Liver

Liver

Slides 46, 48, 68, 110

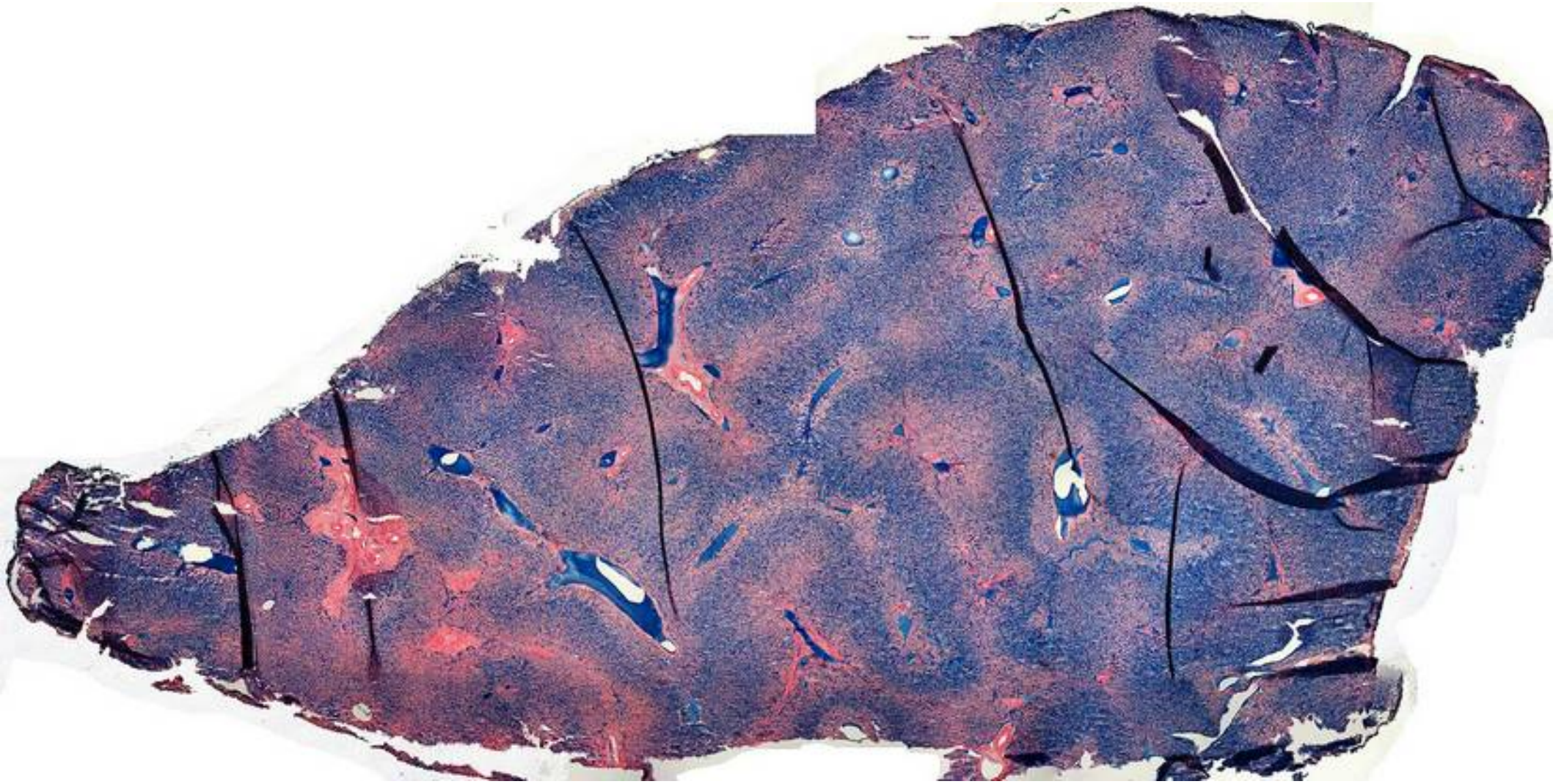
Liver human – HE stain

Very low magnification

Liver – silver stain for reticular fibres

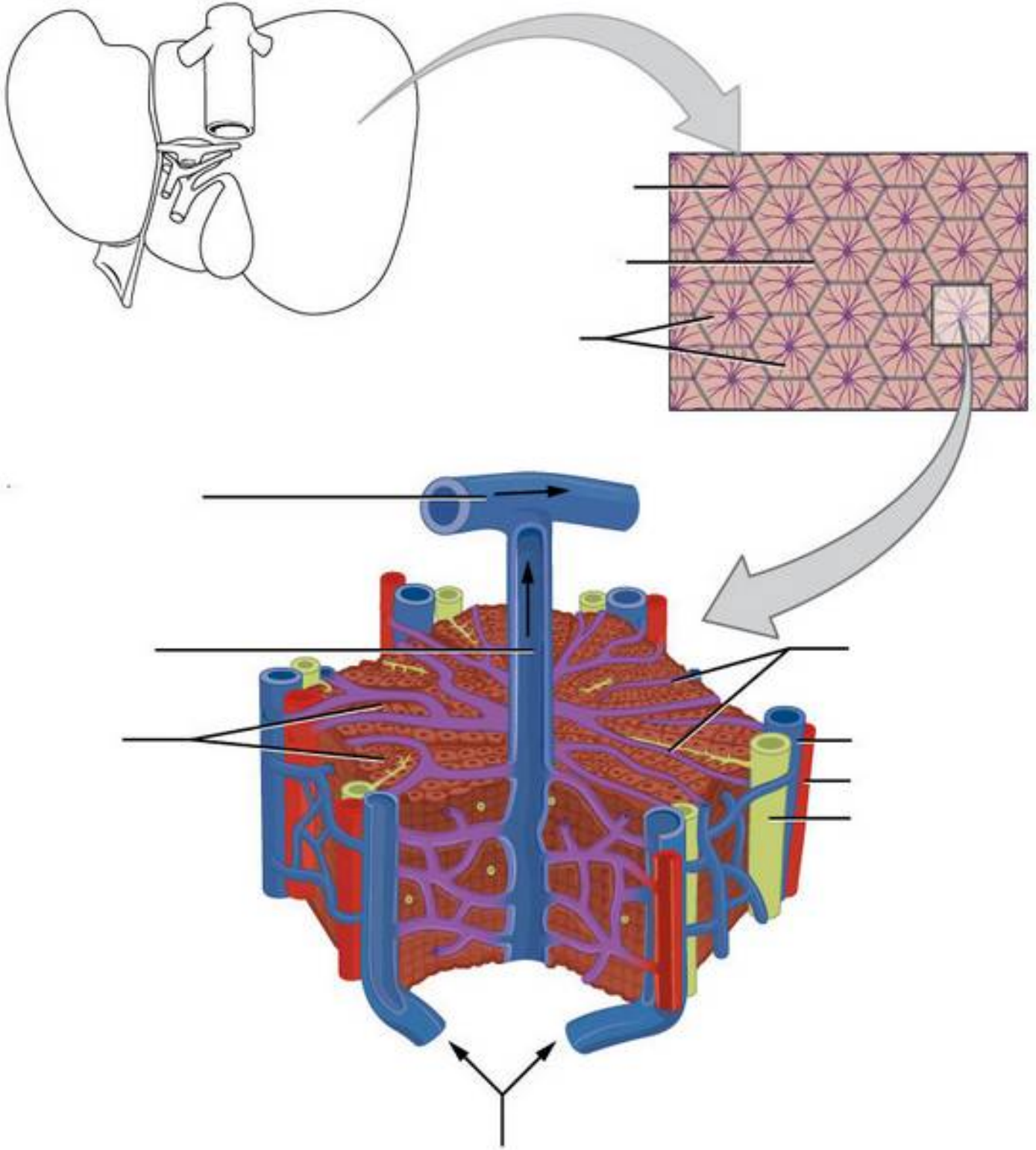

Liver pig – HE stain
Very low magnification

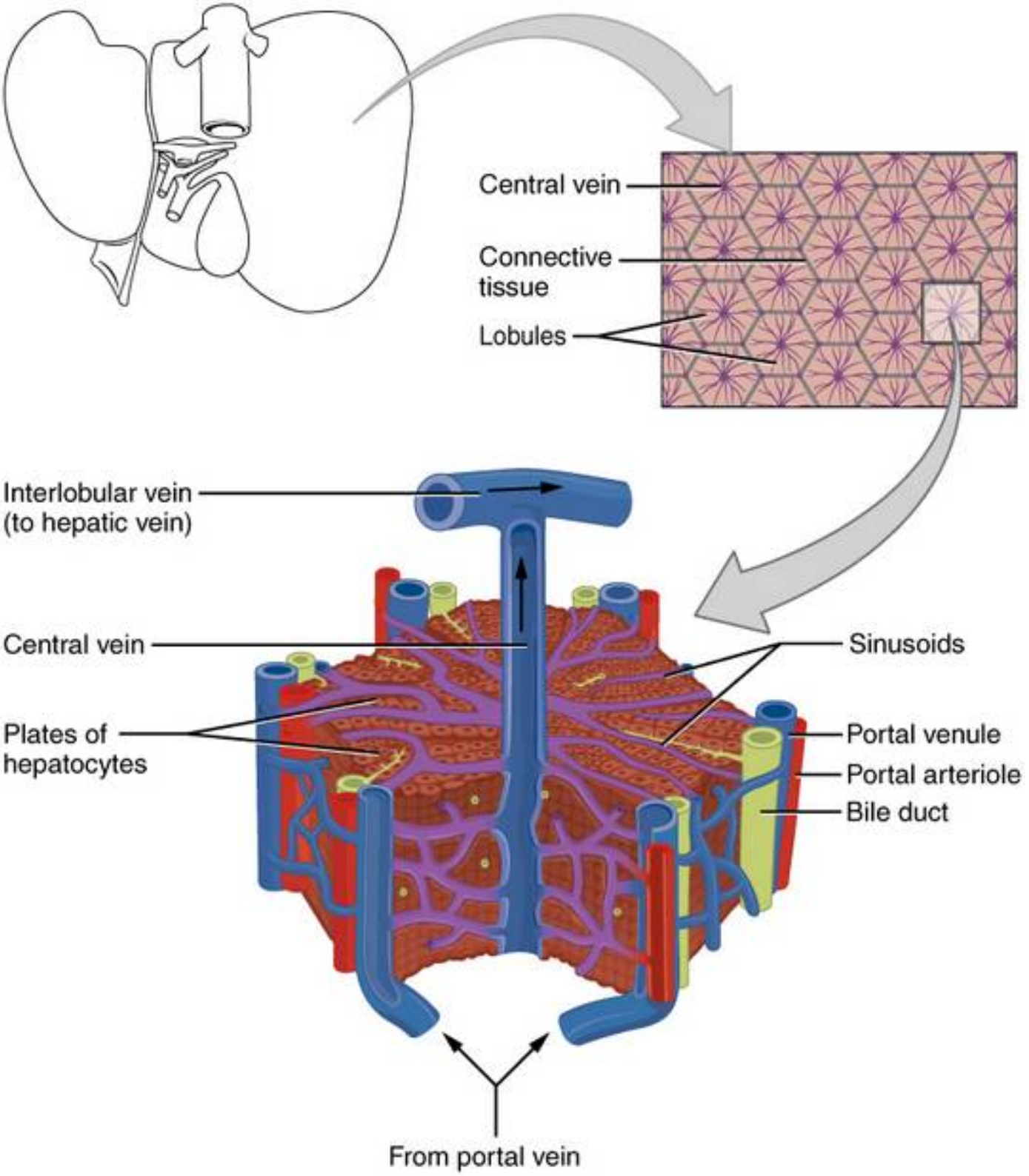
Liver rat – injected

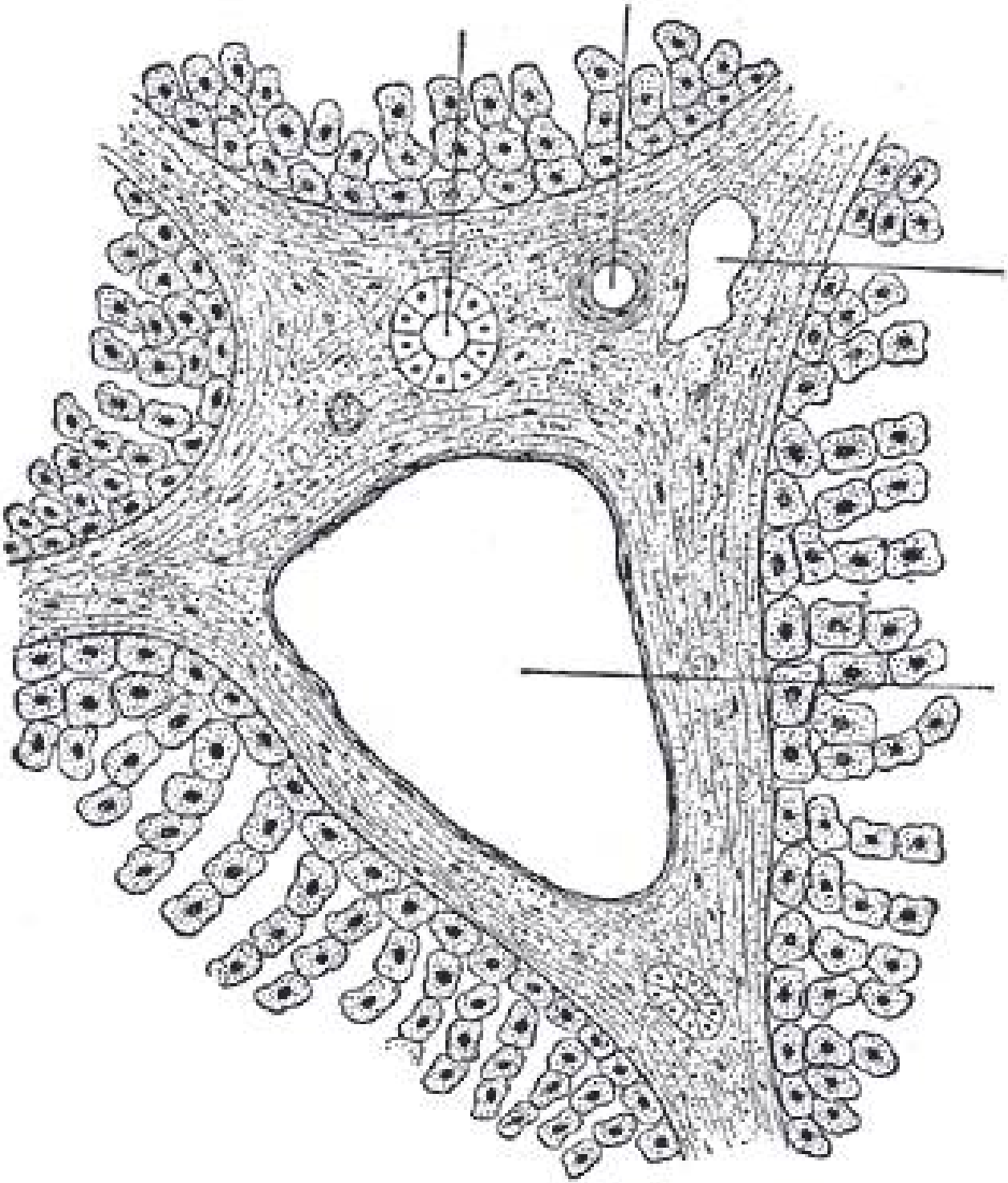


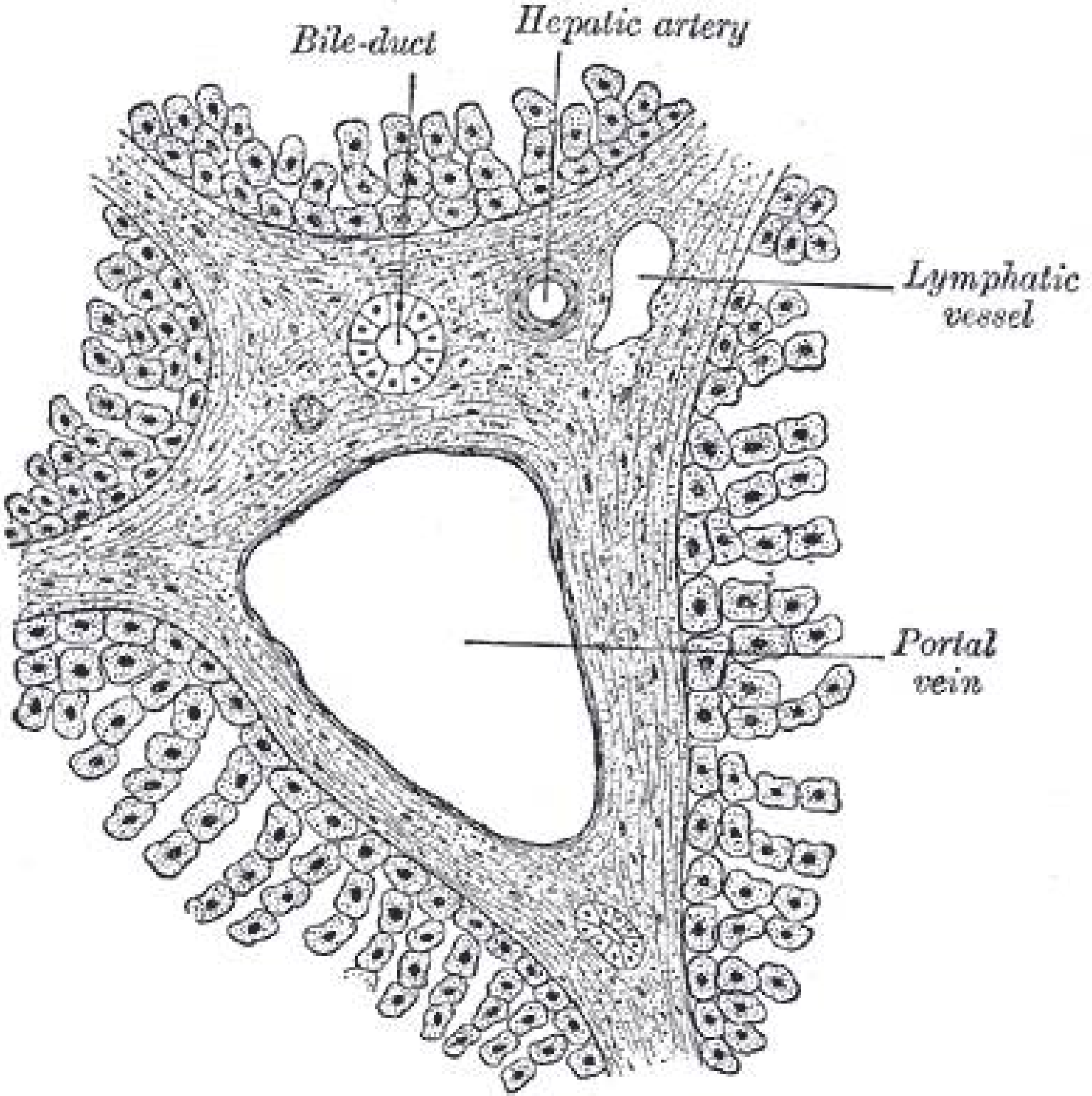
Very low magnification

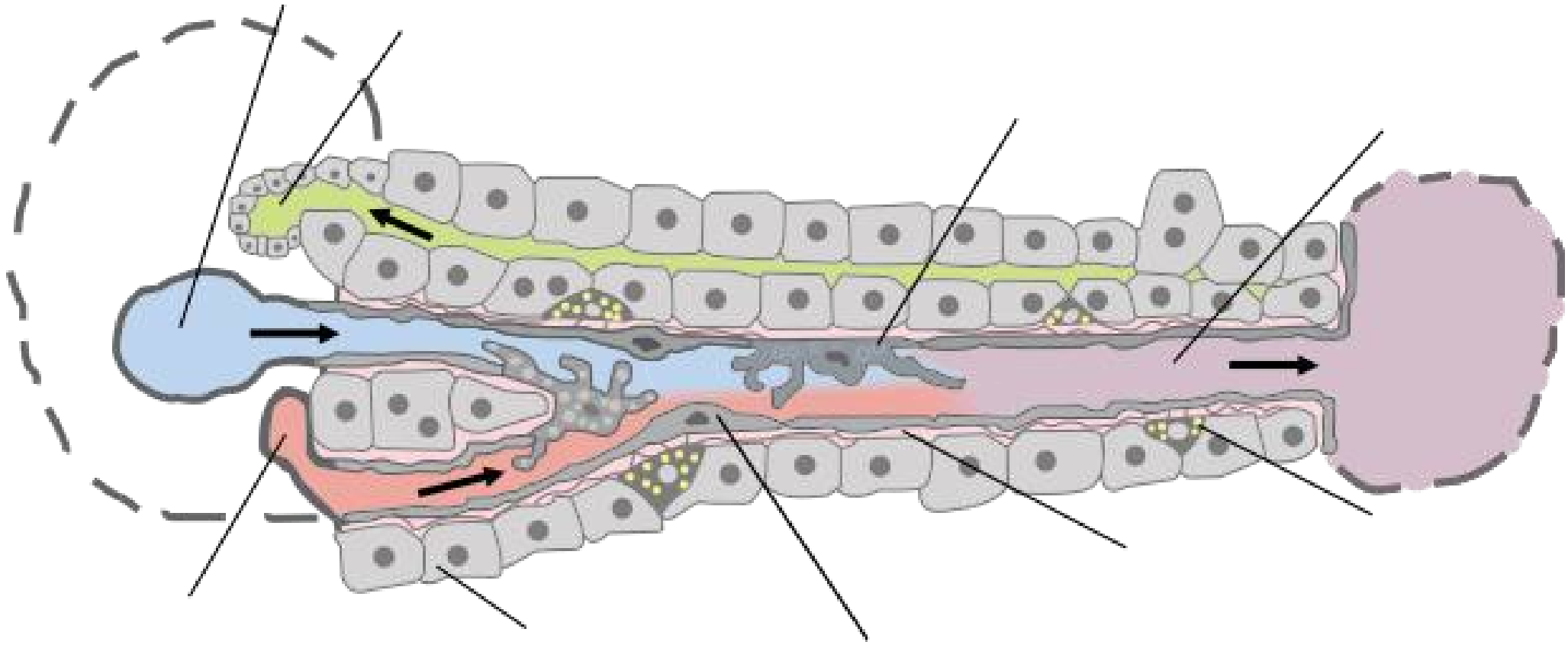
Annotate the following diagrams and micrographs before looking at the slides.




Central vein
Connective tissue
Lobules
Interlobular vein (to hepatic vein)
Central vein
Plates of hepatocytes
Sinusoids
Portal venule
Portal arteriole
Bile duct
From portal vein




Bile-duct
Hepatic artery
Lymphatic vessel
Portal vein



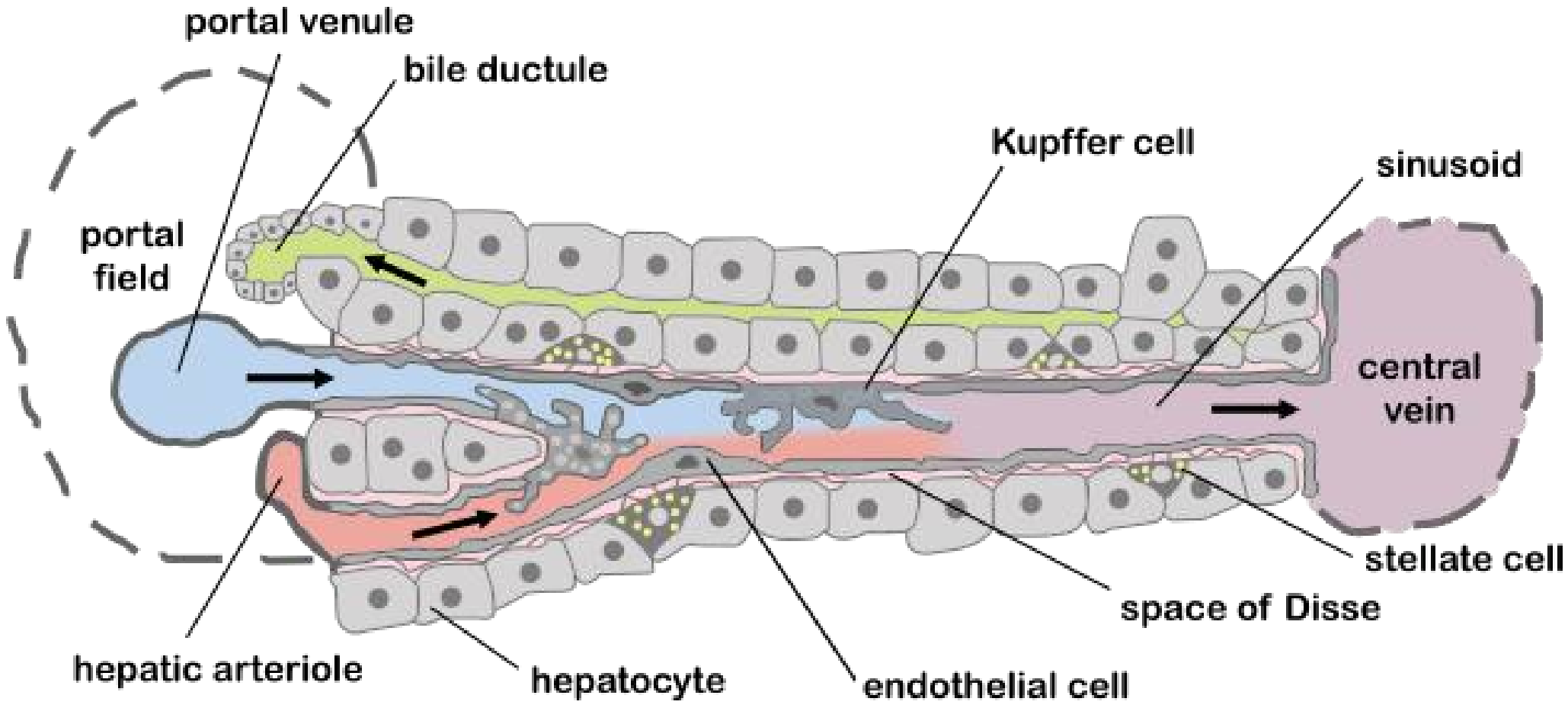
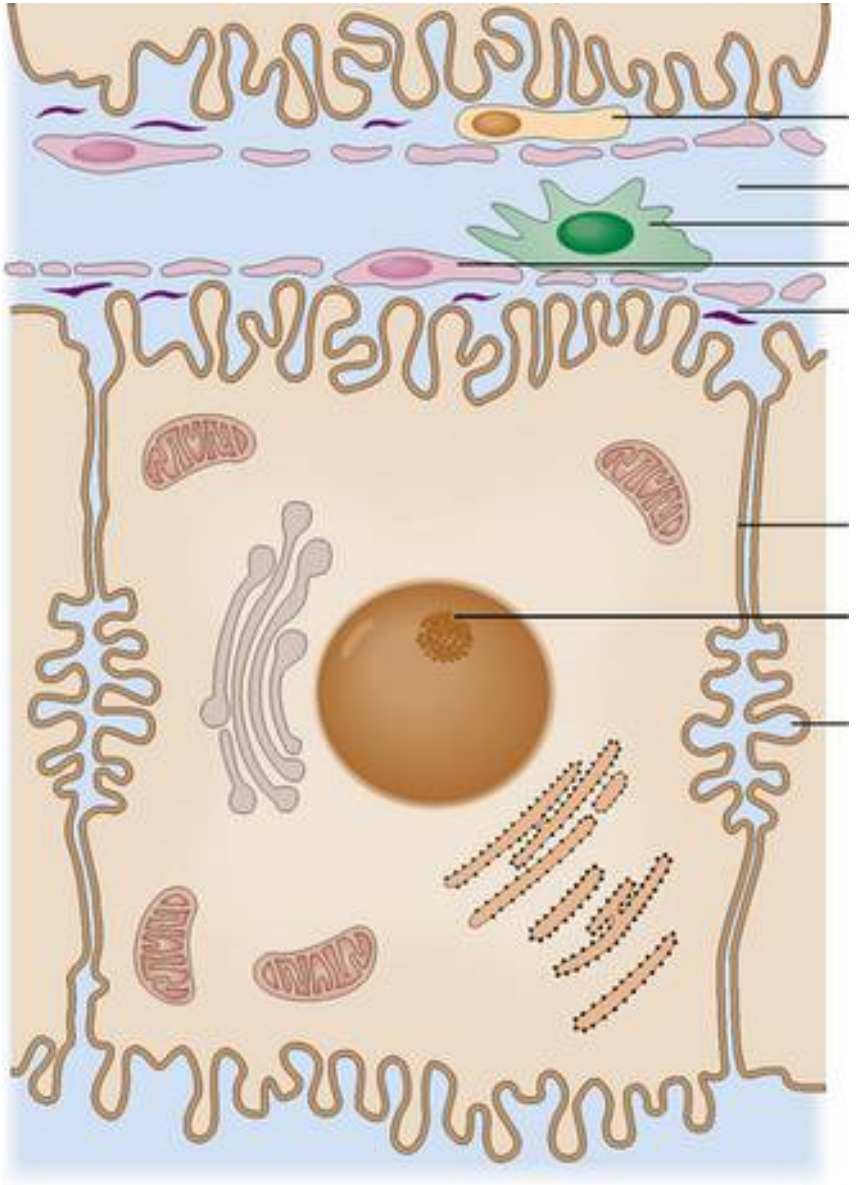

portal venule
bile ductule
Kupffer cell
sinusoid
portal field
central vein
stellate cell
space of Disse
hepatic arteriole
hepatocyte
endothelial cell

Diagram 2



Liver

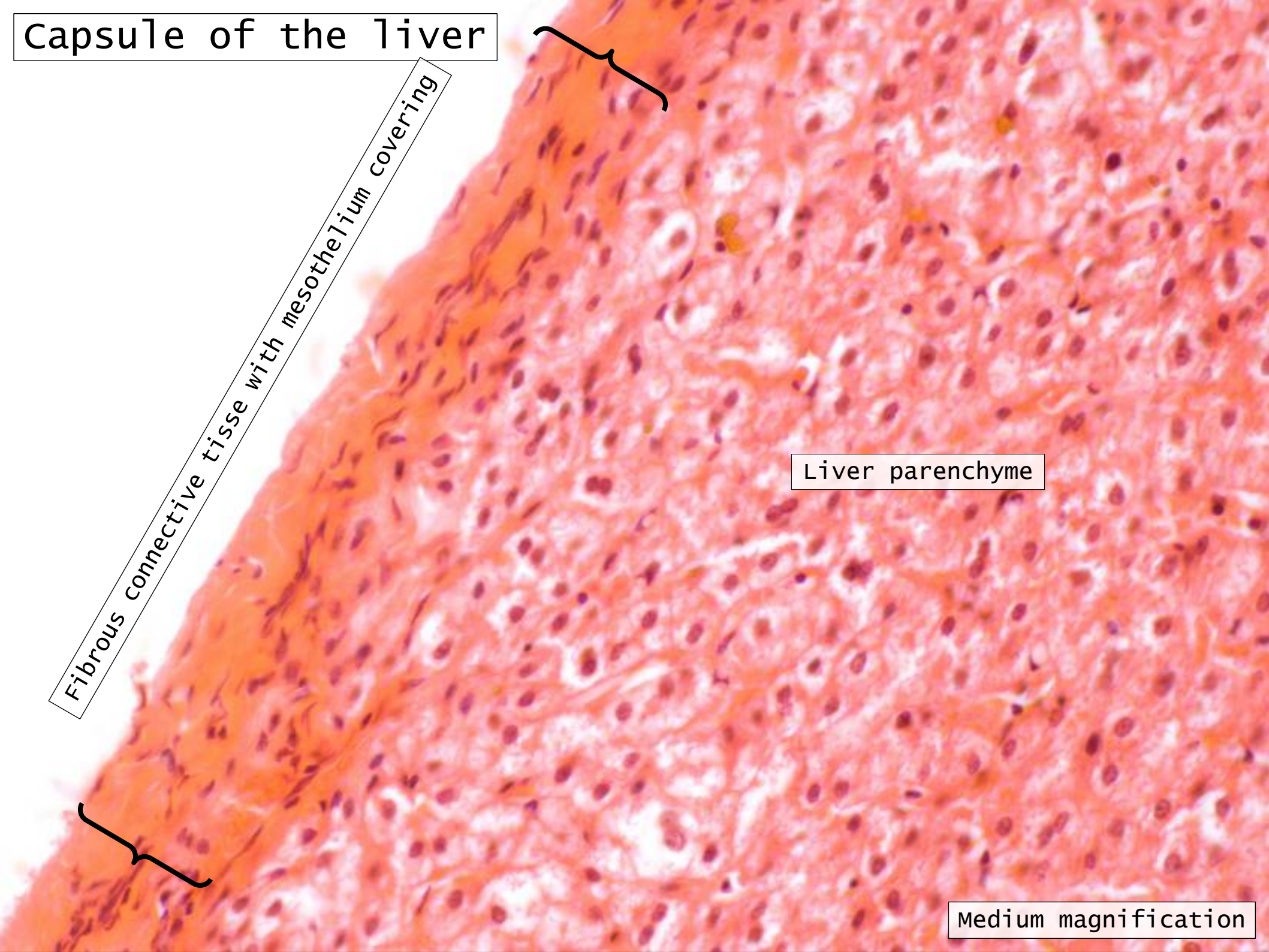
- Liver slides 46, 48, 68 & 110
- Liver arrangement
  - Classic
  - Portal
  - Acinus
- Structures
  - Central vein
  - Portal triad
- Cells in the liver

