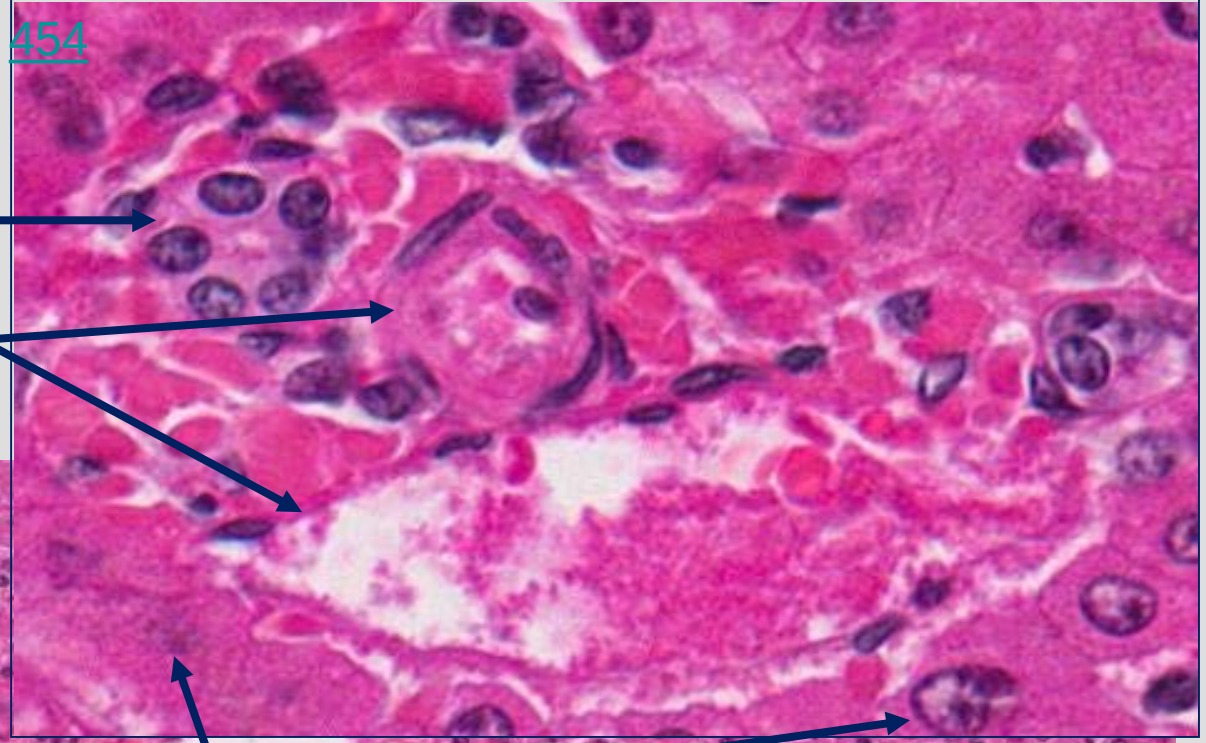


Cords of hepatocytes

Ref code # 6

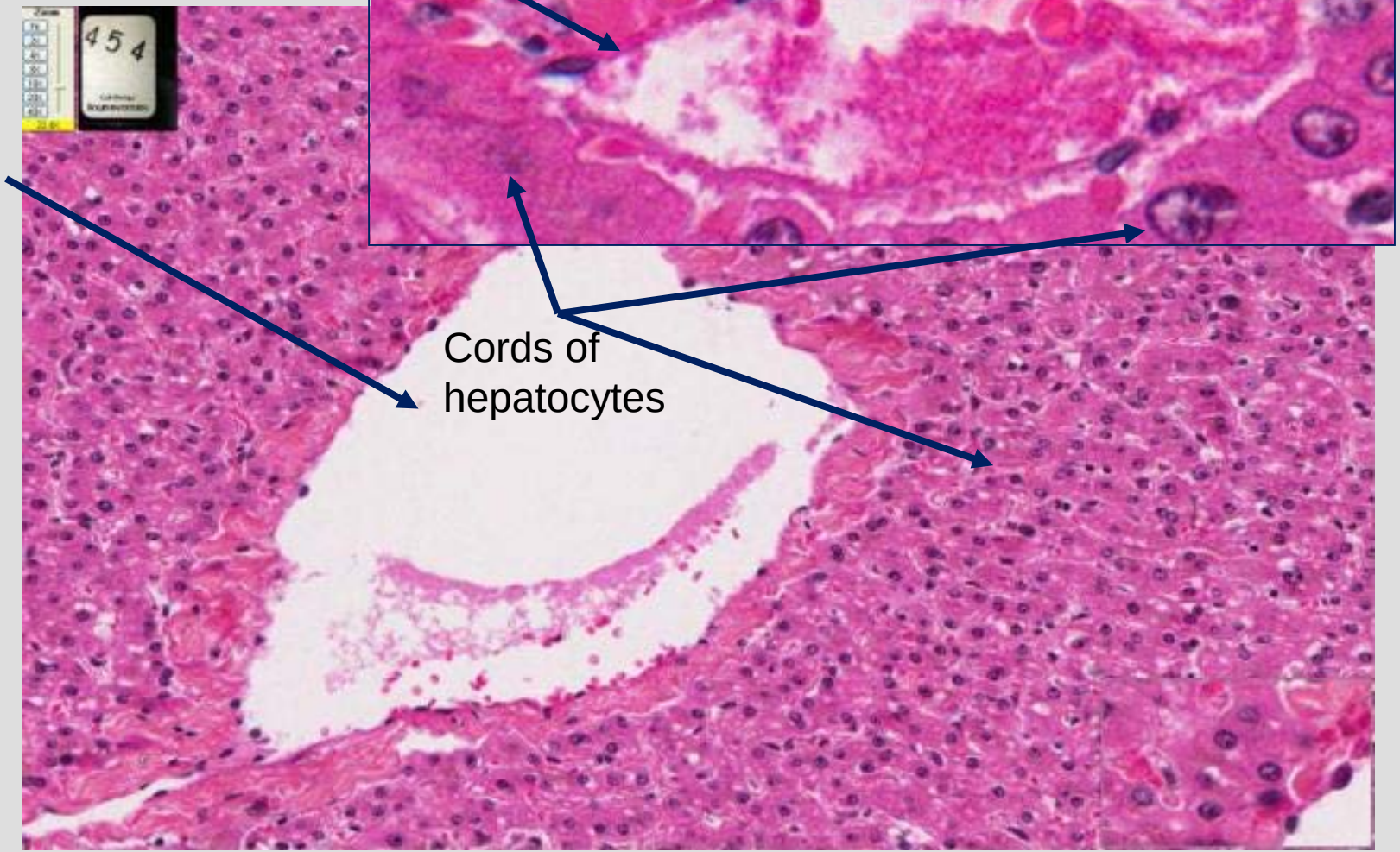
454 Liver

Portal radicles containing:
A bile duct
Branch of portal vein
Branch of hepatic artery
Lymphatic vessel (usually)



Central vein

Cords of hepatocytes

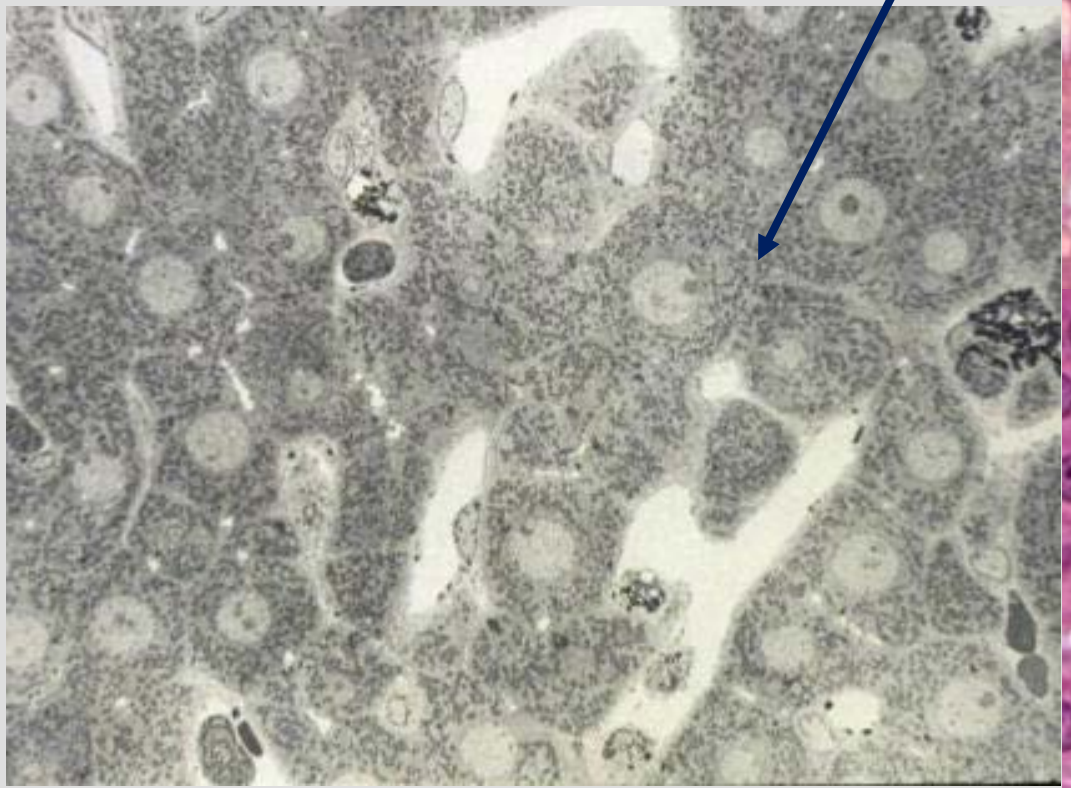


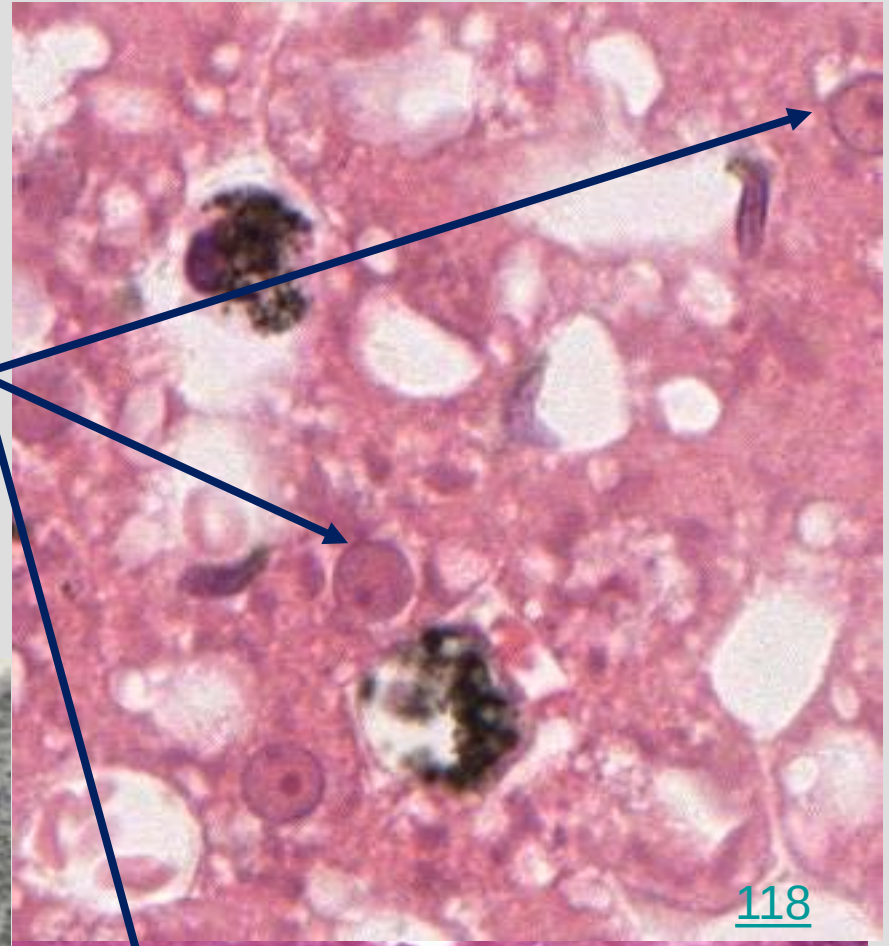
CELLS OF THE LIVER

HEPATOCYTEs

KUPFFER CELLS

ENDOTHELIAL CELLs





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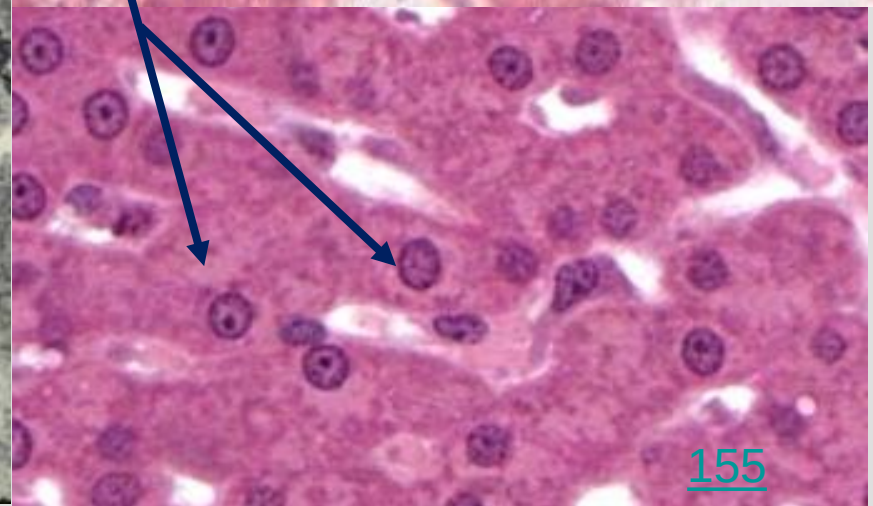

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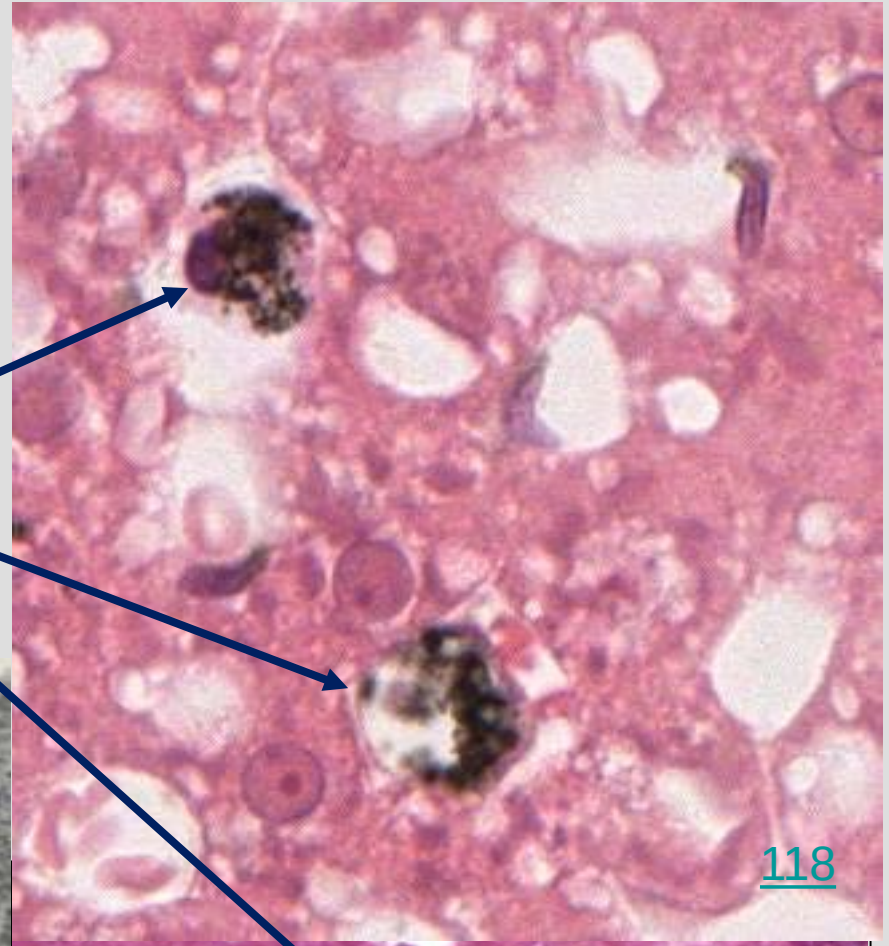
Ref code
7

CELLS OF THE LIVER

HEPATOCYTEs

KUPFFER CELLS

ENDOTHELIAL CELLs



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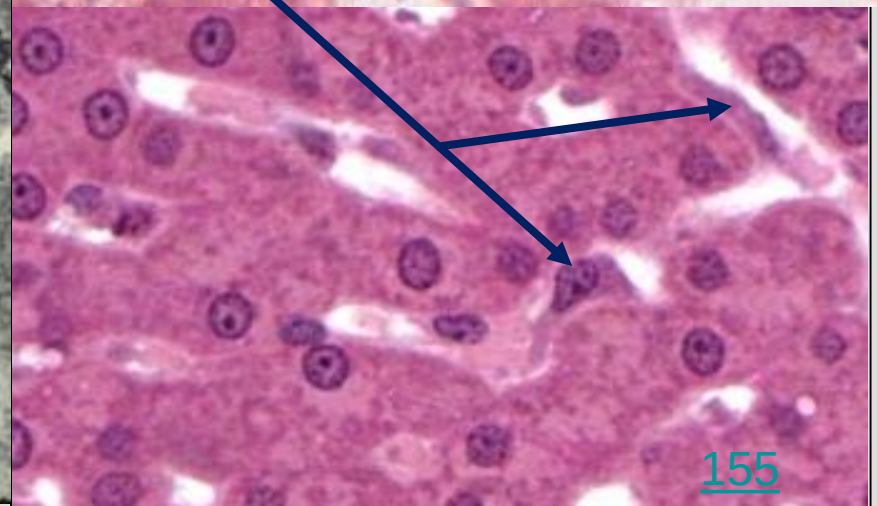

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Ref code
7

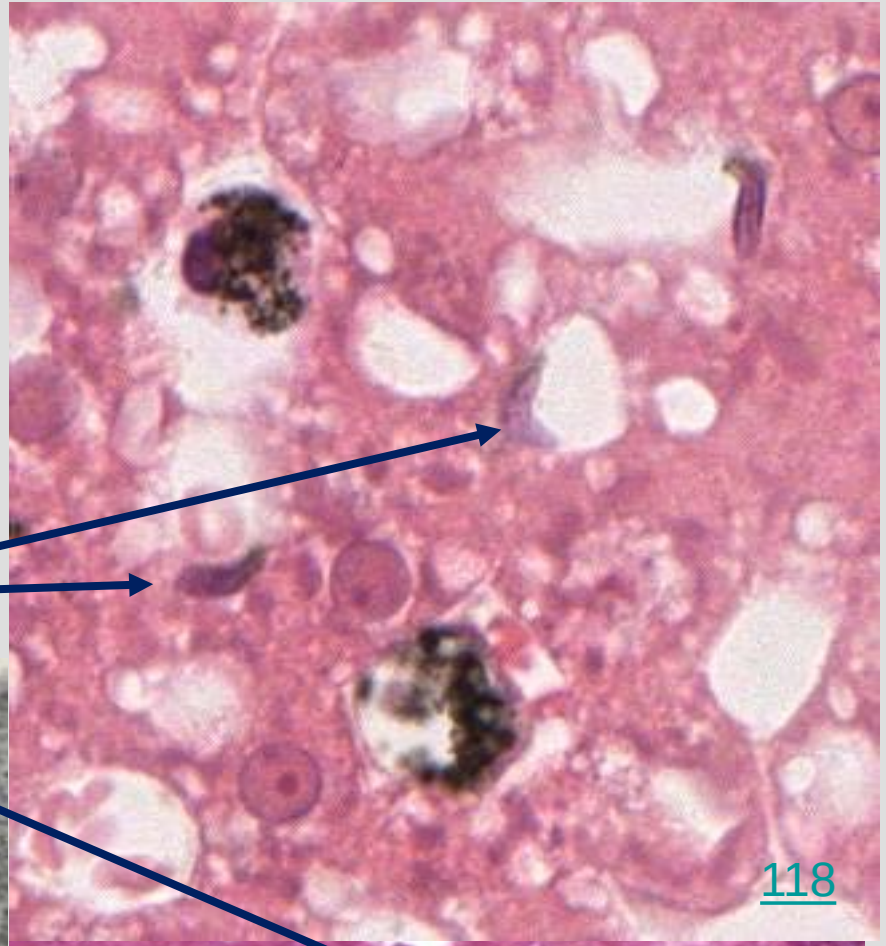
CELLS OF THE LIVER

Ref code # 7

HEPATOCYTEs

KUPFFER CELLS

ENDOTHELIAL CELLs



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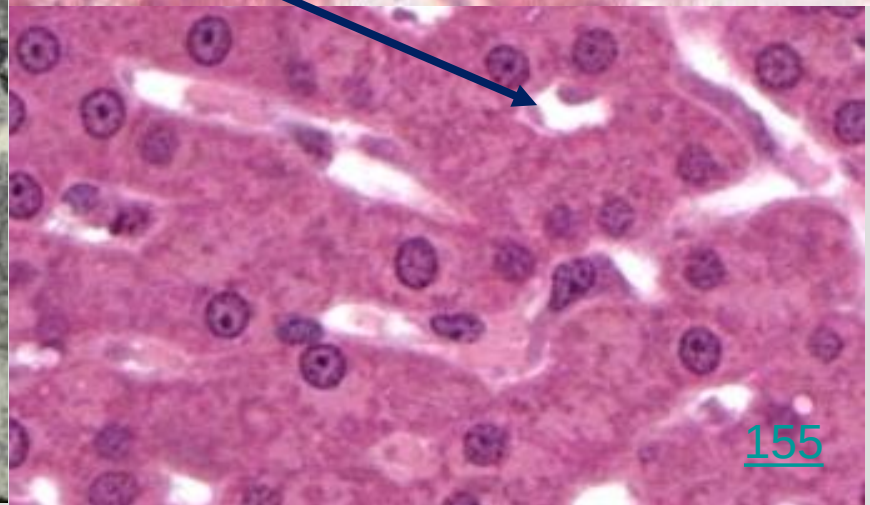

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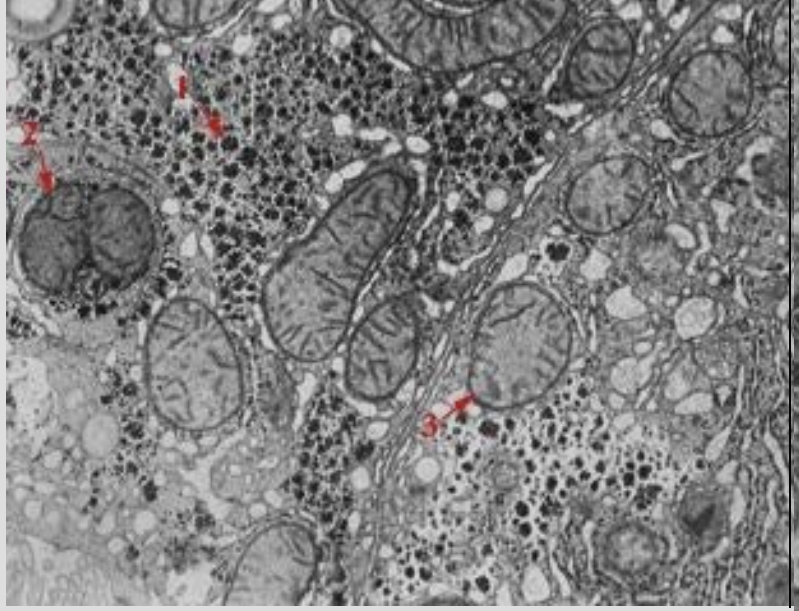


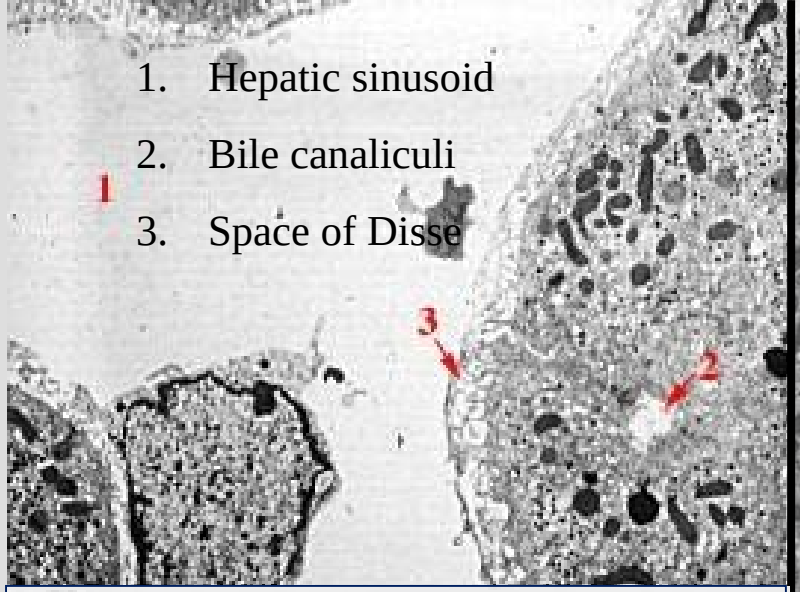
Liver hepatocyte

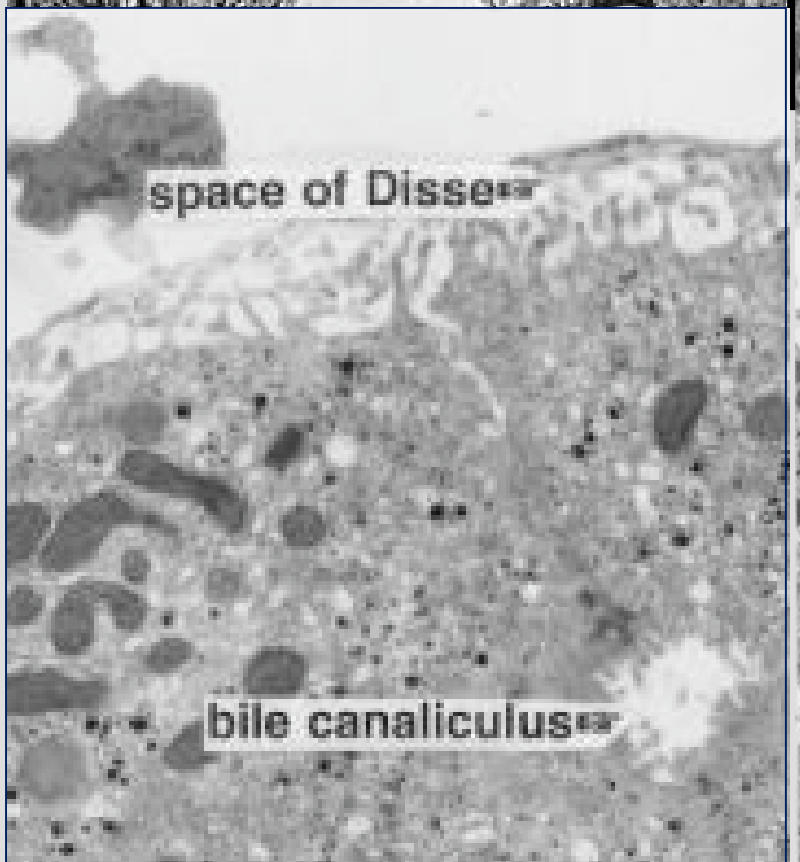
EM 2

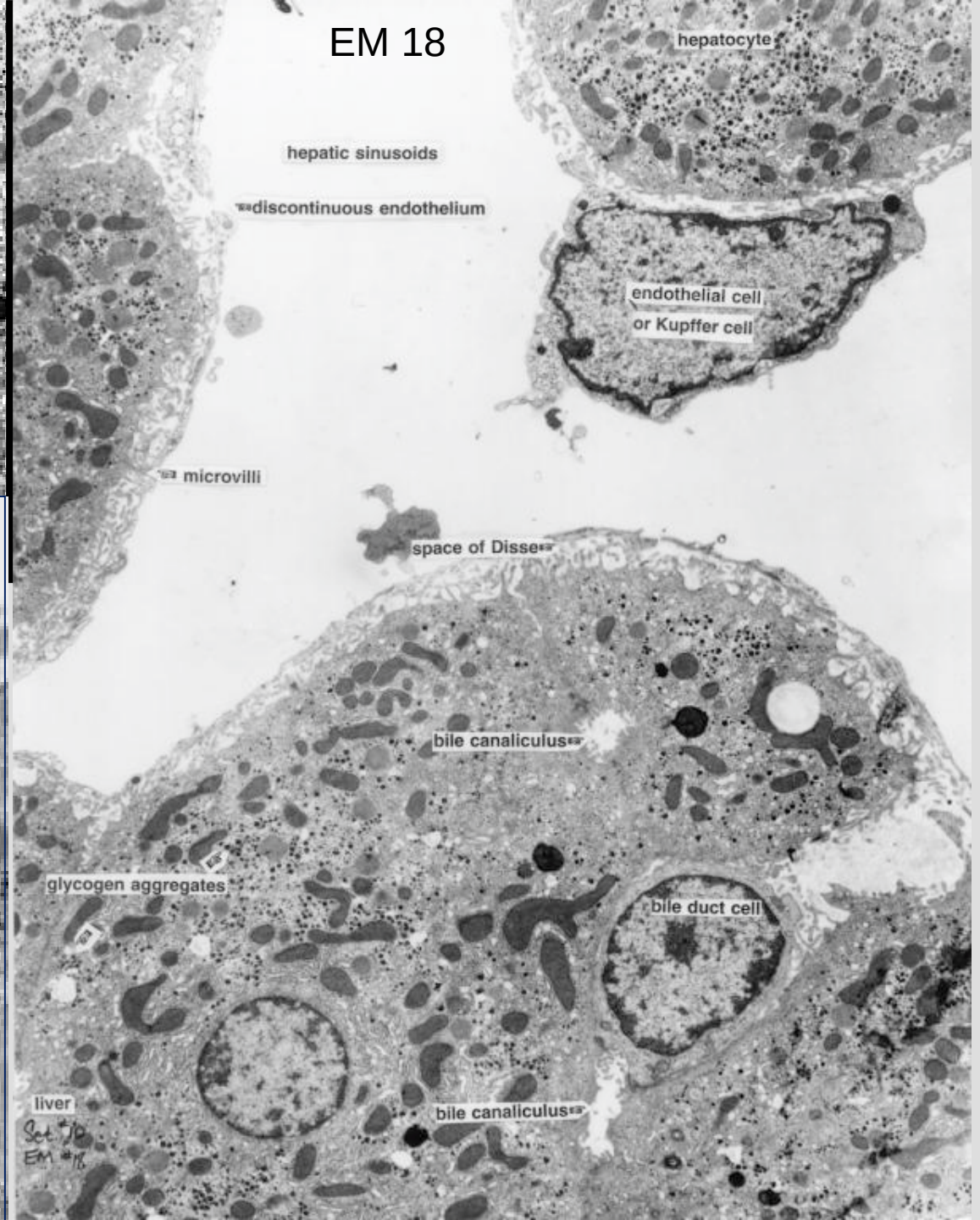
1. Glycogen
2. Autophagosome
3. Mitochondria

EM 18

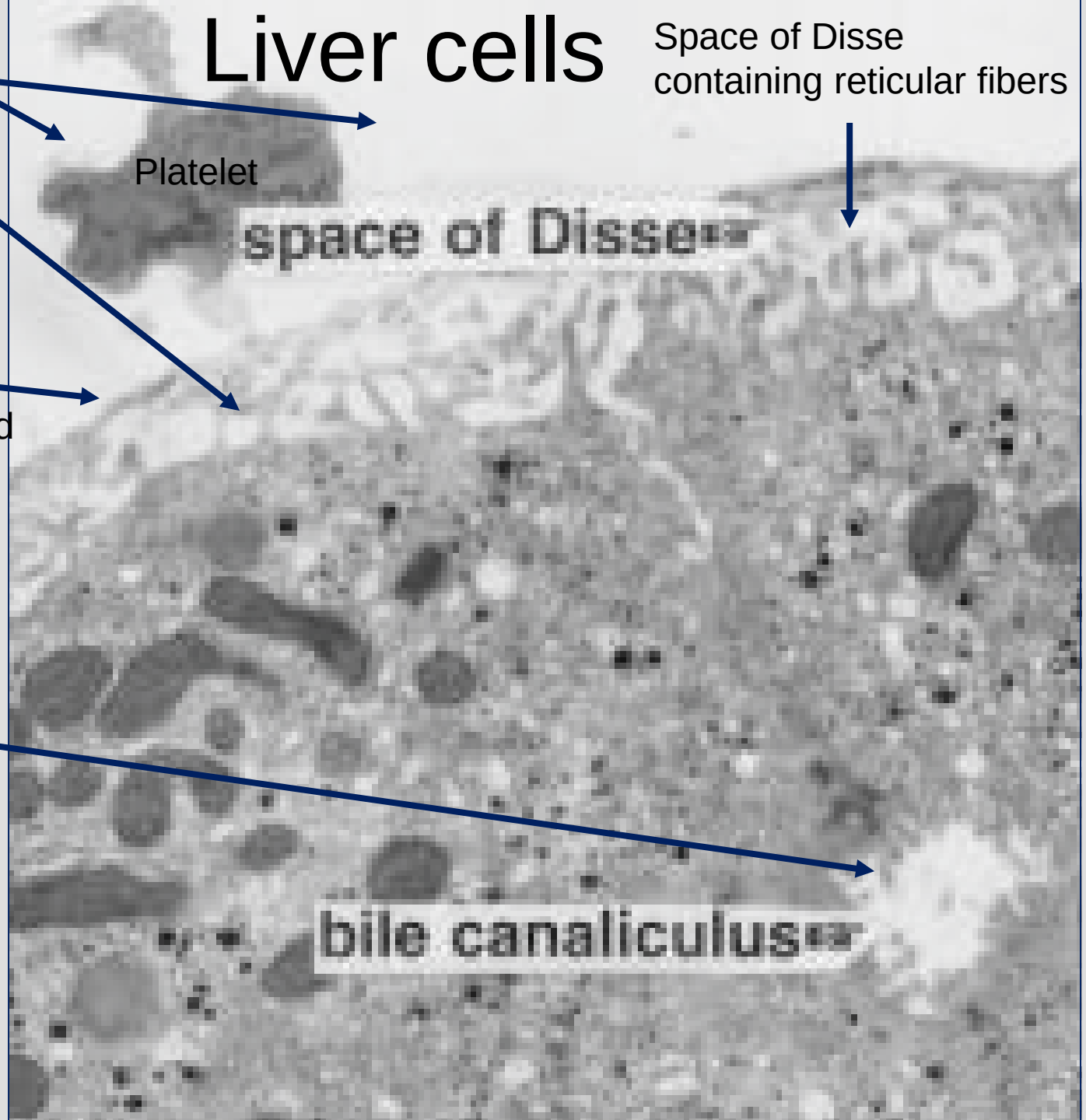
1. Hepatic sinusoid
2. Bile canaliculi
3. Space of Disse







Liver cells



Hepatic sinusoid

Space of Disse
containing reticular fibers

Platelet

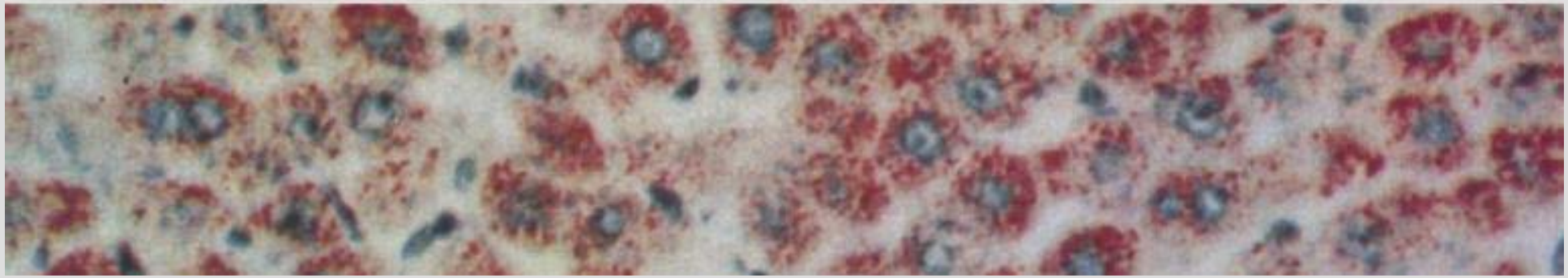
Hepatic parenchymal
cells with microvilli

Endothelial cell
projecting into sinusoid

Bile canaliculi
with lysosomes close
by the canaliculi

Glycogen in Hepatocytes

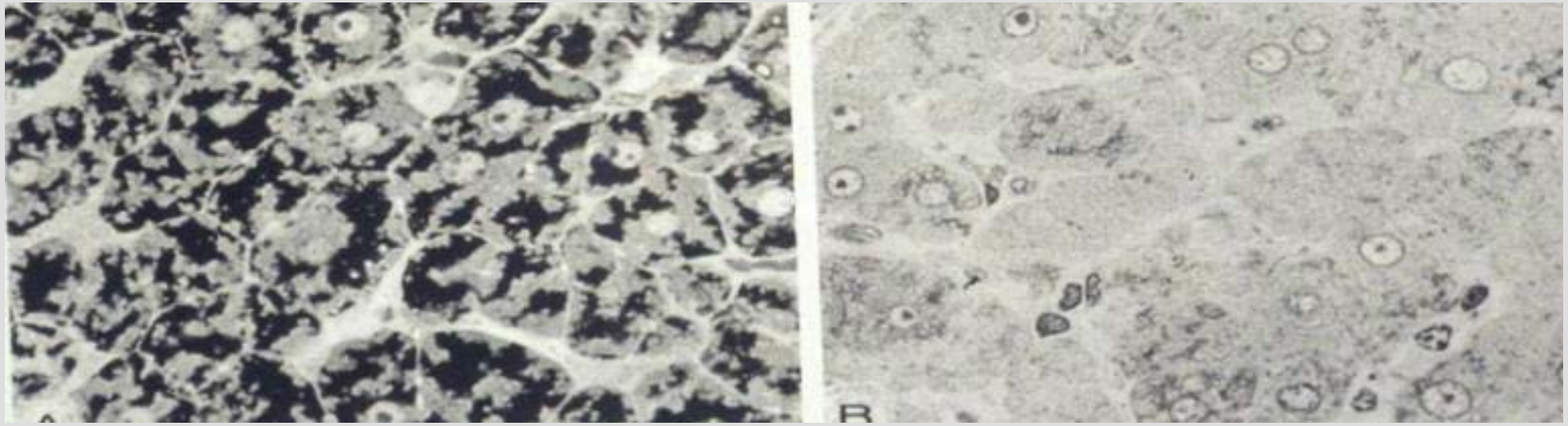
Ref code
7



Dietary Differences In Amount Of Glycogen In Hepatocytes

2-hour Fast (8.2% Glycogen)

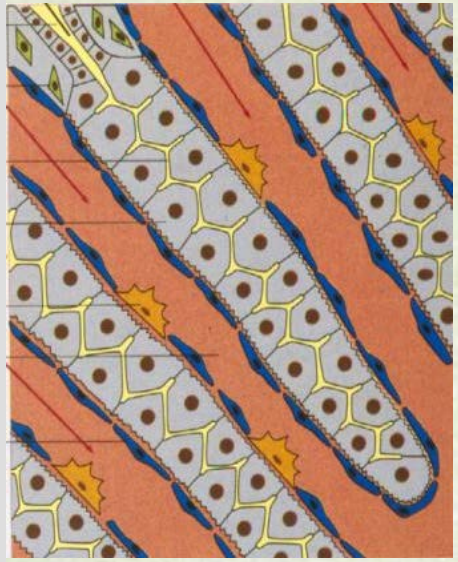
24-hour Fast (0.9% Glycogen)

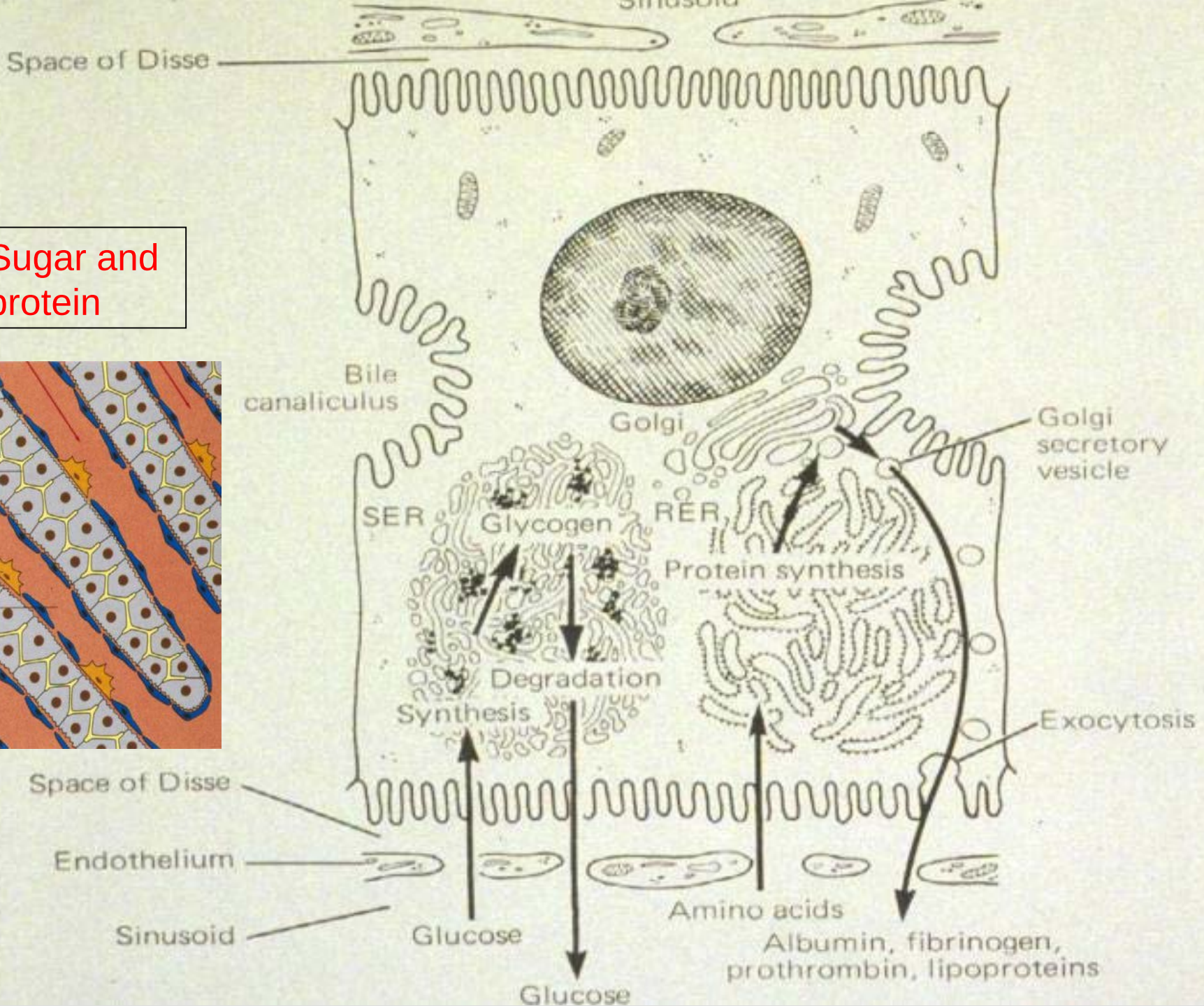


Liver plays a role in blood sugar concentrations on a daily basis.