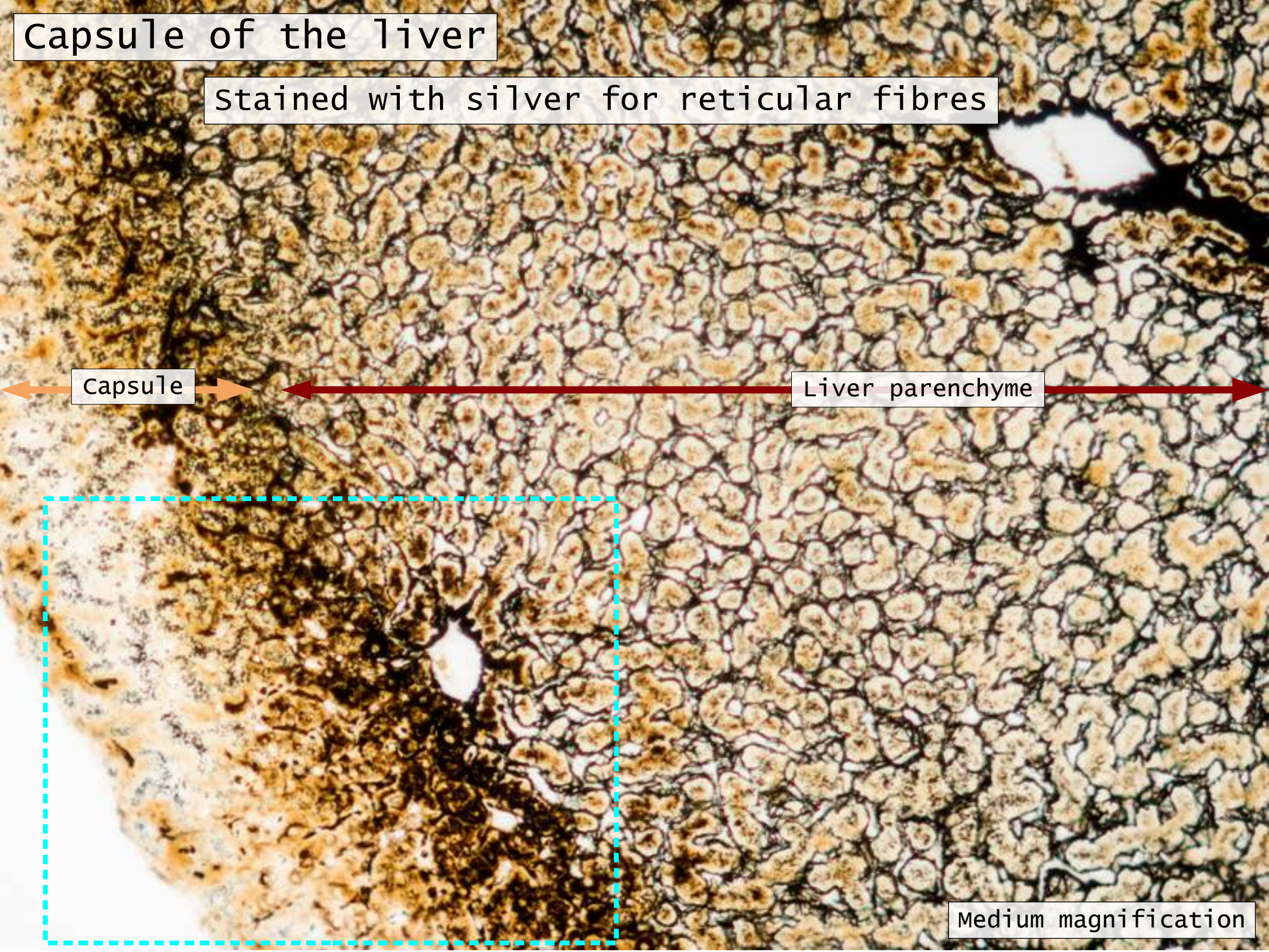
Capsule

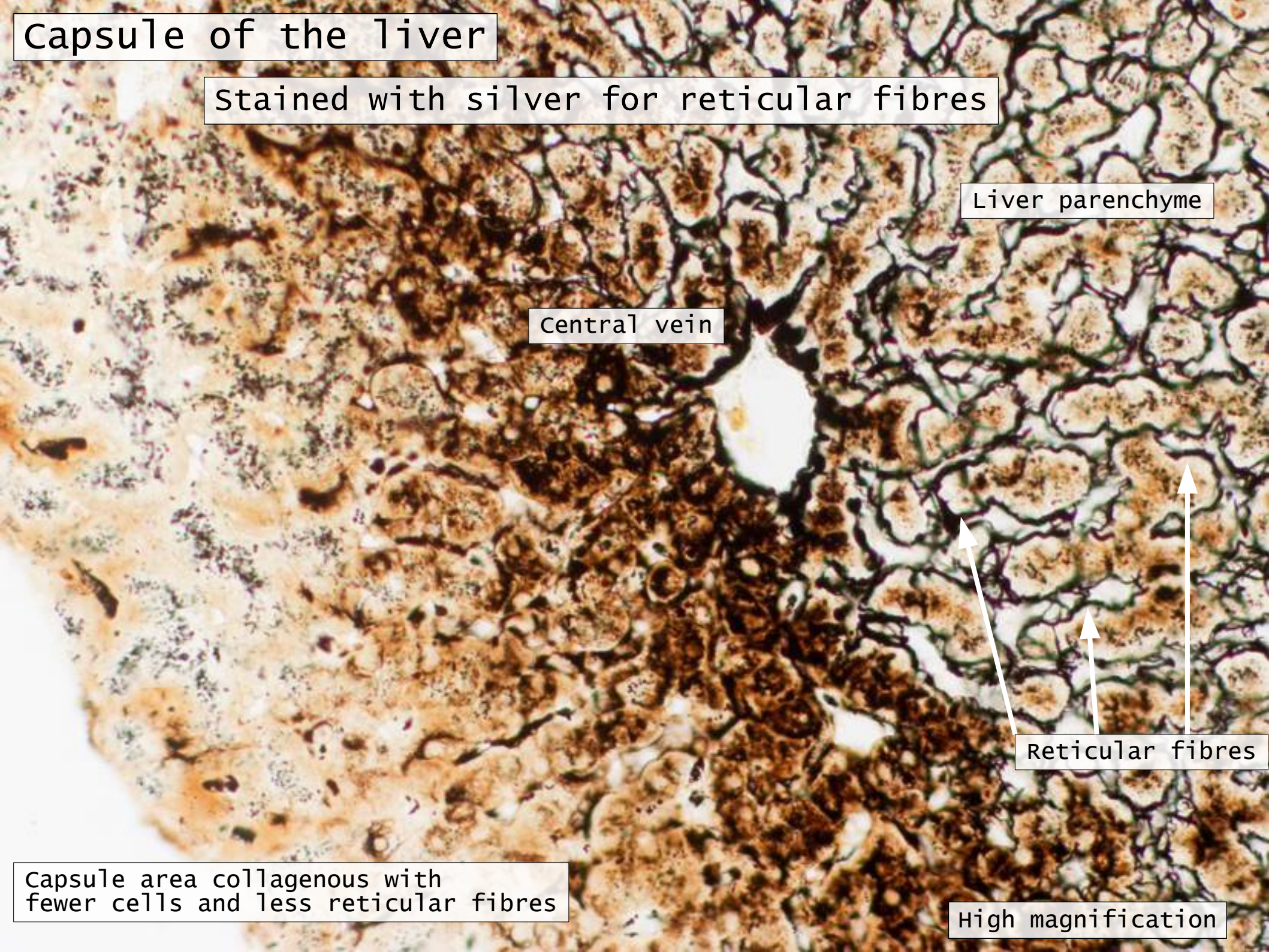
- Thin connective tissue
- Subdivides liver

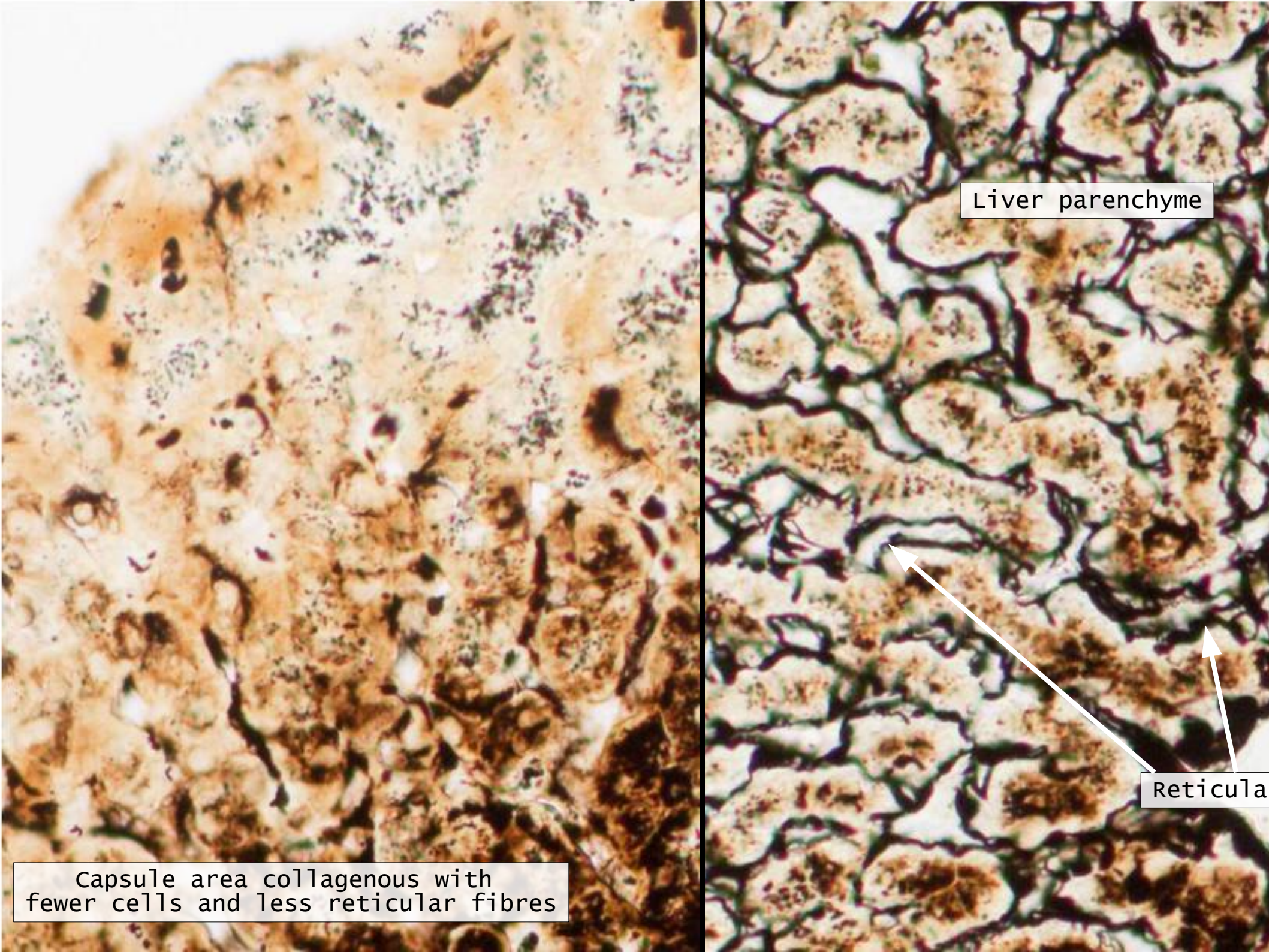
into

- Lobes & Lobules


Capsule of the liver
Fibrous connective tisse with mesothelium covering
Liver parenchyme
Medium magnification


Capsule of the liver
Stained with silver for reticular fibres
Capsule
Liver parenchyme
Medium magnification


Capsule of the liver
Stained with silver for reticular fibres
Liver parenchyme
Central vein
Reticular fibres
Capsule area collagenous with fewer cells and less reticular fibres
High magnification

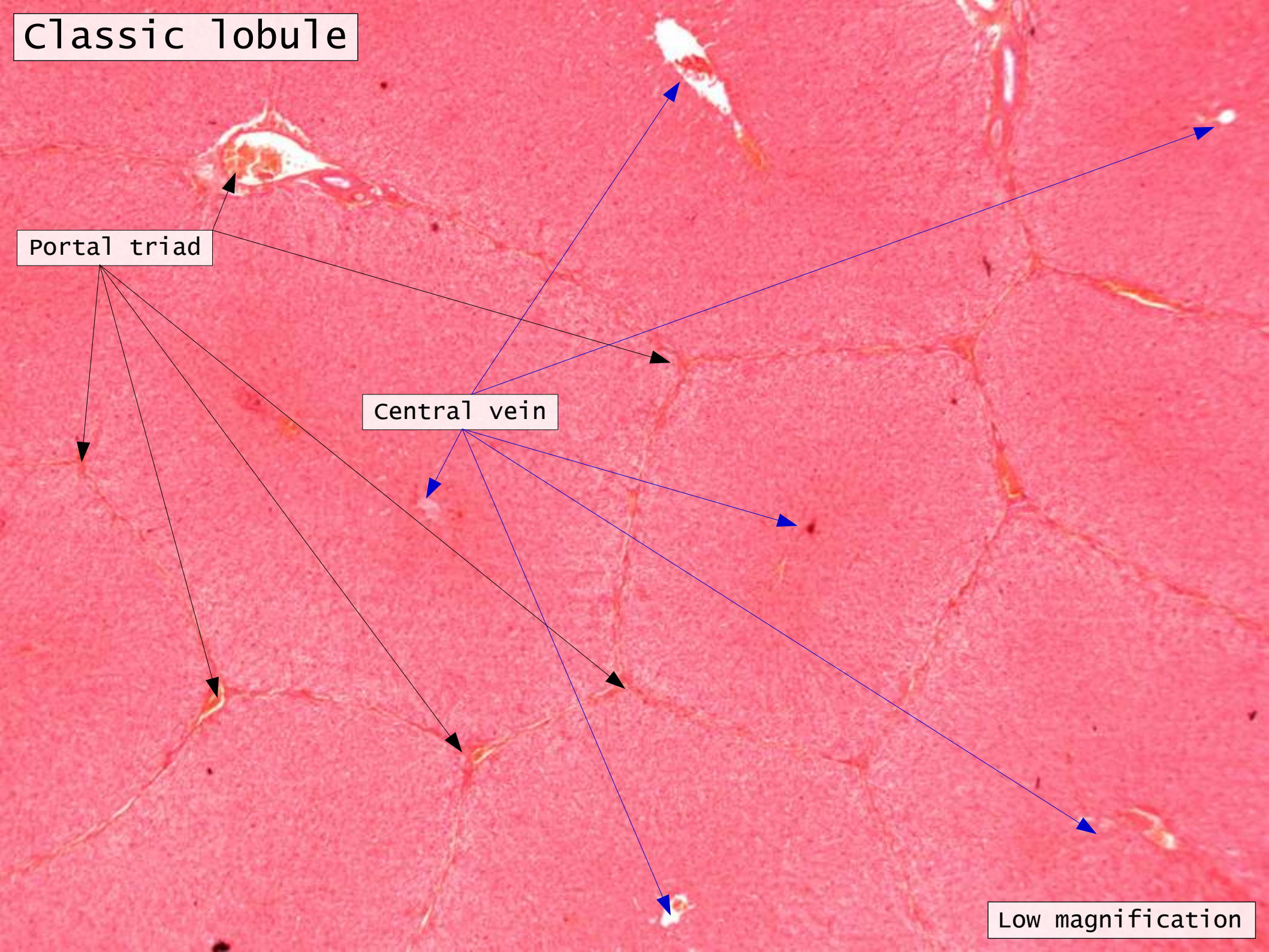

Capsule area collagenous with
fewer cells and less reticular fibres
Liver parenchyme
Reticula

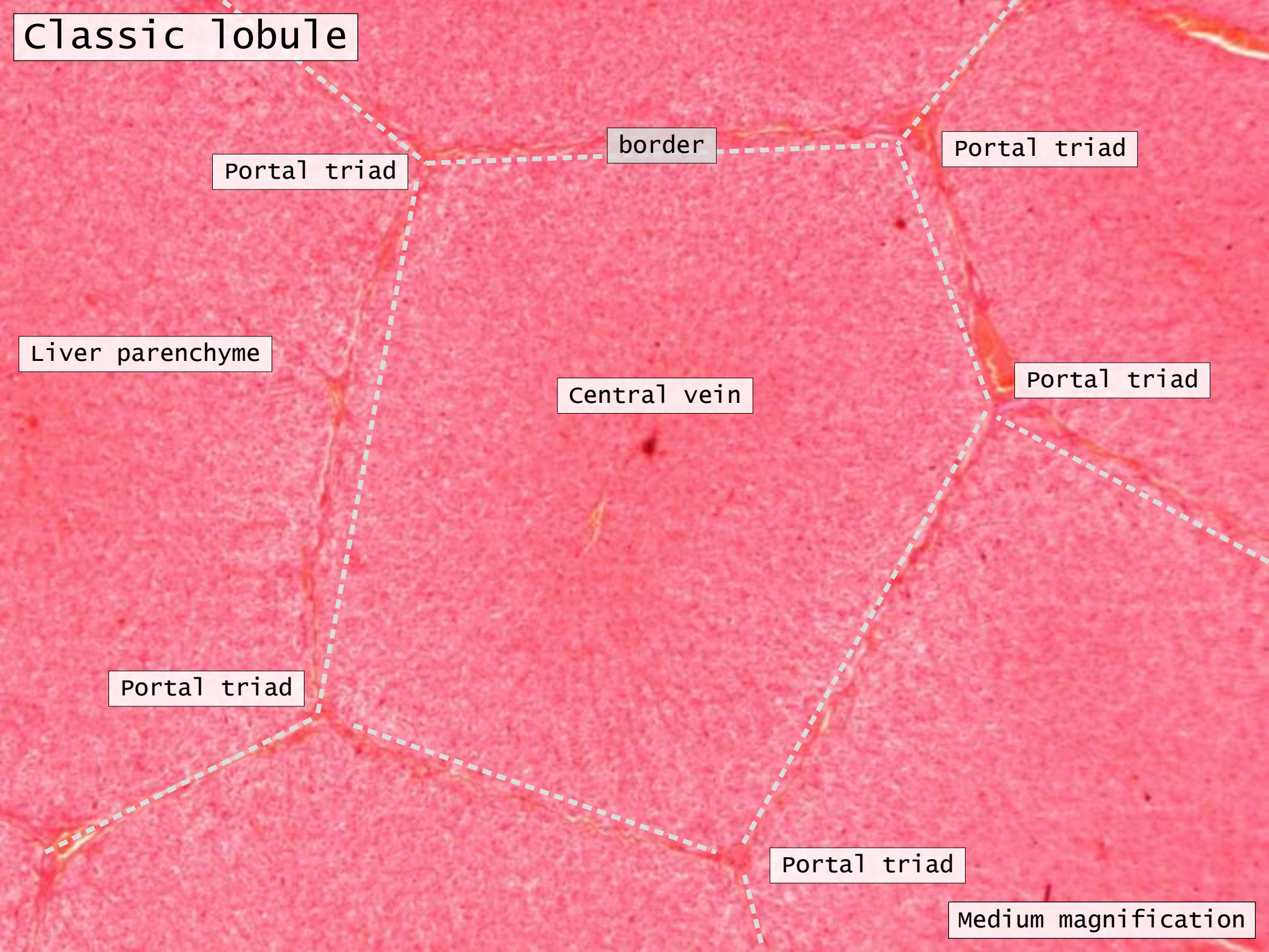
Liver lobules

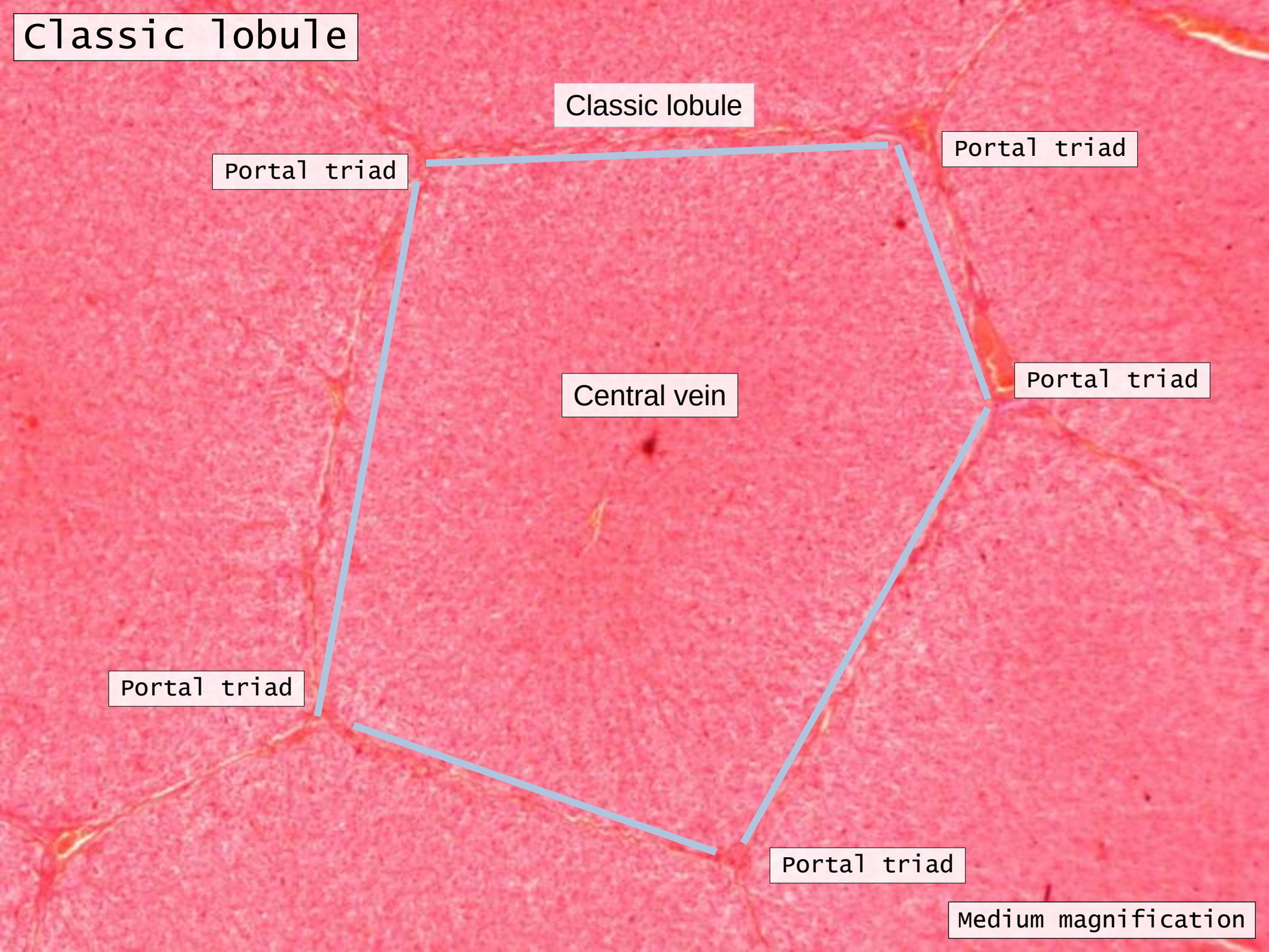
- 3 types
- Classic lobule
  - hexagonal shaped
- Portal lobule
  - triangular shaped
- Liver acinus
  - diamond shaped

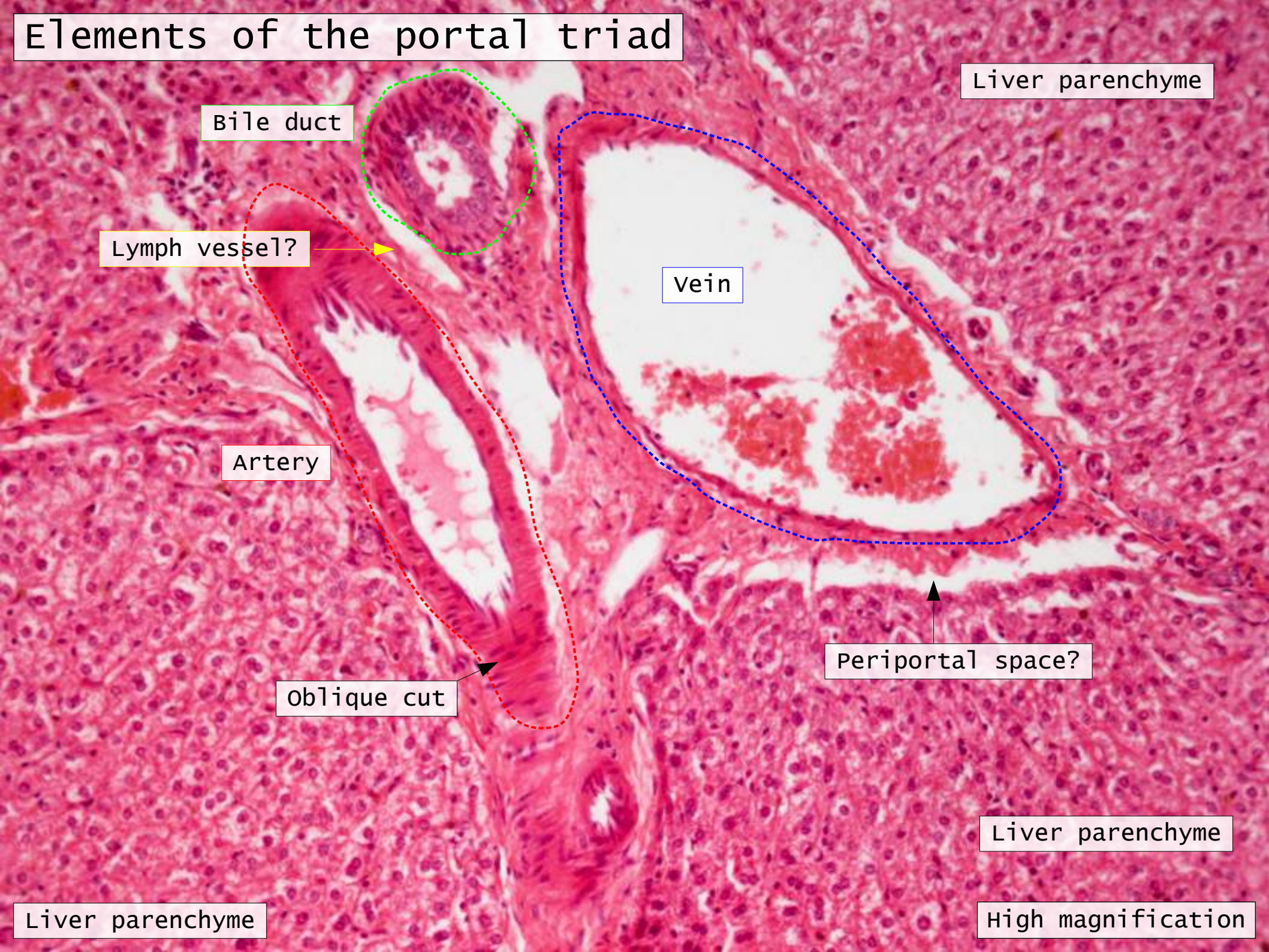
Classical lobule

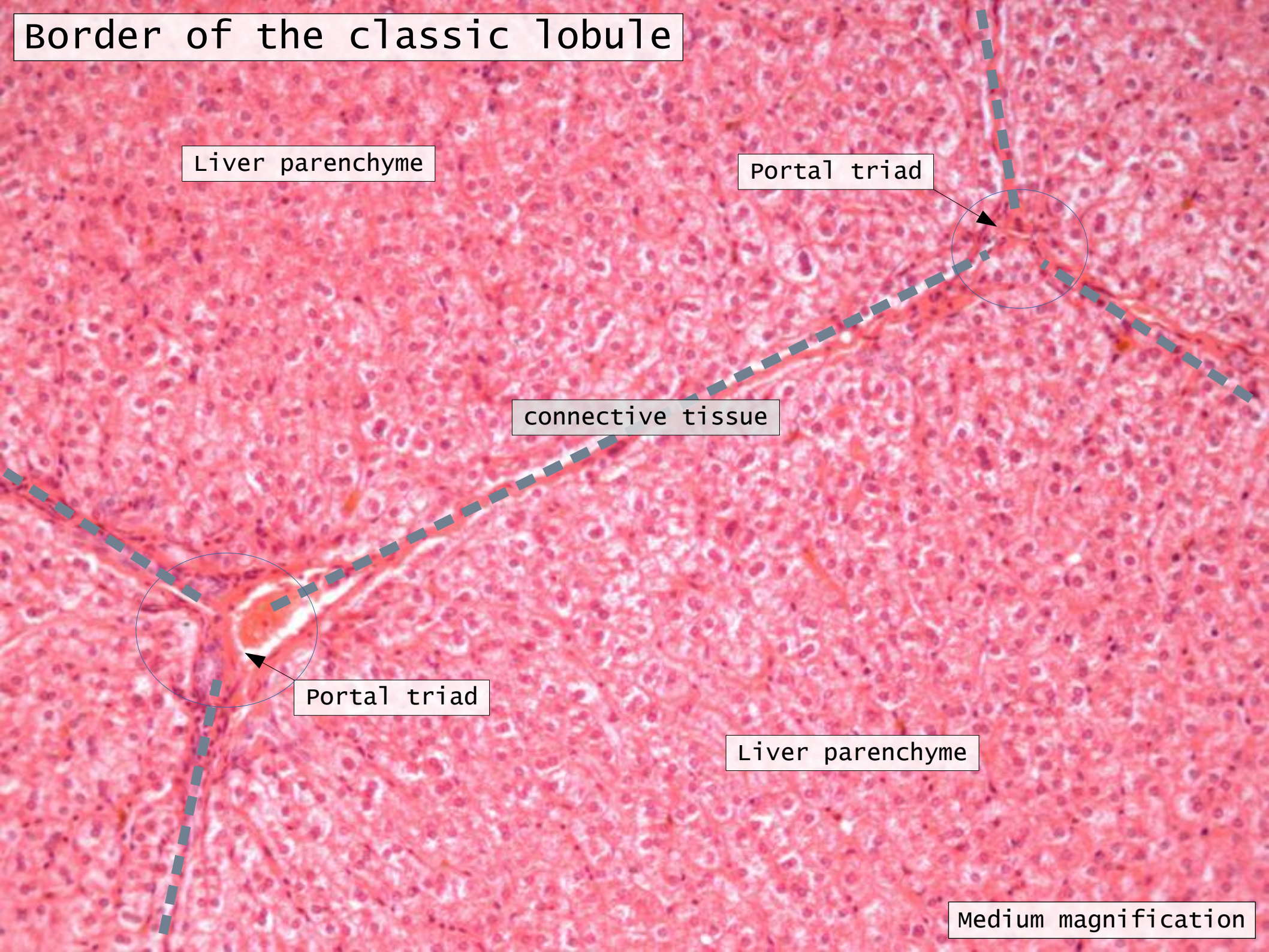
- Based on pig's liver
- CT delineate borders
- Portal area at each corner
  - Portal triad
    - Portal vein
    - Hepatic artery
    - Bile duct
    - Lymph vessel

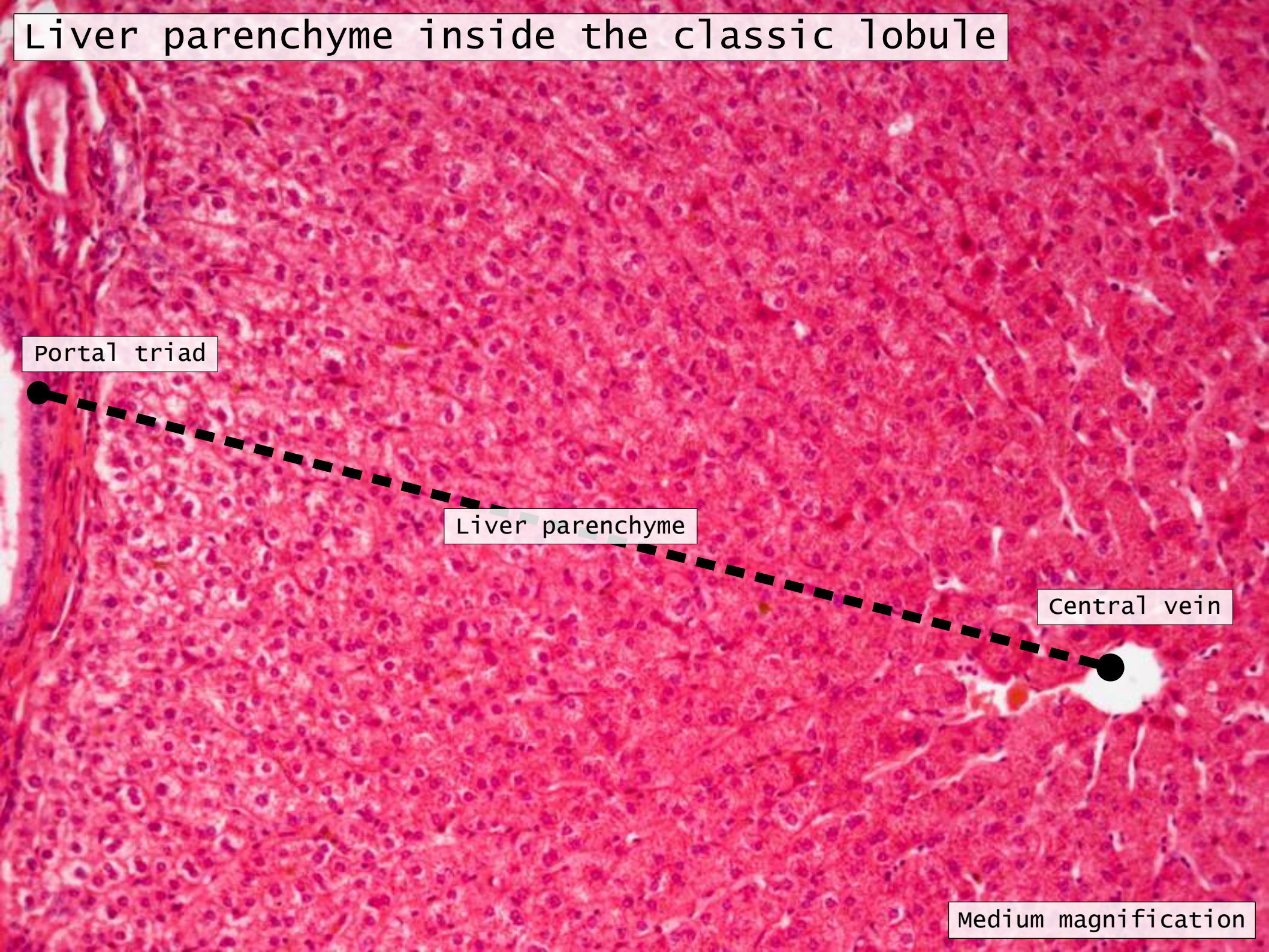

Classic lobule
Portal triad
Central vein
Low magnification

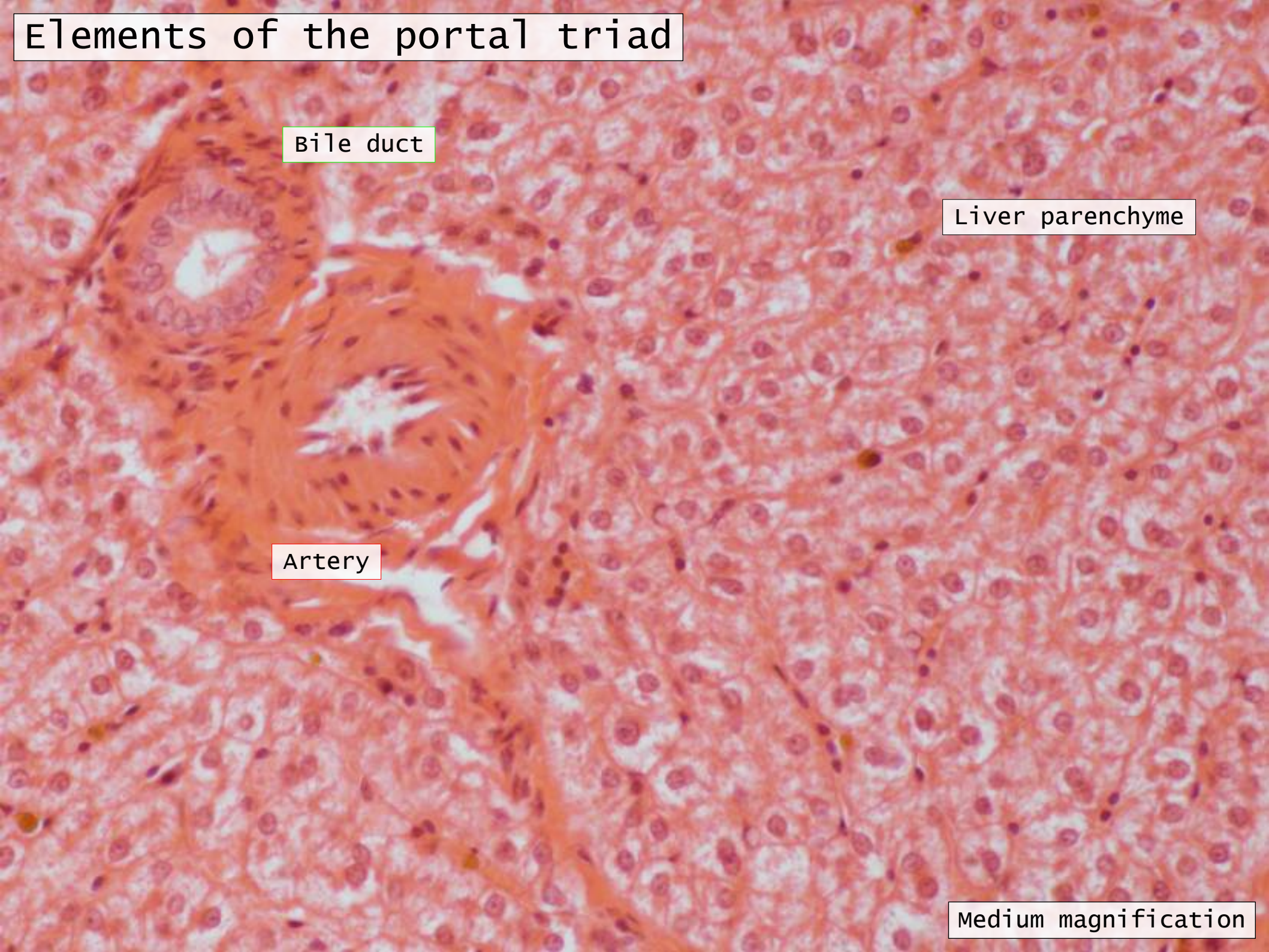

Classic lobule
border
Portal triad
Portal triad
Liver parenchyme
Central vein
Portal triad
Portal triad
Portal triad
Medium magnification