Ref code
2, 12

Sugar and protein





Acinus with portal vein and artery in center

Ref code # 12

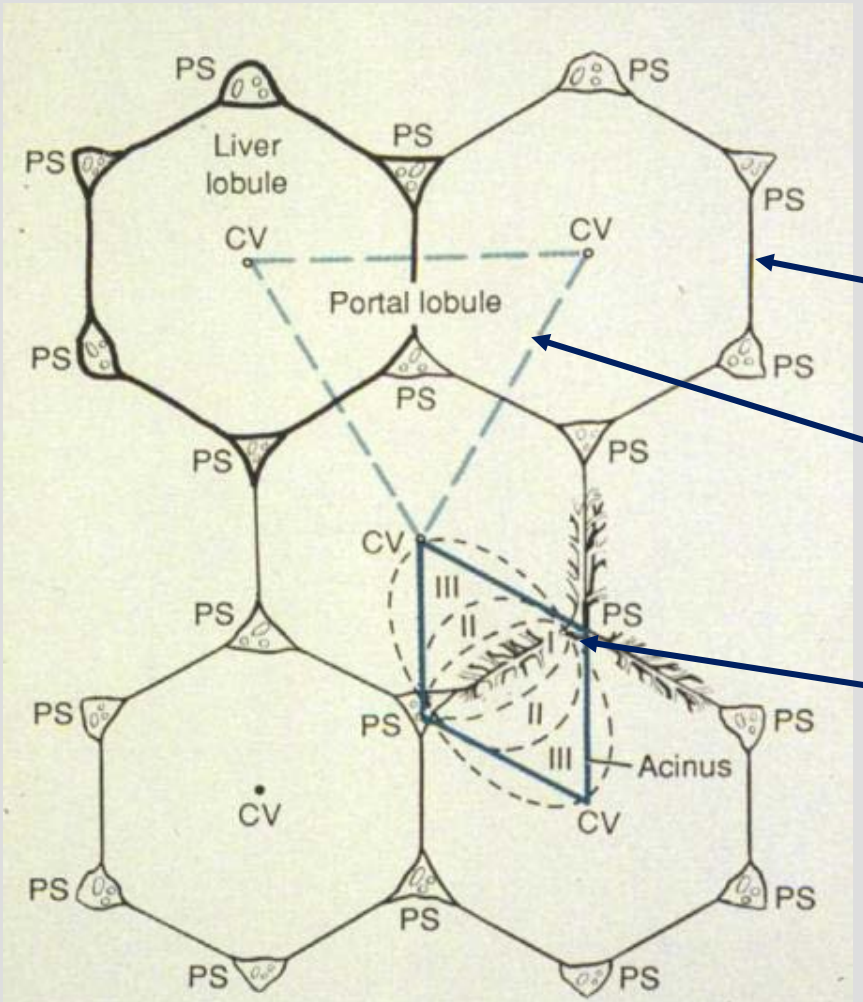
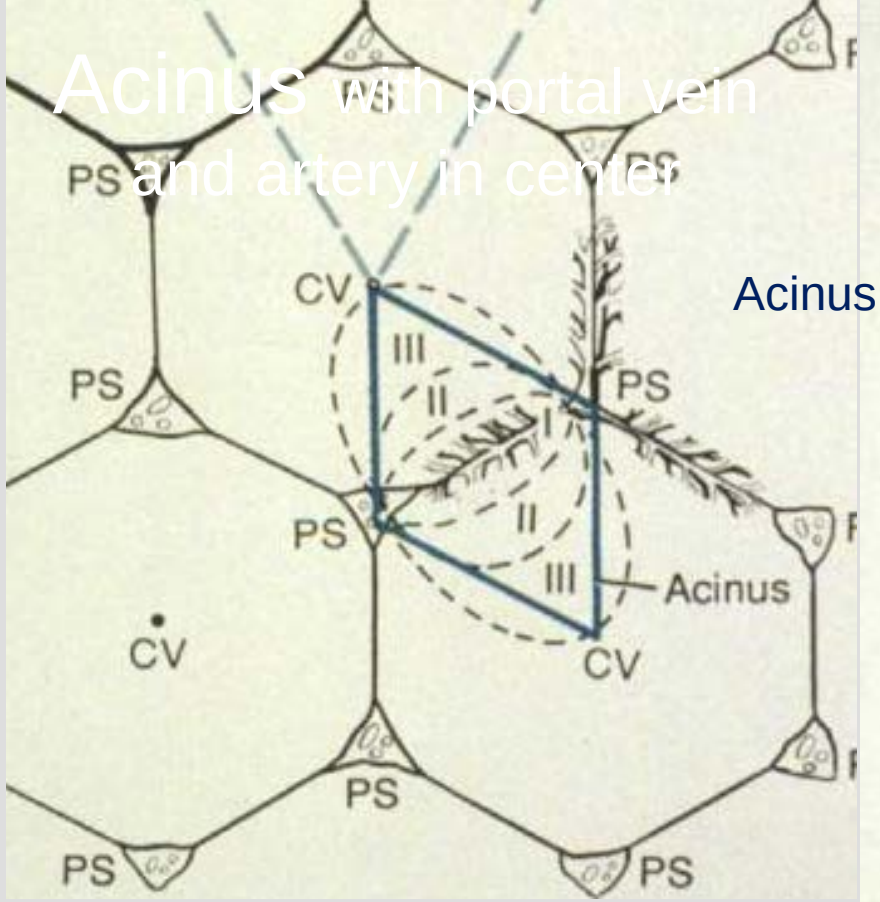


Figure 16–16. Schematic drawing illustrating the territories of the classic liver lobules, hepatic acini, and portal lobules. The classic lobule has a central vein (CV) and is outlined by the solid lines that connect the portal spaces

ZONATION OF THE LIVER

1. Classical lobule
2. Portal lobule with triad in center
3. Acinus layers between two central veins

Acinus with portal vein and artery in center



Acinus

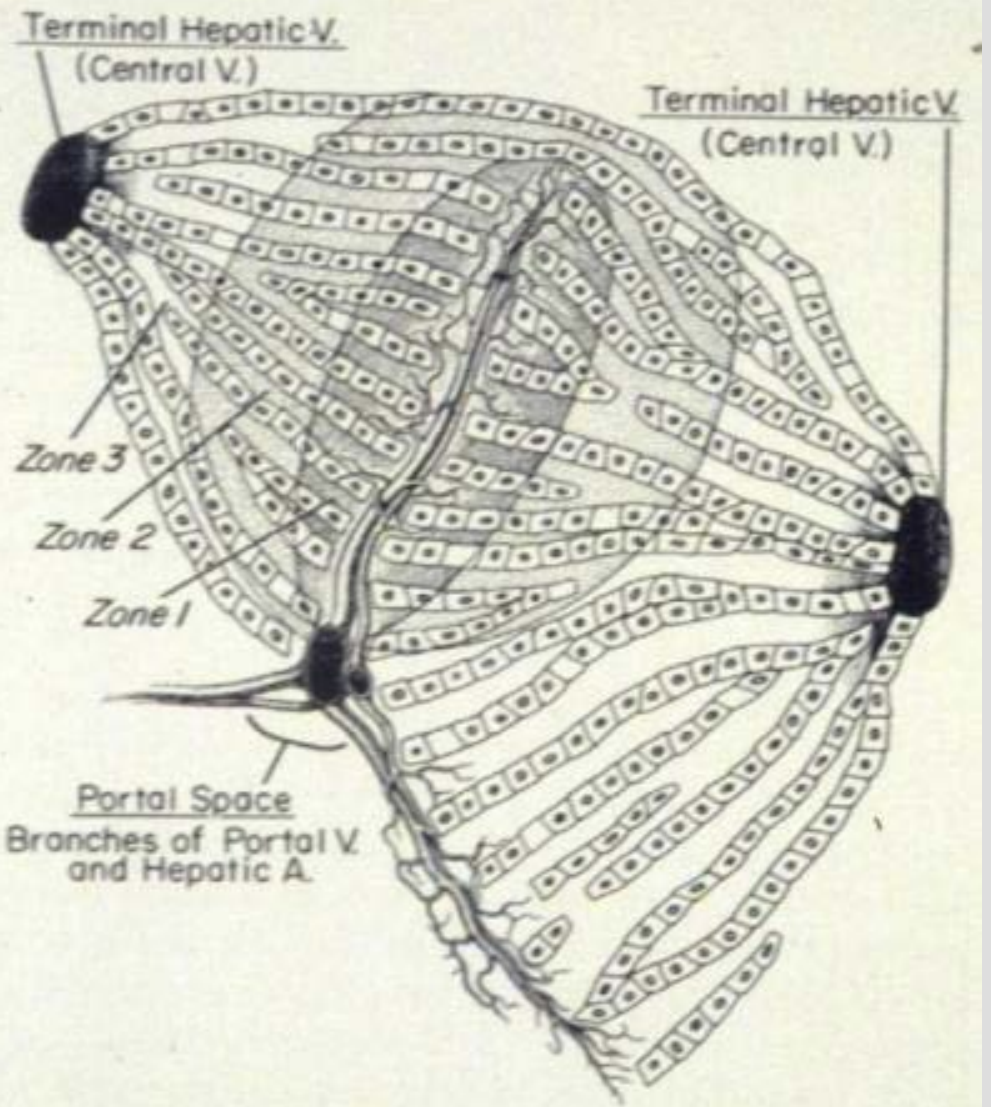


Figure 27–13. Diagram of the acinus, consisting of parenchyma centered around the terminal branches of the hepatic artery and portal vein. The cells in zone-1 have first call on the incoming oxygen and nutrients. The cells of zone-2 are less favored, and those of zone-3 are least favorably situated. (Redrawn after Rappaport, A.M. et al. 1954. Anat. Rec. 119:11.)

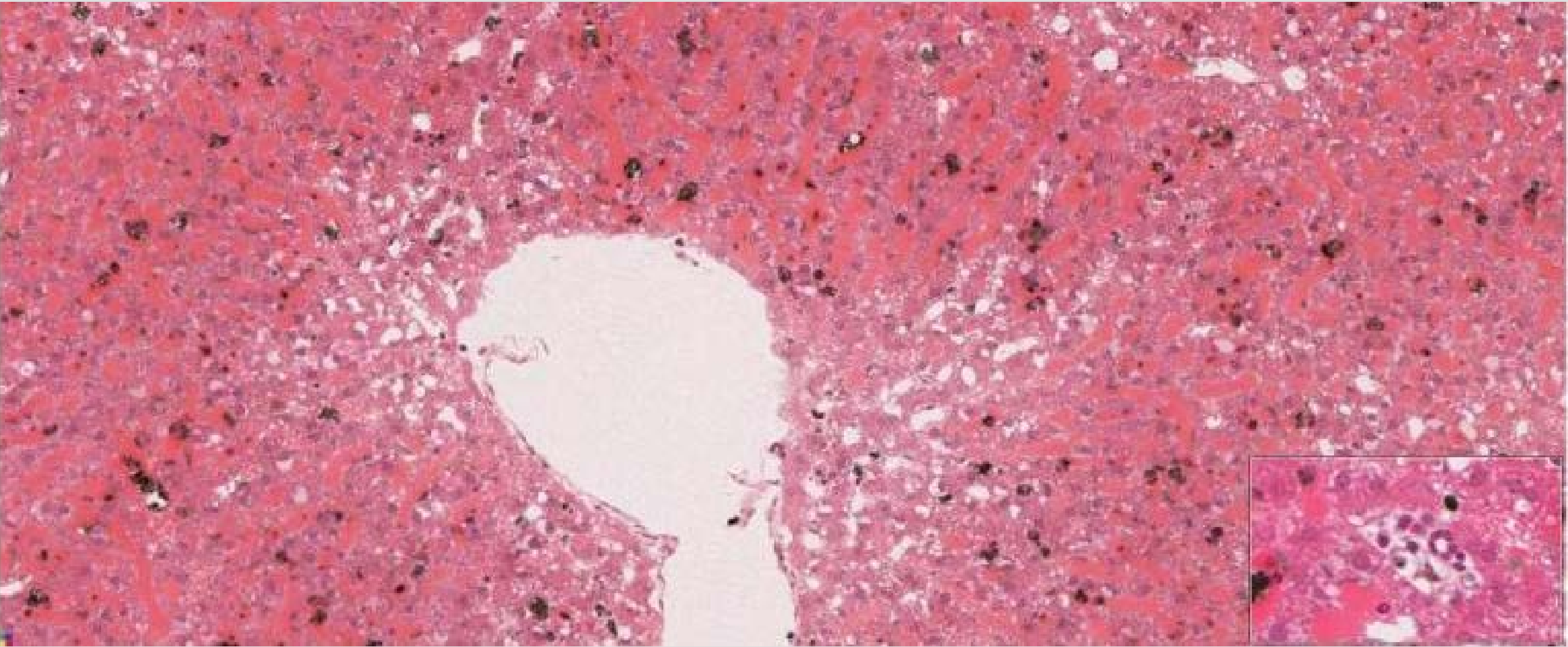
If liver damage is due to a toxicant, it kills hepatocytes in Zone I first.

If liver damage is due to a oxygen deprivation, it will kill the hepatocytes in Zone III first.

Ref code
6, 12

Triad with bile duct and central vein

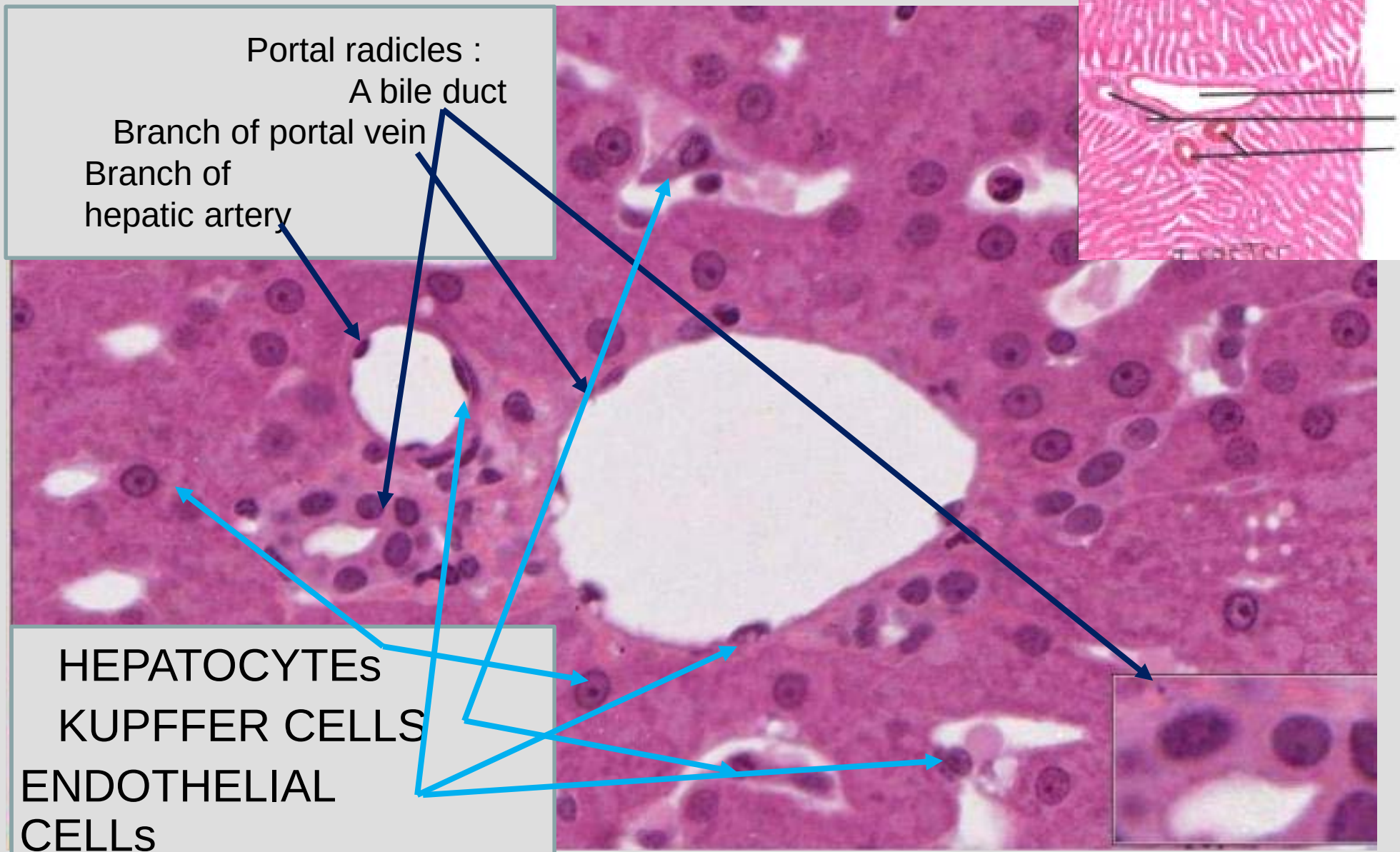
Liver with colloidal carbon, rat

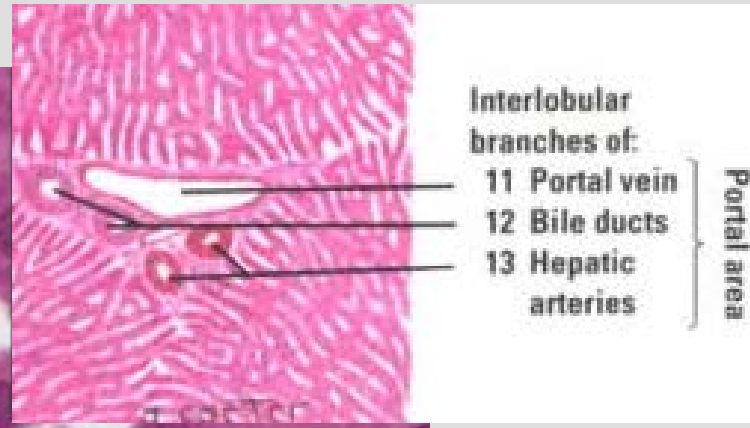


Gallbladder & liver, monkey – Triad with bile duct in Liver

Ref code # 5

Portal radicles :
A bile duct
Branch of portal vein
Branch of hepatic artery

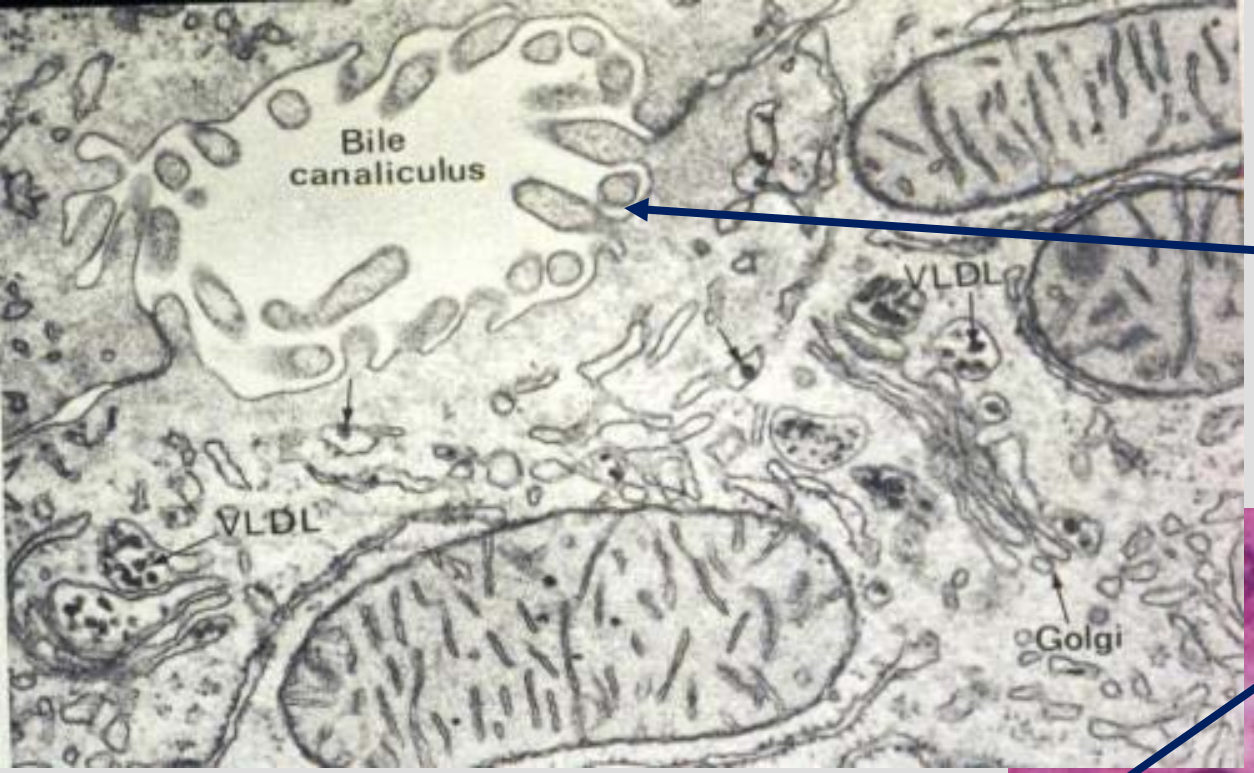




HEPATOCYTEs
KUPFFER CELLS
ENDOTHELIAL CELLs

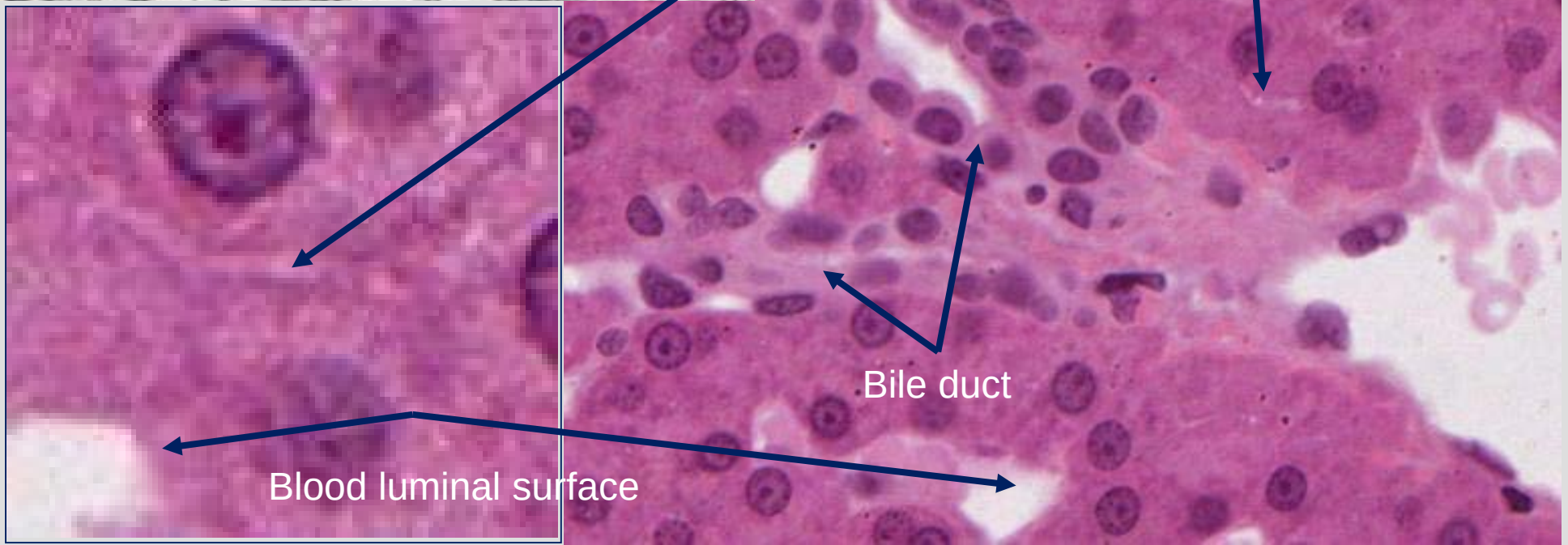
Bile Canaliculi

Ref code # 6



Bile luminal surfaces

155



BILE CANALICULI

Stained to see the bile canaliculi as embedded in hepatocytes

Bile canaliculus

Four + compounds that are deposited/secreted into this space.