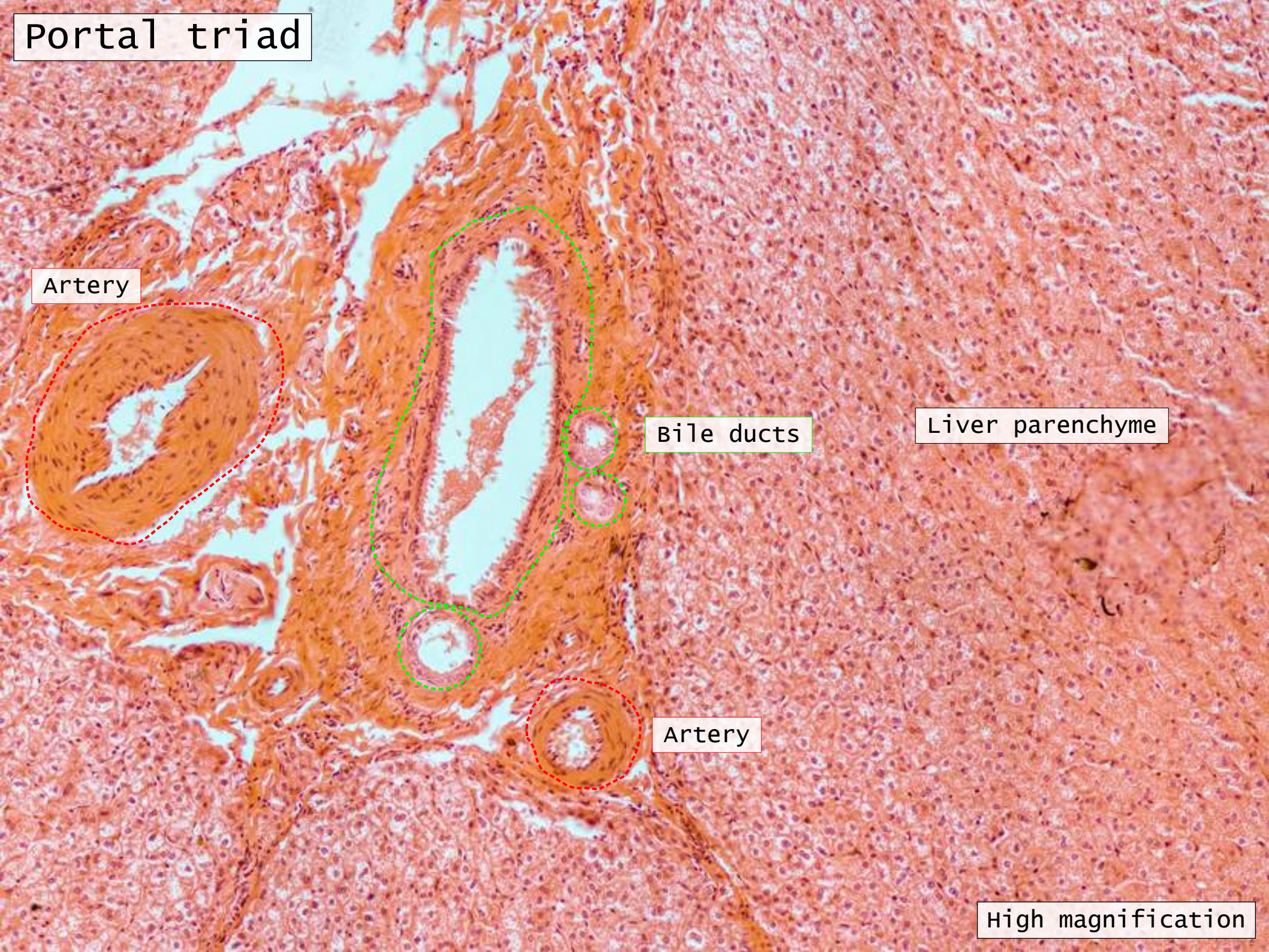

Classic lobule
Classic lobule
Portal triad
Portal triad
Central vein
Portal triad
Portal triad
Portal triad
Medium magnification

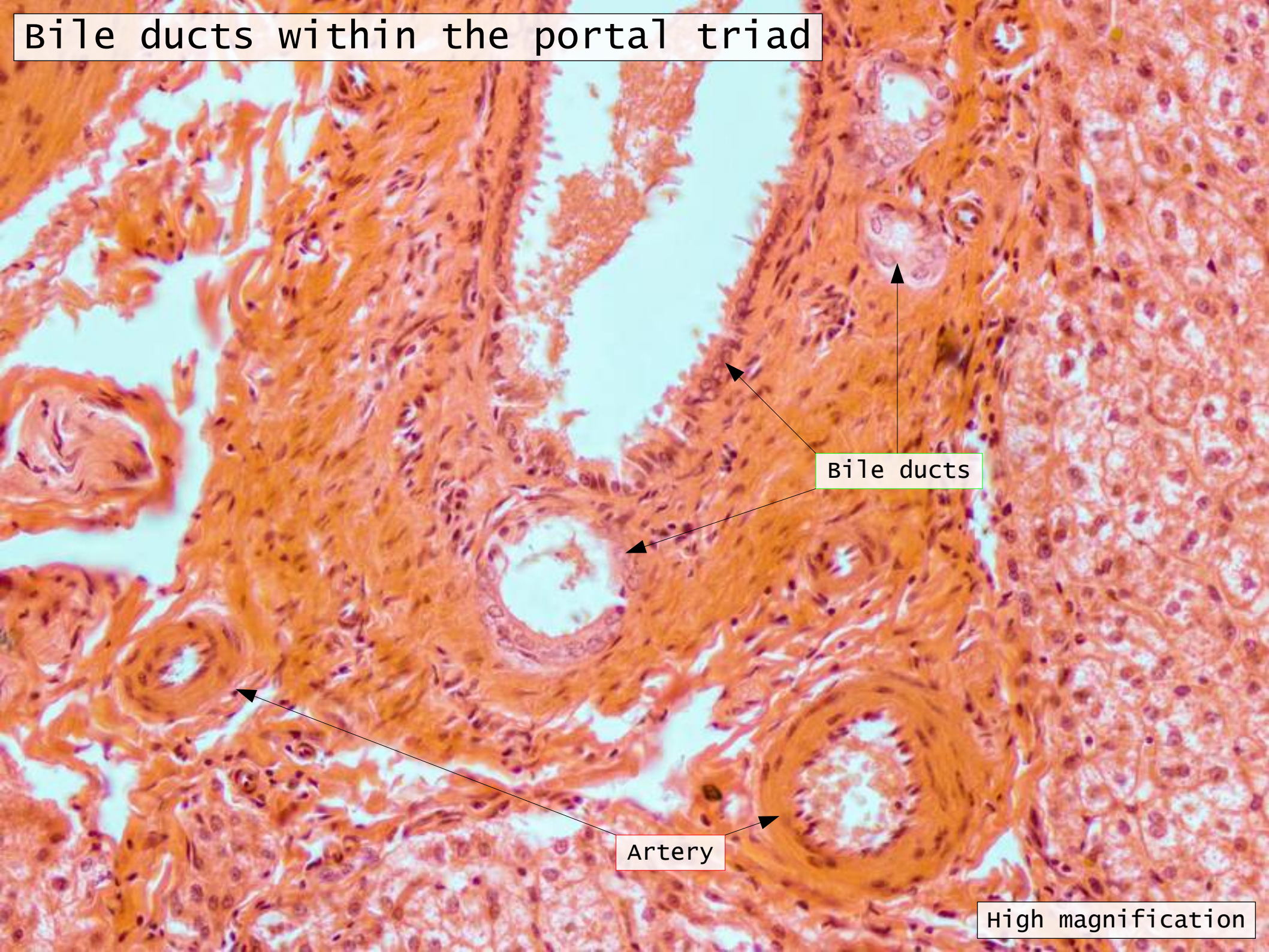

Elements of the portal triad
Liver parenchyme
Bile duct
Lymph vessel?
Vein
Artery
Periportal space?
Oblique cut
Liver parenchyme
Liver parenchyme
High magnification

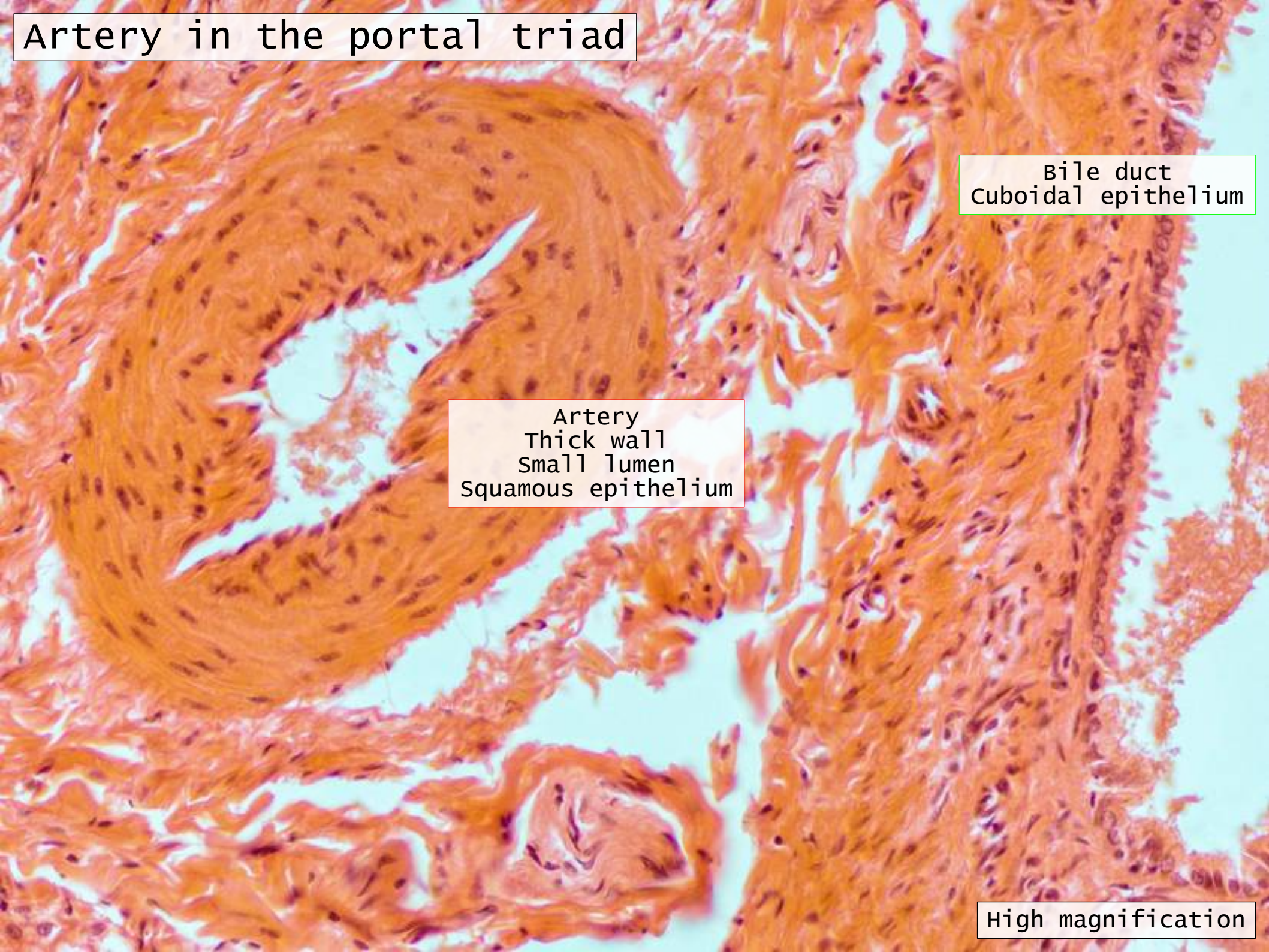

Border of the classic lobule
Liver parenchyme
Portal triad
connective tissue
Portal triad
Liver parenchyme
Medium magnification

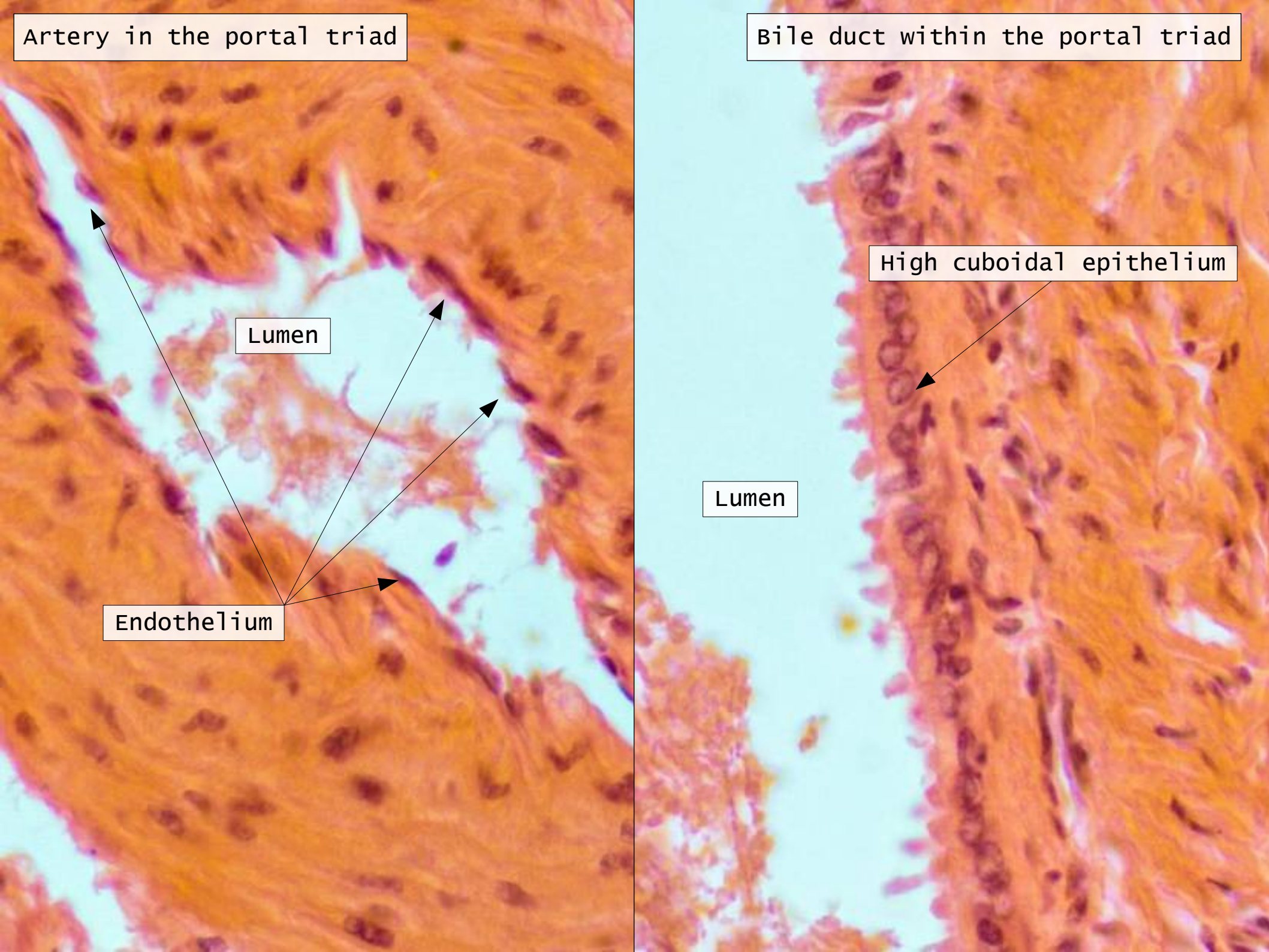

Liver parenchyme inside the classic lobule
Portal triad
Liver parenchyme
Central vein
Medium magnification

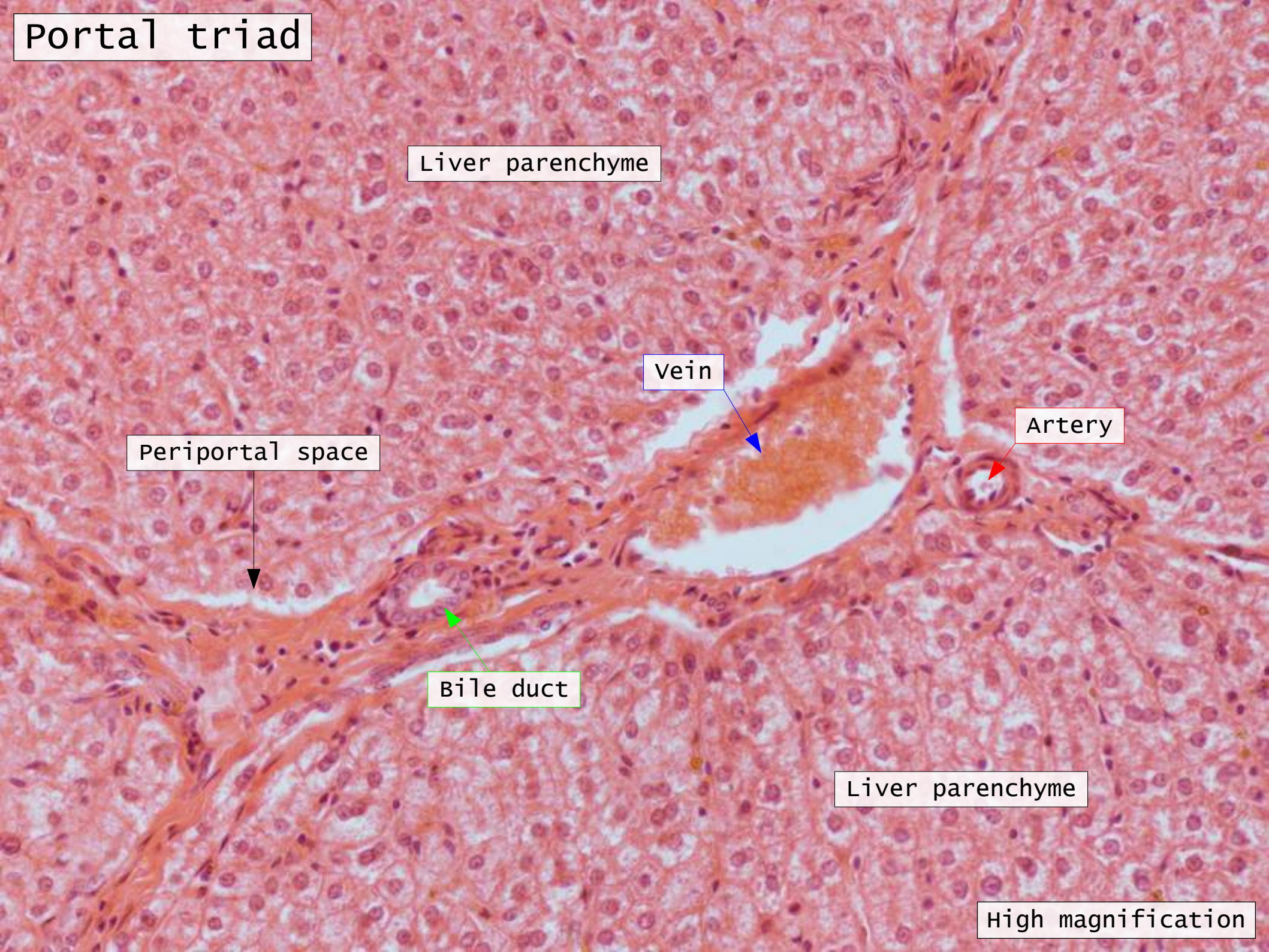

Elements of the portal triad
Bile duct
Liver parenchyme
Artery
Medium magnification

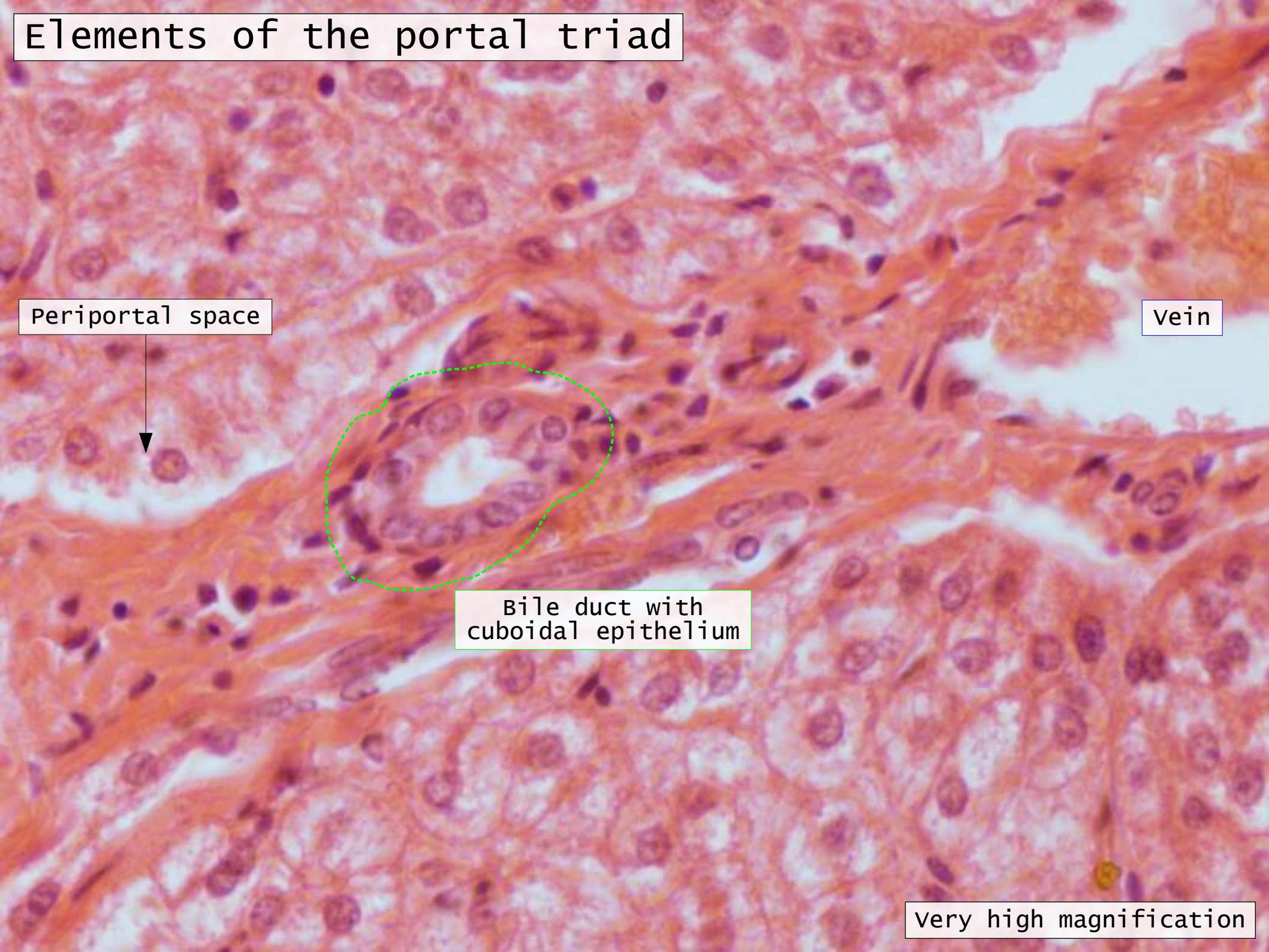

Portal triad
Artery
Bile ducts
Liver parenchyme
Artery
High magnification

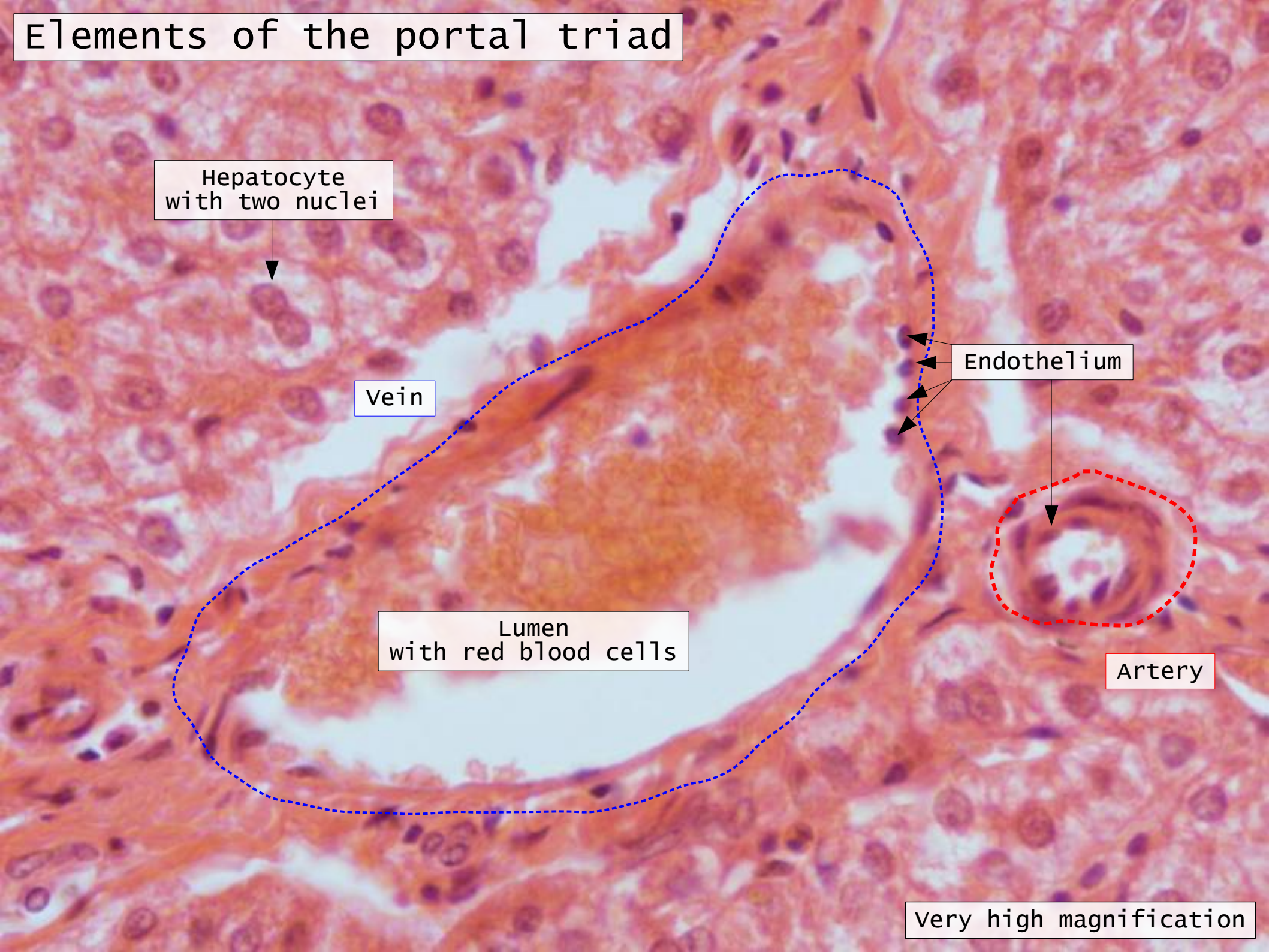

Bile ducts within the portal triad
Bile ducts
Artery
High magnification

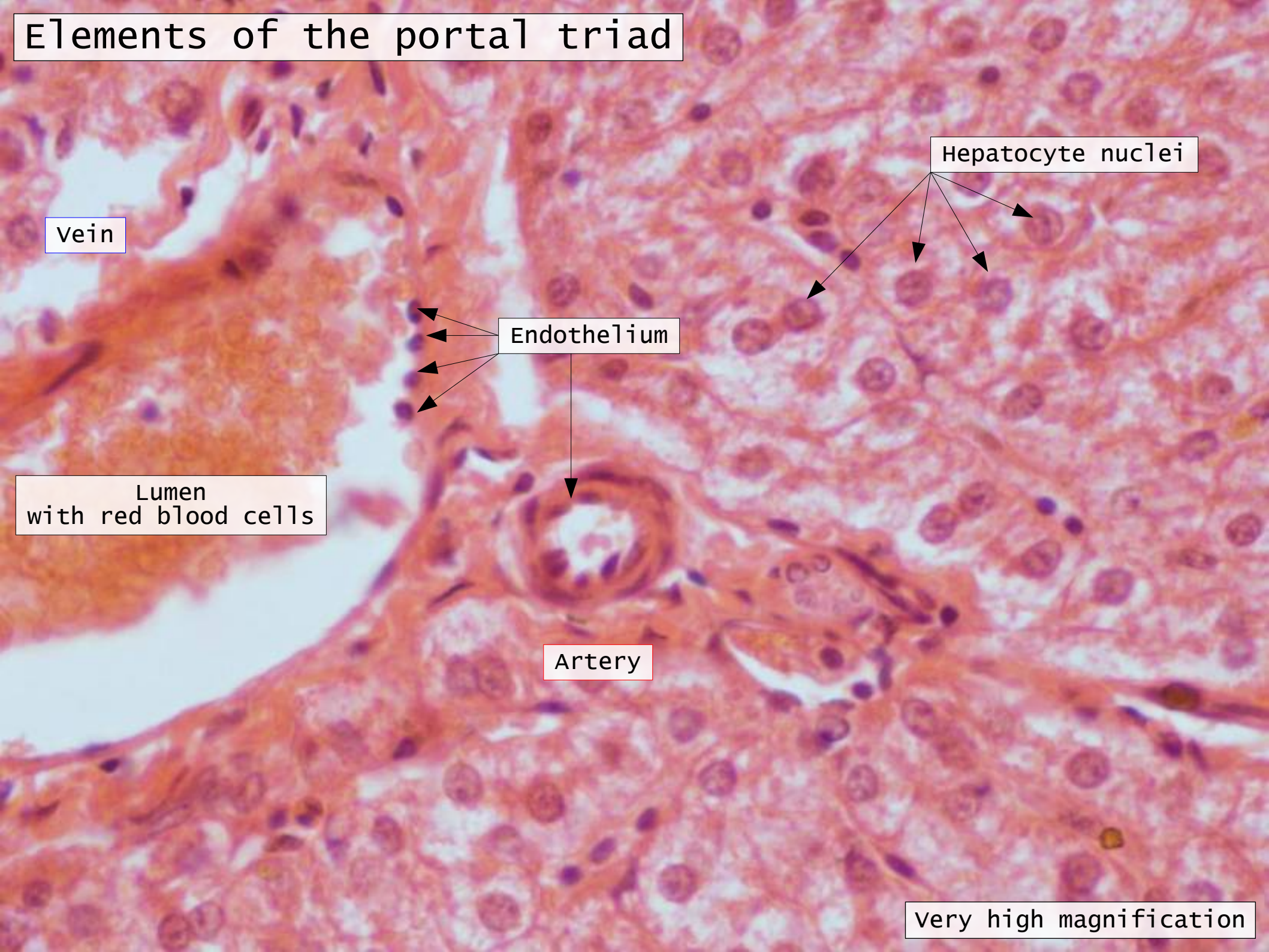

Artery in the portal triad
Bile duct
Cuboidal epithelium
Artery
Thick wall
Small lumen
Squamous epithelium
High magnification


Artery in the portal triad
Lumen
Endothelium
Bile duct within the portal triad
High cuboidal epithelium
Lumen

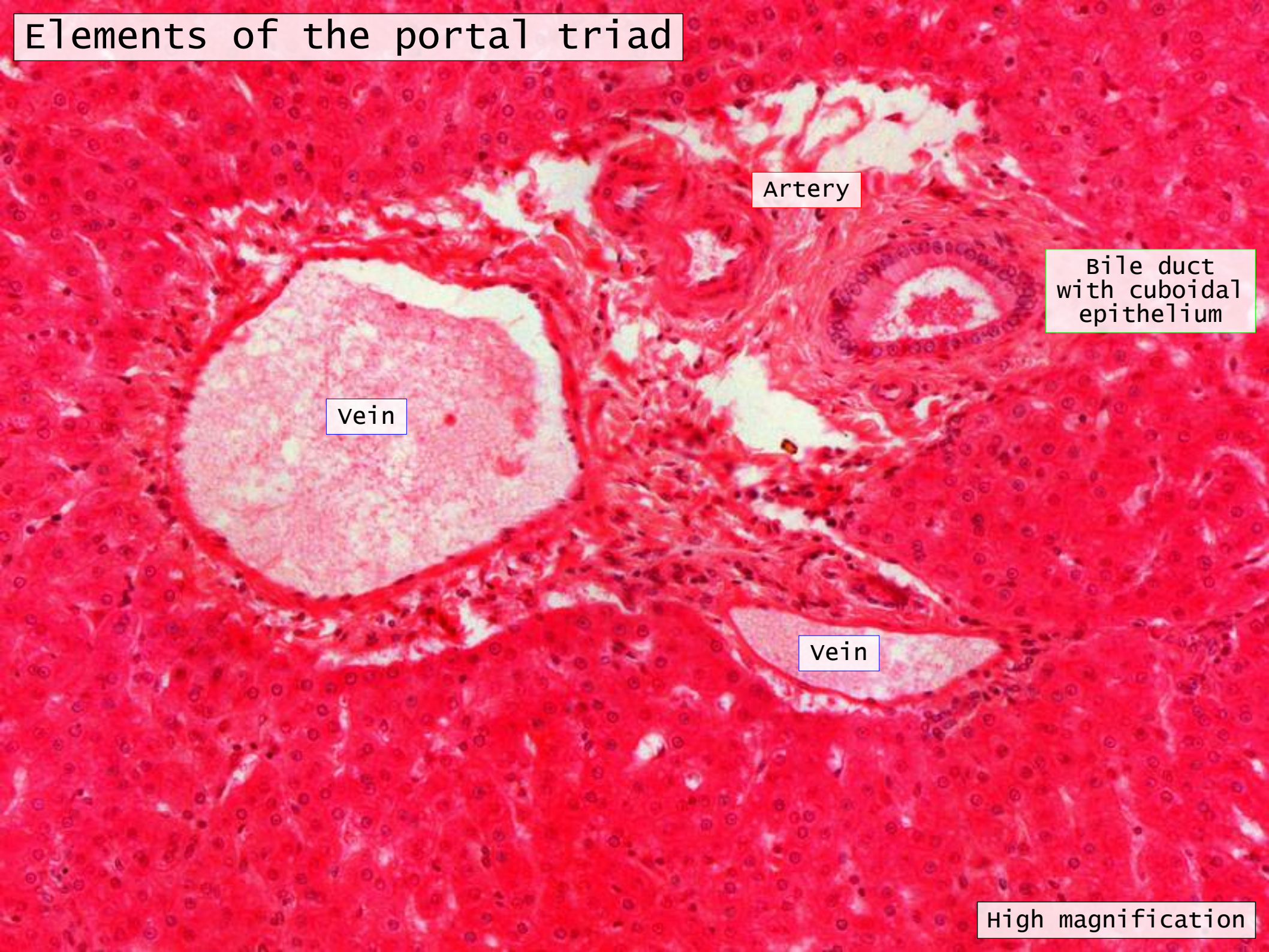

Portal triad
Liver parenchyme
Vein
Artery
Periportal space
Bile duct
Liver parenchyme
High magnification


Elements of the portal triad
Periportal space
Vein
Bile duct with
cuboidal epithelium
Very high magnification

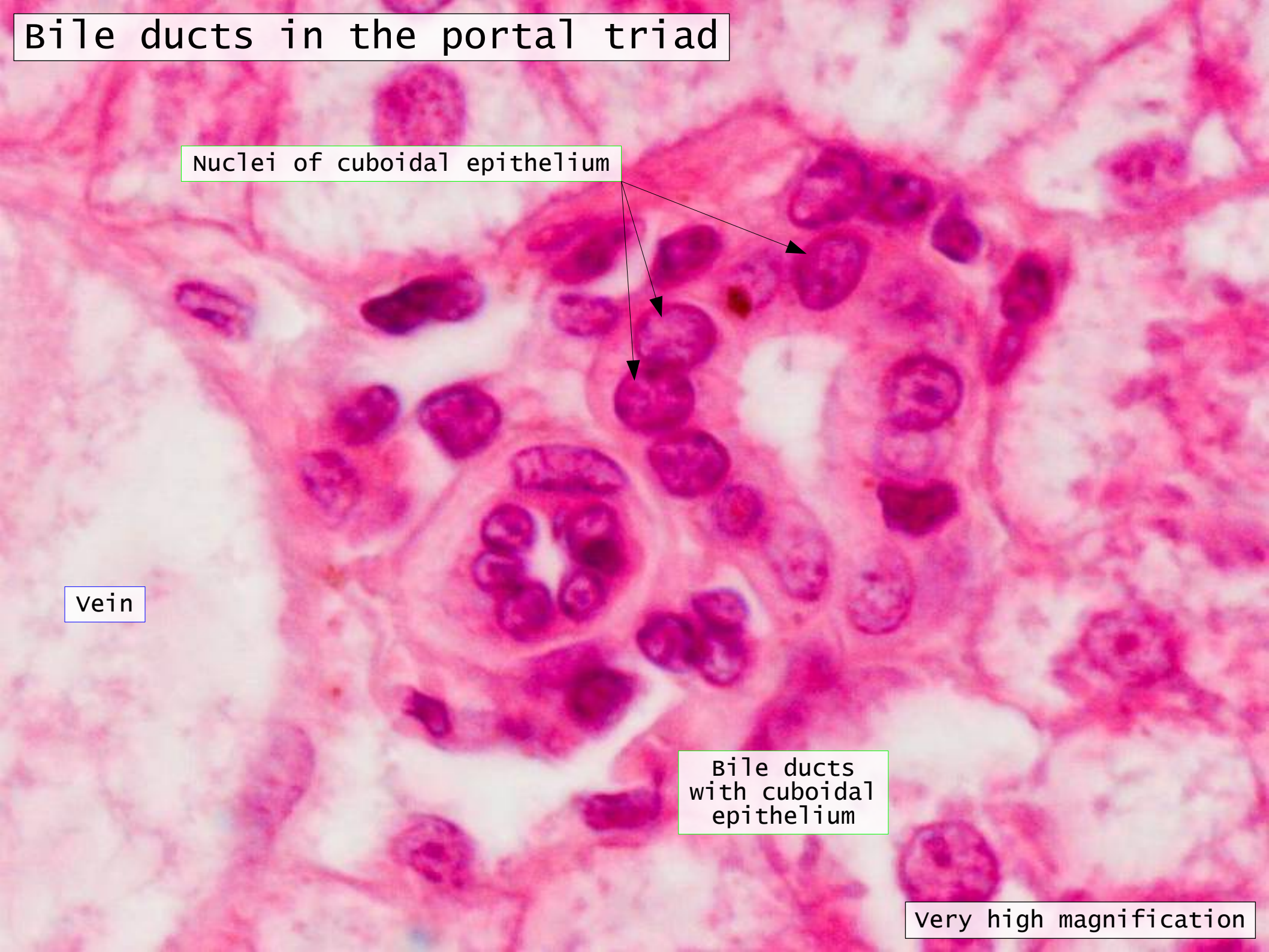

Elements of the portal triad
Hepatocyte with two nuclei
Vein
Endothelium
Lumen with red blood cells
Artery
Very high magnification

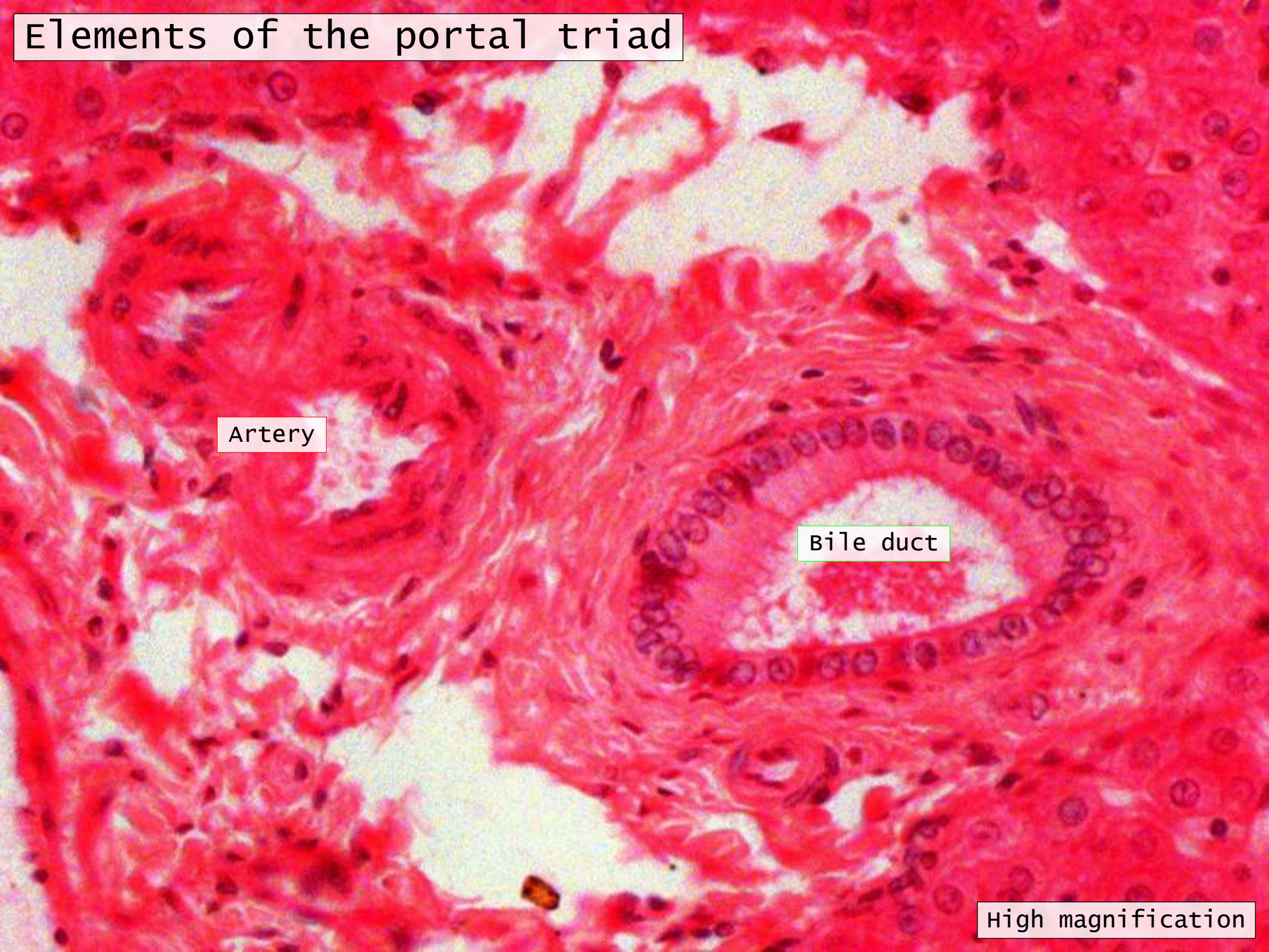

Elements of the portal triad
Hepatocyte nuclei
Vein
Endothelium
Lumen
with red blood cells
Artery
Very high magnification

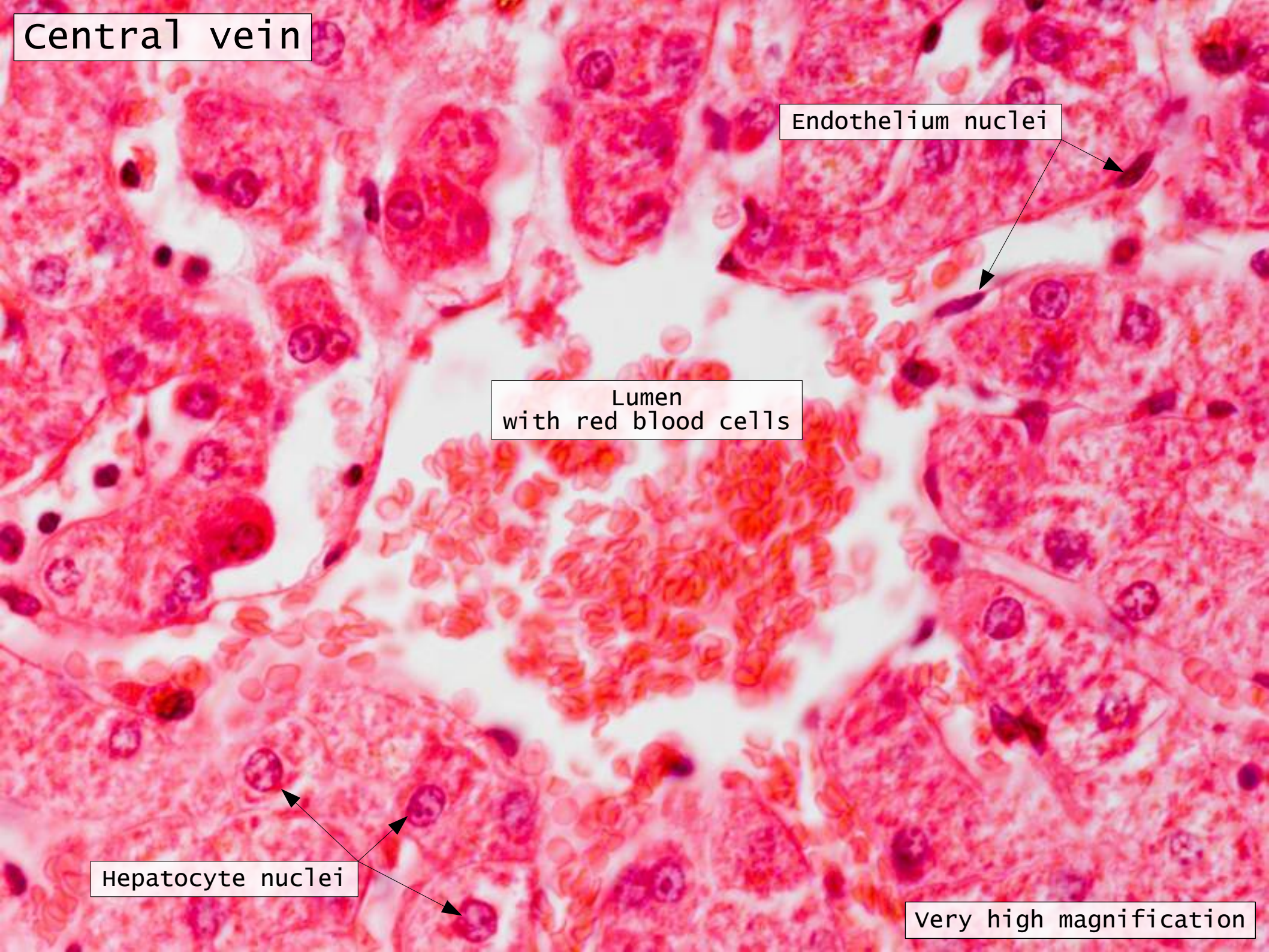

Elements of the portal triad
Bile duct
Artery
Vein
High magnification

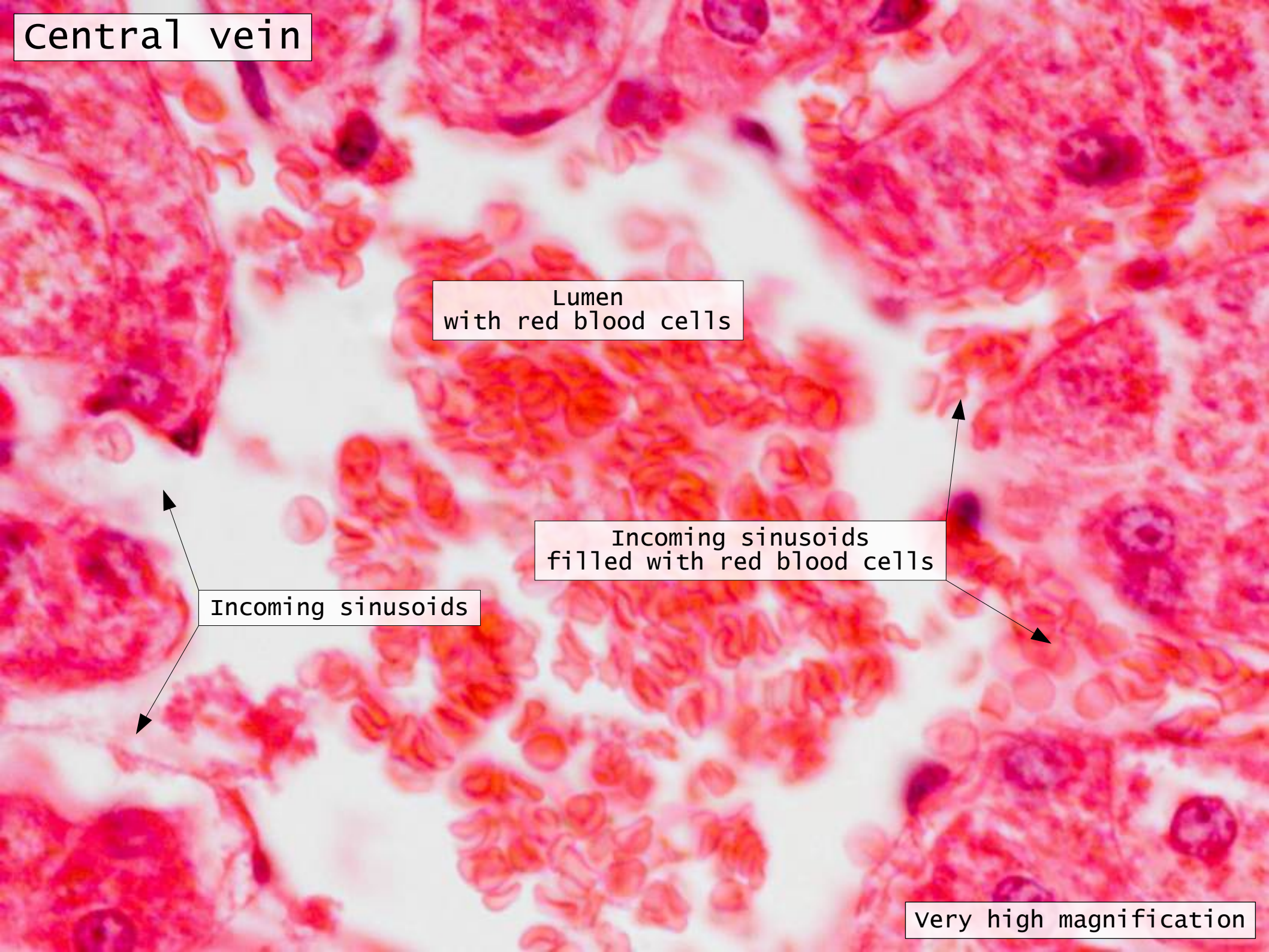

Elements of the portal triad
Artery
Bile duct with cuboidal epithelium
Vein
Vein
High magnification


Elements of the portal triad
Bile ducts
Vein
Hepatocyte nuclei
High magnification


Bile ducts in the portal triad
Nuclei of cuboidal epithelium
Vein
Bile ducts with cuboidal epithelium
Very high magnification

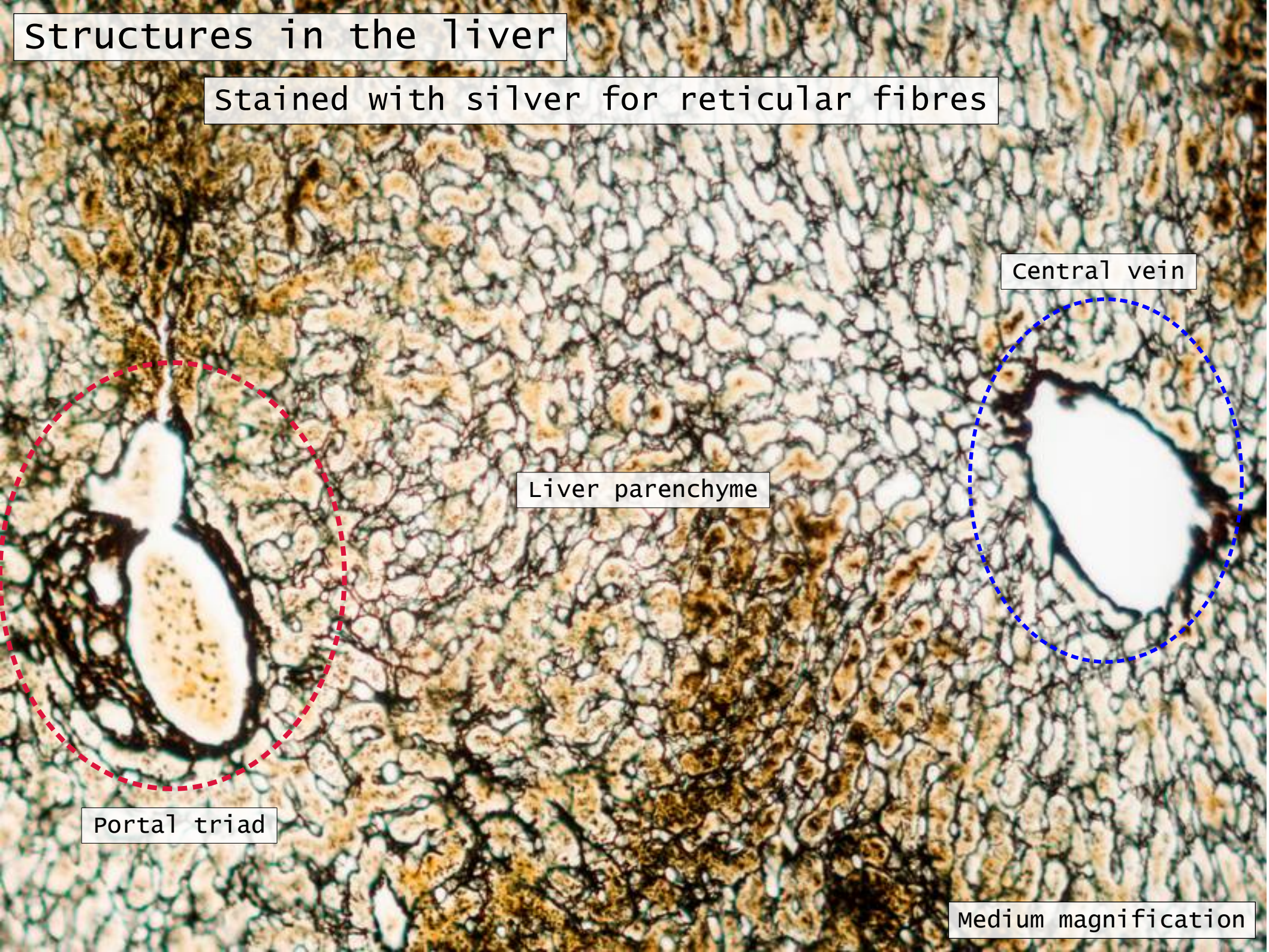

Elements of the portal triad
Artery
Bile duct
High magnification


Central vein
Endothelium nuclei
Lumen
with red blood cells
Hepatocyte nuclei
Very high magnification

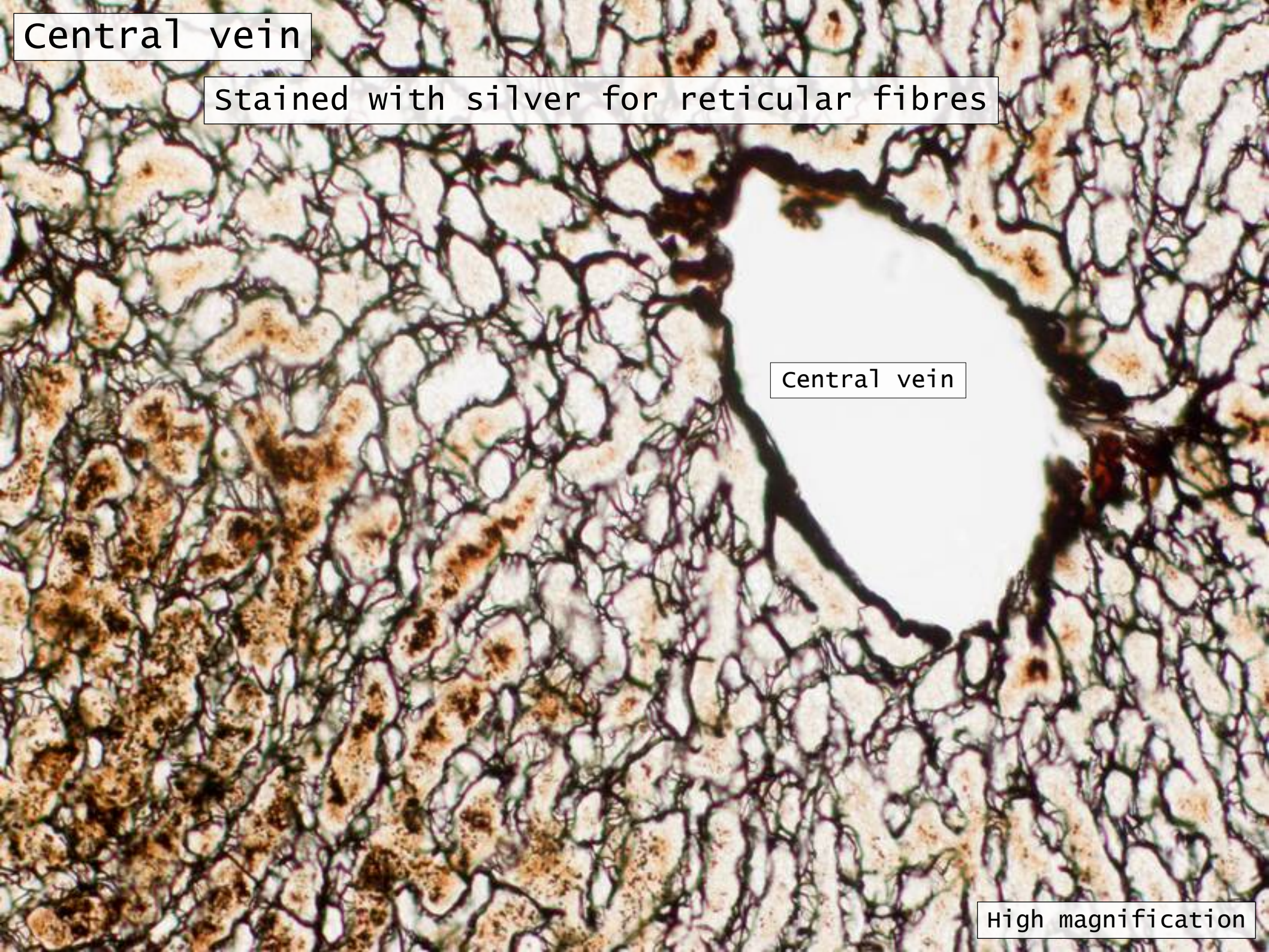

Central vein
Lumen
with red blood cells
Incoming sinusoids
filled with red blood cells
Incoming sinusoids
Very high magnification


Central vein
Very high magnification


Vein in portal triad
Very high magnification

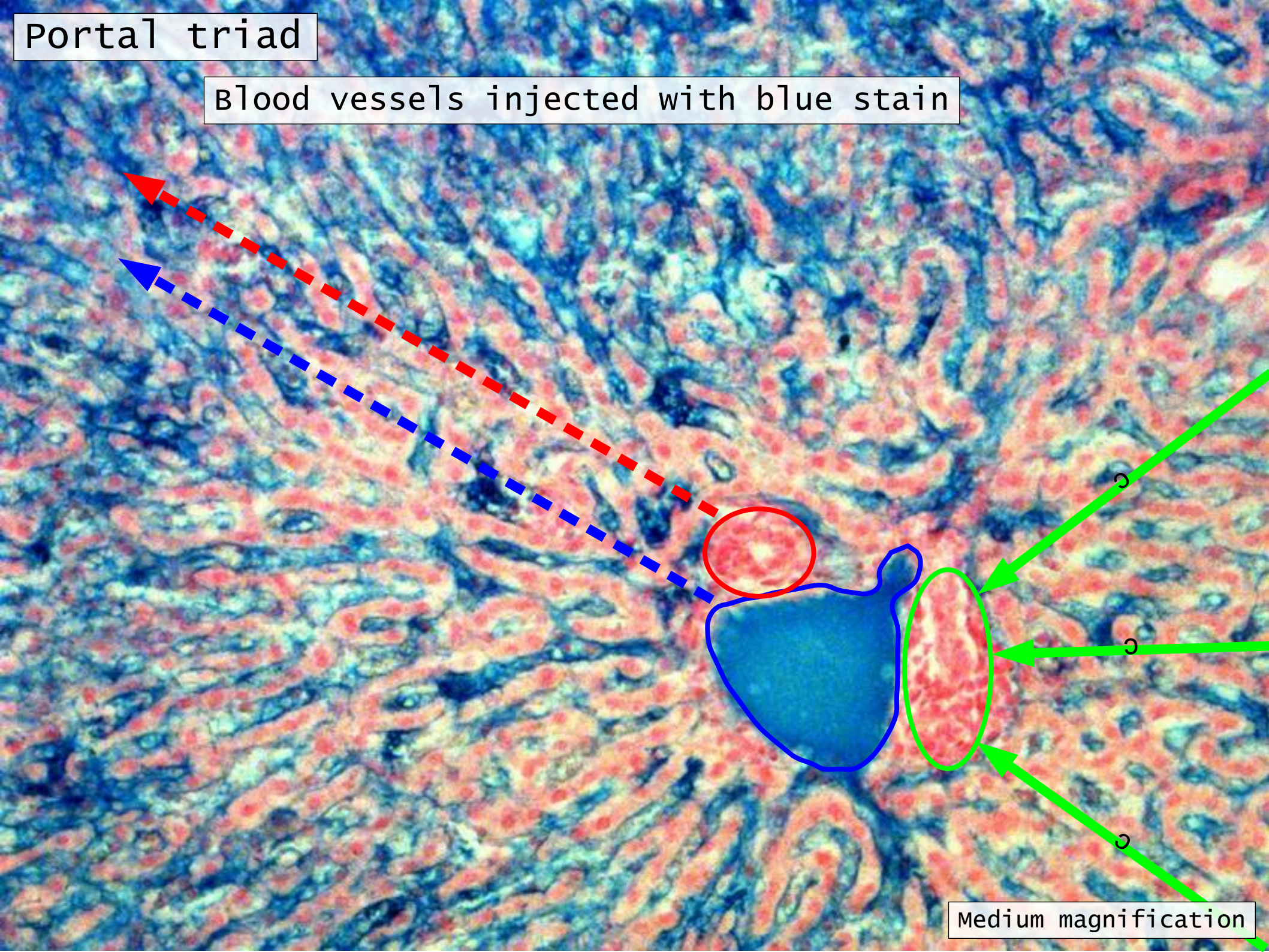

Structures in the liver
Stained with silver for reticular fibres
Central vein
Liver parenchyme
Portal triad
Medium magnification


Portal triad
Stained with silver for reticular fibres
High magnification

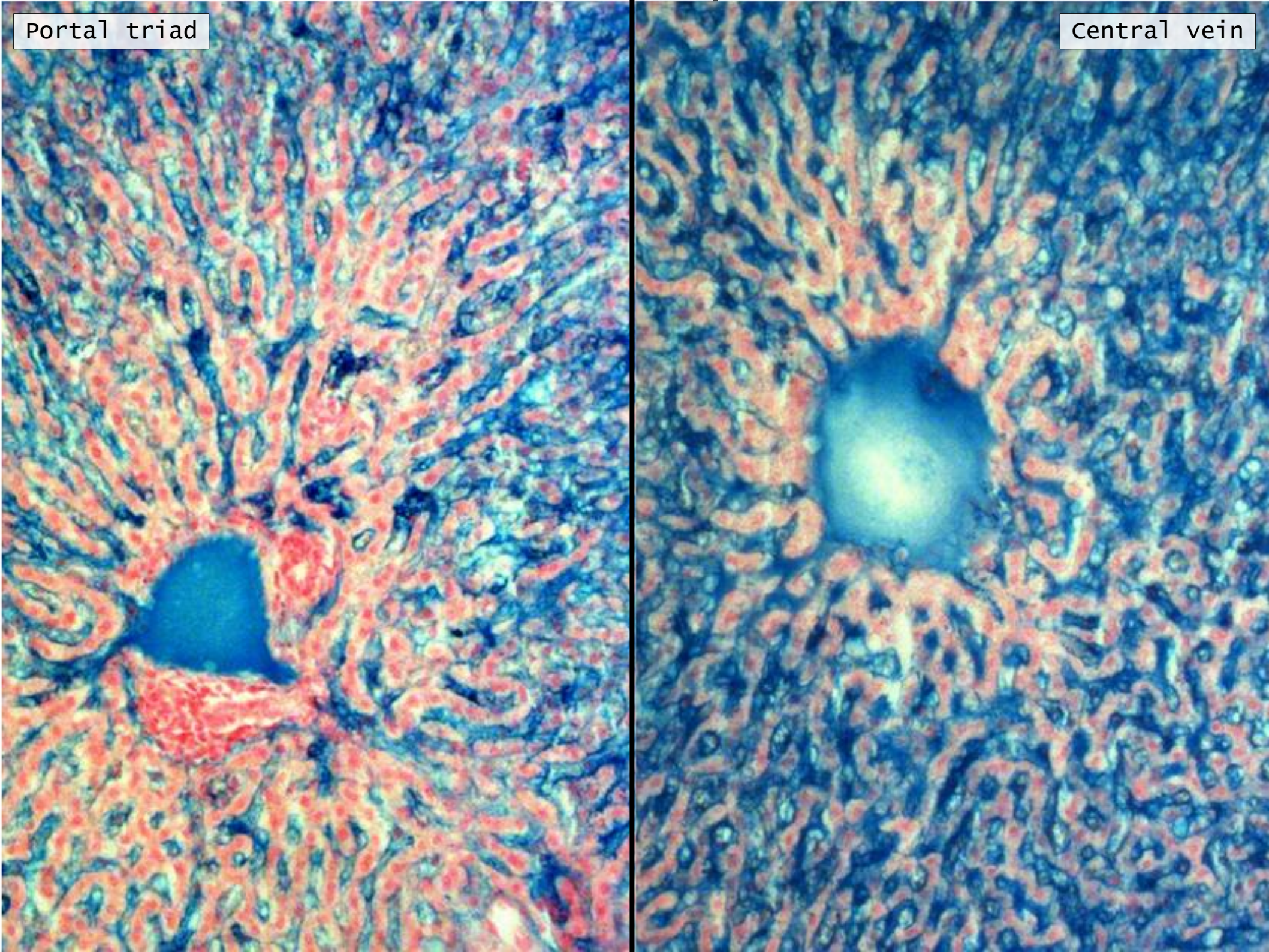

Central vein
Stained with silver for reticular fibres
Central vein
High magnification


Elements of the portal triad
Stained with silver for reticular fibres
Artery
Vein
High magnification


Artery in the portal triad
Stained with silver for reticular fibres
Artery
High magnification