a. Cholesterol

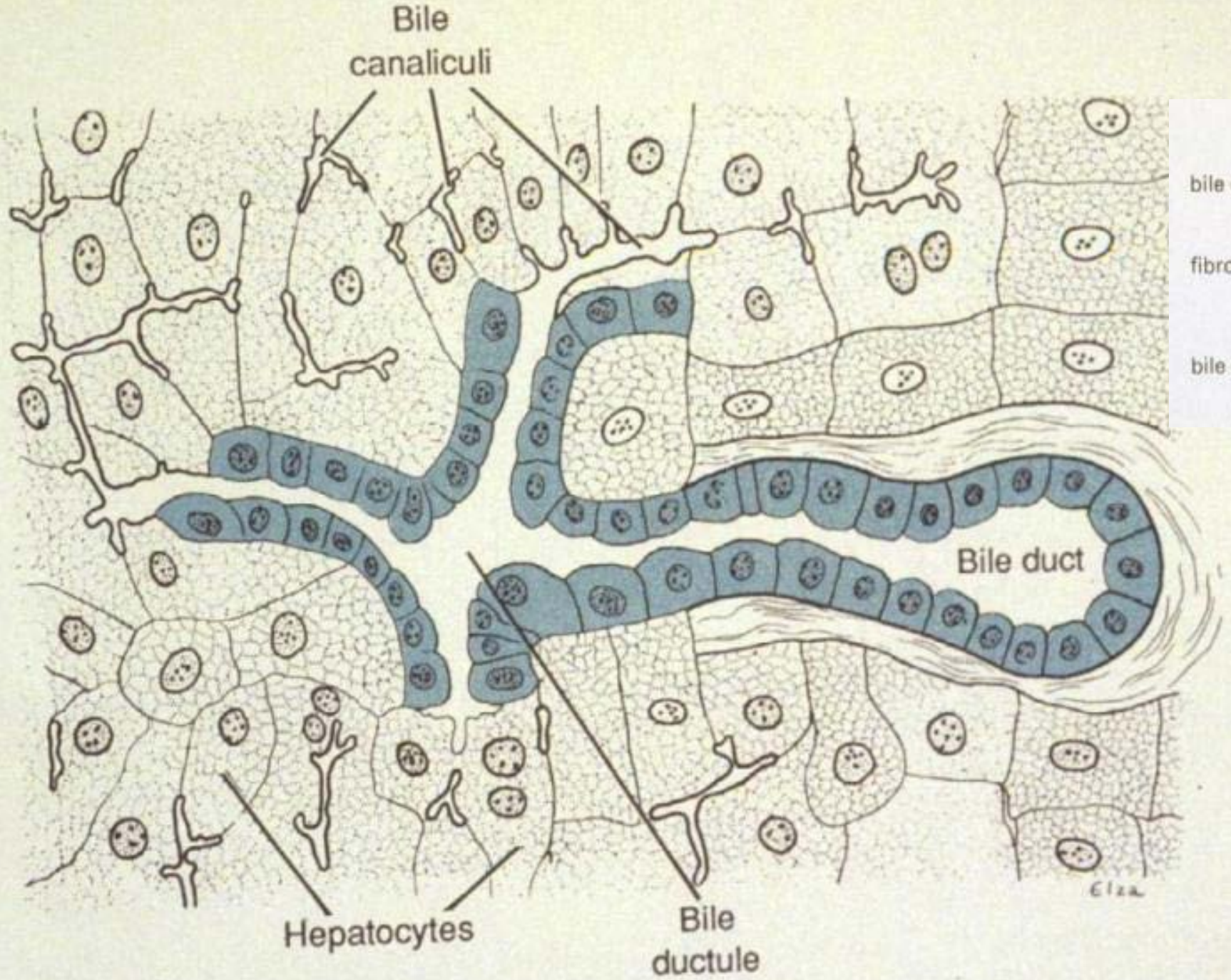
b. EGF

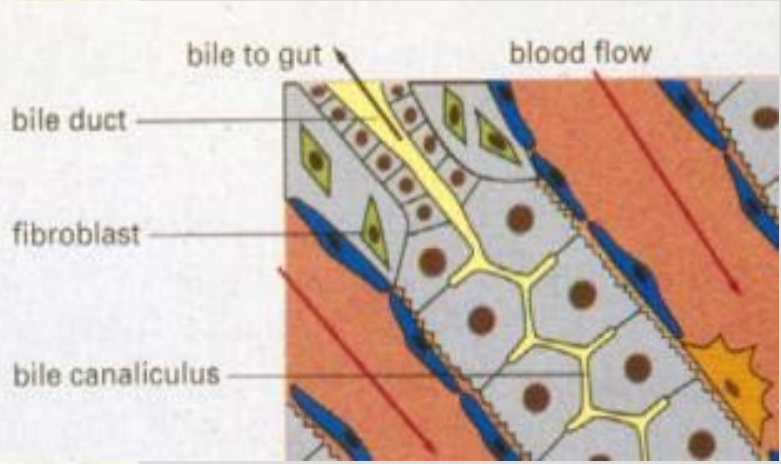
c. insulin

d. IgA

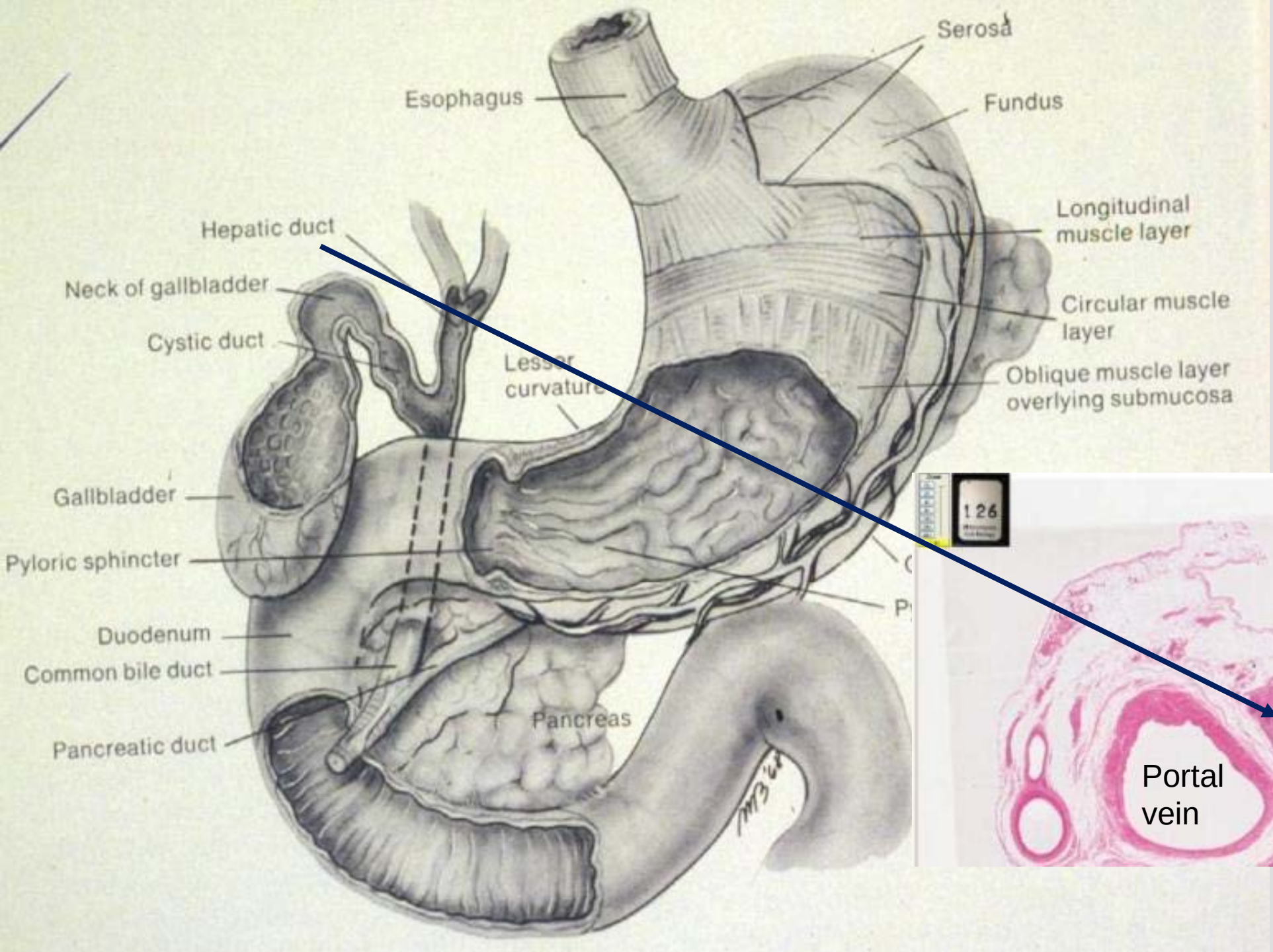
also bile salts and BILIRUBIN

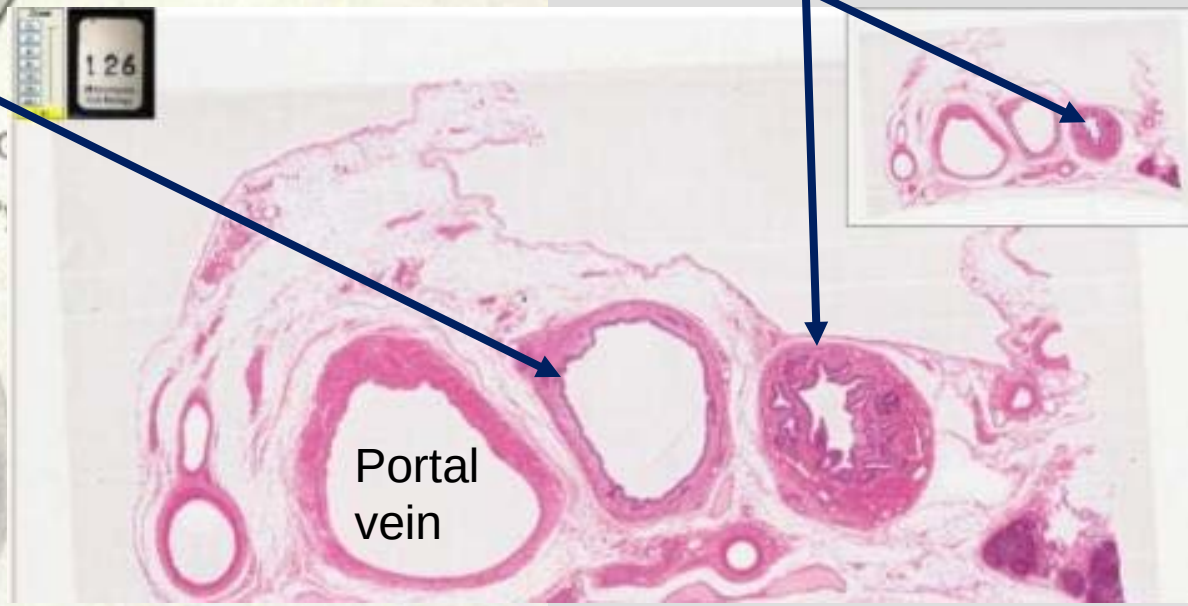
Ref code
2, 12


Bile canaliculi
Bile duct
Hepatocytes
Bile ductule

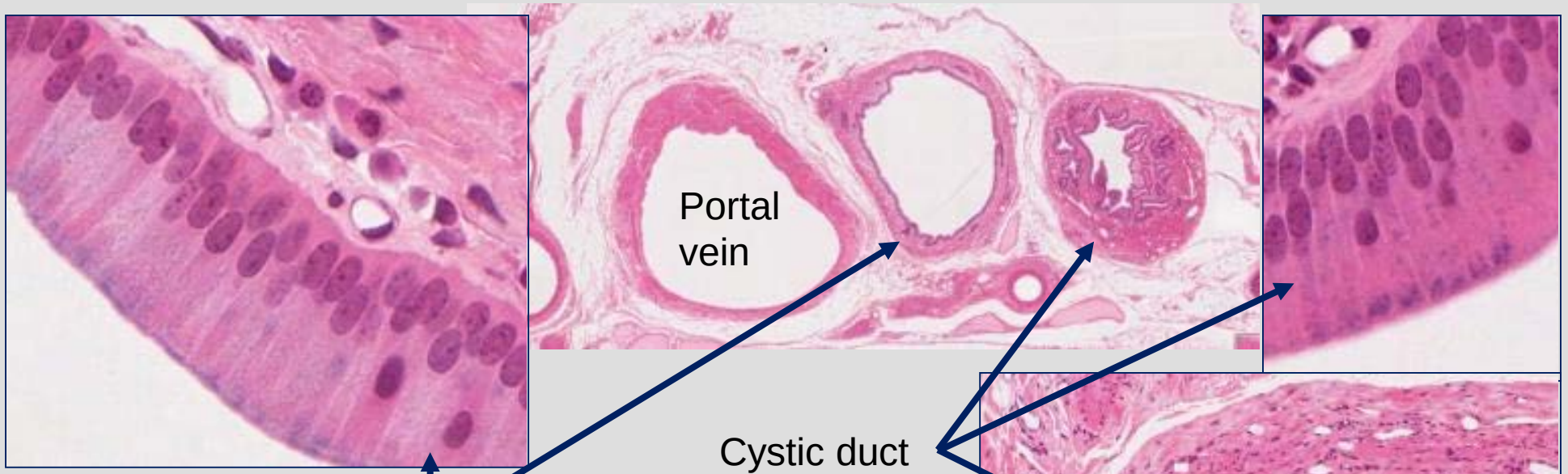

bile to gut
blood flow
bile duct
fibroblast
bile canaliculus

Ref code
16

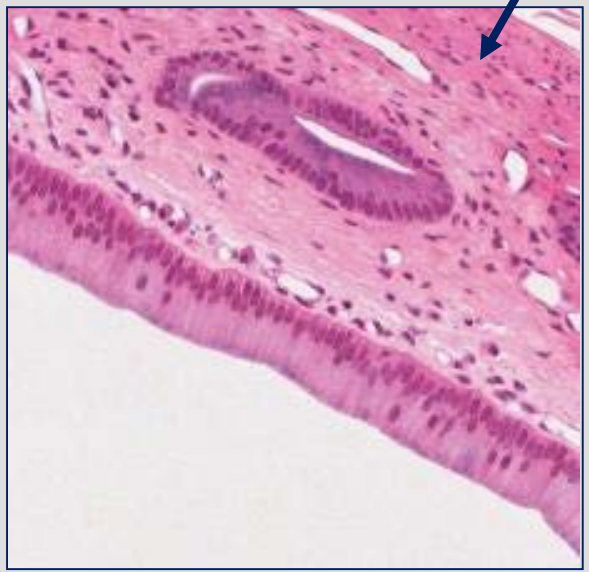

Serosa
Esophagus
Fundus
Hepatic duct
Longitudinal muscle layer
Neck of gallbladder
Circular muscle layer
Cystic duct
Lesser curvature
Oblique muscle layer overlying submucosa
Gallbladder
Pyloric sphincter
Duodenum
Common bile duct
Pancreas
Pancreatic duct


Cystic duct
Portal vein

Bile duct with portal vein, monkey



The wall of the cystic duct is convoluted and contains abundant smooth muscle fibers which represent the spiral valve preventing distention or collapse of the cystic duct when the latter is subject to sudden changes of pressure.



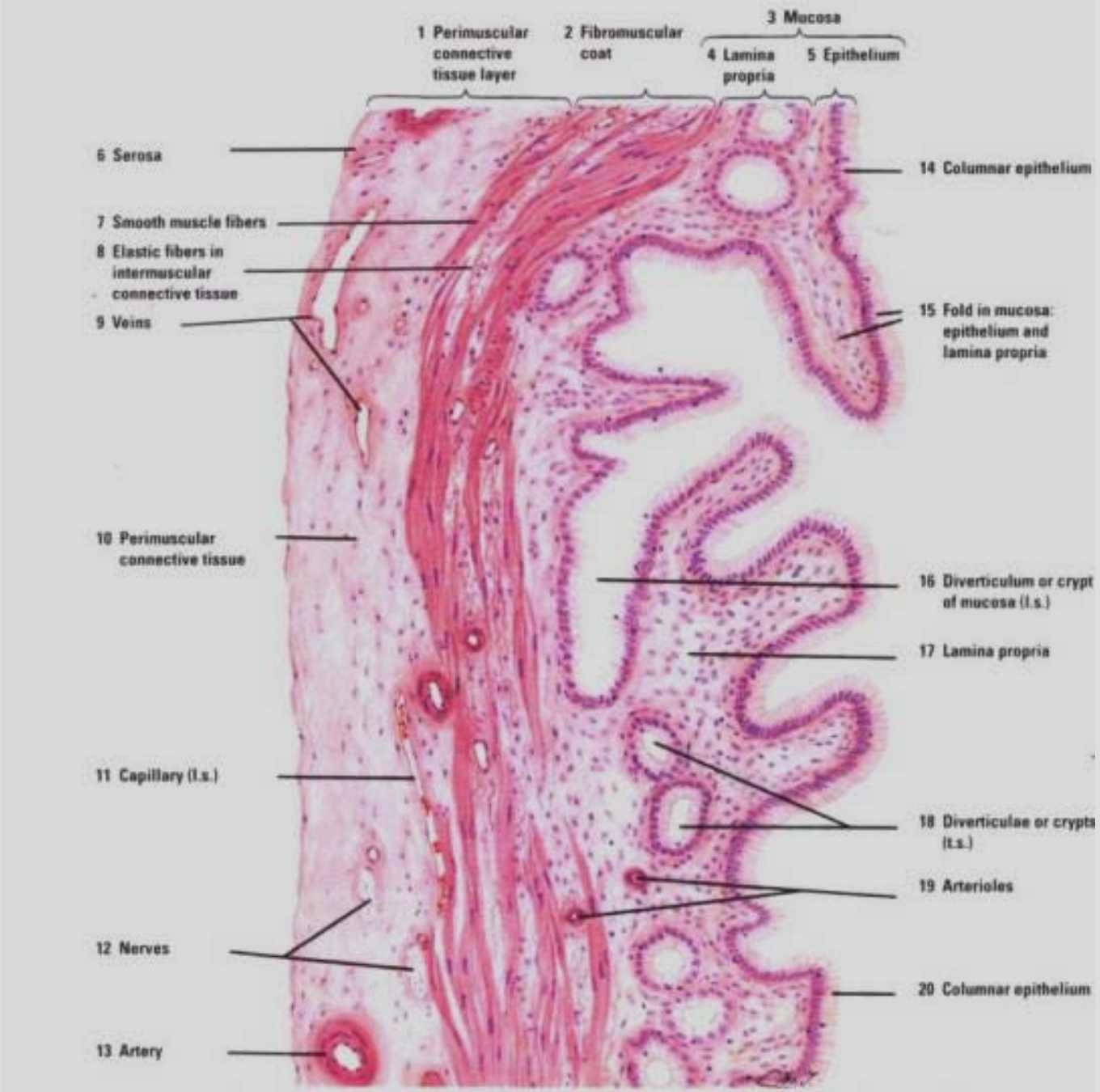
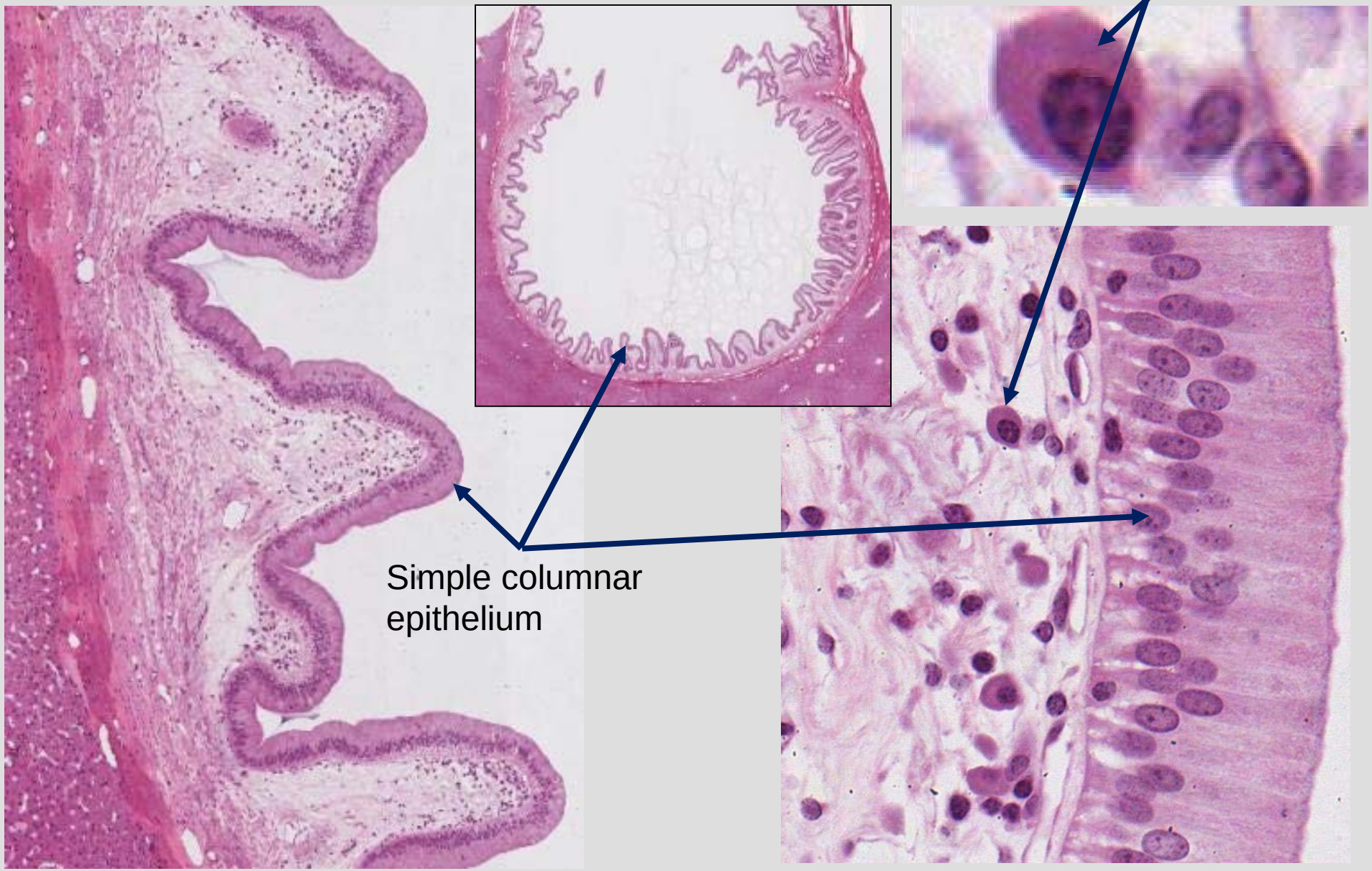


Fig. 13.8 Gallbladder (panoramic view). Stain: hematoxylin-eosin. Medium magnification.