Portal triad
Blood vessels injected with blue stain
Medium magnification


Portal triad
Blood vessels injected with blue stain
Medium magnification

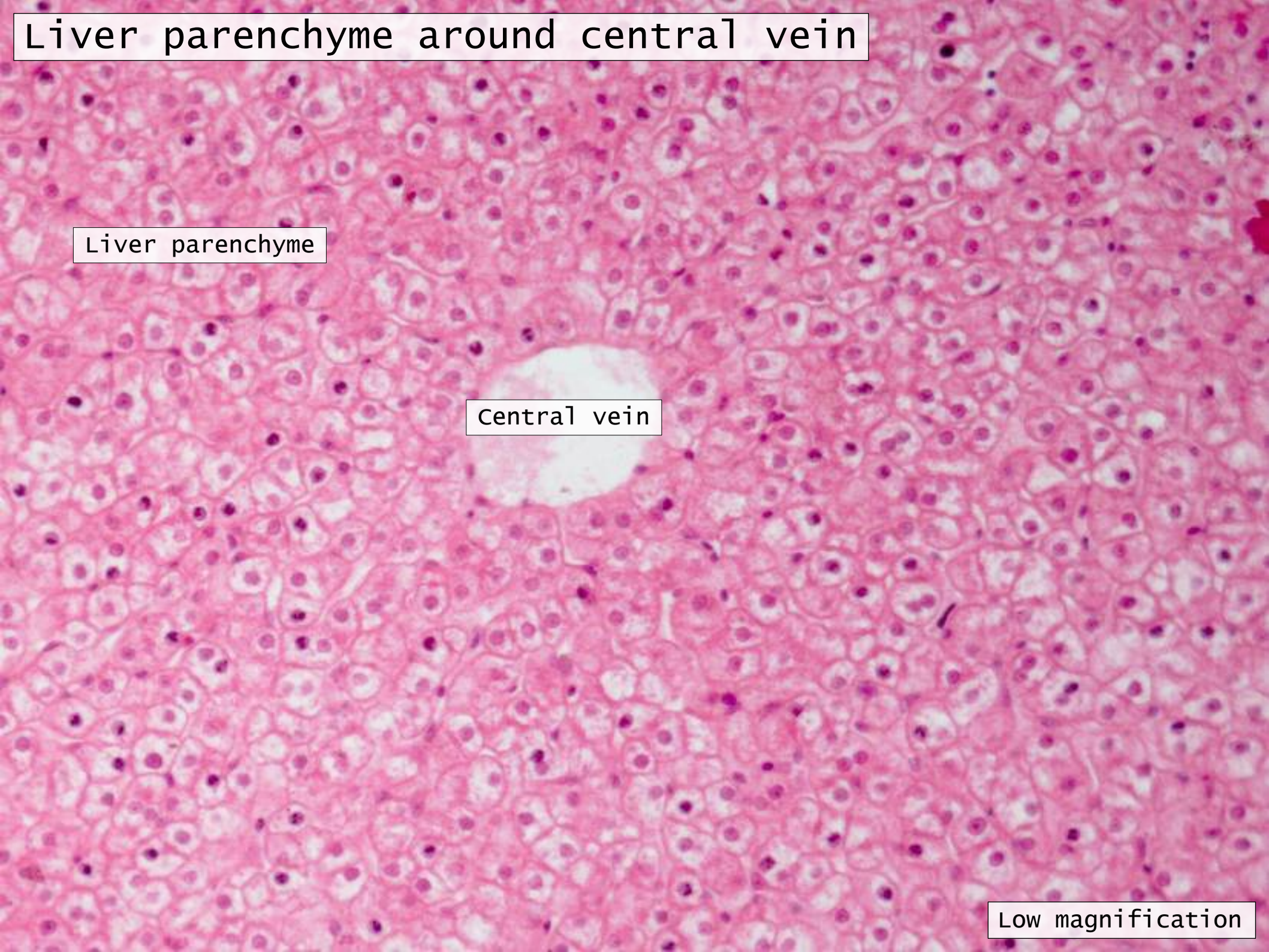

Portal triad
Central vein

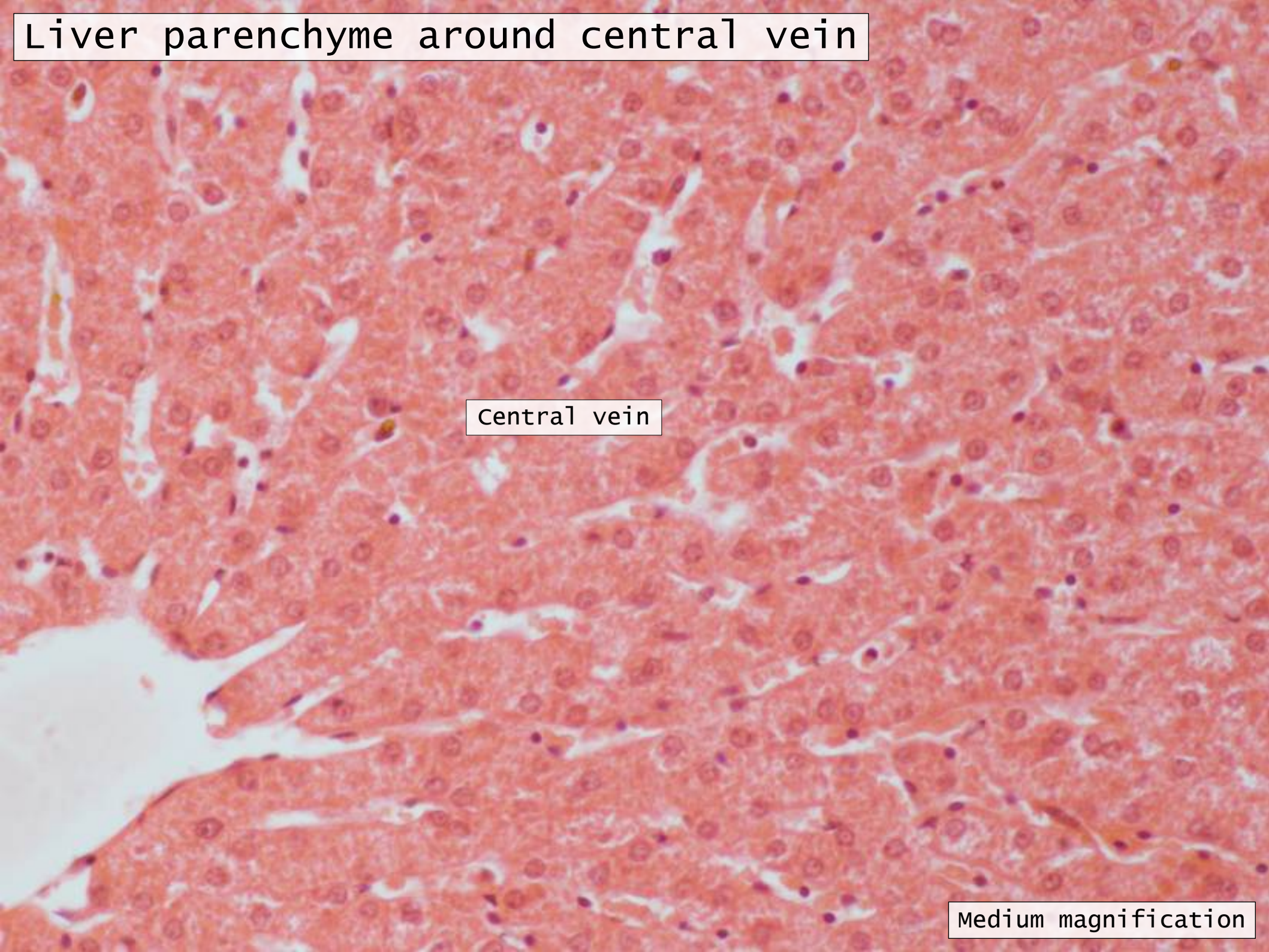
Plates of hepatocytes

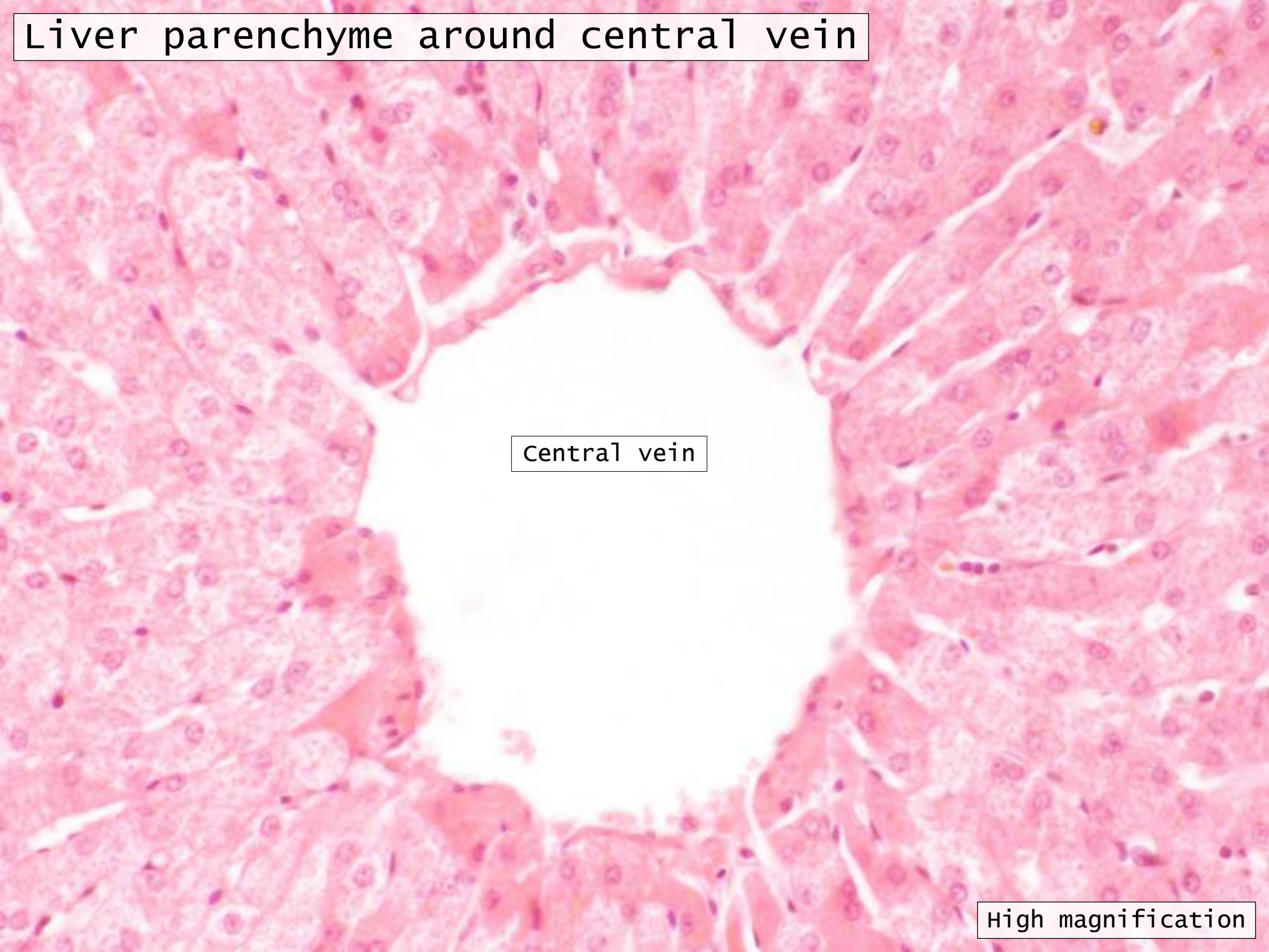
- Arranged radially
- Around central vein
- Blood flows from periphery
- Towards central vein
- Supported by reticular fibres

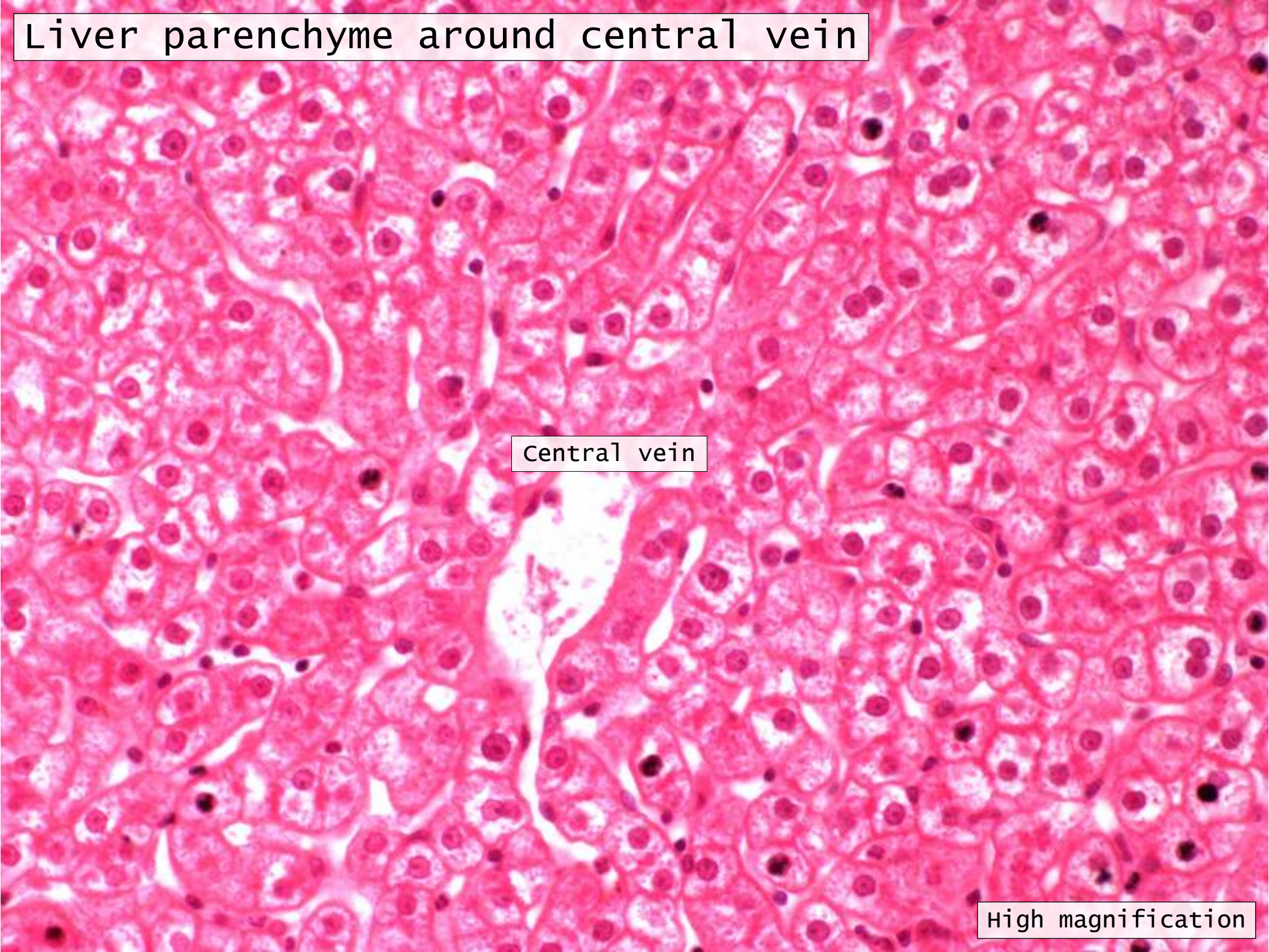
Hepatocytes

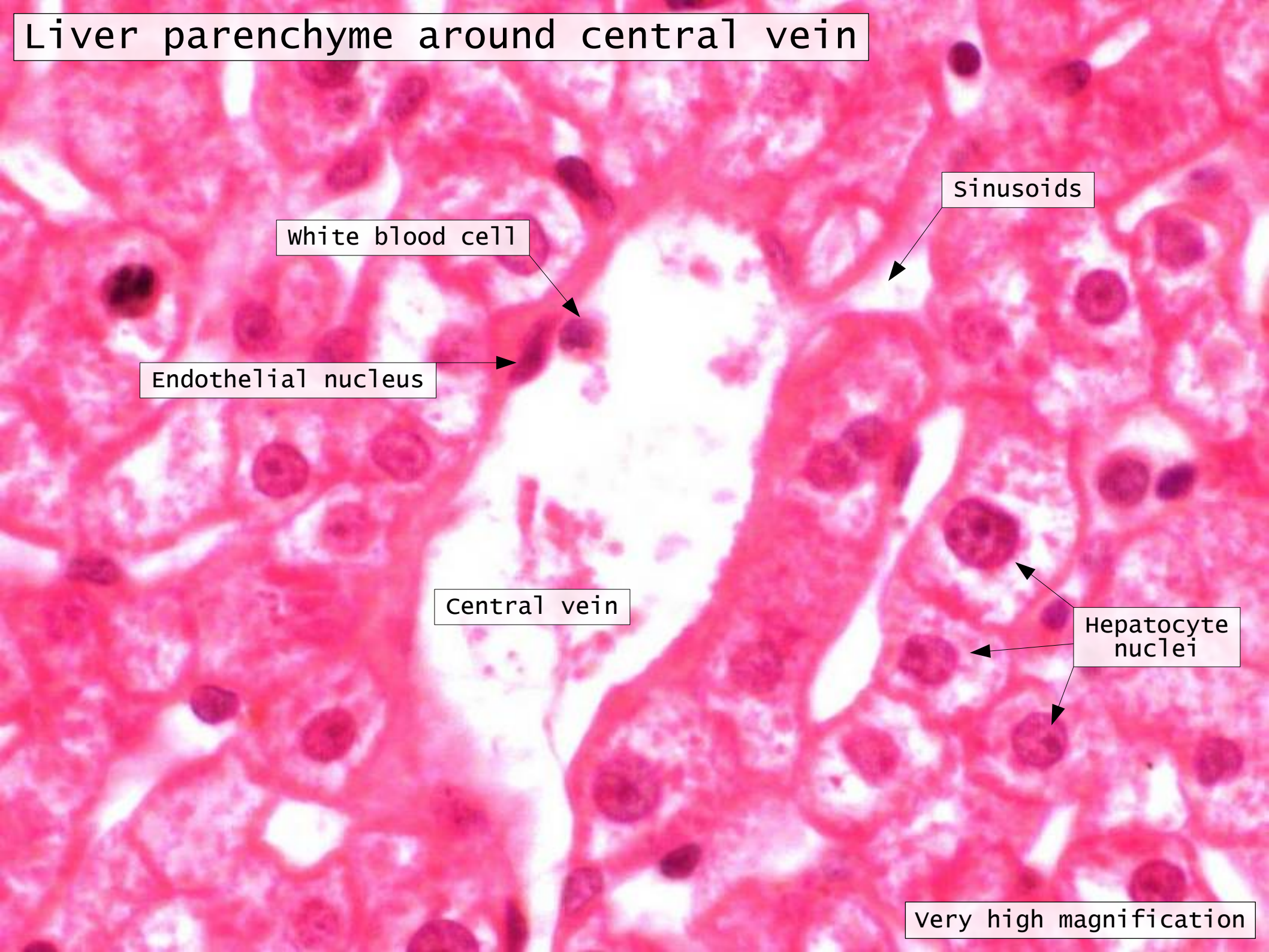
- Large polyhedral cells
- One sometimes two centrally placed round nuclei
- Bile canaliculi between cells
- Two surfaces
  - Bordering space of Disse
    - Microvilli
    - Endocrine secretions
  - Adjacent neigbouring hepatocytes
    - Bile canaliculi as intercellular spaces
    - Occluding junctions at cell surface
    - Microvilli are present

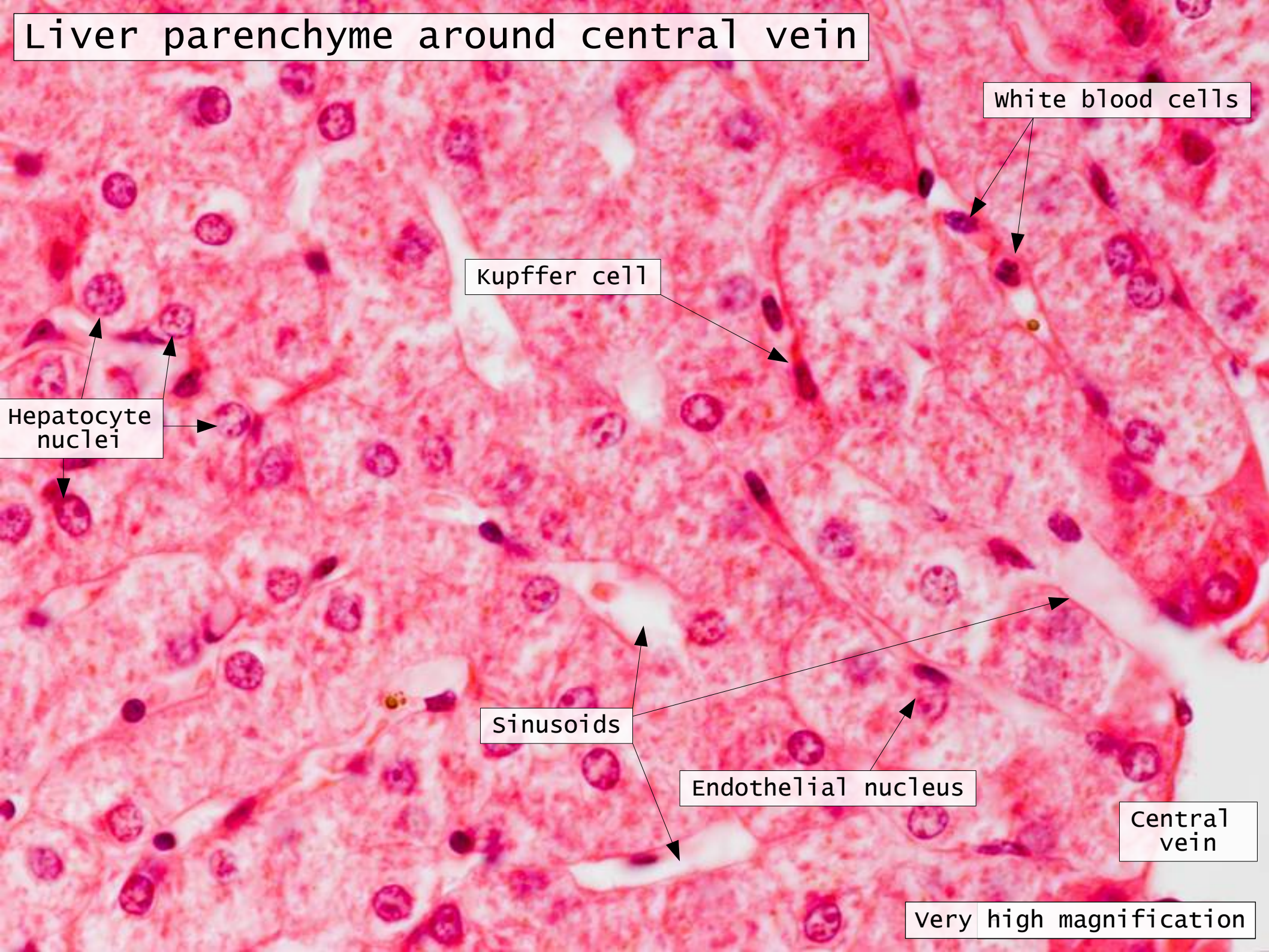

Liver parenchyme around central vein
Liver parenchyme
Central vein
Low magnification

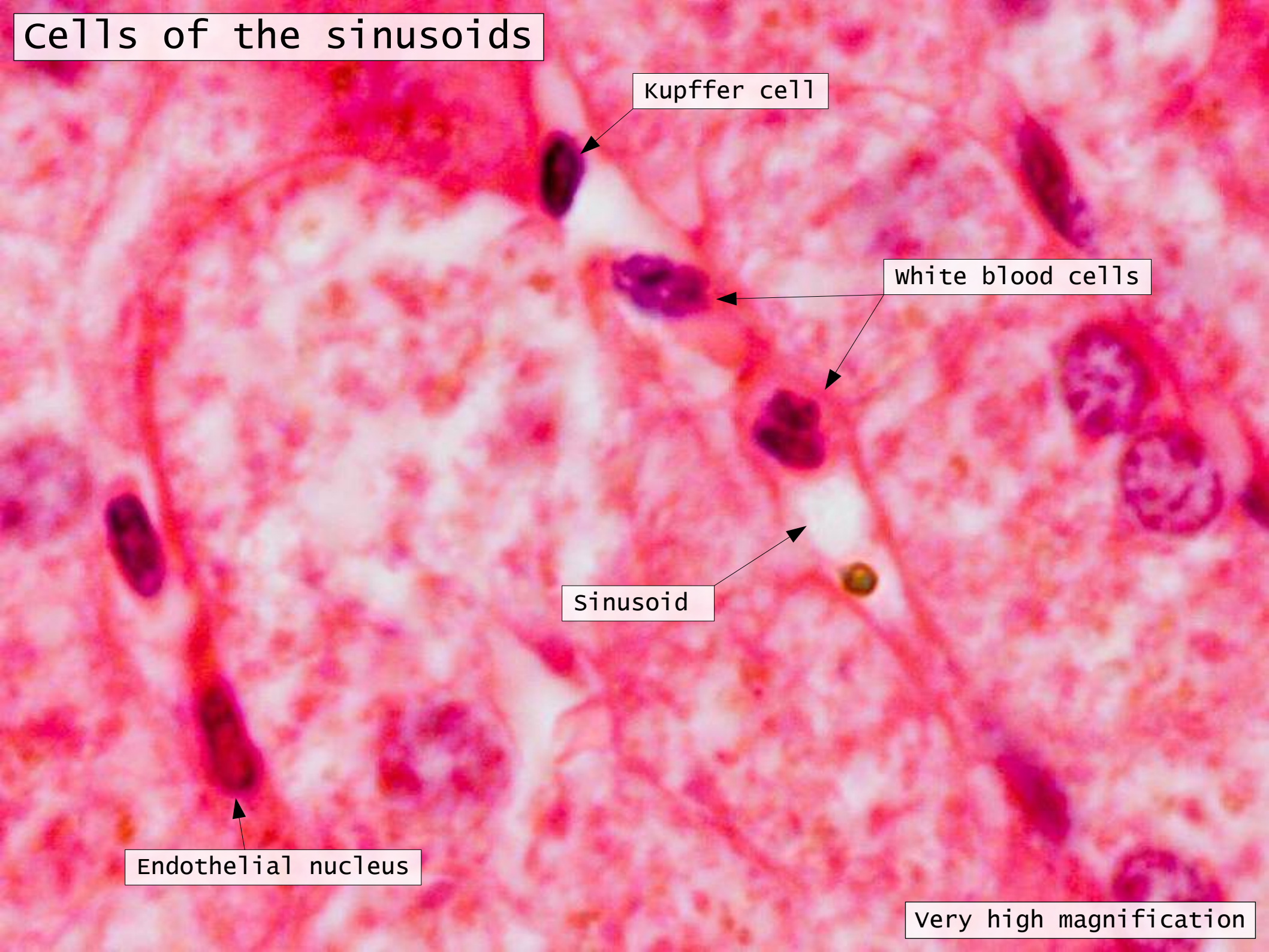

Liver parenchyme around central vein
Central vein
Medium magnification

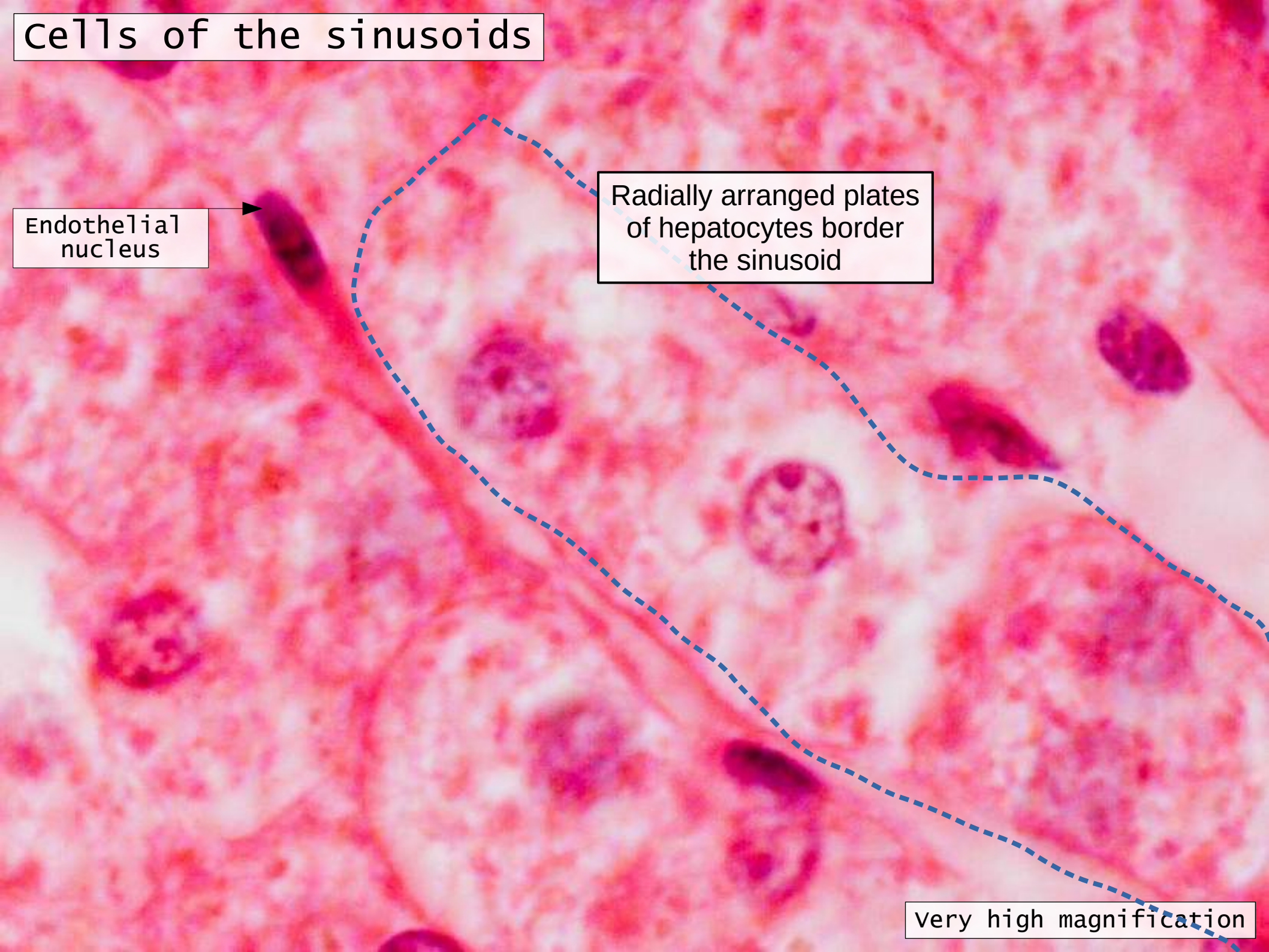

Liver parenchyme around central vein
Central vein
High magnification

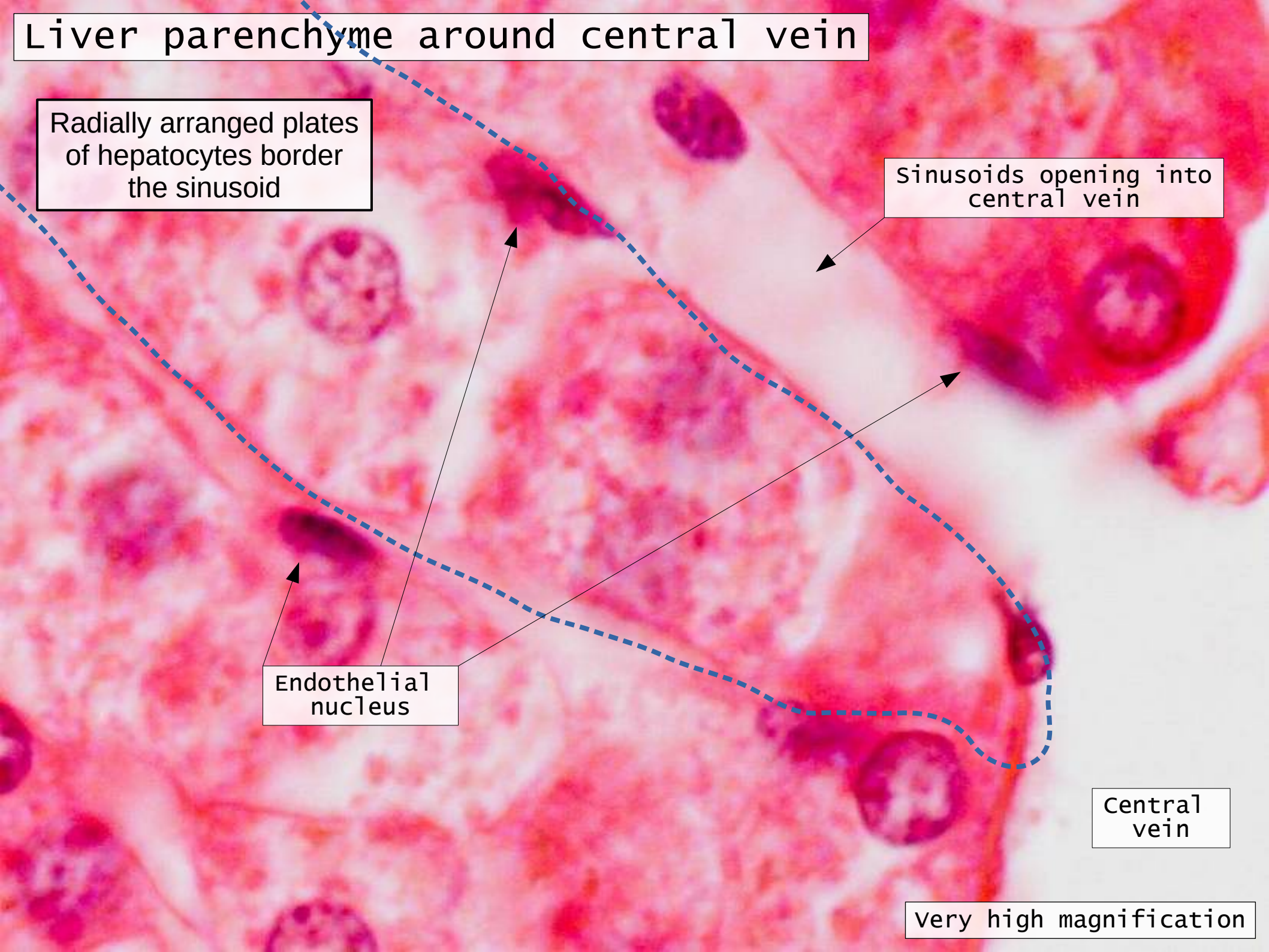

Liver parenchyme around central vein
Central vein
High magnification

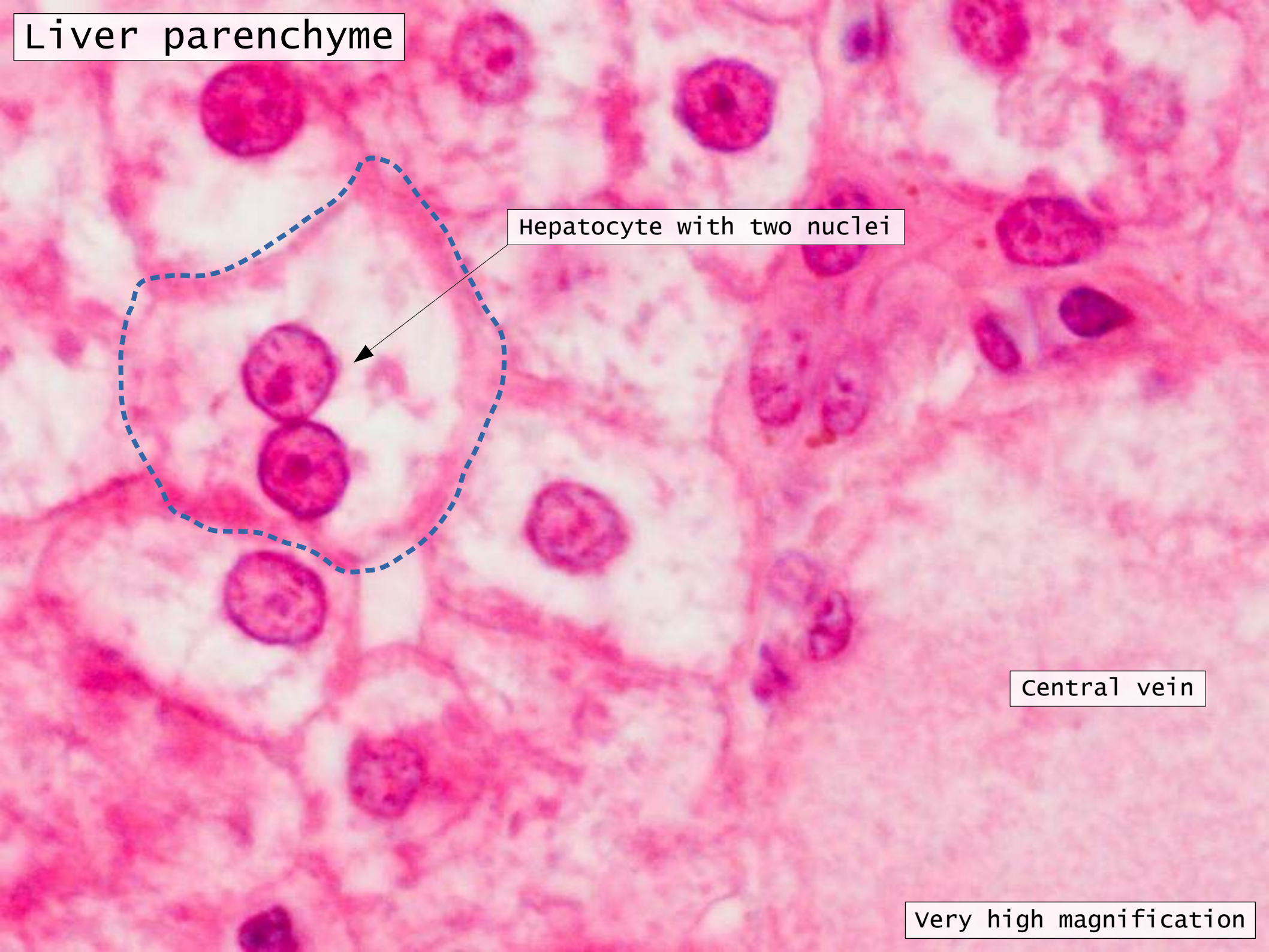

Liver parenchyme around central vein
Sinusoids
White blood cell
Endothelial nucleus
Central vein
Hepatocyte nuclei
Very high magnification

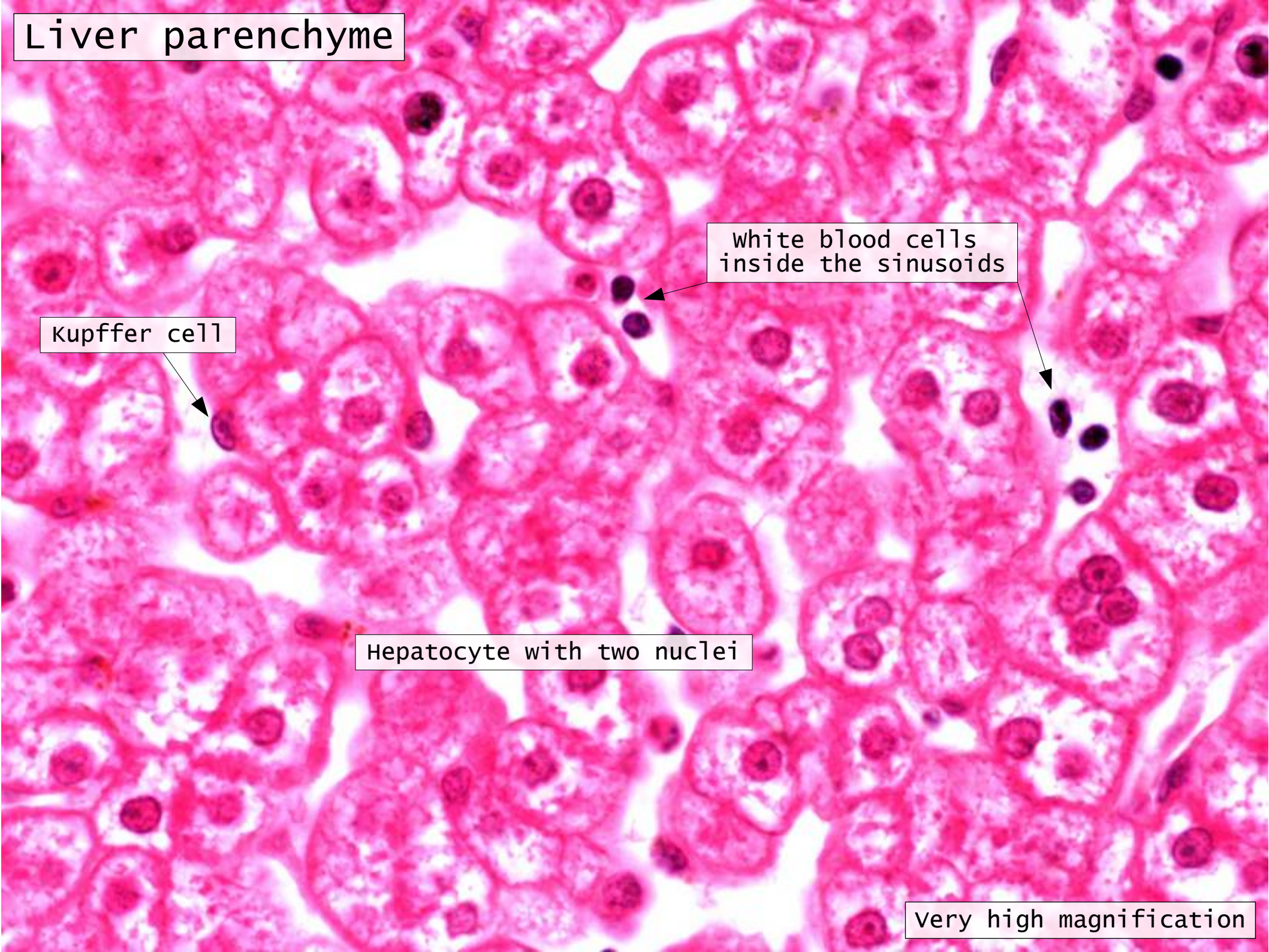

Liver parenchyme around central vein
White blood cells
Kupffer cell
Hepatocyte nuclei
Sinusoids
Endothelial nucleus
Central vein
Very high magnification

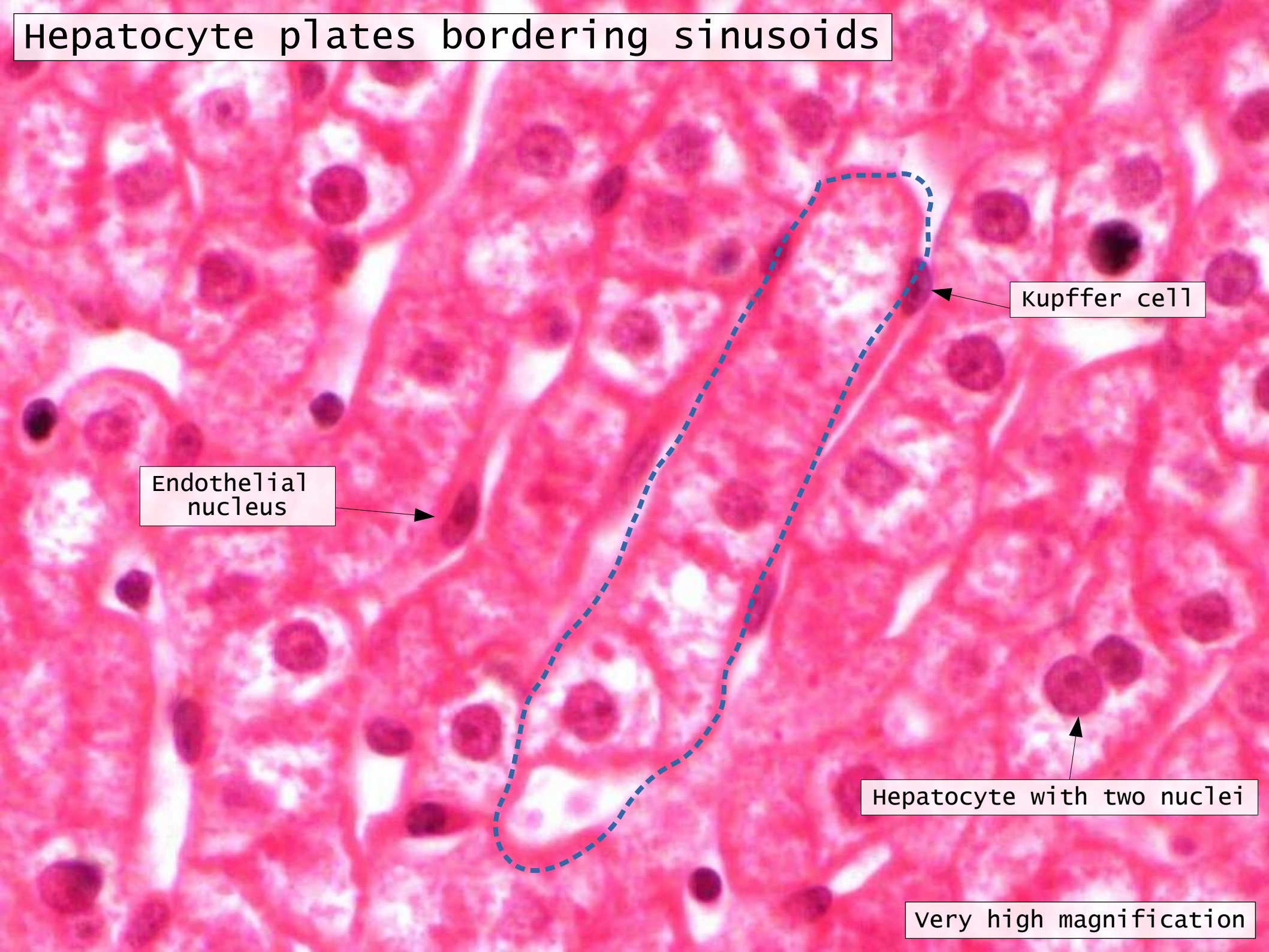

Cells of the sinusoids
Kupffer cell
White blood cells
Sinusoid
Endothelial nucleus
Very high magnification


Cells of the sinusoids
Endothelial nucleus
Radially arranged plates of hepatocytes border the sinusoid
Very high magnification

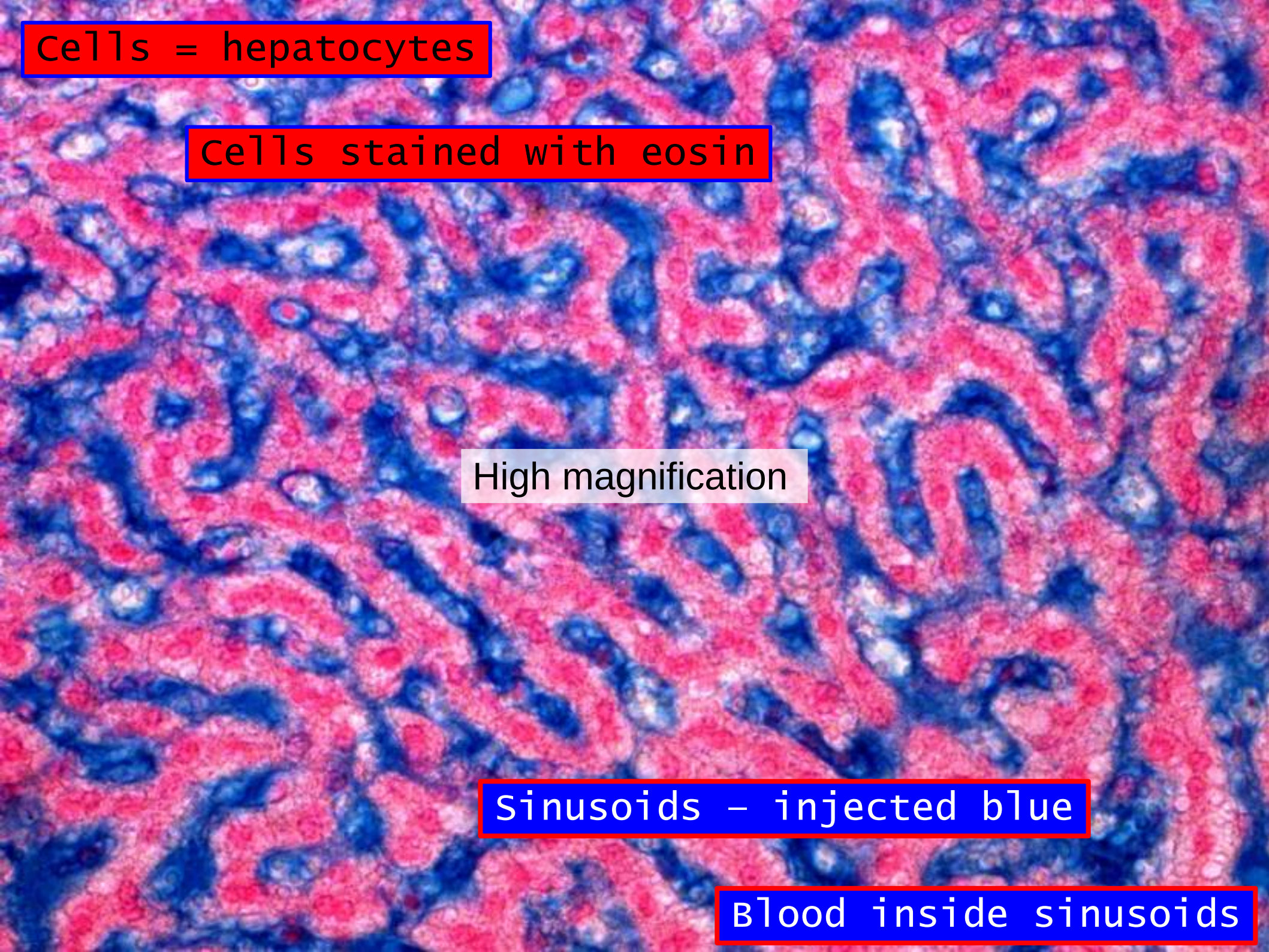

Liver parenchyme around central vein
Radially arranged plates of hepatocytes border the sinusoid
Sinusoids opening into central vein
Endothelial nucleus
Central vein
Very high magnification


Liver parenchyme
Hepatocyte with two nuclei
Central vein
Very high magnification


Liver parenchyme
White blood cells inside the sinusoids
Kupffer cell
Hepatocyte with two nuclei
Very high magnification


Hepatocyte plates bordering sinusoids
Kupffer cell
Endothelial nucleus
Hepatocyte with two nuclei
Very high magnification


Liver parenchyme
White blood cells inside the sinusoids
Kupffer cell
Very high magnification


Cells = hepatocytes
Cells stained with eosin
High magnification
Sinusoids – injected blue
Blood inside sinusoids

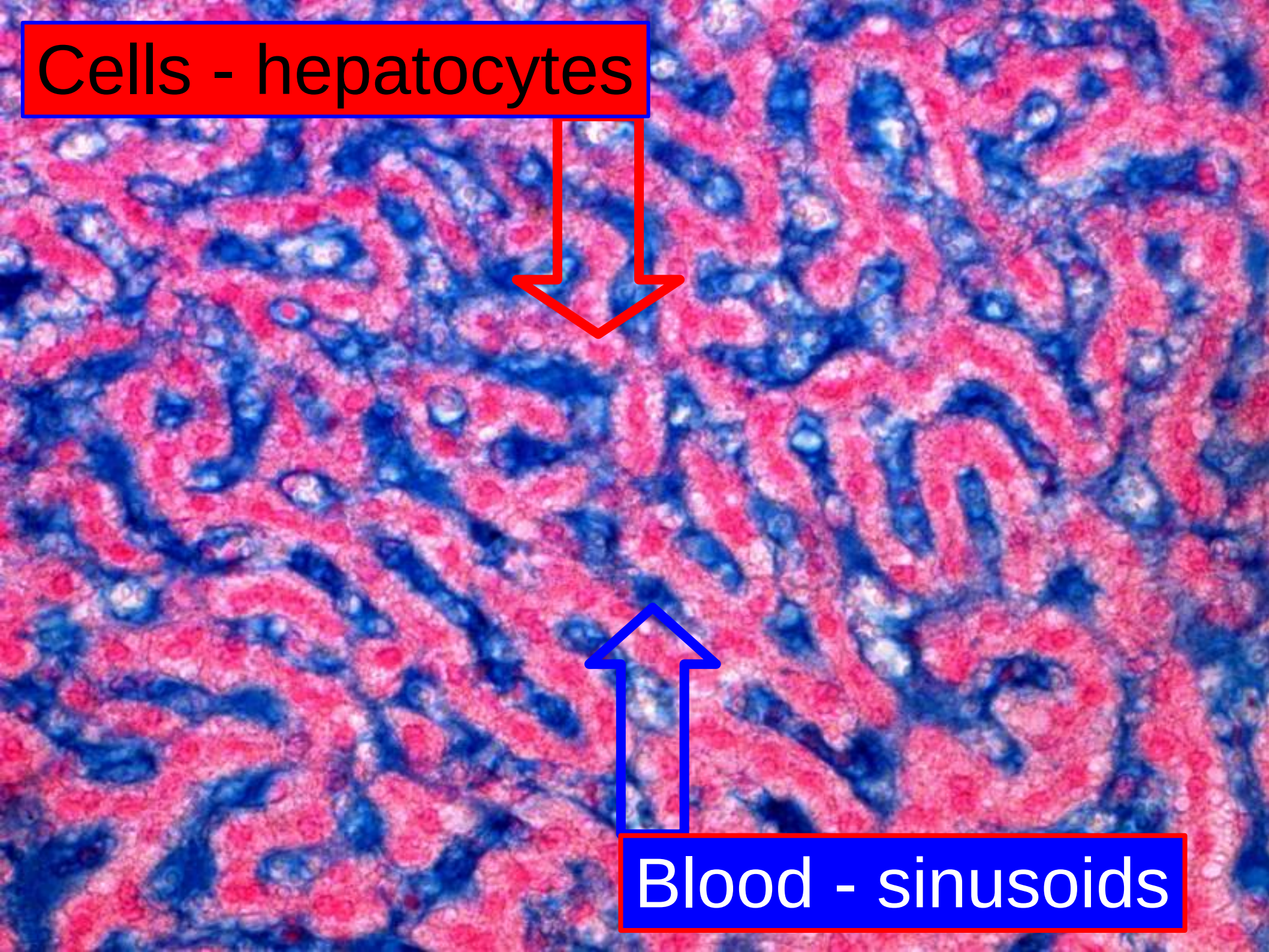
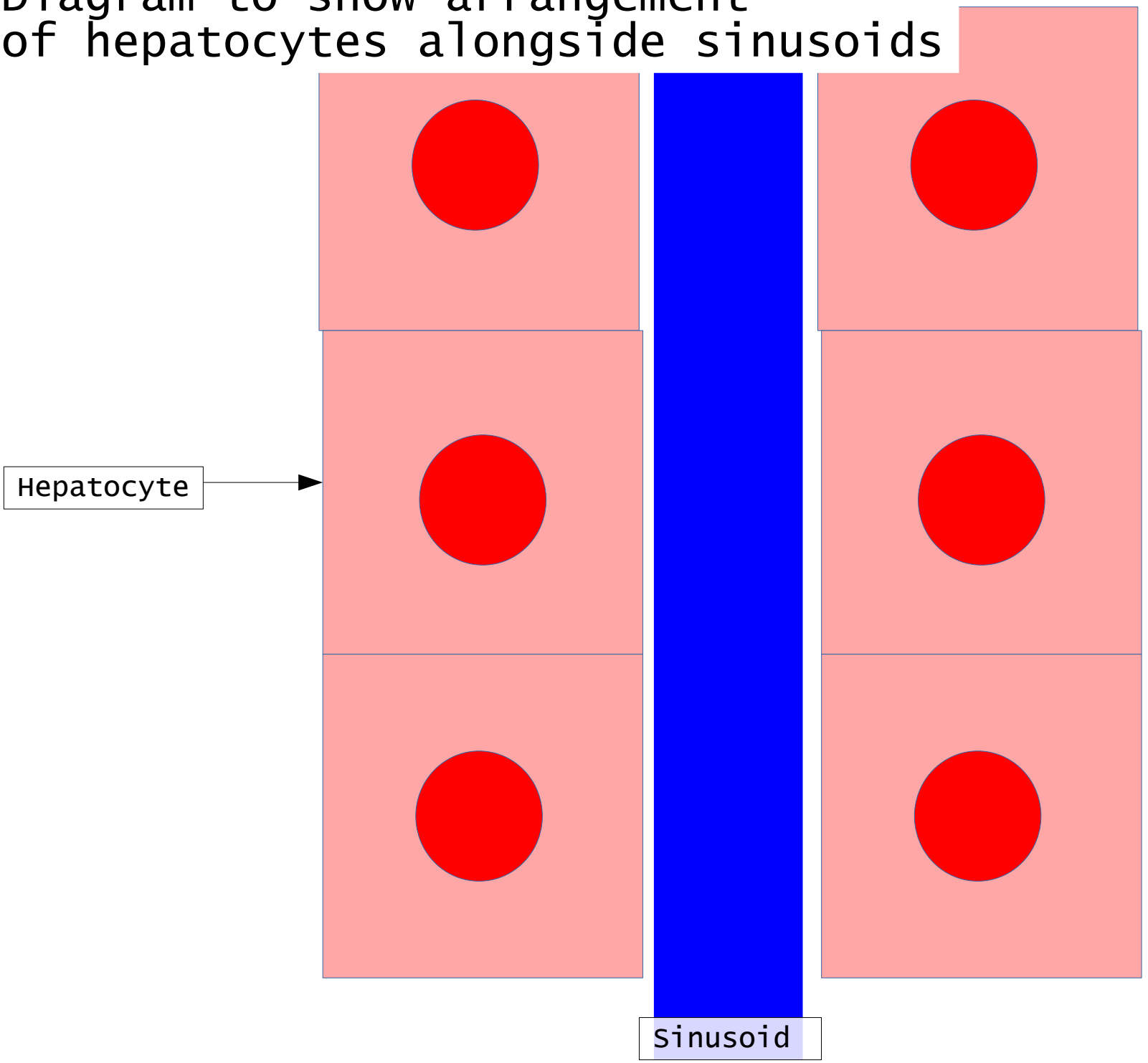
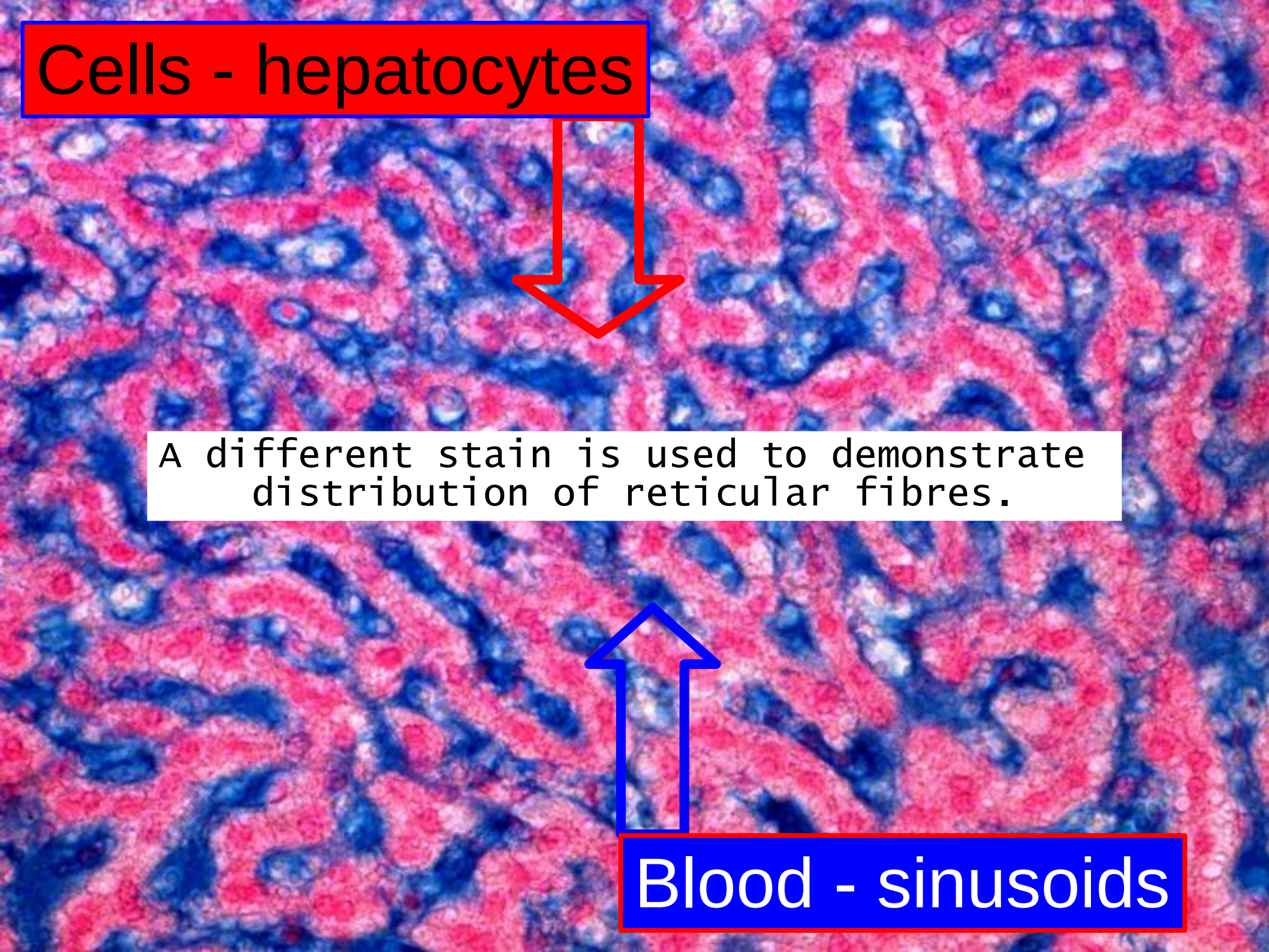
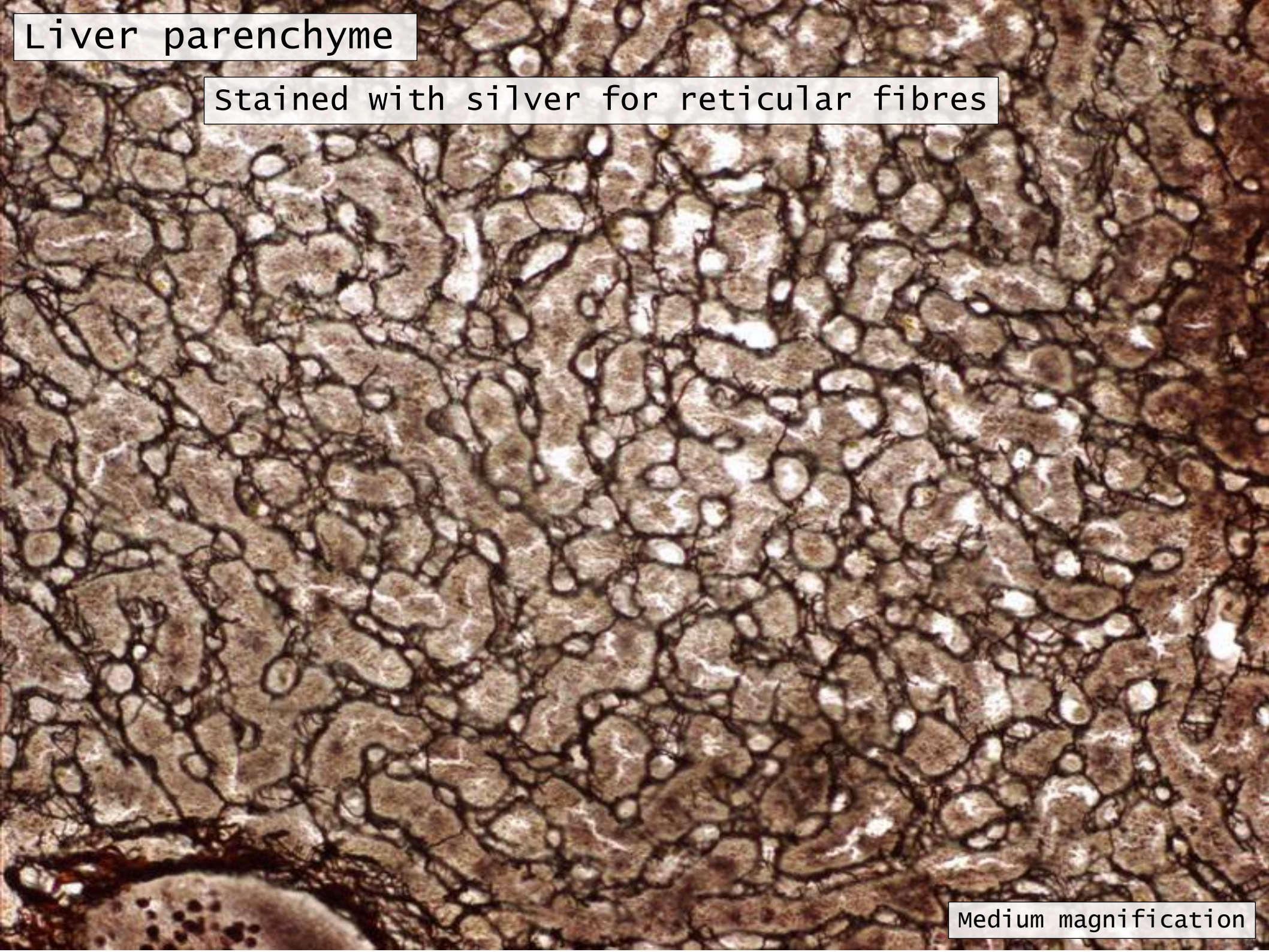

Cells - hepatocytes
Blood - sinusoids

Diagram to show arrangement of hepatocytes alongside sinusoids

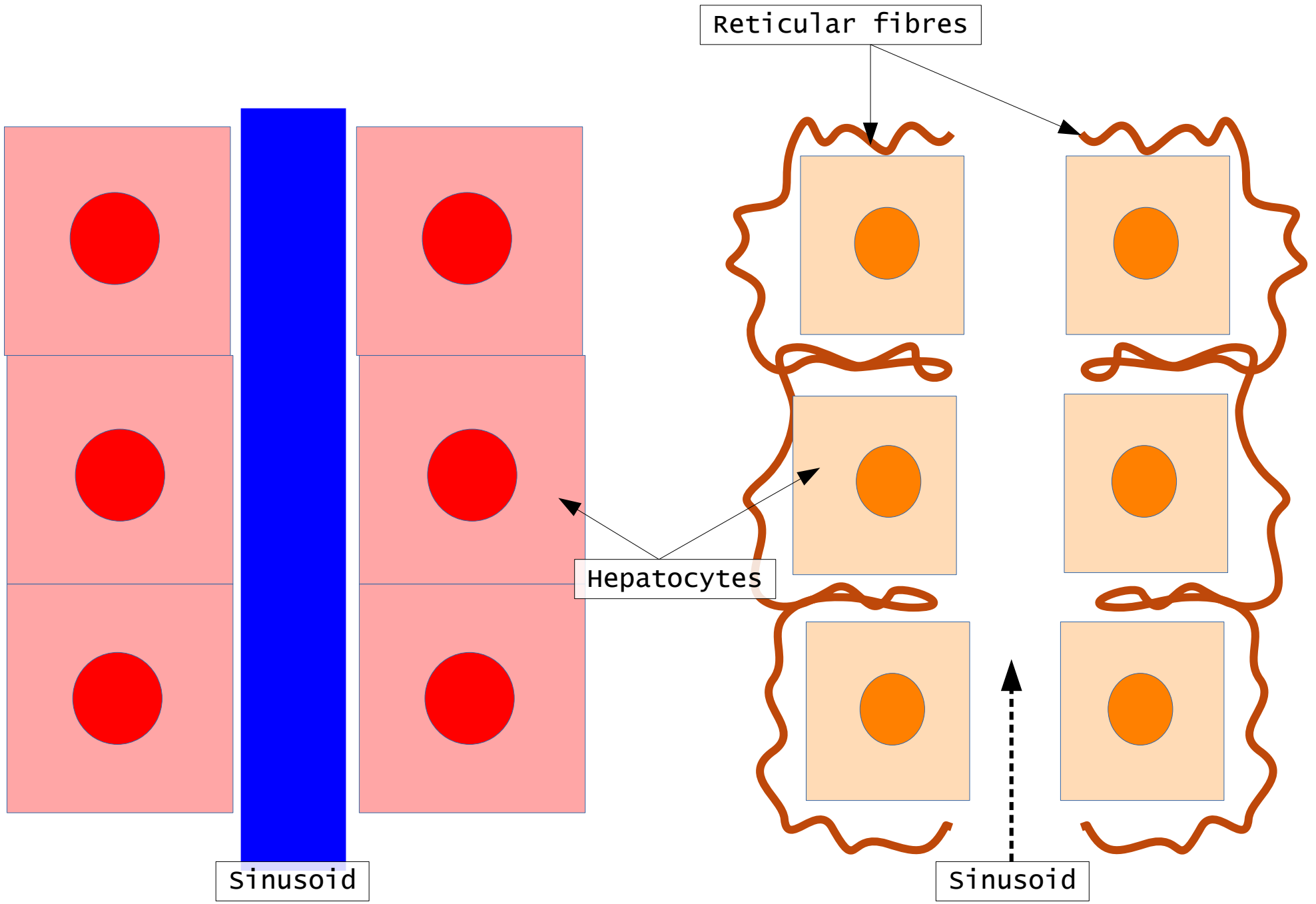


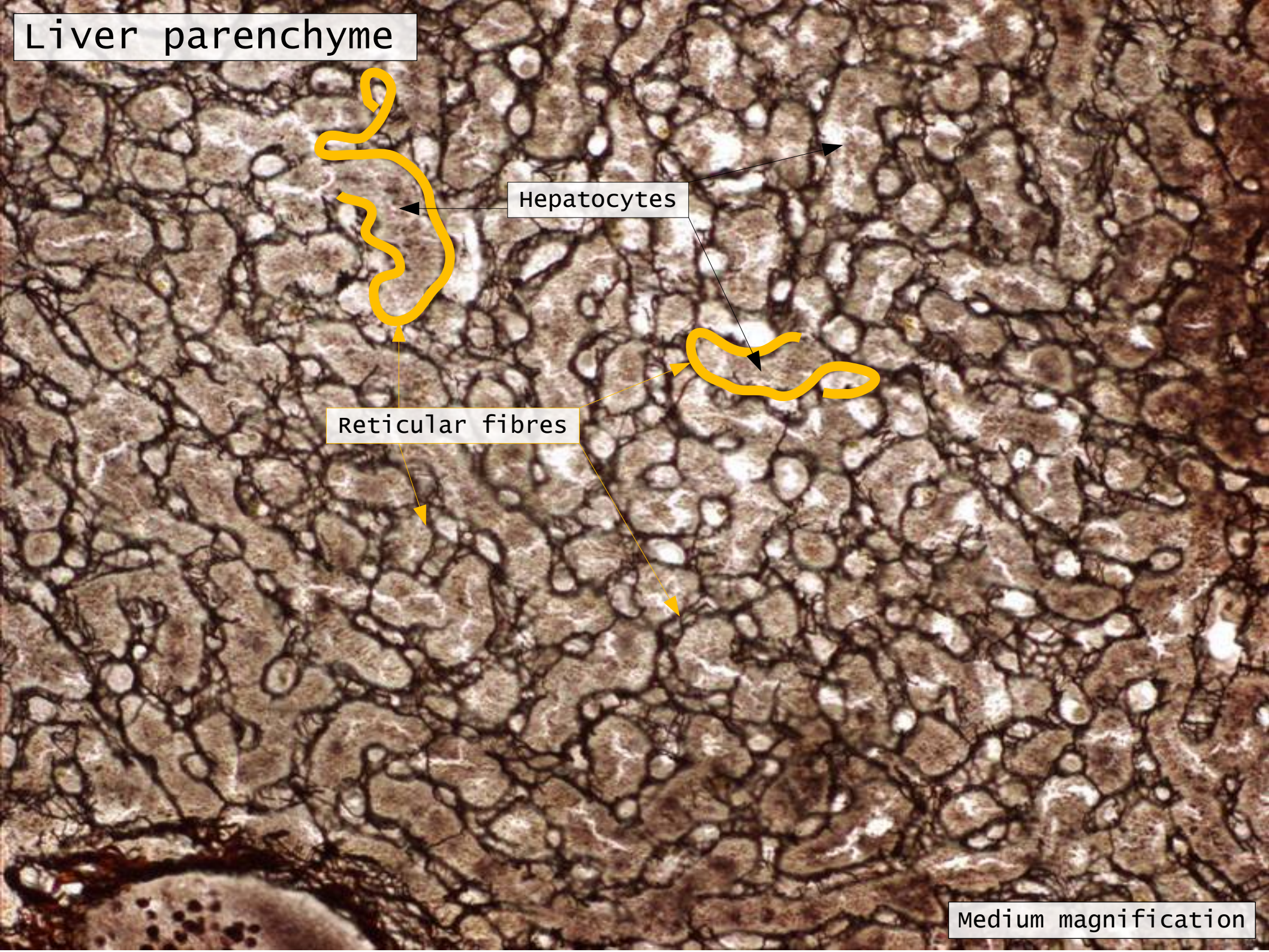

Cells - hepatocytes
A different stain is used to demonstrate distribution of reticular fibres.
Blood - sinusoids