The gallbladder stores and concentrates the bile elaborated by the liver

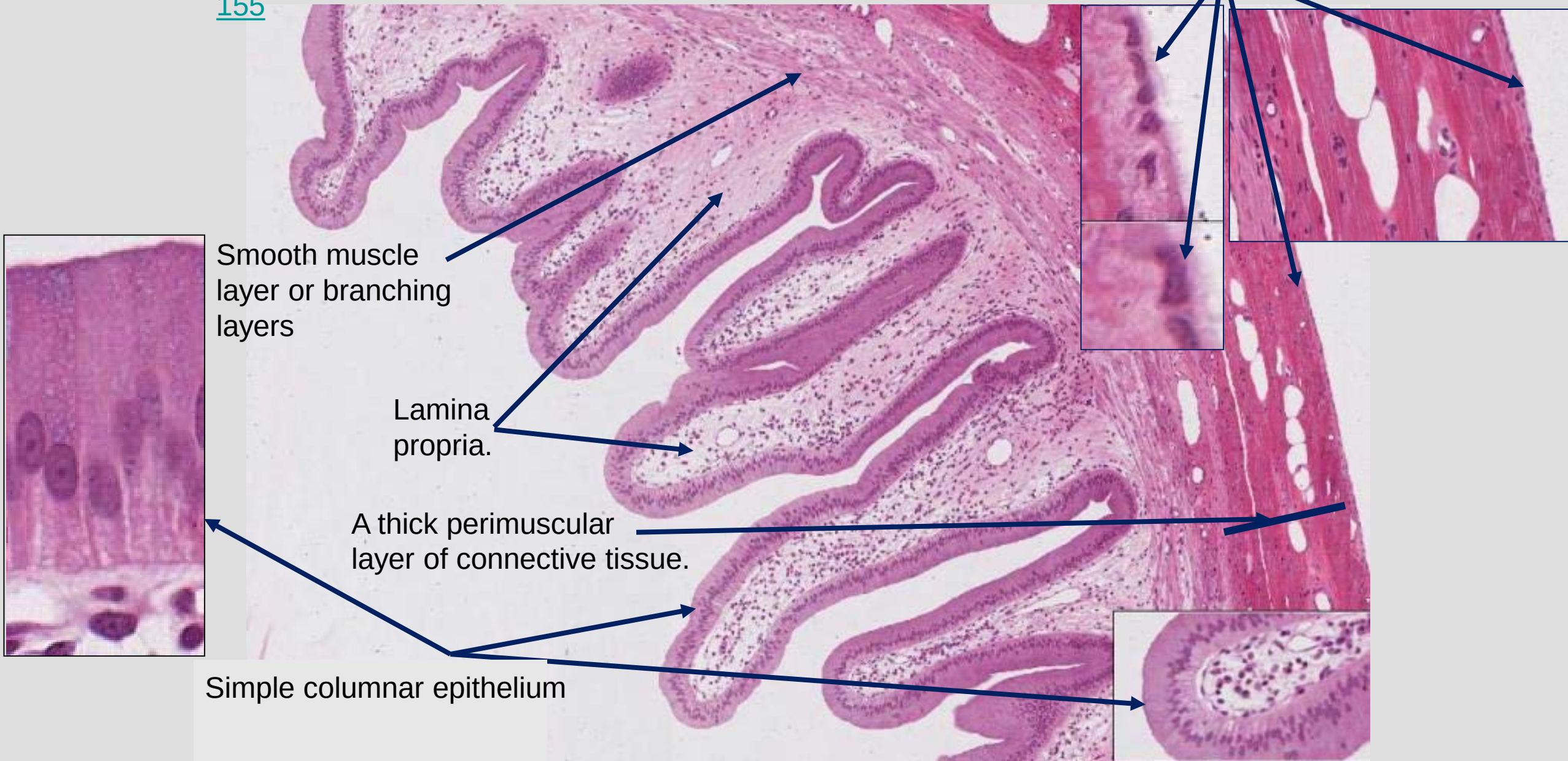
155 Mucosa



Gallbladder

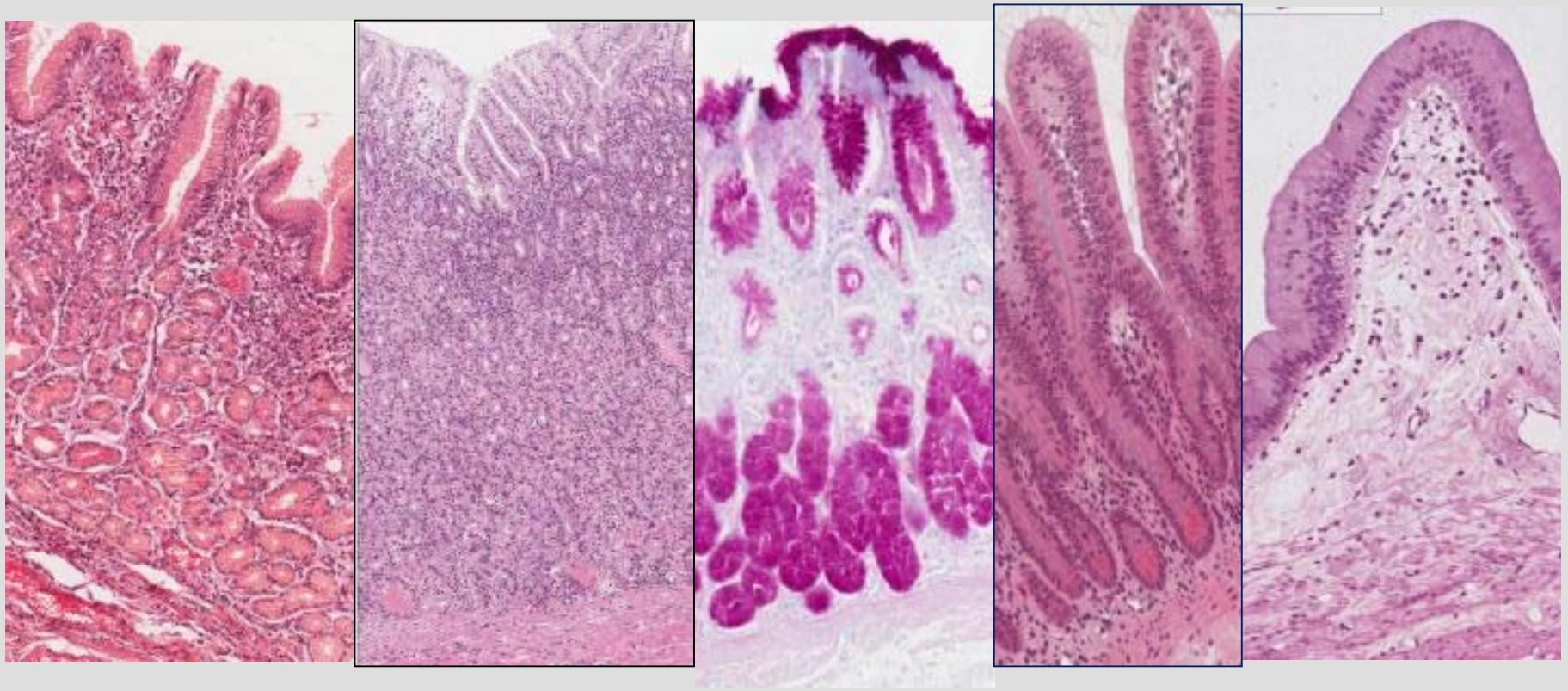
The mucosa is thrown into folds which project into the lumen of the gallbladder.

155



Distinguishing characteristics between the mucosa of the various parts of the stomach, intestines, and gallbladder.

Mucosa = surface epithelium, lamina propera, and muscularis mucosa



Cardiac stomach
437

Fundic stomach
145

Pyloric stomach
141

Intestines
148

Gallbladder
155

SALIVARY GLANDS

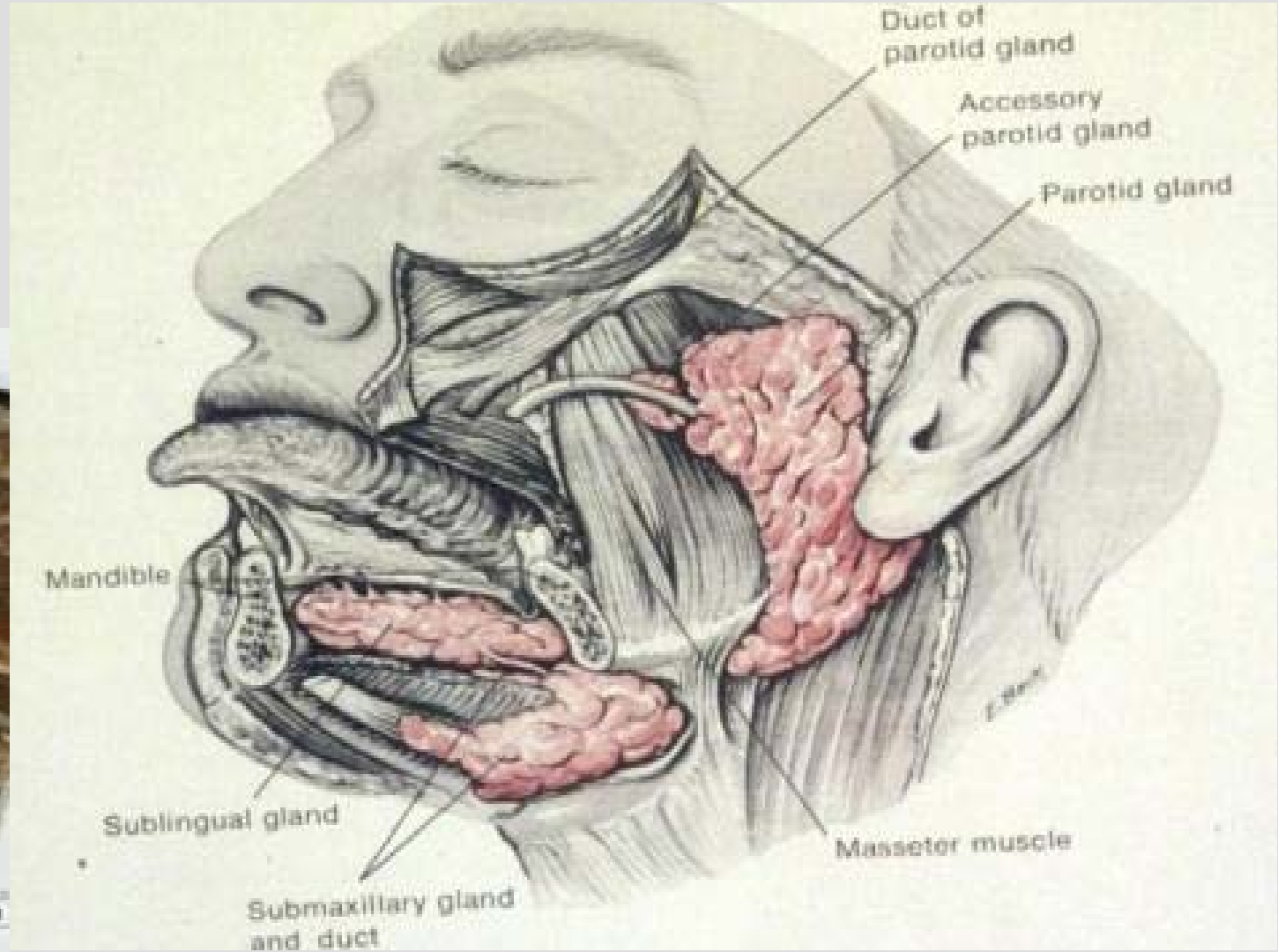
Ref code
16

ACINUS = FUNCTIONAL UNIT

SEROUS

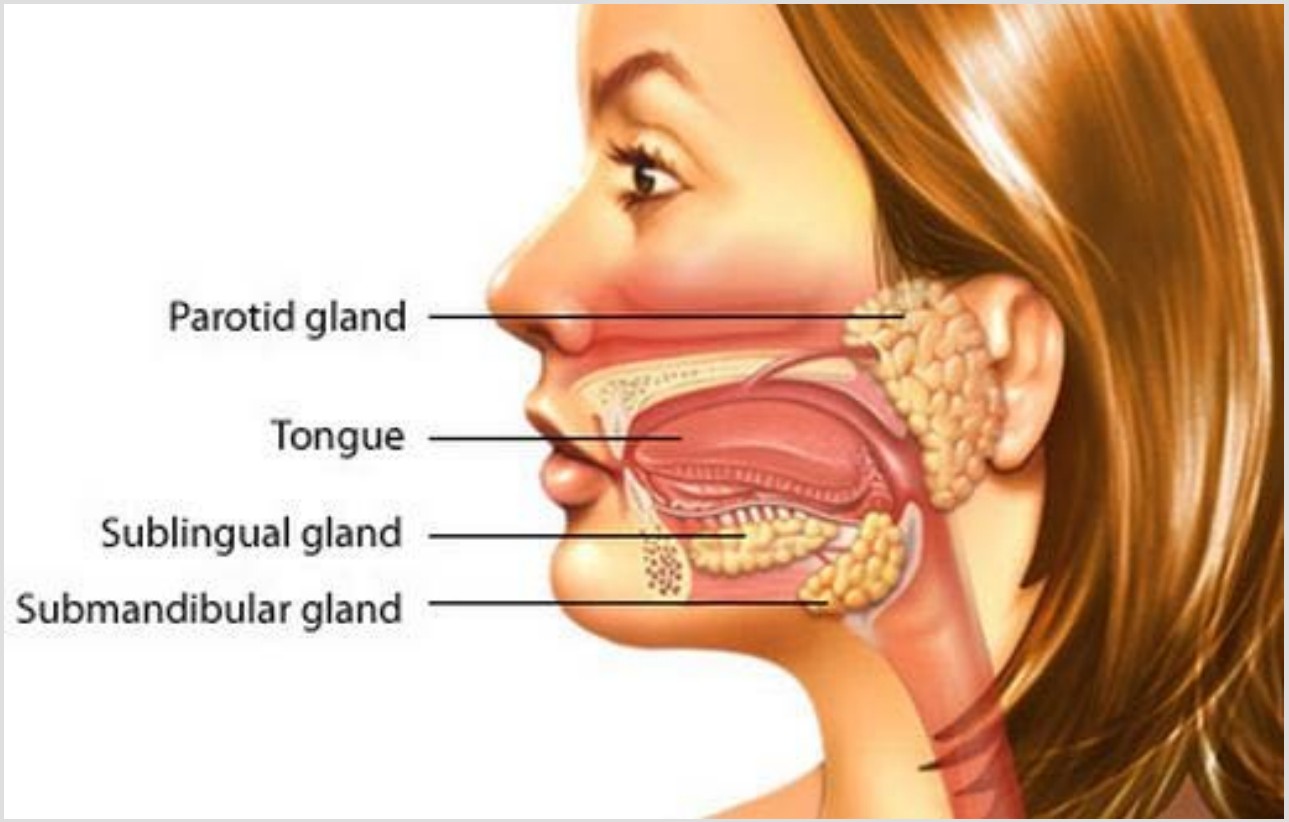
MUCOUS

MIXED



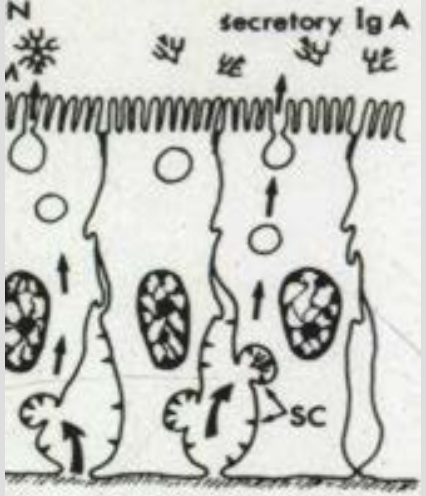
Origin of Salivary Glands?

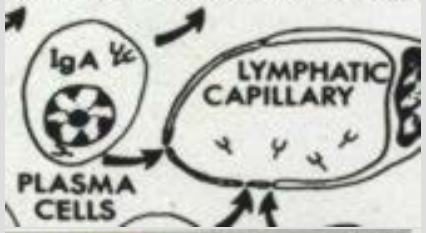
- Ectoderm - oral ectoderm
  epithelial sheet
- Endoderm - alimentary tract

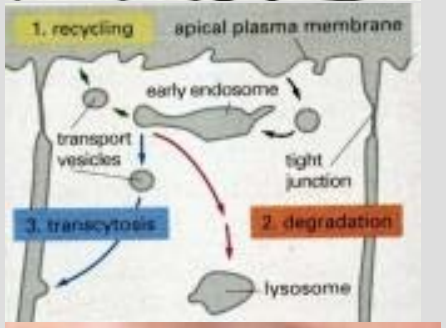


Saliva Helps Prevents Infections

- Contains secreted IgA
- Contains Lactoferin - bind up iron needed for bacteria division
- Contains lysosome that kills bacteria
- Constantly washes mouth to dislodge and sweep bacteria down GI tract

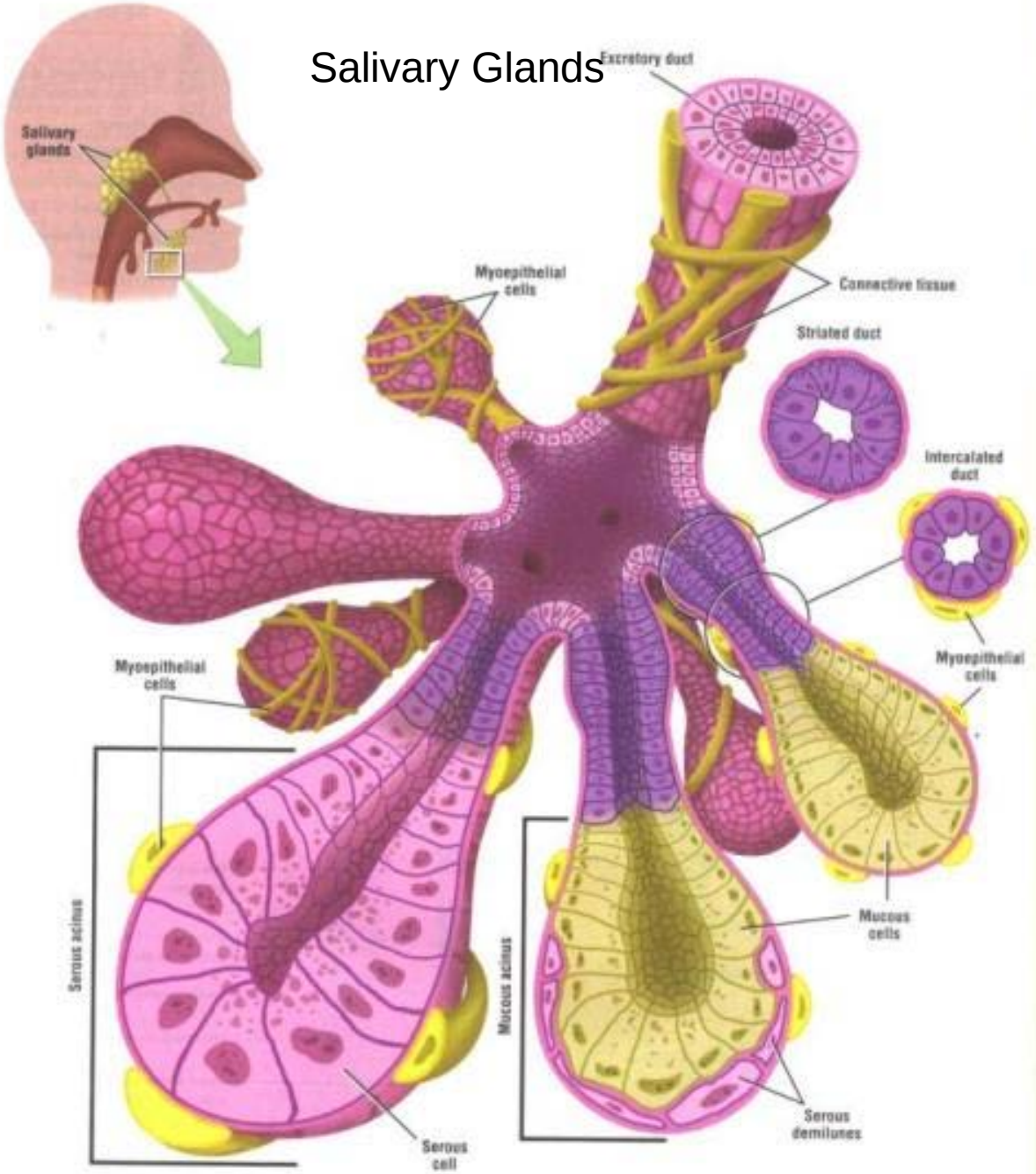


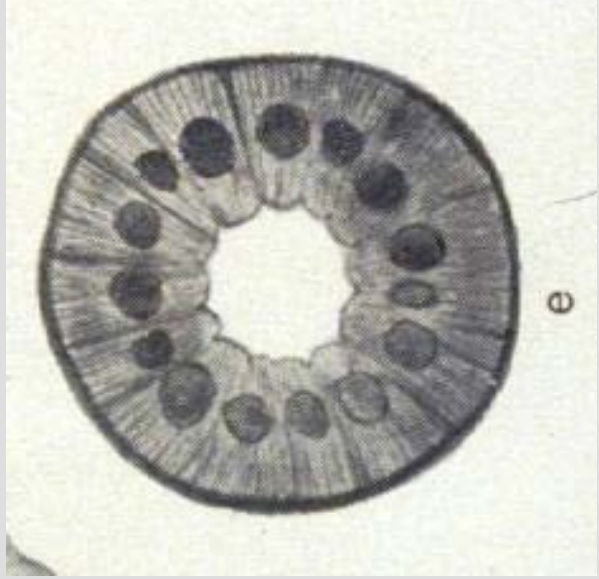


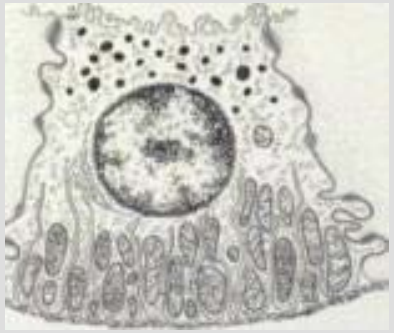


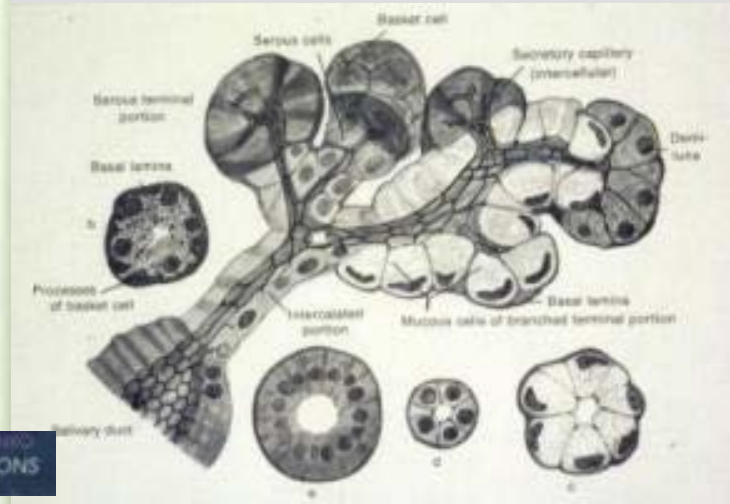
Ref code # 2, 19

Salivary Glands





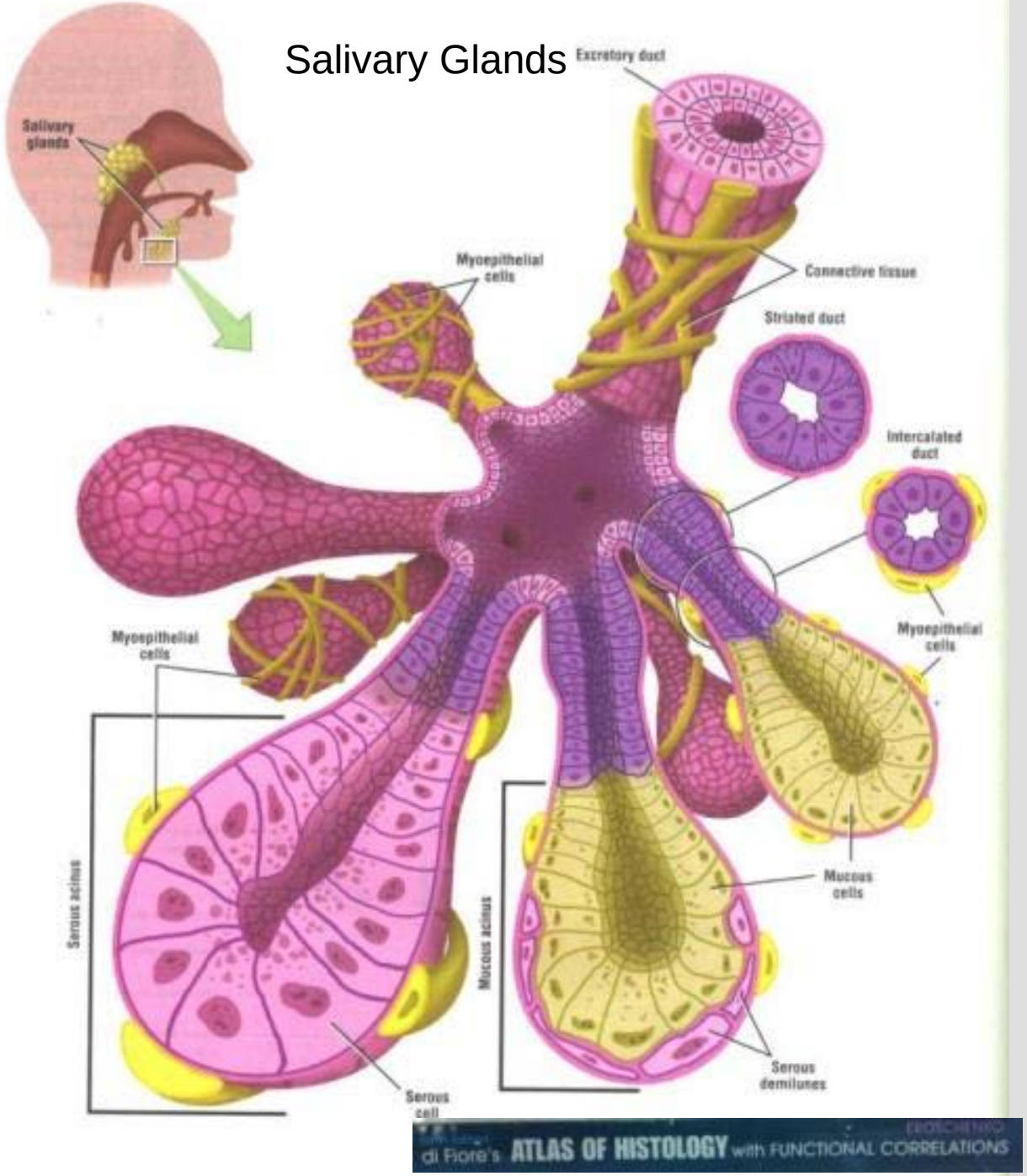




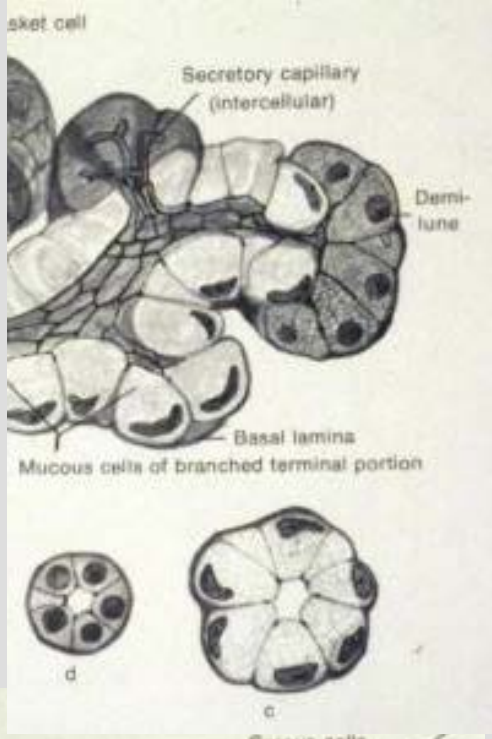
di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS