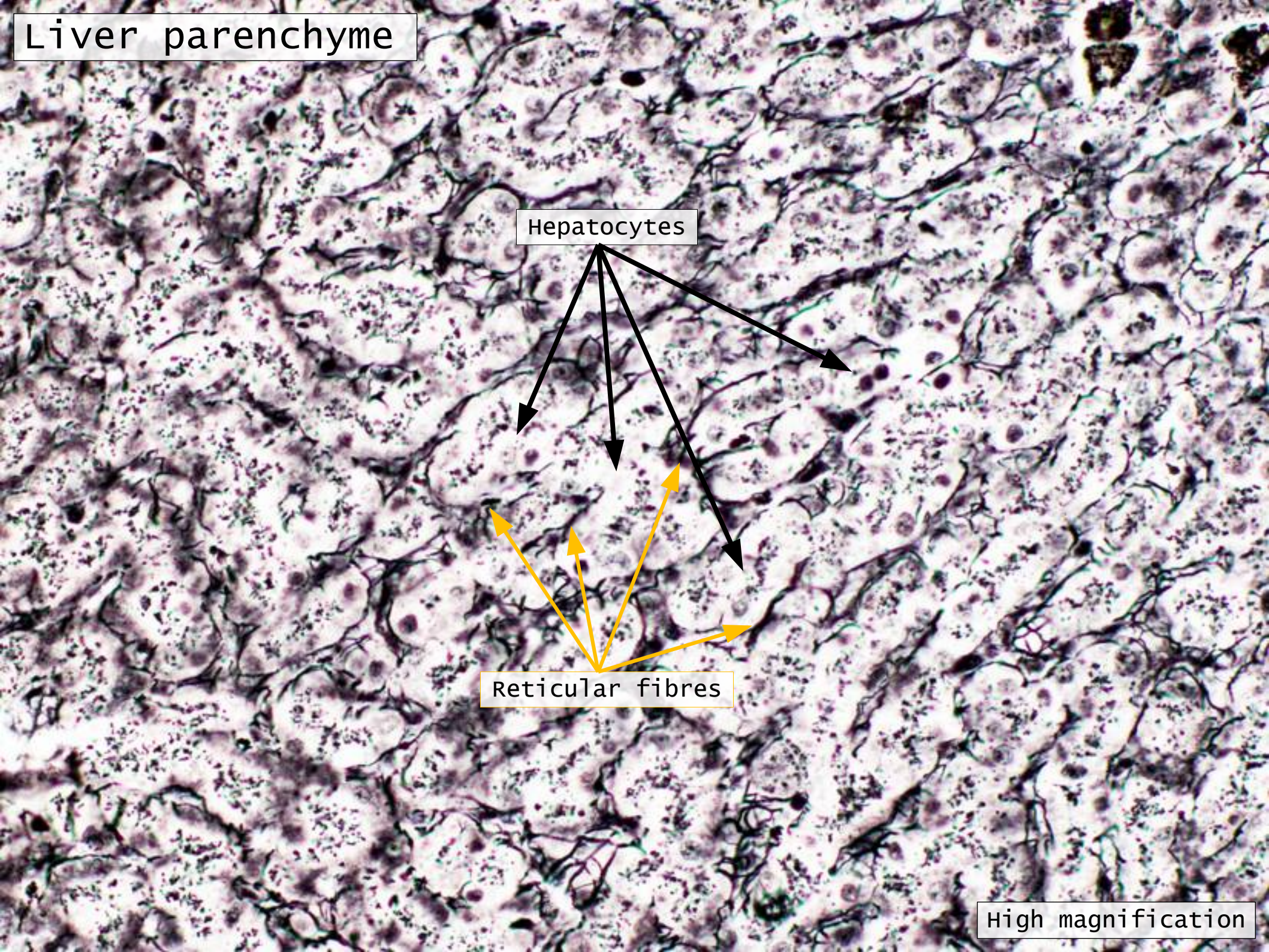

Liver parenchyme
Stained with silver for reticular fibres
Medium magnification

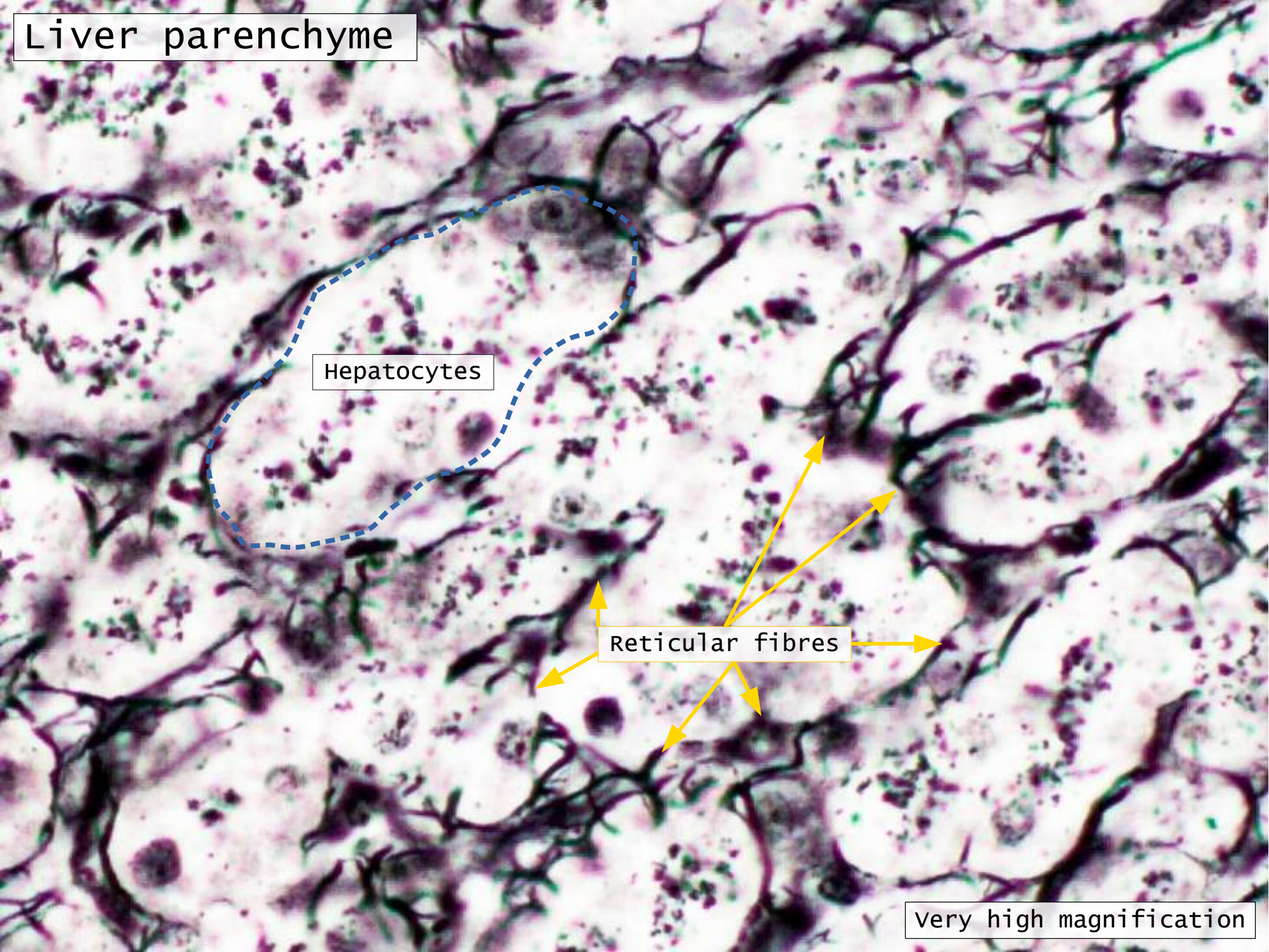
Reticular fibres surround and support hepatocytes.
Almost like eggs in a nest.
This is visible when using a special stain for reticular fibres.

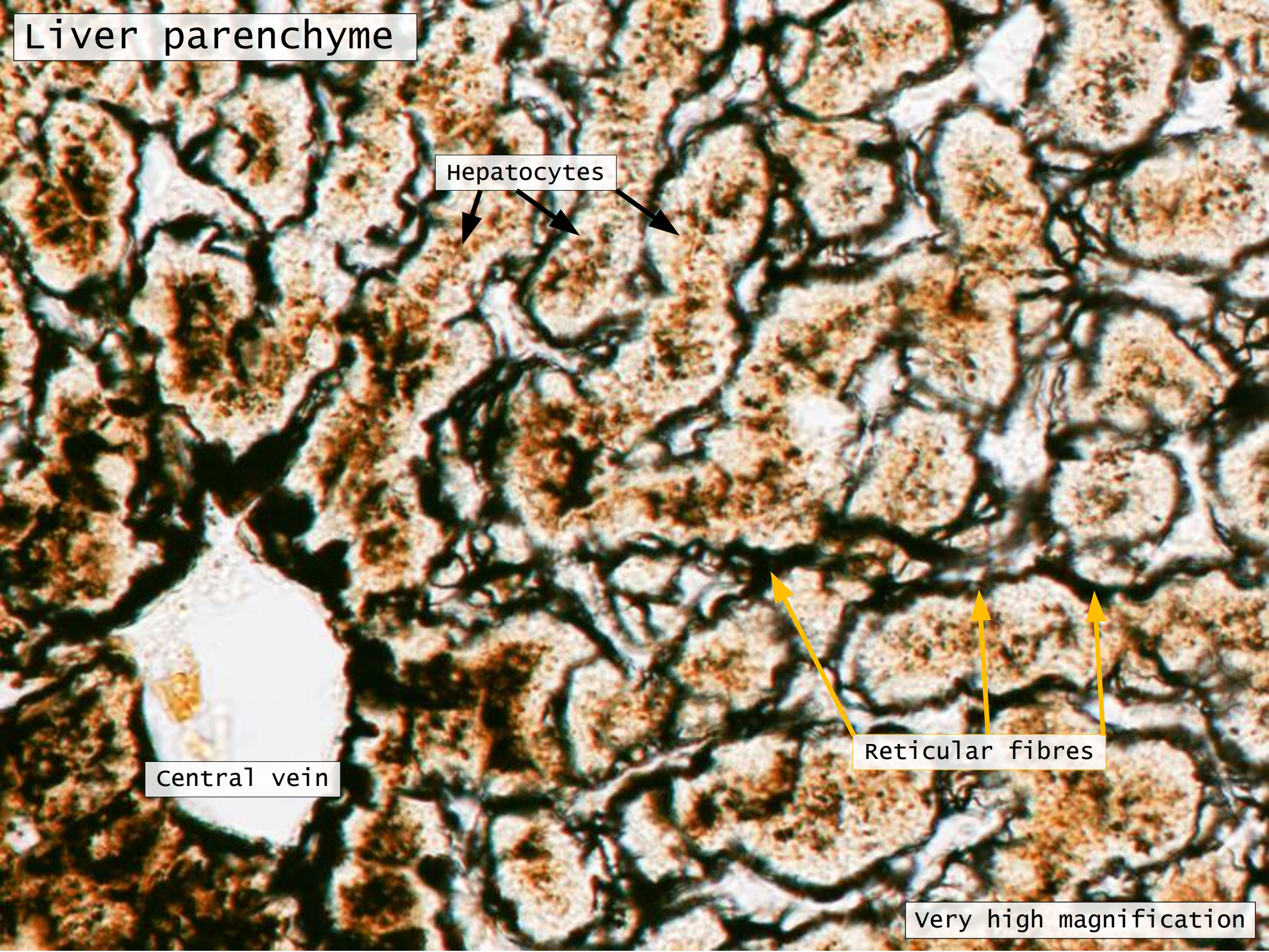
Diagram to show distribution of reticular fibres




Liver parenchyme
Hepatocytes
Reticular fibres
Medium magnification


Liver parenchyme
Hepatocytes
Reticular fibres
High magnification


Liver parenchyme
Hepatocytes
Reticular fibres
Very high magnification


Liver parenchyme
Hepatocytes
Central vein
Reticular fibres
Very high magnification

Bile

- Exocrine secretion of liver
- Through bile canaliculi
- Towards bile ducts at portal triad

Bile canaliculi

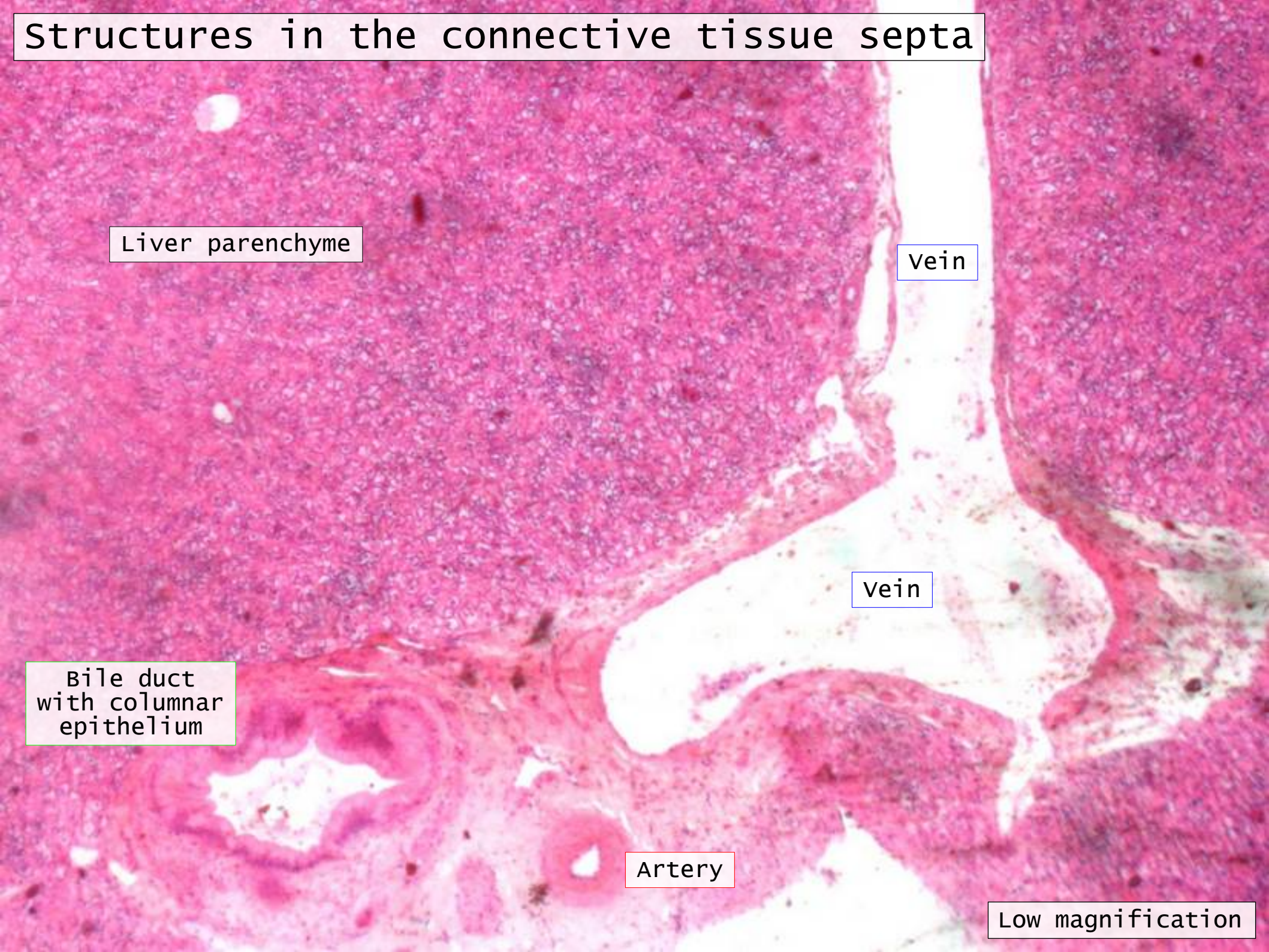
- Intercellular spaces between hepatocytes
- Represent beginning of duct system
- Canaliculi -> canals of Hering -> ducts
- Bile and blood flow opposite directions
- Intrahepatic bile ducts
  - Low cuboidal to cuboidal epithelium


Liver parenchyme
Hepatocyte
Canaliculi between adjacent hepatocytes
Kupffer cell
Sinusoid
Very high magnification

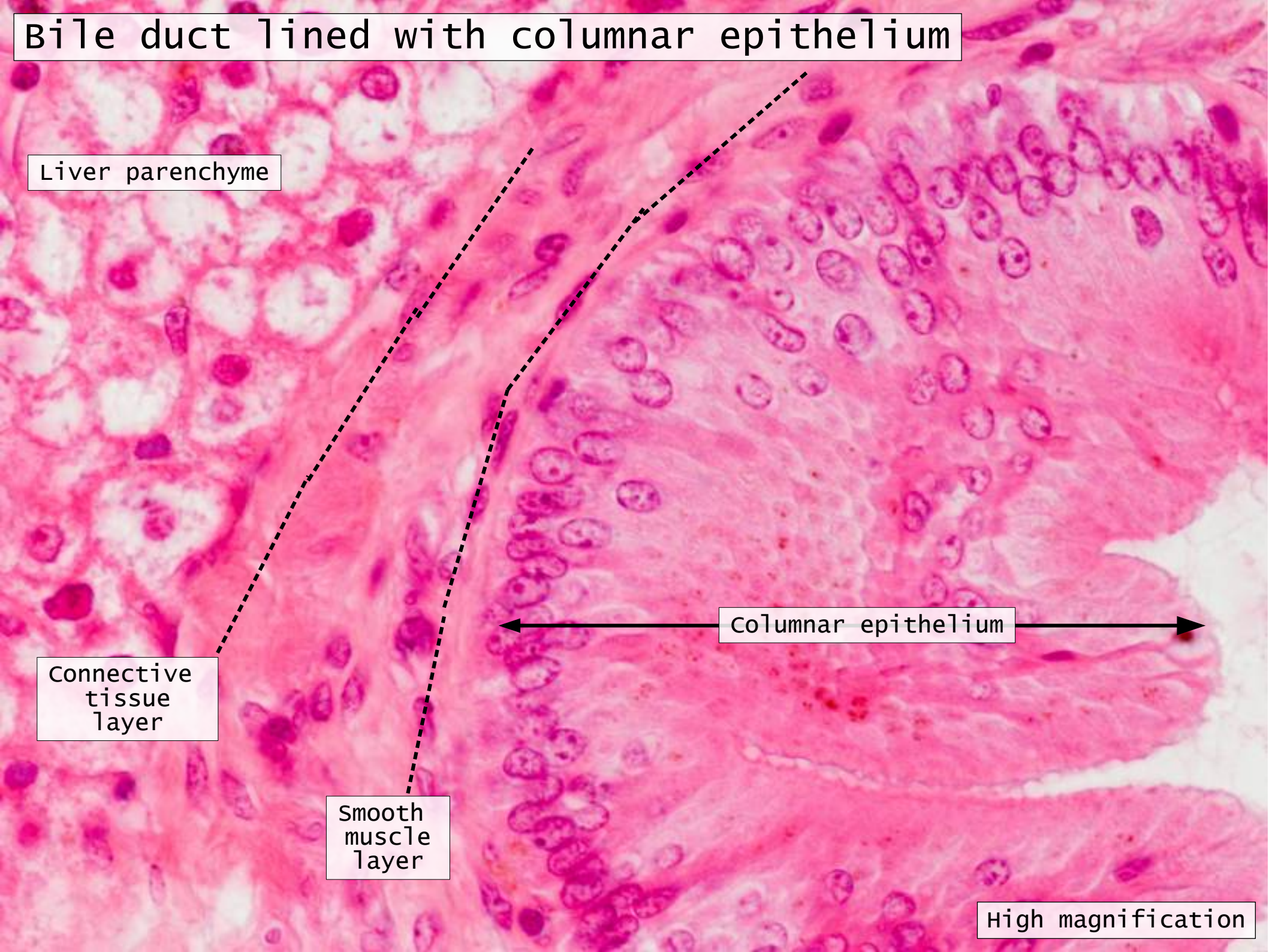
Hepatic ducts

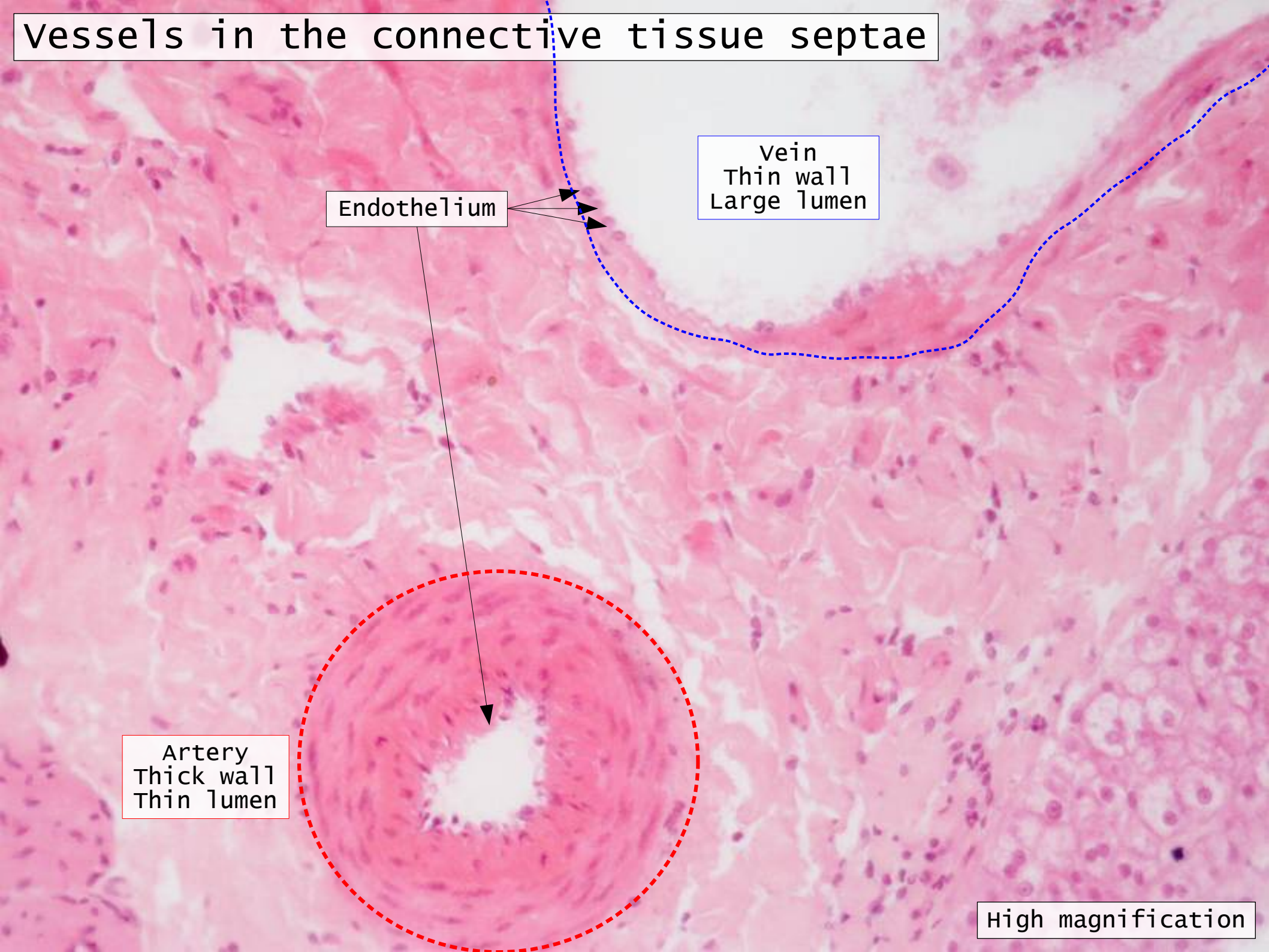
- Tall columnar epithelium
- Surrounded by smooth muscle
- Embedded in connective tissue

Structures in the connective tissue septa



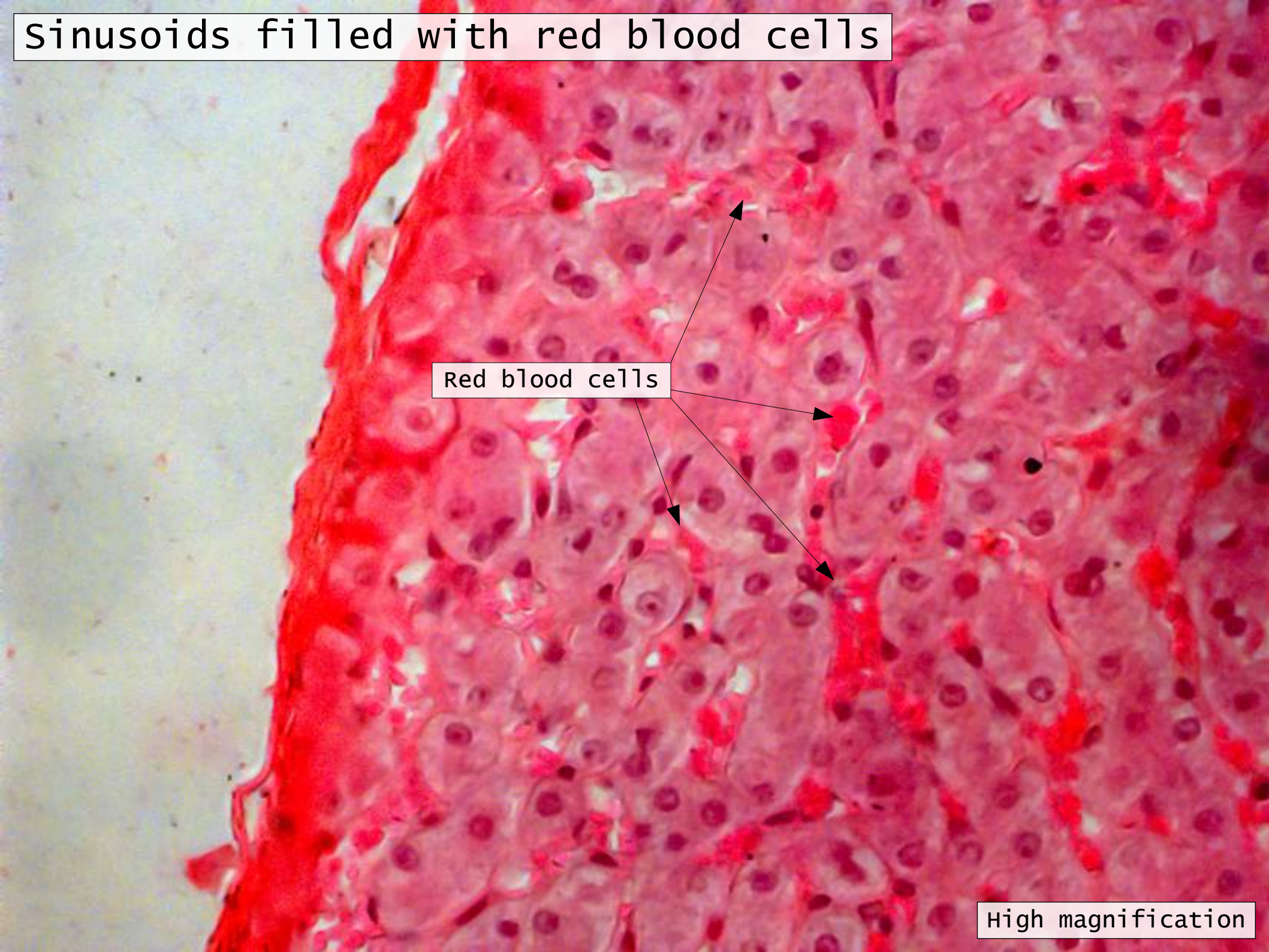

Bile duct lined with columnar epithelium
Liver parenchyme
Medium magnification


Bile duct lined with columnar epithelium
Liver parenchyme
Connective tissue layer
Smooth muscle layer
Columnar epithelium
High magnification


Vessels in the connective tissue septae
Vein
Thin wall
Large lumen
Endothelium
Artery
Thick wall
Thin lumen
High magnification

Sinusoids

- Endothelial lined spaces between plates of hepatocytes
- Blood flow through sinusoids
- From portal artery & vein to central vein
- Endothelial cells
  - Large fenestrations
  - Discontinuity between adjacent cells
- Kupffer cells
  - Present within endothelium lining
  - Phagocytic derived from monocytes
  - Remove debris & cellular fragments from blood stream

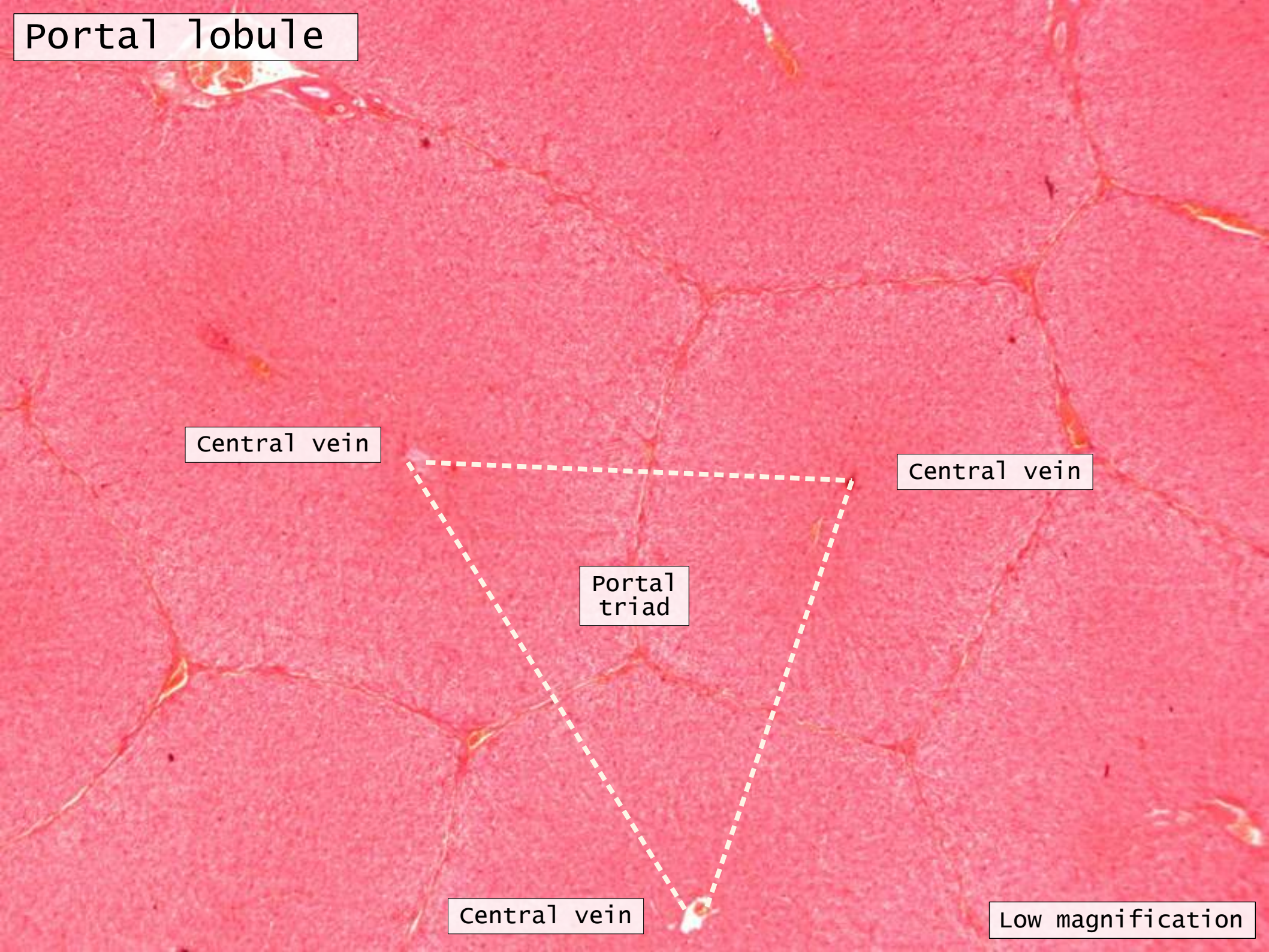

Sinusoids filled with red blood cells
Red blood cells
High magnification

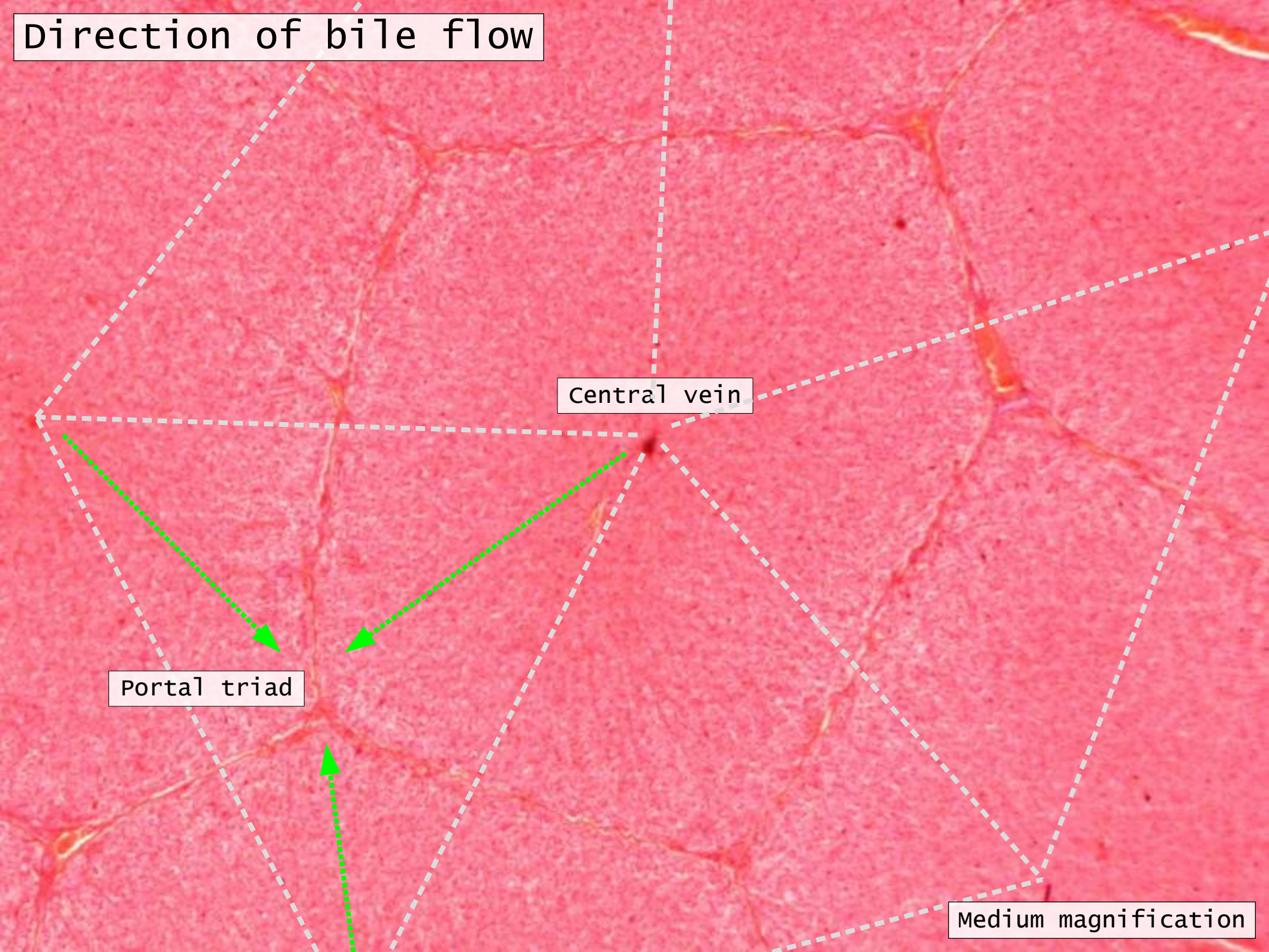
Space of Disse

- Subendothelial space
- Separate endothelium and hepatocytes
- Contains
  - Stellate fat & vit A storing cells
  - Reticular fibres
    - Maintain architecture of sinusoids
  - Nonmyelinated nerve fibres
  - Microvilli from hepatocytes
- No basal lamina
- Functions in exchange of material between hepatocytes and bloodstream
  - Hepatocytes do not contact bloodstream