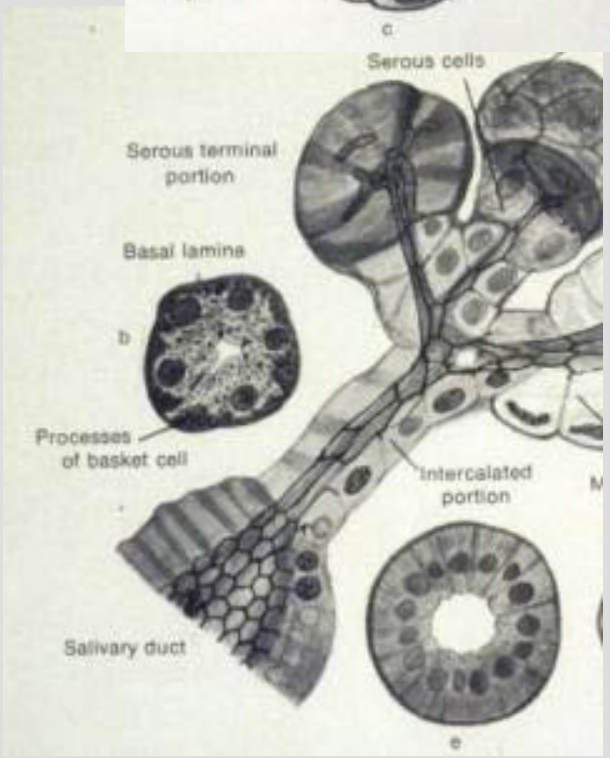
Ref code
5, 6

Salivary Glands



di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS





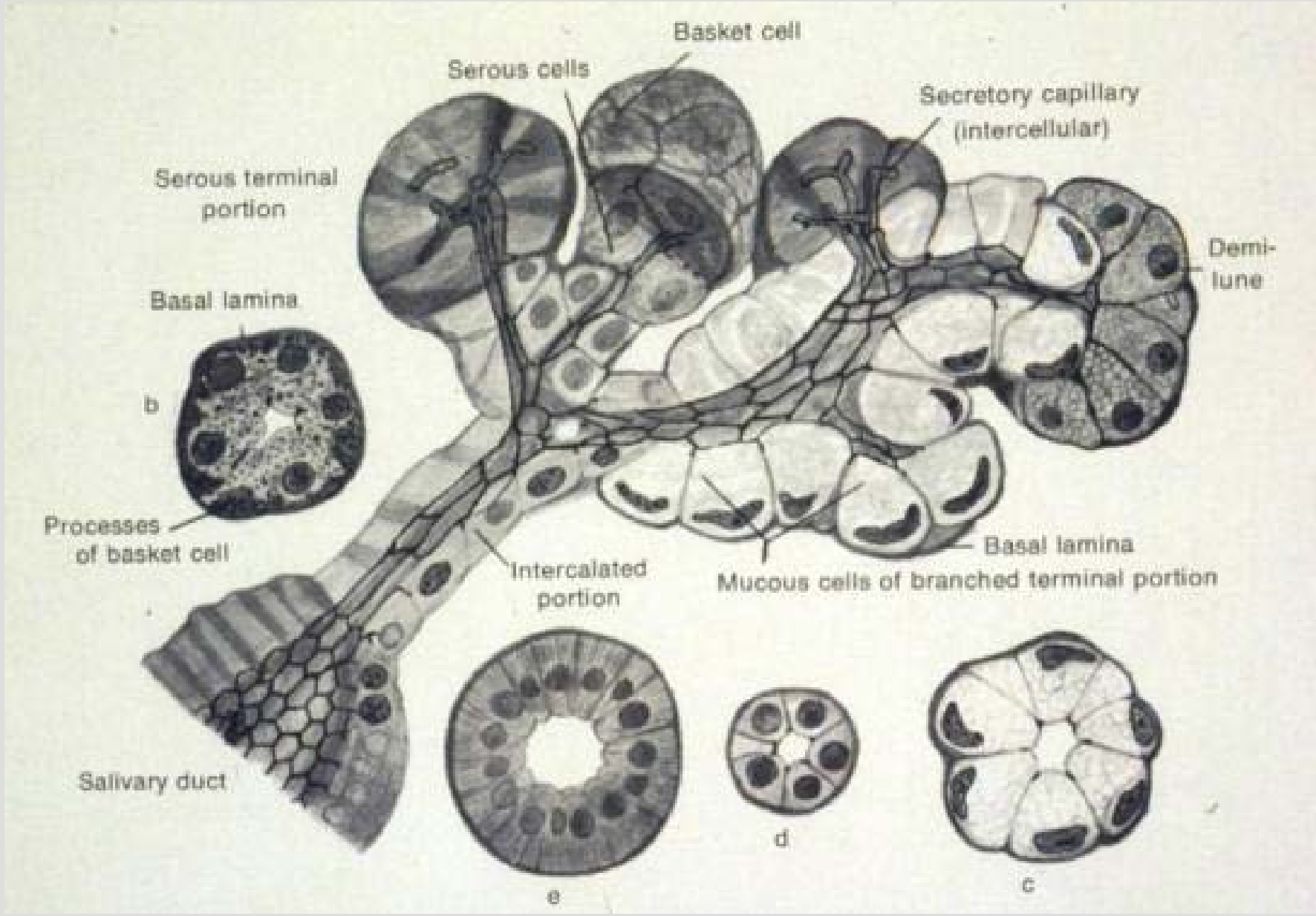
Ref code # 5, 6

Ducts of Salivary Glands

Ref code # 6

Intercalated

Striated



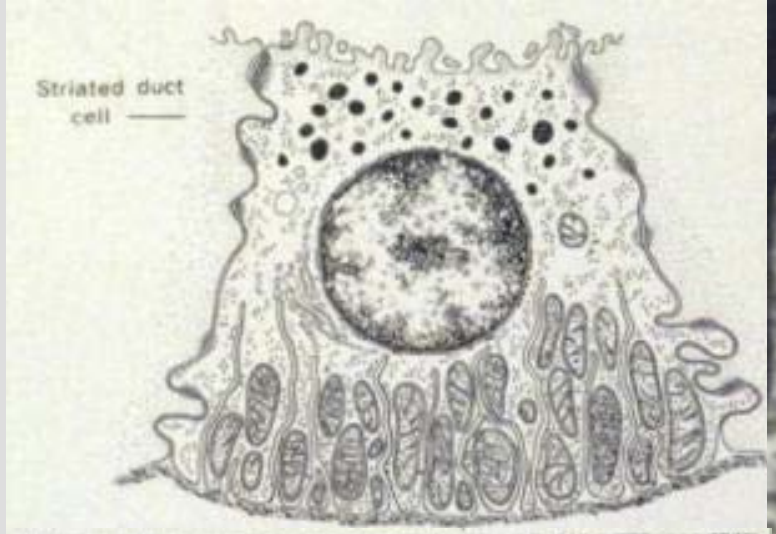
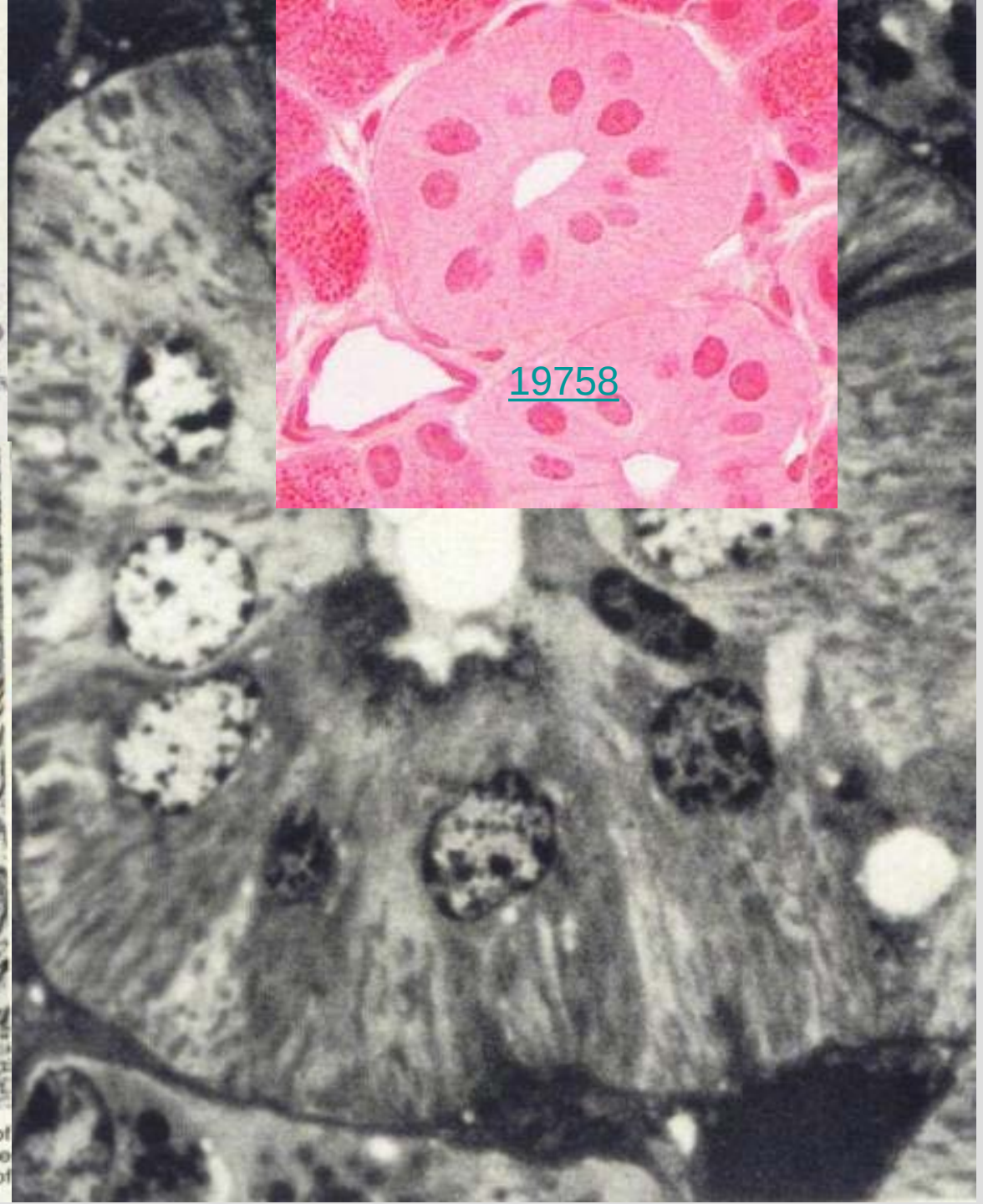
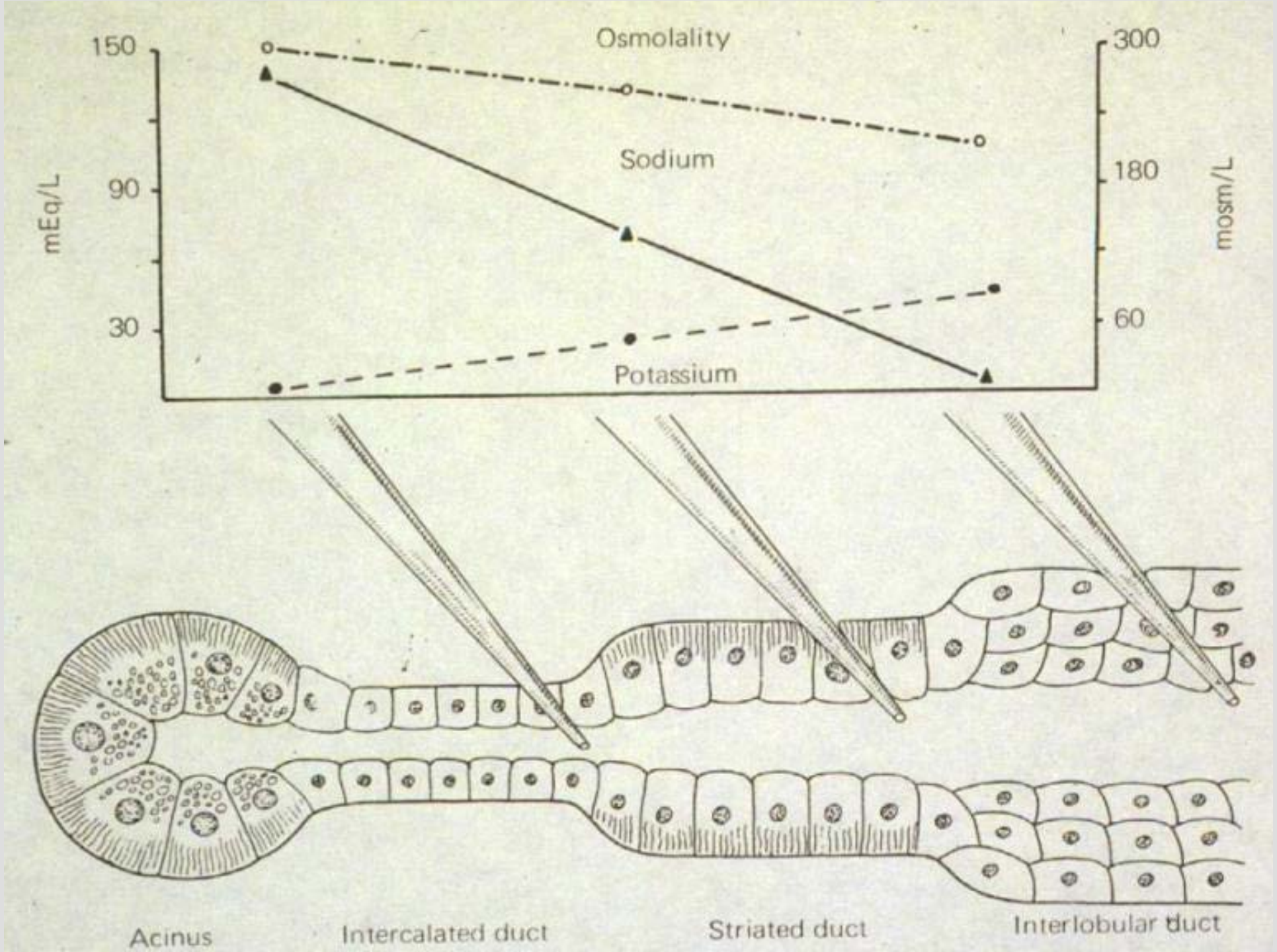


Figure 23–21. Electron micrograph of basal region of striated duct cells from cat submandibular gland. Notice the desmosomes joining the interdigitating processes of



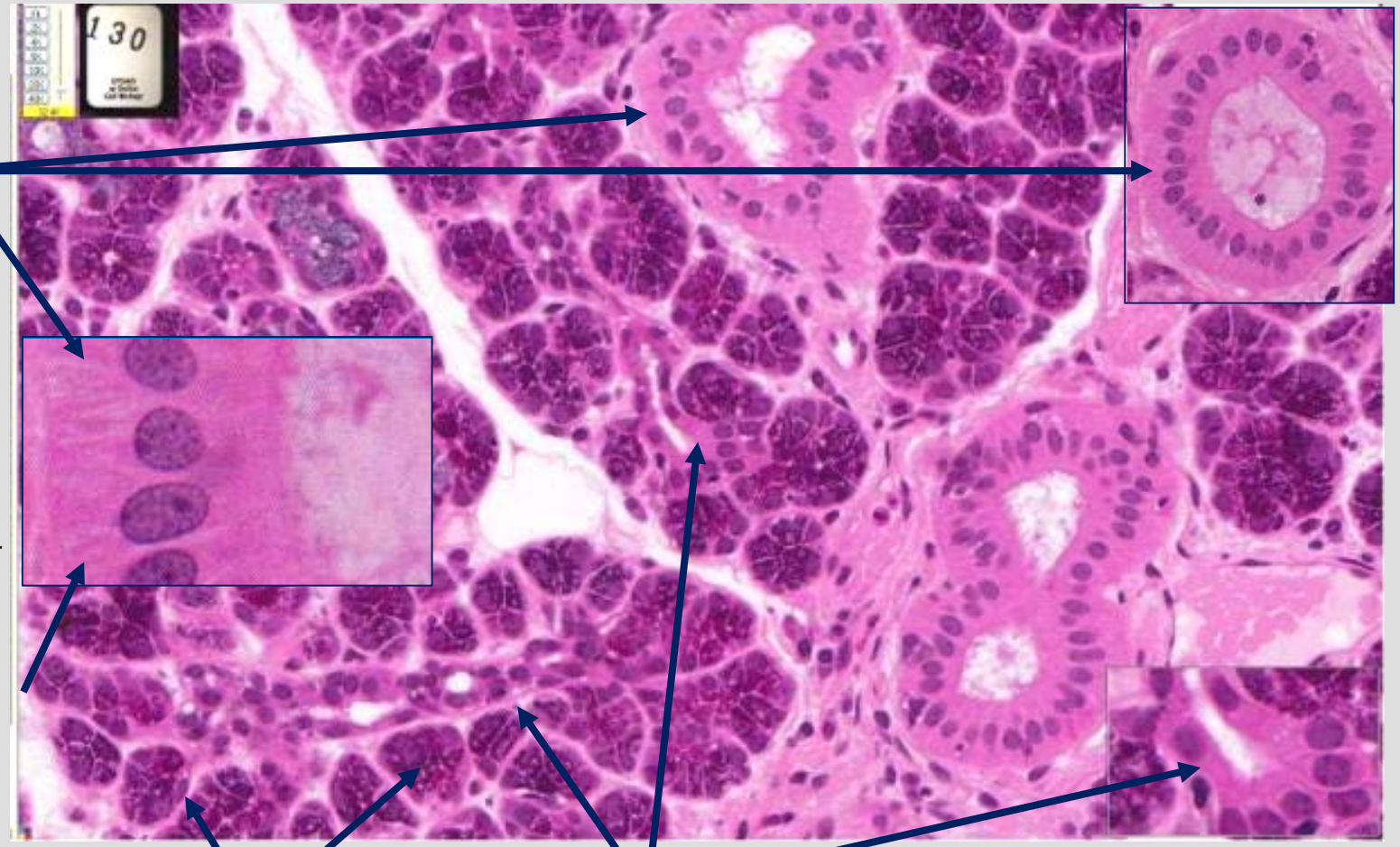
19758

Ref code
6

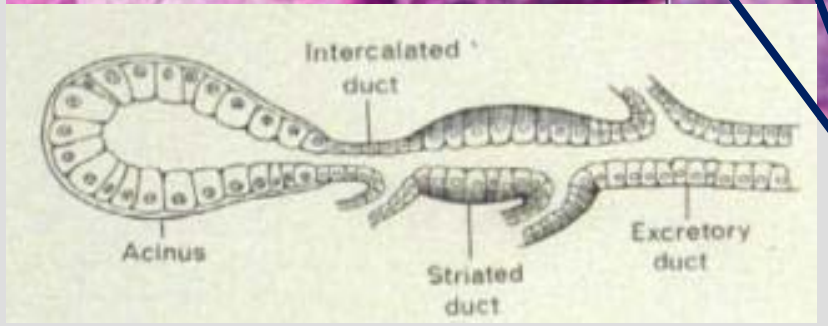

Osmolality
150
300
Sodium
90
180
mEq/L
mosm/L
30
60
Potassium
Acinus
Intercalated duct
Striated duct
Interlobular duct

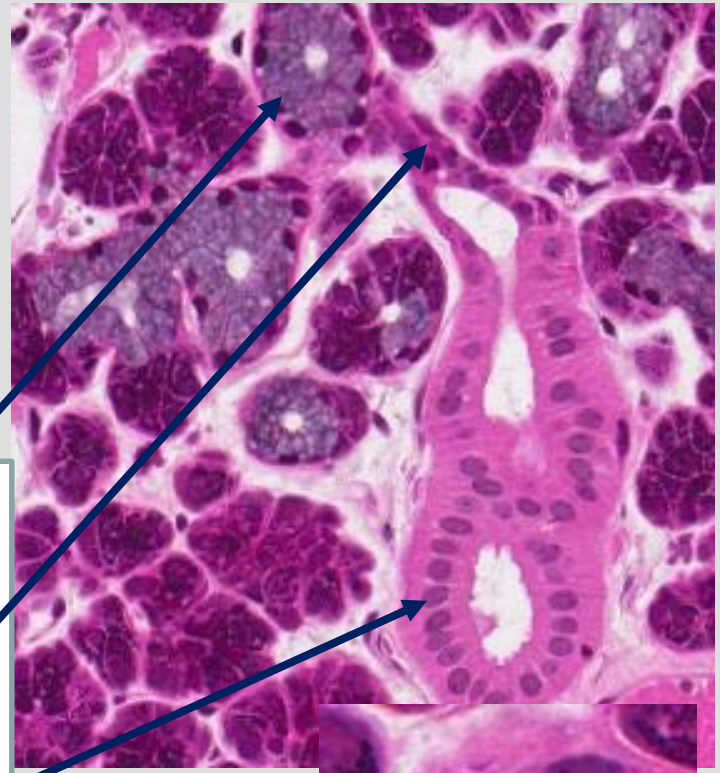
130 Submandibular gland - intercalated duct runs into Striated duct of salivary gland

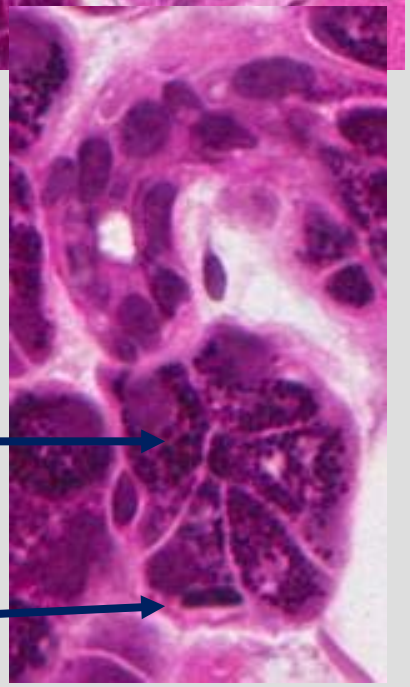
The salivary gland is a compound, tubuloacinar gland.



Salivary gland





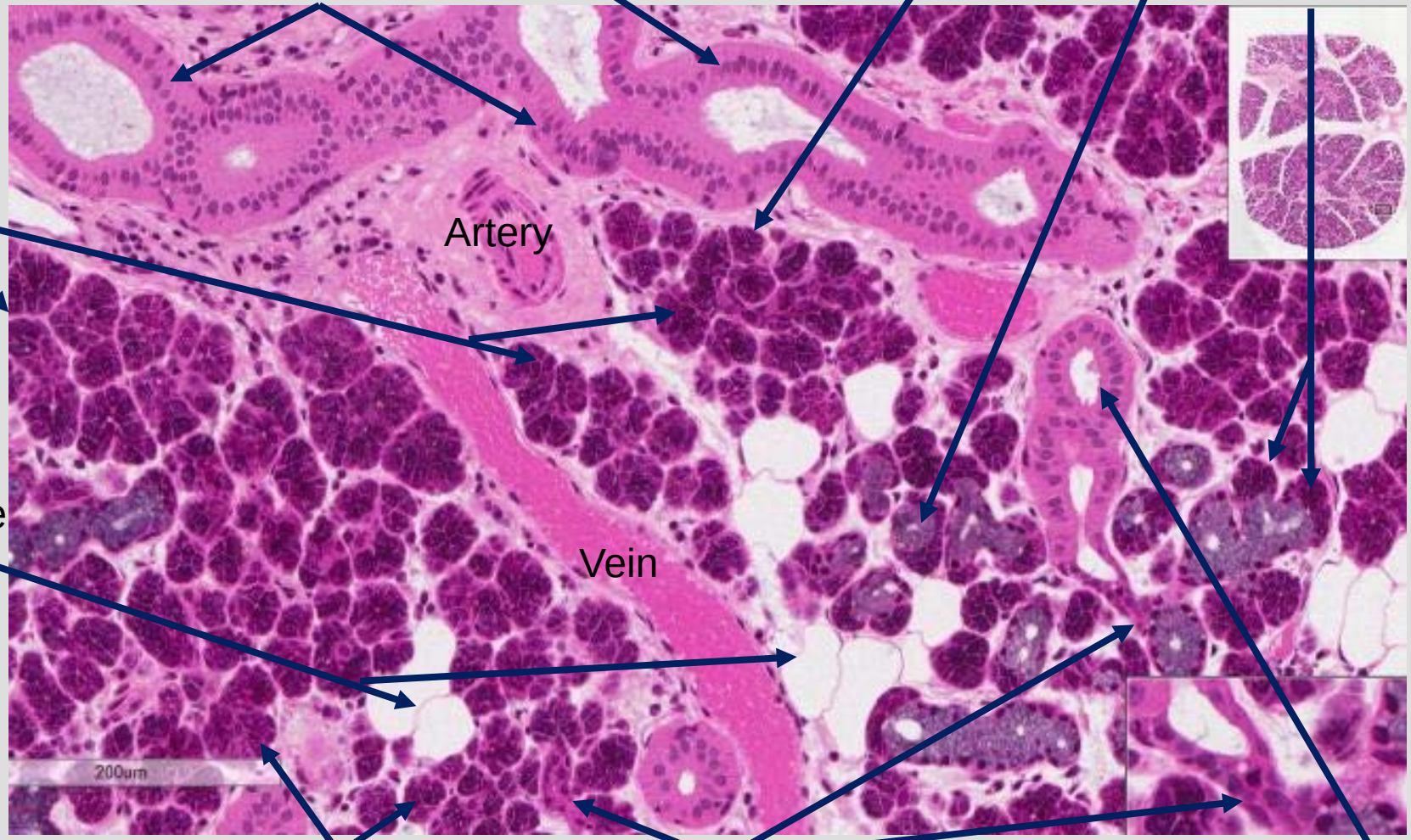


Secretory acini are drained by intercalated ducts and join striated ducts

Serous and mucous acini

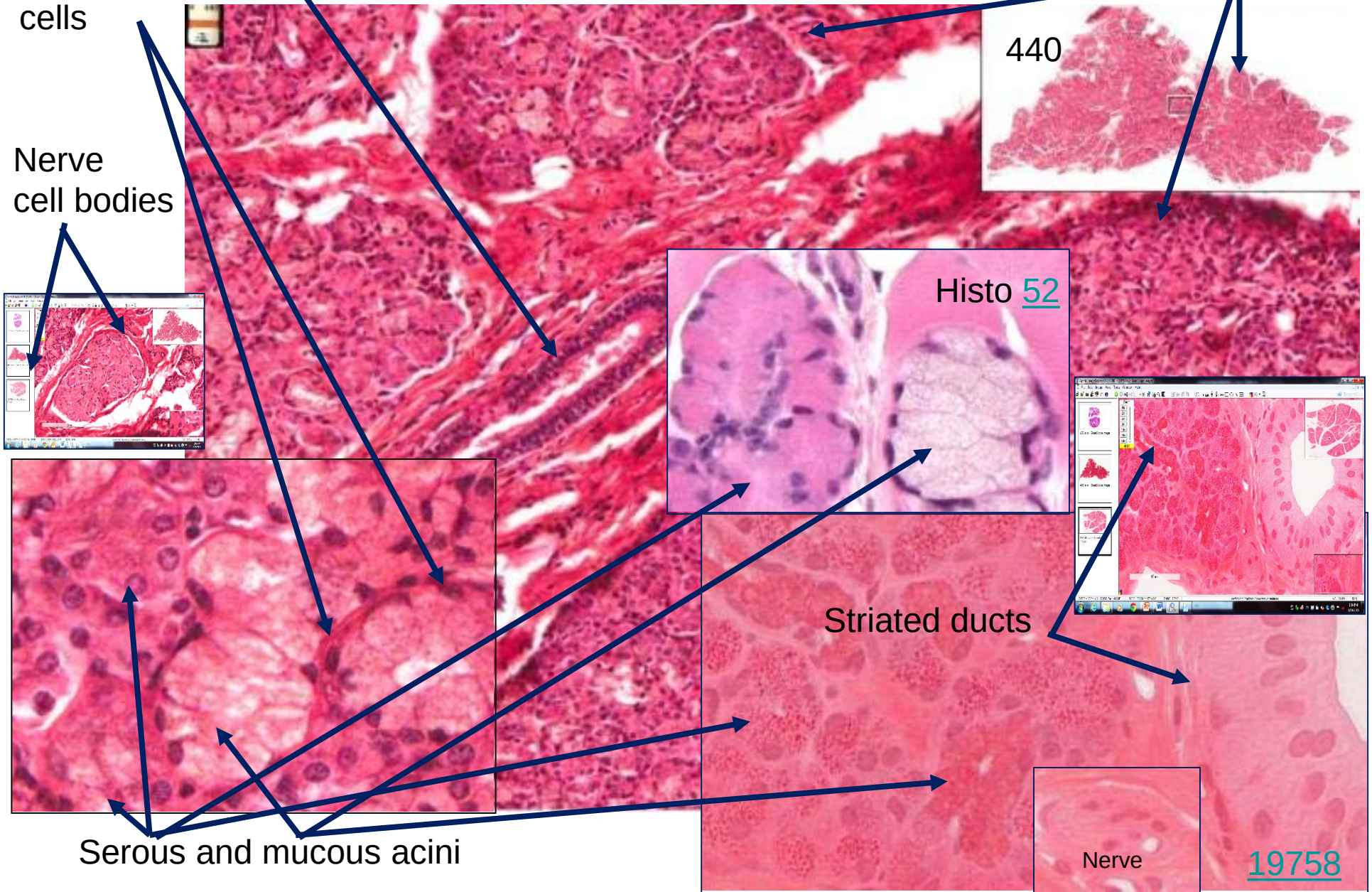
Myoepithelial cells

Salivary gland



Individual secretory acini are drained by intercalated ducts and join striated ducts

Salivary glands 440



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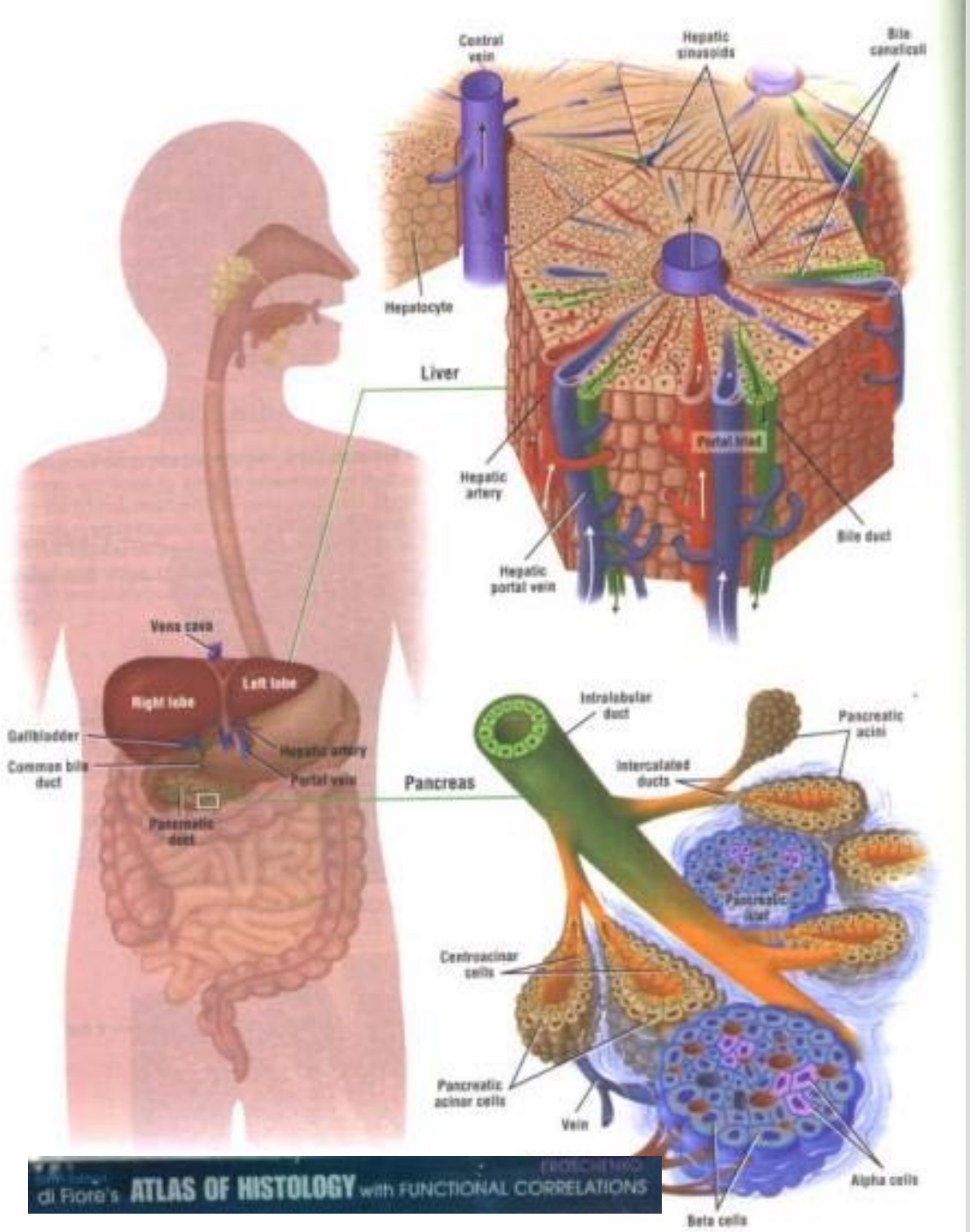


Pancreas

PANCREAS

FUNCTION

1. EXOCRINE
2. ENDOCRINE

HISTOLOGICAL ORGANIZATION,

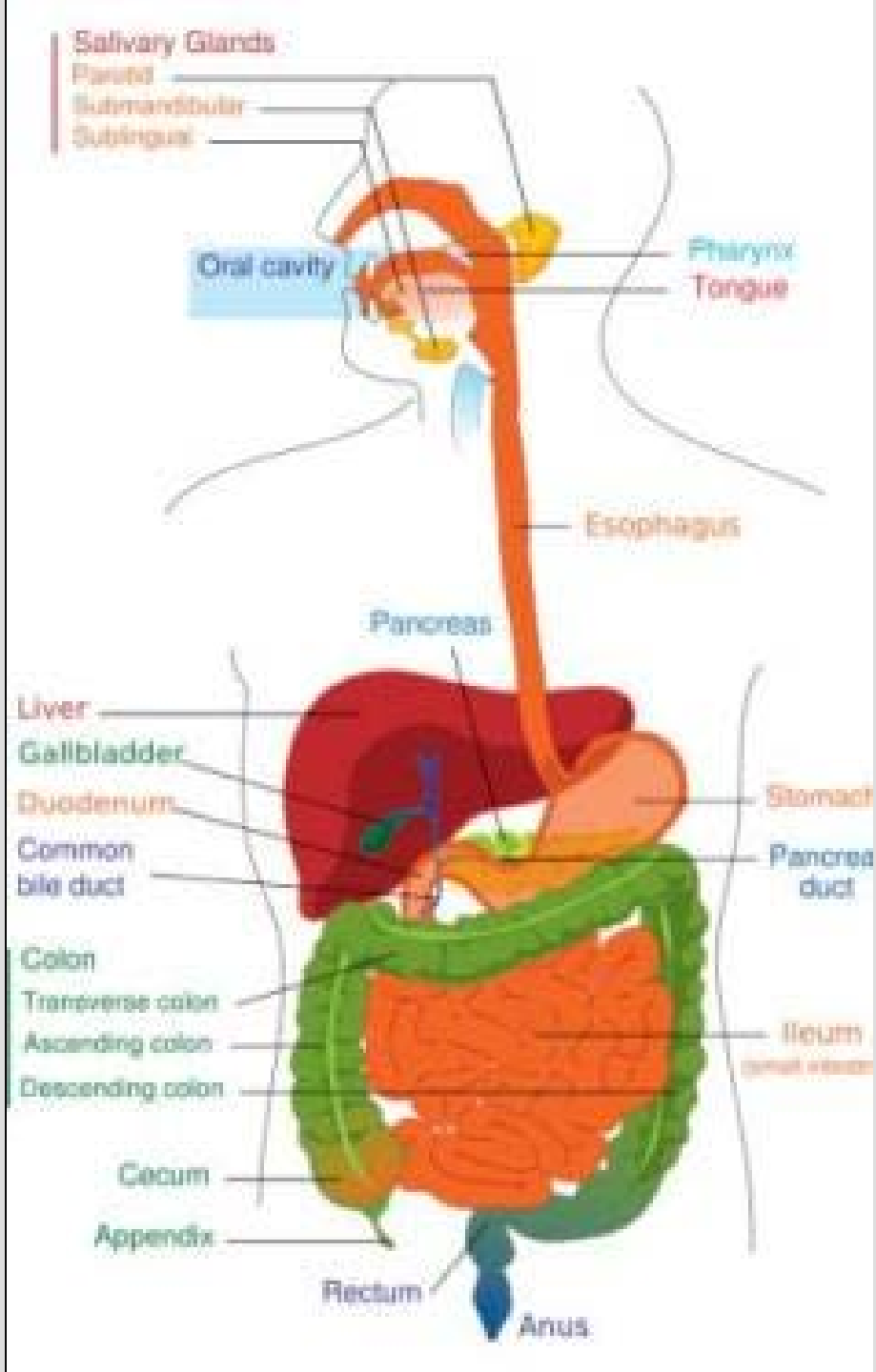
EXOCRINE PORTION

1. ACINI
2. DUCTS

ENDOCRINE PORTION

- ISLETS OF LANGERHANS

HISTOPHYSIOLOGY



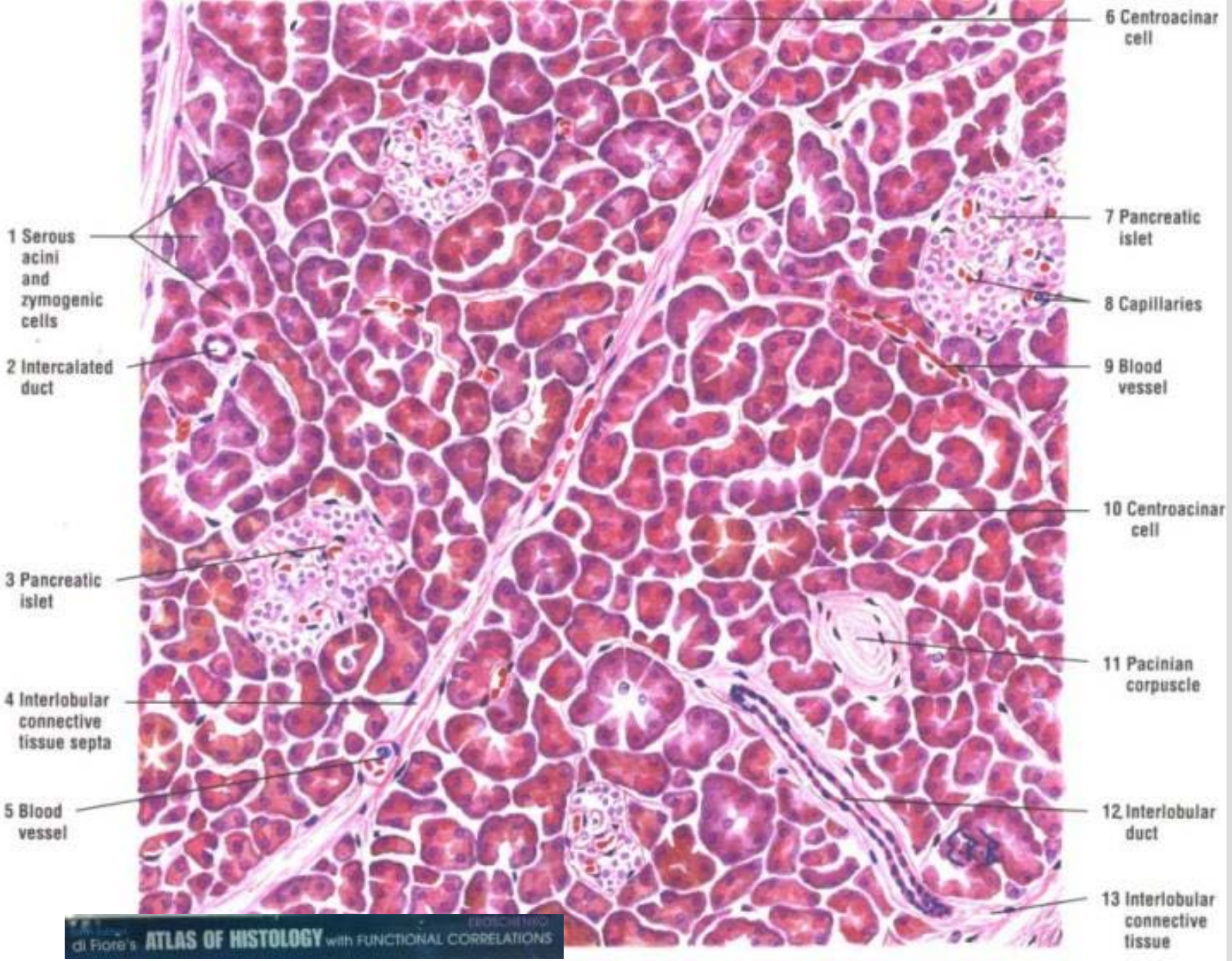
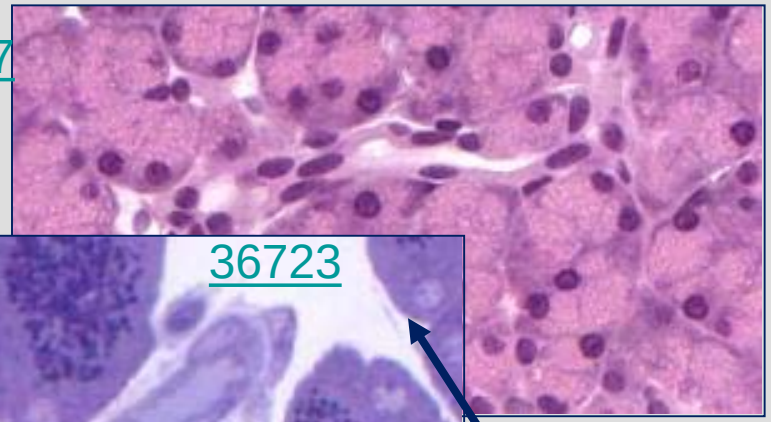


Fig. 13-10 Pancreas (sectional view). Stain: hematoxylin-eosin. Low magnification.

156 and 157 Pancreas

Ref code # 6

157



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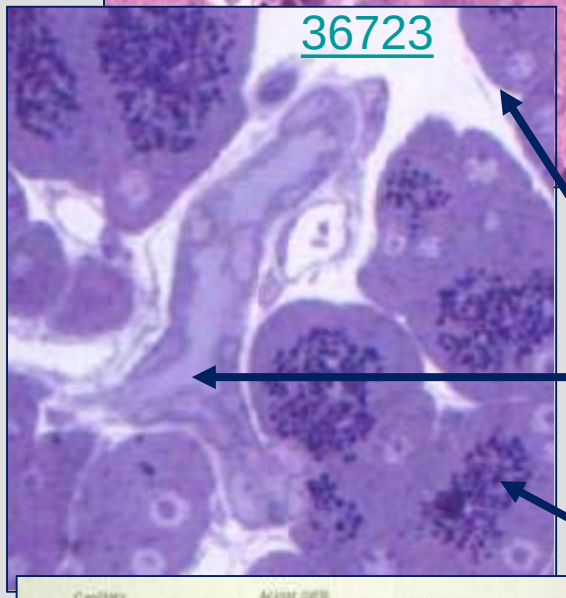

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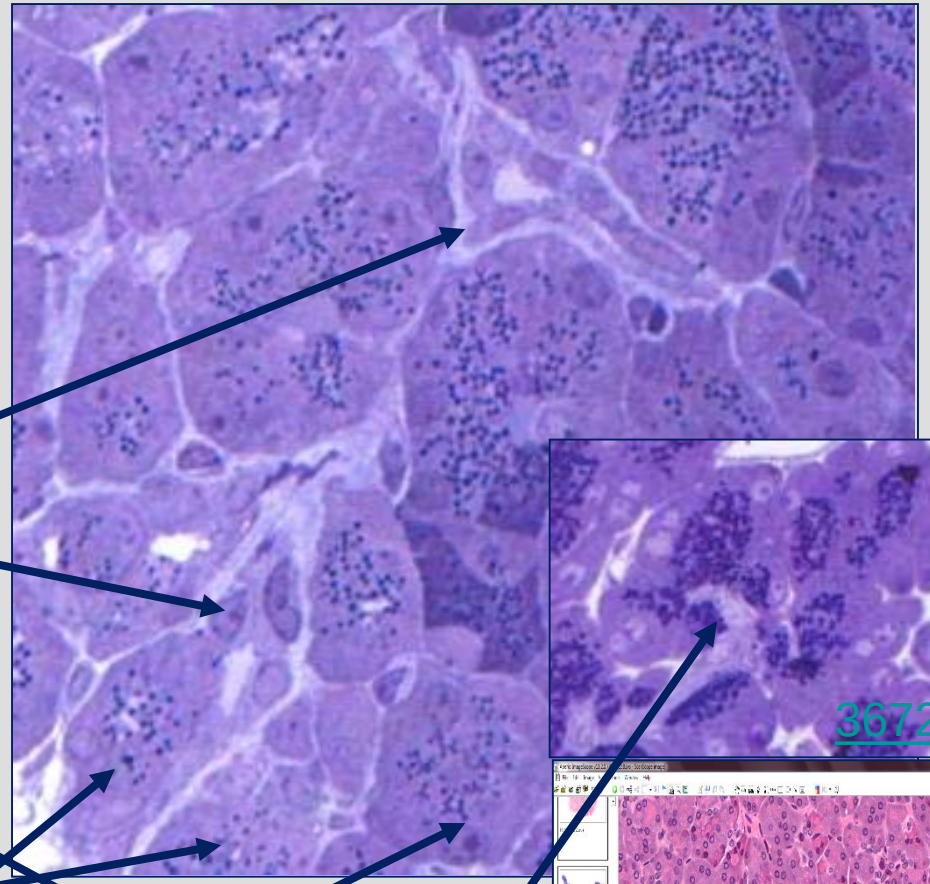

Intercalated duct

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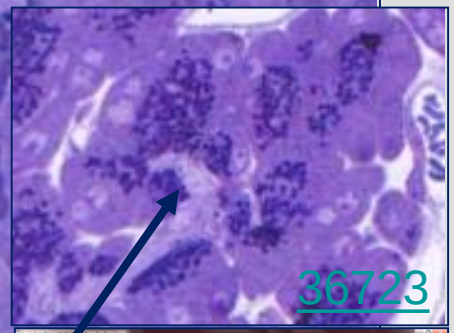
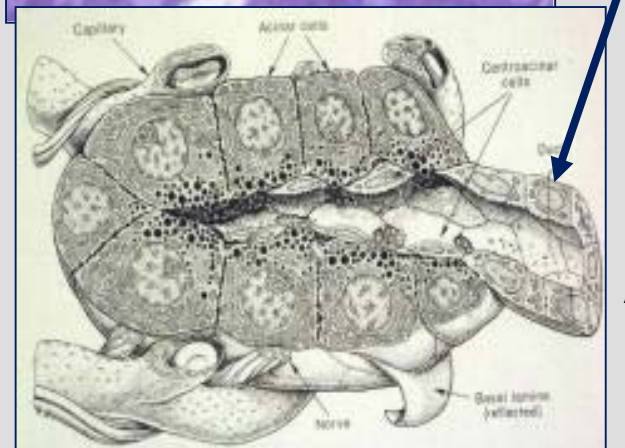
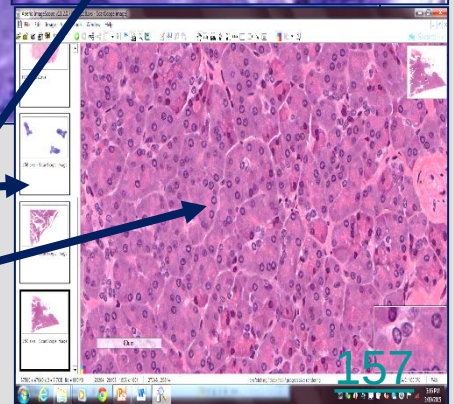


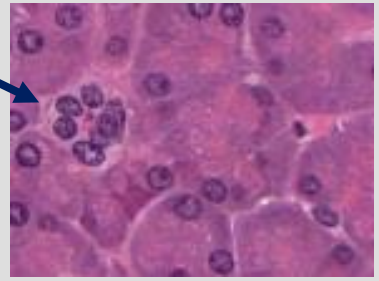


Secretory granules



All acini are of the serous type and many contain centroacinar cells initiate the duct inside the acinus.

Pancreas - Islets of Langerhans



Intercalated duct

The pancreas is a compound tubuloalveolar (tubuloacinar) gland which functions in the digestion of food.

Islets of Langerhans

Insulin is secreted by the B cells which are most numerous and centrally located in the islets.

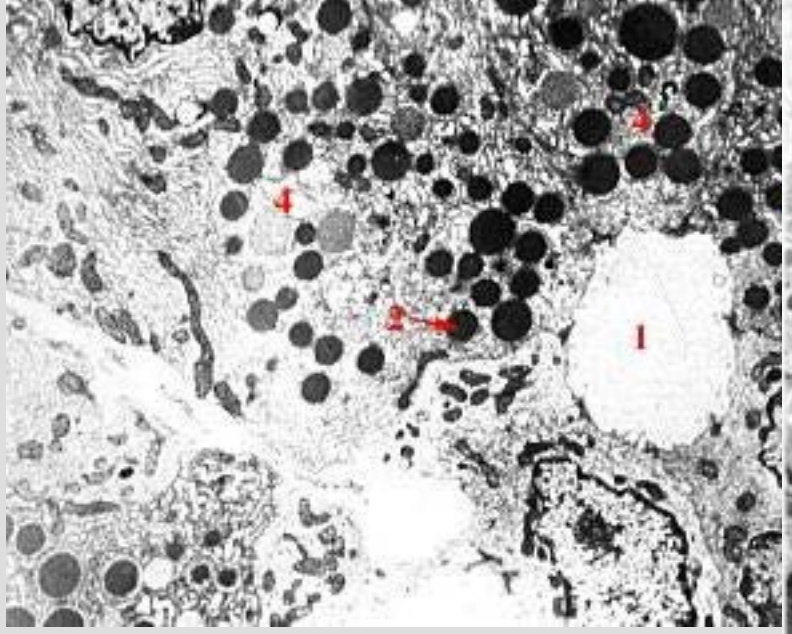
Lobes composed of lobules

Connective tissue septa.

Blood vessels

Nerve

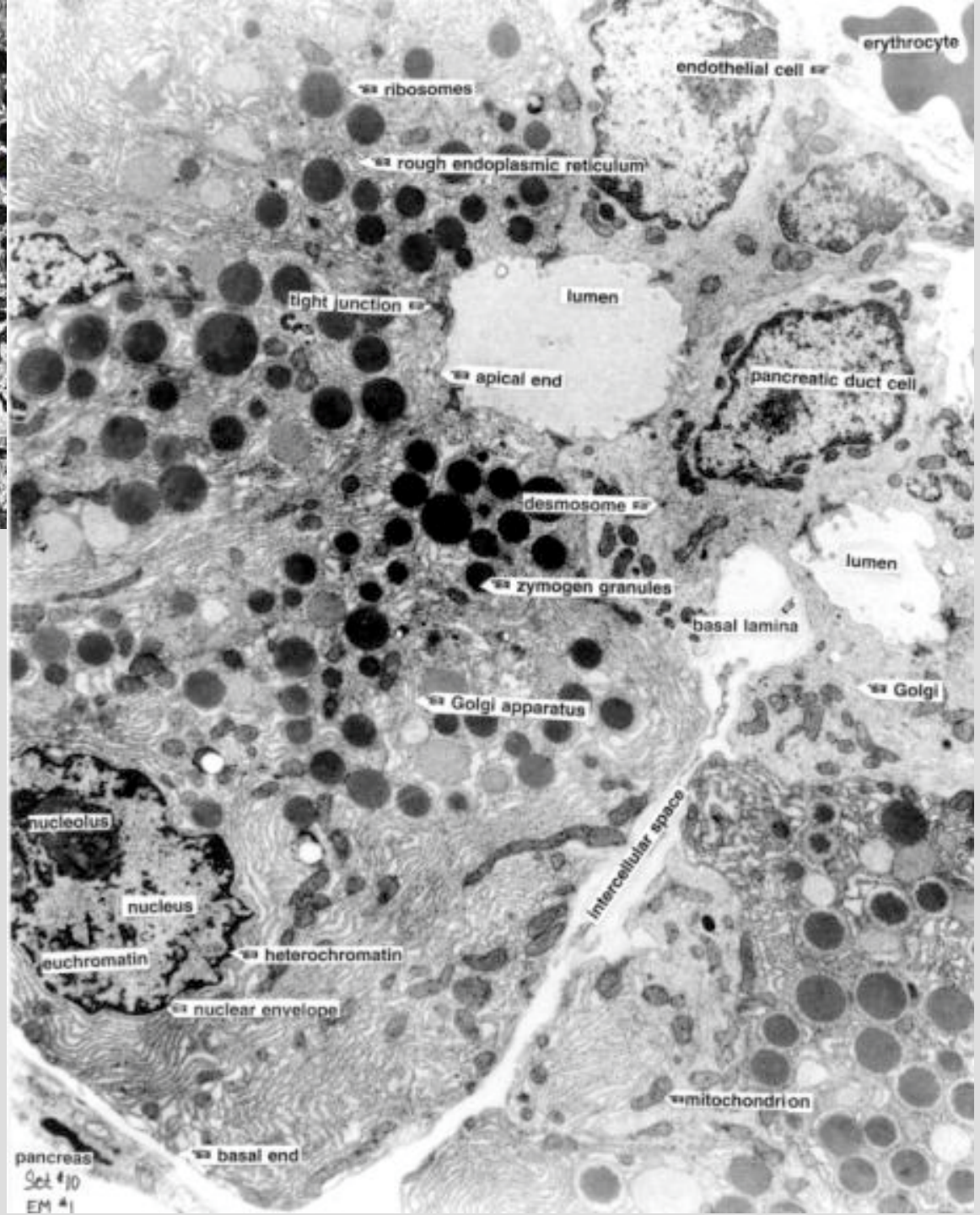
Interlobular duct



EM 1

Pancreatic acinar cell (EM 1)

1. Lumen
2. Zymogen granule
3. Vesicles
4. Central acinar cell



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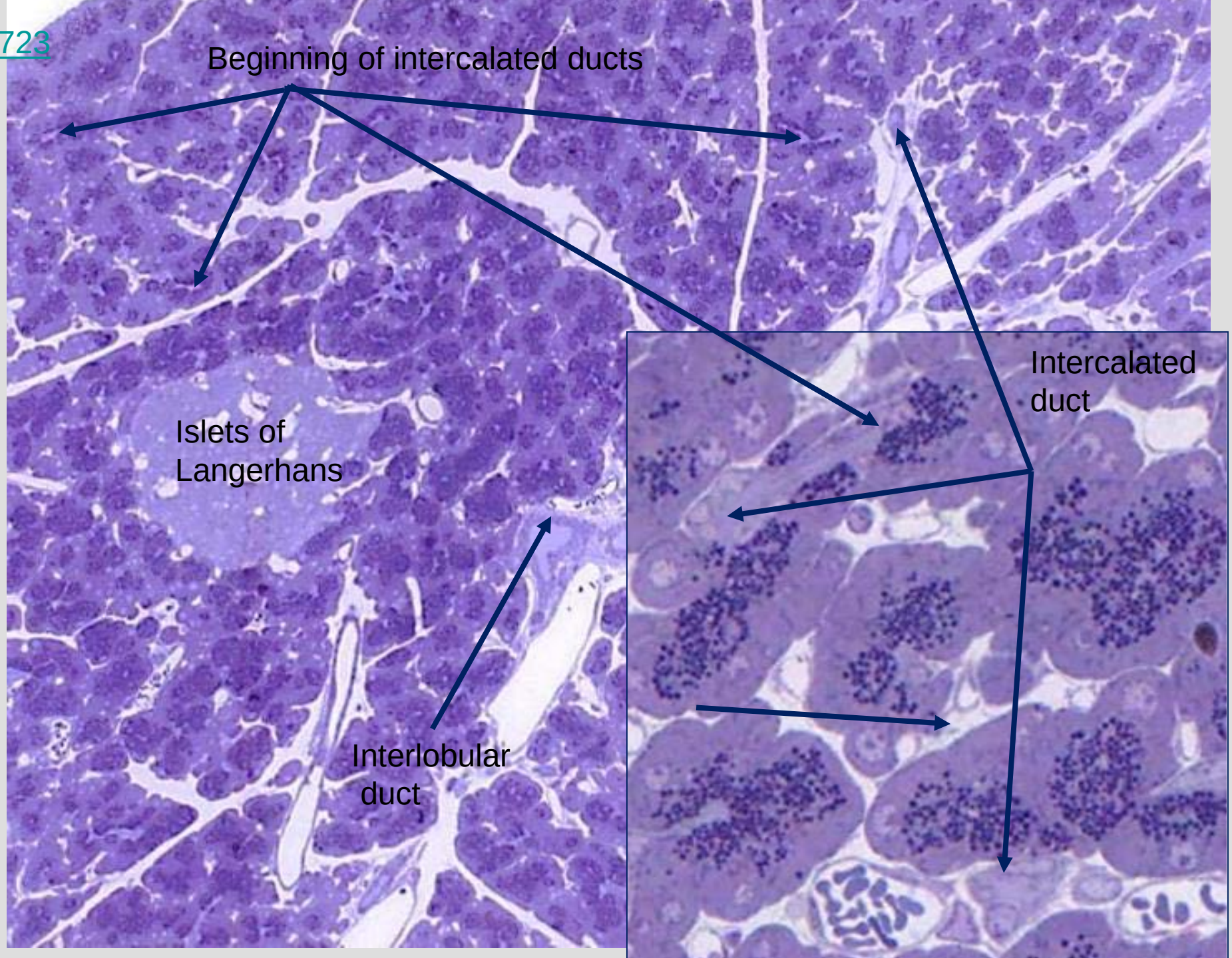

Beginning of intercalated ducts
Islets of Langerhans
Interlobular duct
Intercalated duct

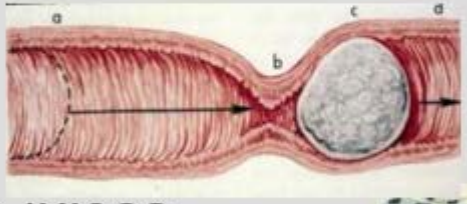
In summary

Function of the Digestive System

Role of liver, gall bladder, salivary glands, and pancreas

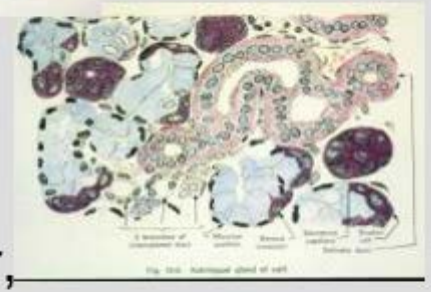
Movement of food

Salivary glands lubricates



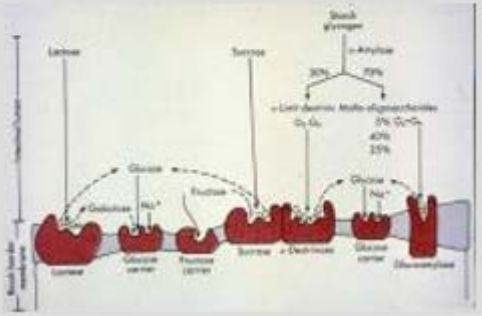
Secretion of digestive juices

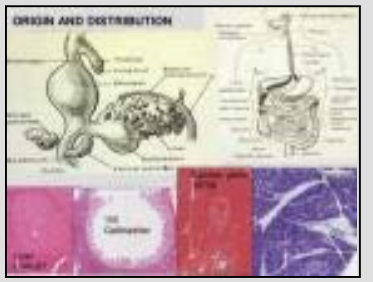
Salivary glands and pancreas secretes digestive juices and liver secretes bile

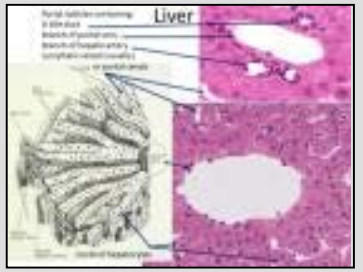


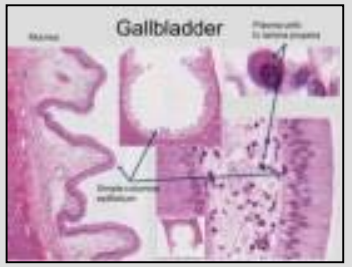
Absorption of digested foods, water, and electrolytes

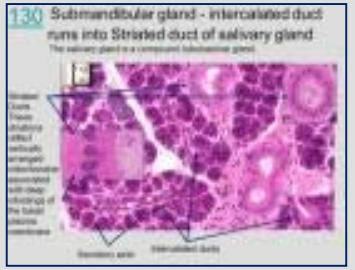
Liver stores nutrients and cleans the blood. Also, the accessory digestive organs contribute antibodies and antibacterial/viral growth substances.

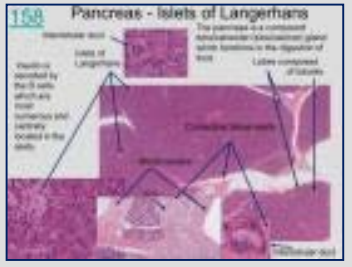












Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

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Questions on the Liver, pancreas, and salivary glands

The humoral activity of the immune system is illustrated by the transfer of IgA immunoglobin by epithelial cells into which of the following body fluids?

a. saliva
b. milk
c. bile
d. a and b
e. a, b, and c

Which function(s) do the gallbladder and urinary bladder have in common?

a. temporary storage of waste products
b. concentration of their respective luminal contents
c. similar type of luminal epithelium
d. a and b
e. a, b, and c

Characteristics of the pancreas include:

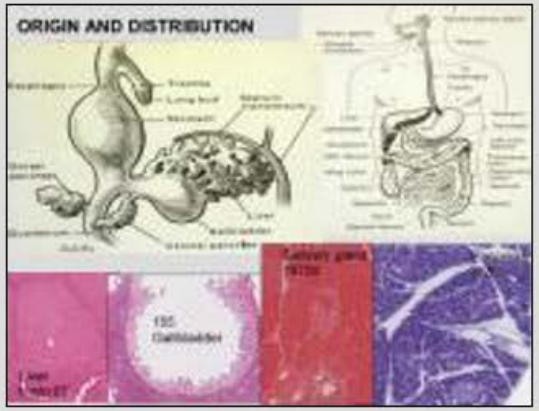
a. a portal blood vascular system
b. endocrine cells of the islets of Langerhans
c. acinar cells and striated ducts
d. a and b
e. a, b, and c

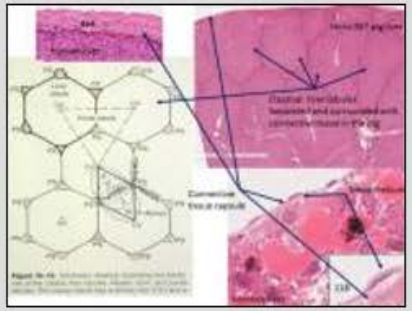

GENERAL STORE
CANDLE SHOP
HITCHIN POST
HITCHIN POST

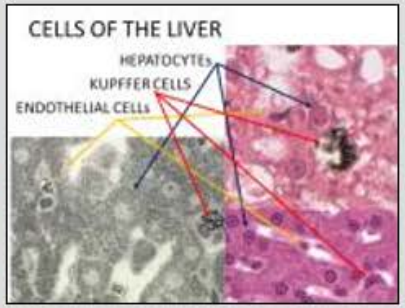
The end of

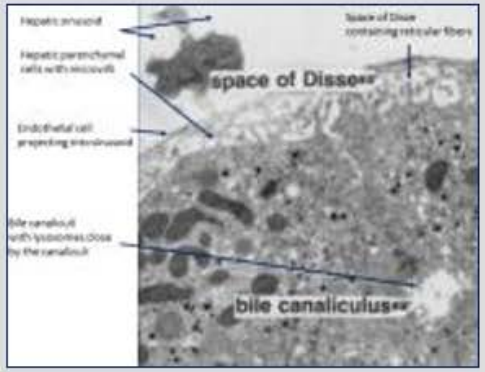
Medical School Histology Basics
Liver, gallbladder, salivary glands, and pancreas

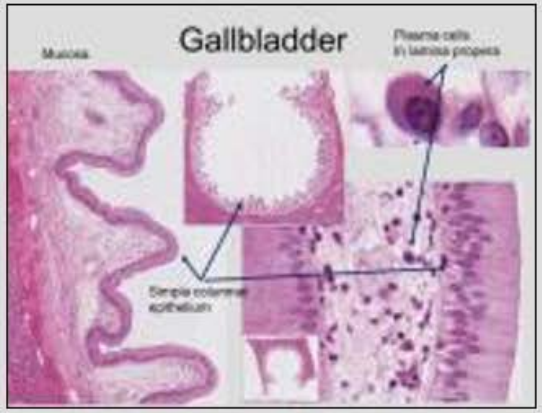
VIBS 243 lab

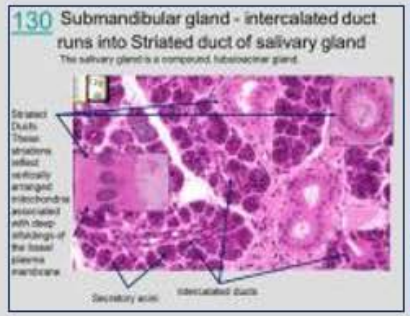


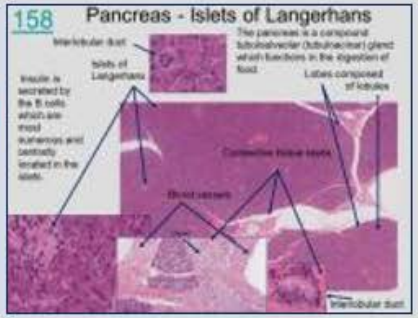


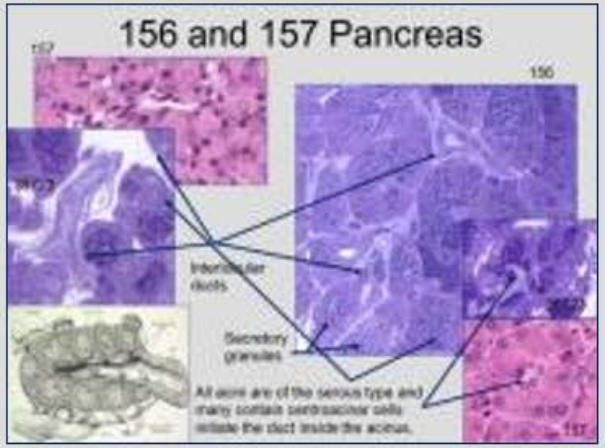












Larry Johnson Texas A&M University