Portal lobule

- Based on exocrine function -> bile flow
- Triangular area
- Corners 3 central veins
- Portal triad in centre


Portal lobule
Central vein
Central vein
Portal triad
Central vein
Low magnification


Direction of bile flow
Central vein
Portal triad
Medium magnification

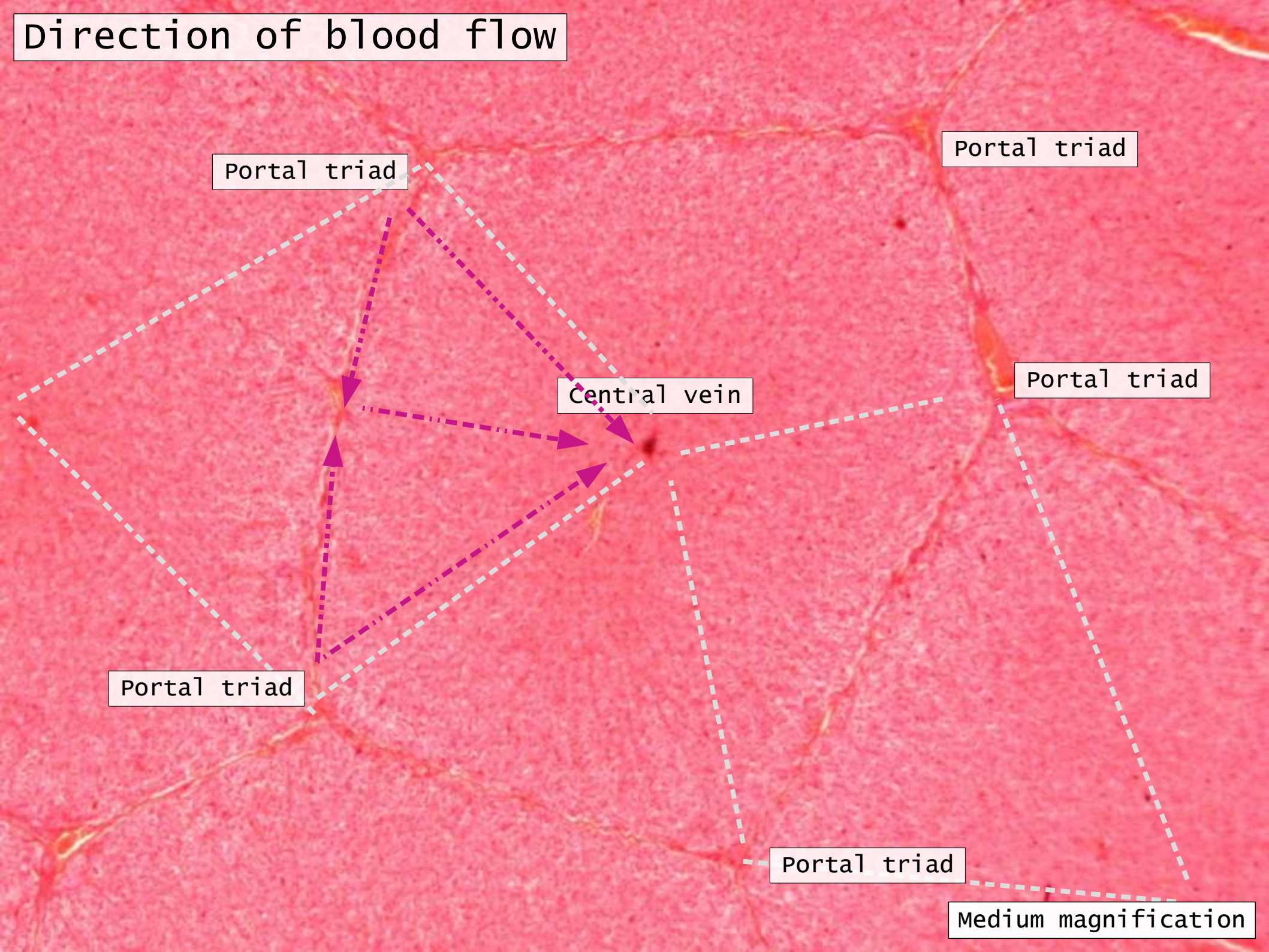
Liver acinus

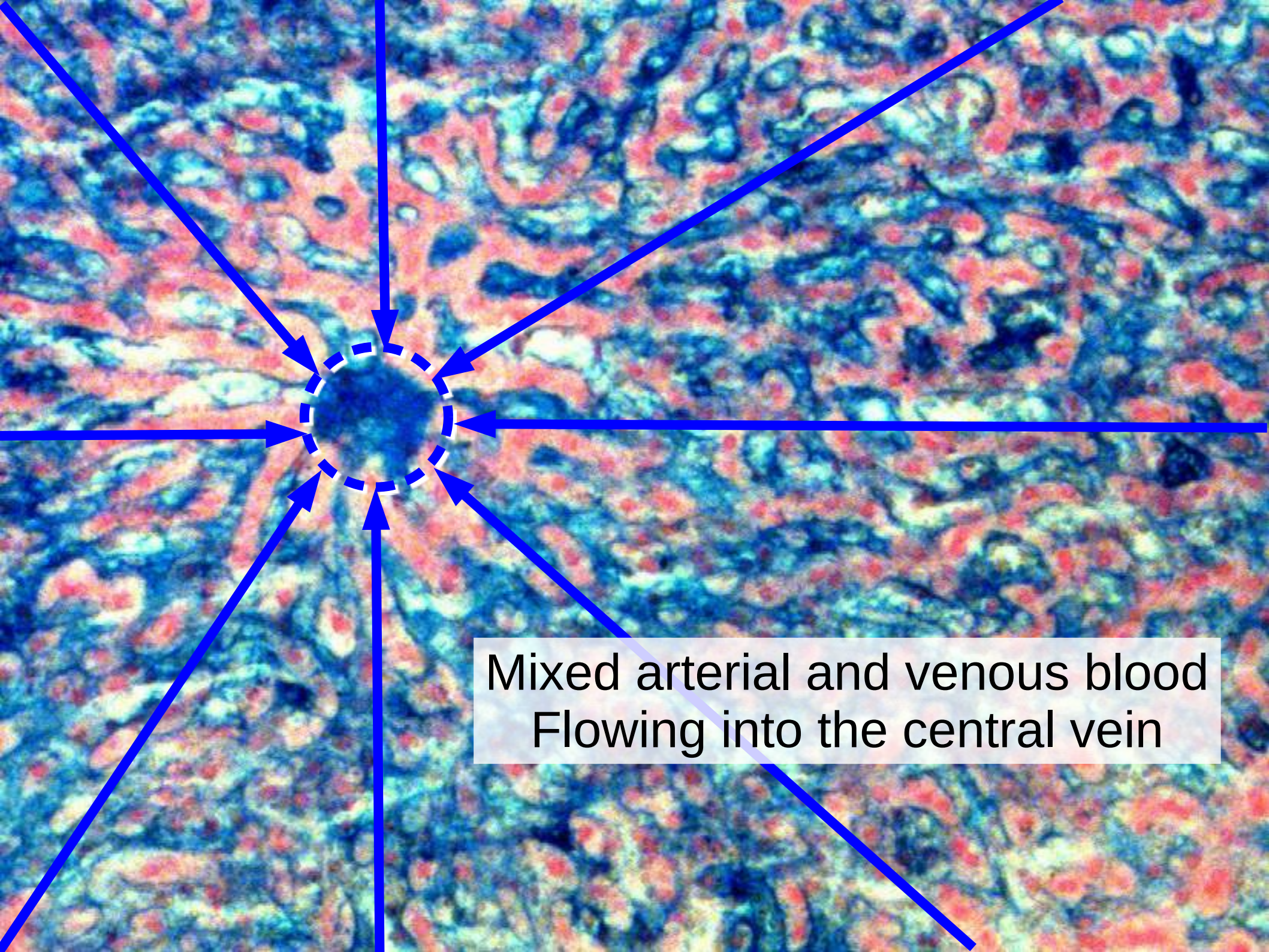
- Based on blood flow
- Diamond-shaped
- Central veins at two corners
- Portal triads at two corners
- Creates 3 zones based on blood flow
- Hepatocytes differ in exposure to entering blood based on location in the zones

3 zones

- Zone 1
  - In immediate vicinity of blood supply
- Zone 2
  - Between zones 1 & 3
- Zone 3
  - In the area of the central vein


Liver acinus
Portal triad
Central vein
Central vein
Portal triad
Central vein
Low magnification


Direction of blood flow
Portal triad
Portal triad
Central vein
Portal triad
Portal triad
Portal triad
Medium magnification


Mixed arterial and venous blood
Flowing into the central vein

Zonal necrosis

Centri-lobular

Peri-portal

Centri-lobular

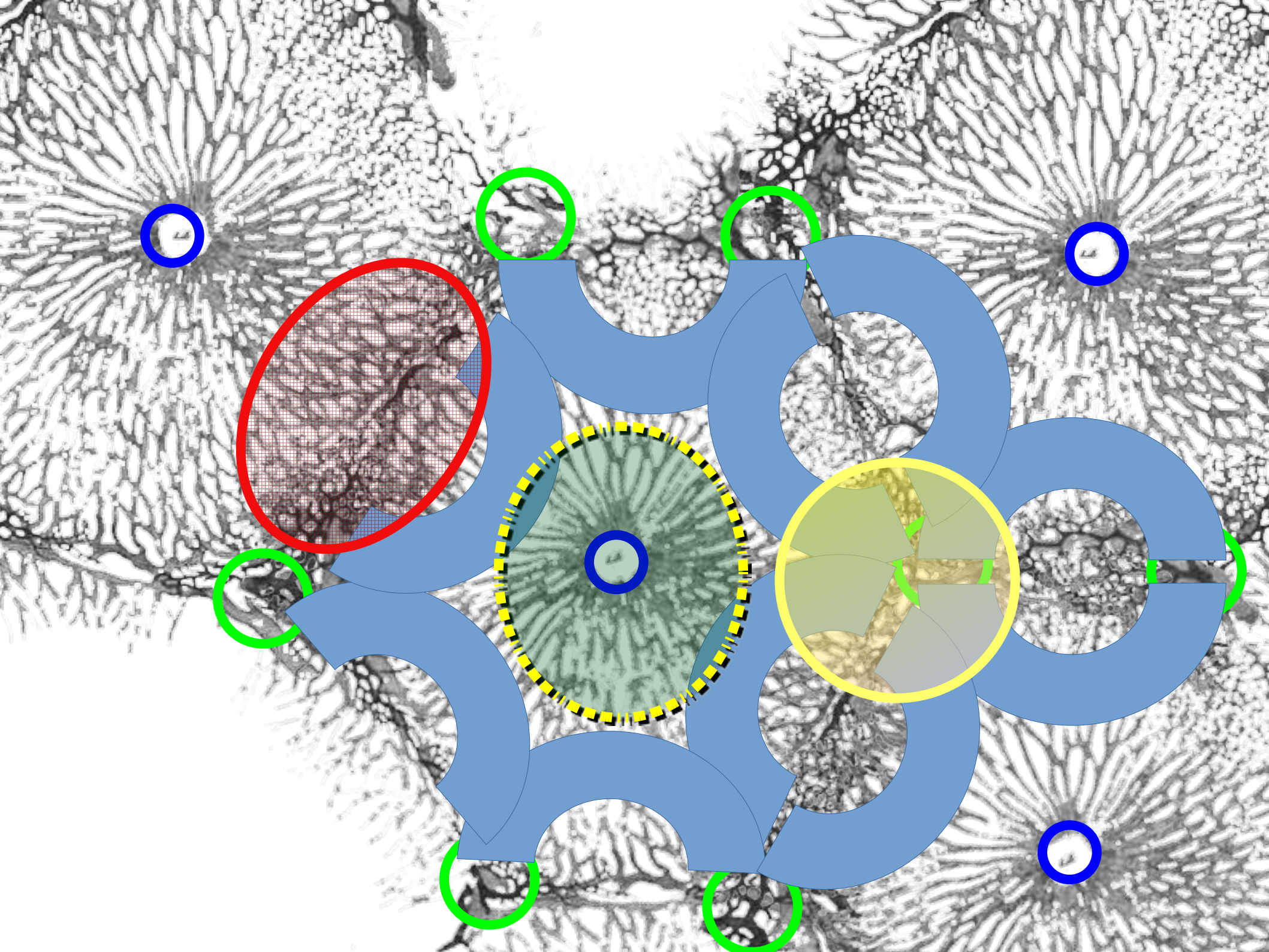
Around central vein
Acinar zone 3

Ischaemia
Drugs

Peri-portal

Around portal area
Acinar zone 1

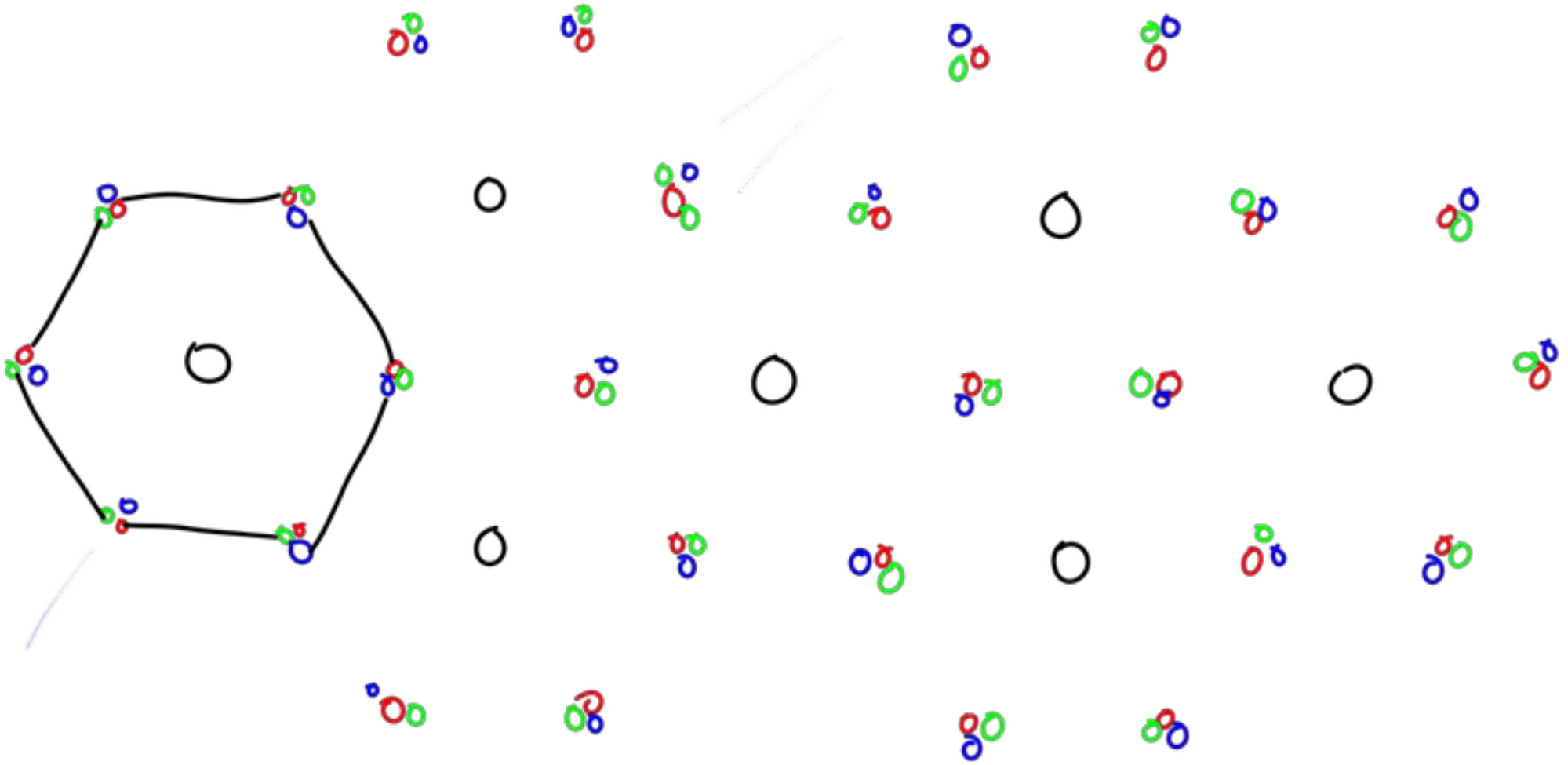
Hepatitis



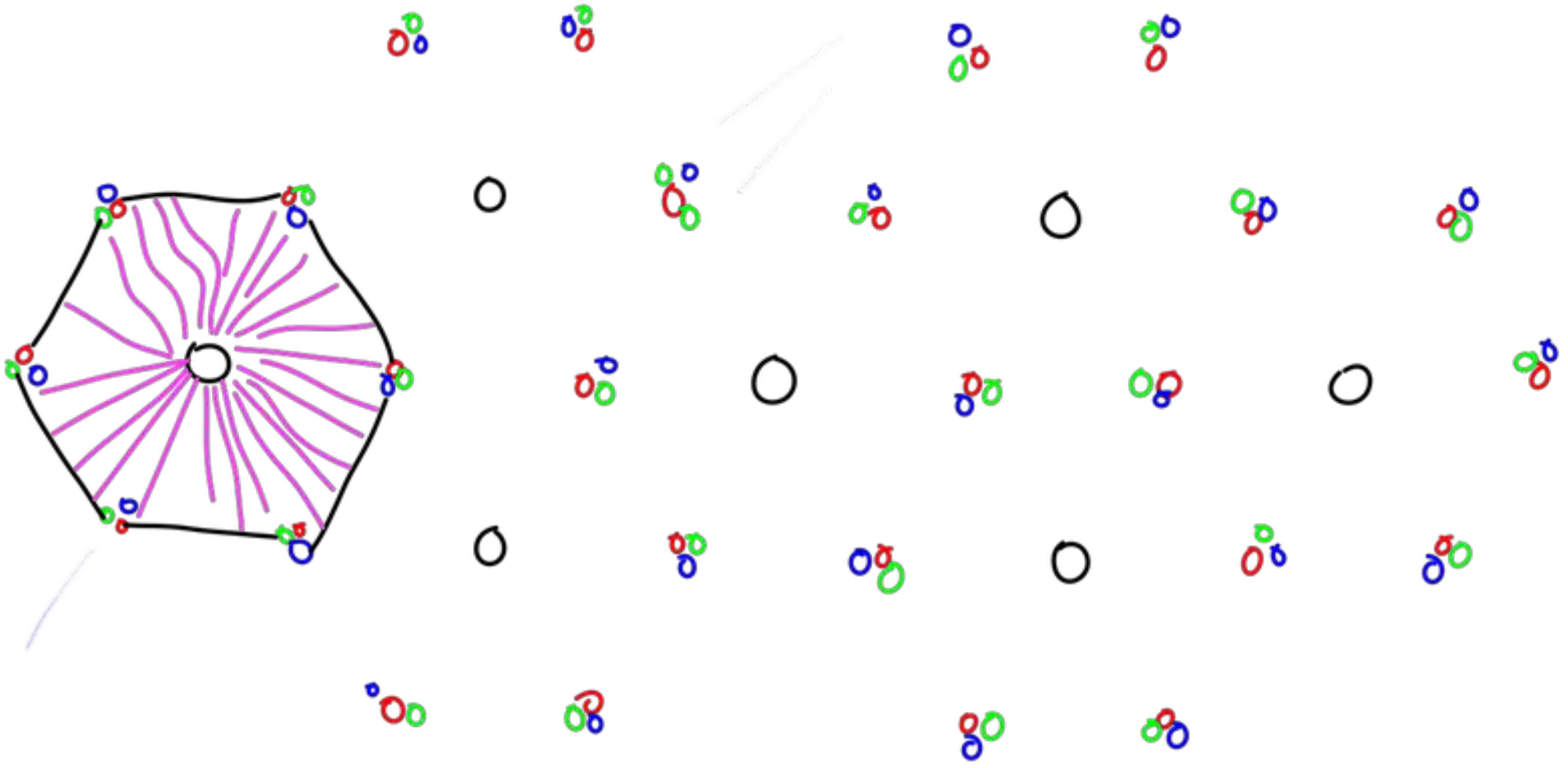
Tasks: Liver

1. Make annotated diagrams of the three alternative views of liver structure.
2. Explain the relevance of each structural unit of the liver.
3. Using the relevant structural unit, explain liver damage seen in the liver.
4. Compare and correlate the annotated diagrams with the histological view of the liver.
5. Complete the drawings for each slide in the practical workbook.

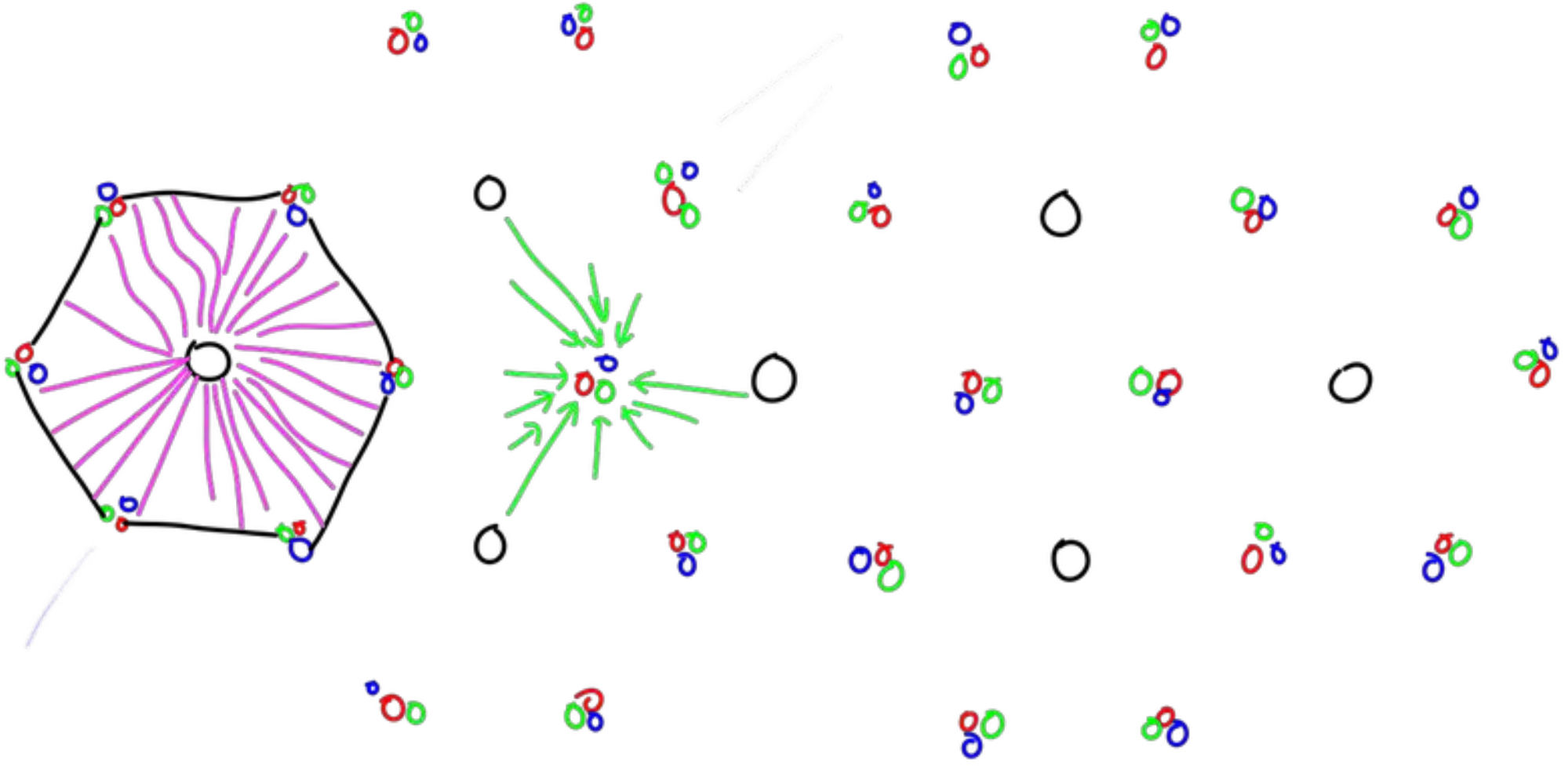
Classic lobule



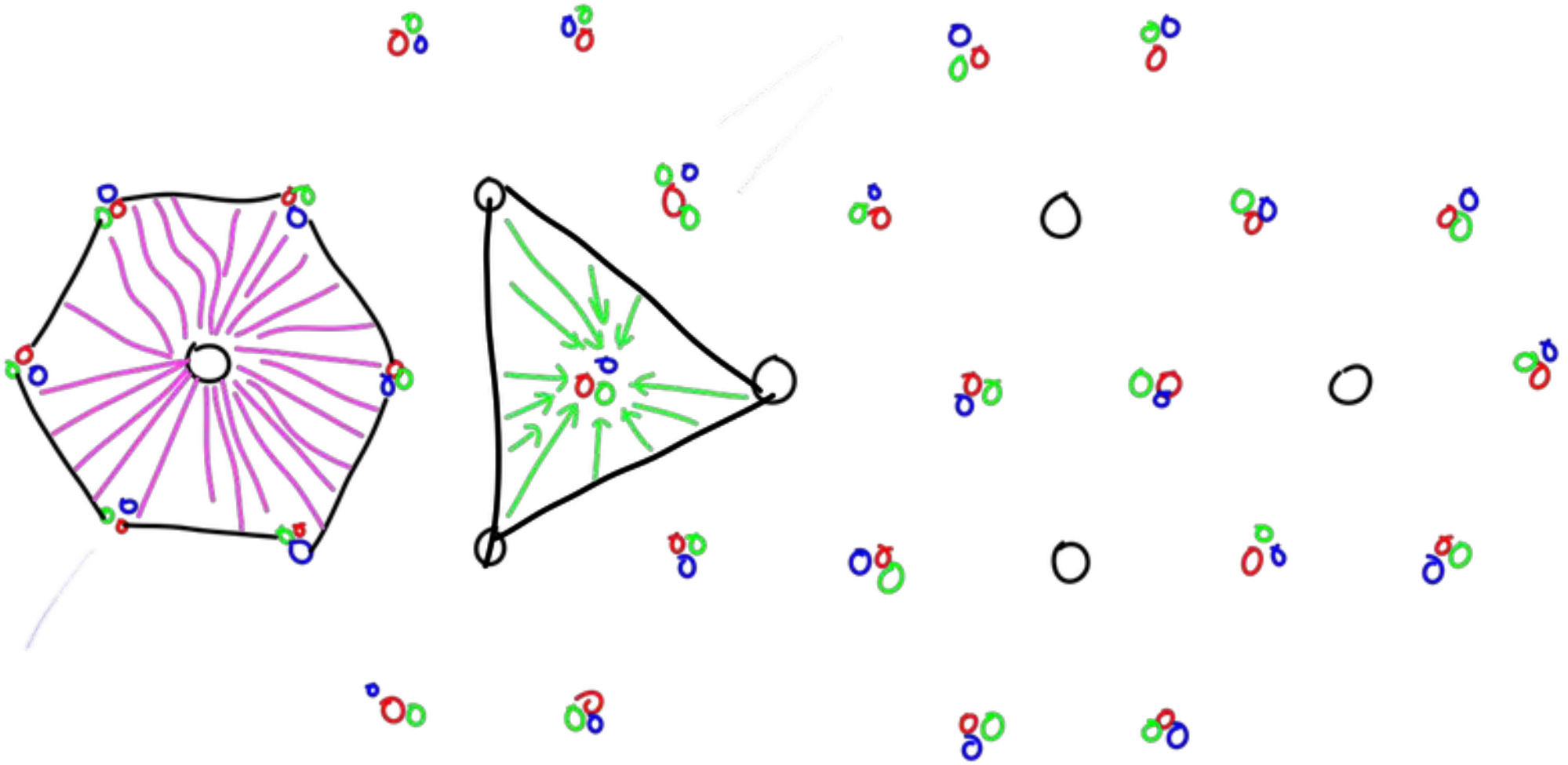
Classic lobule

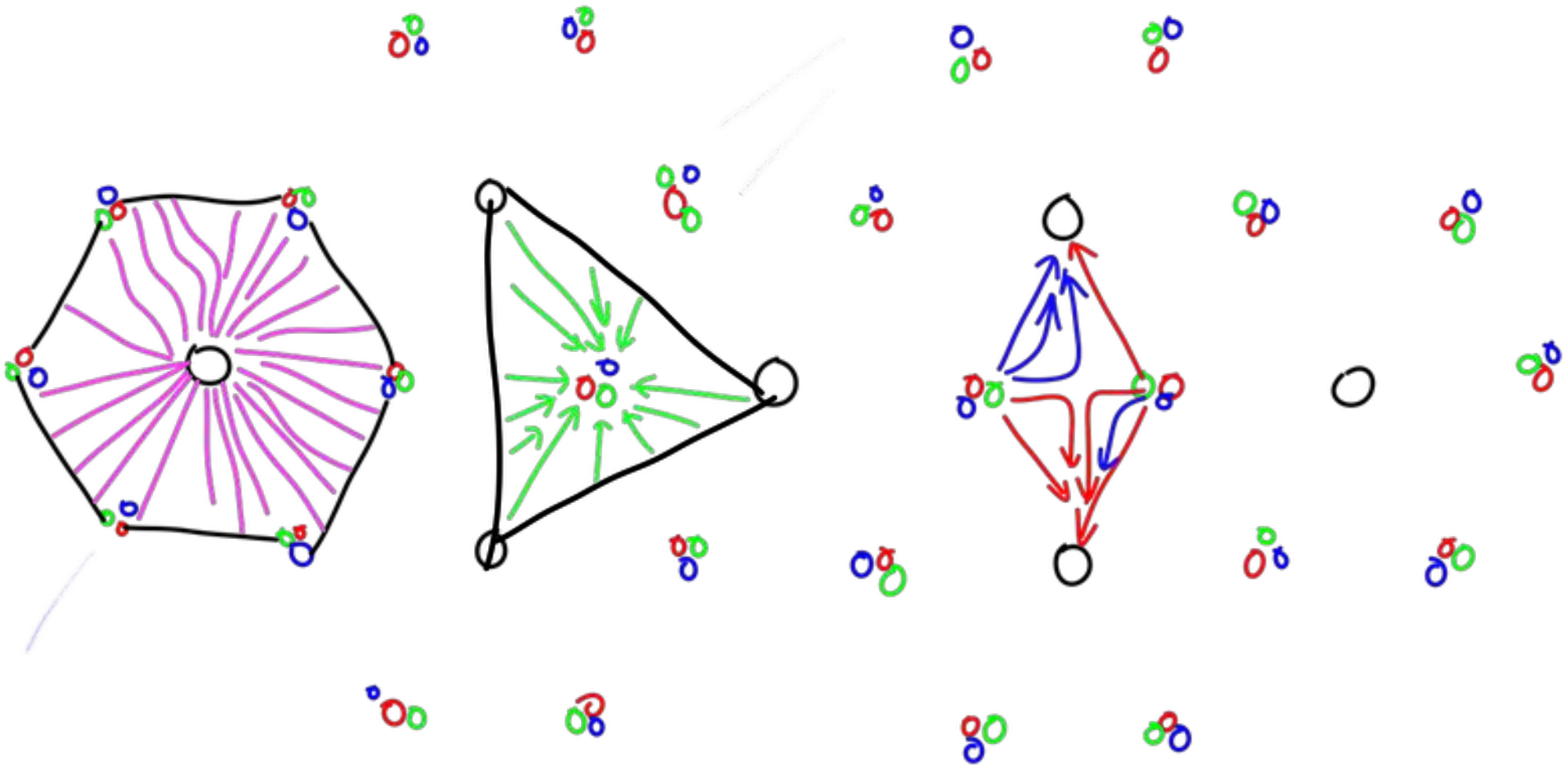


Bile – away from V centralis towards portal triad

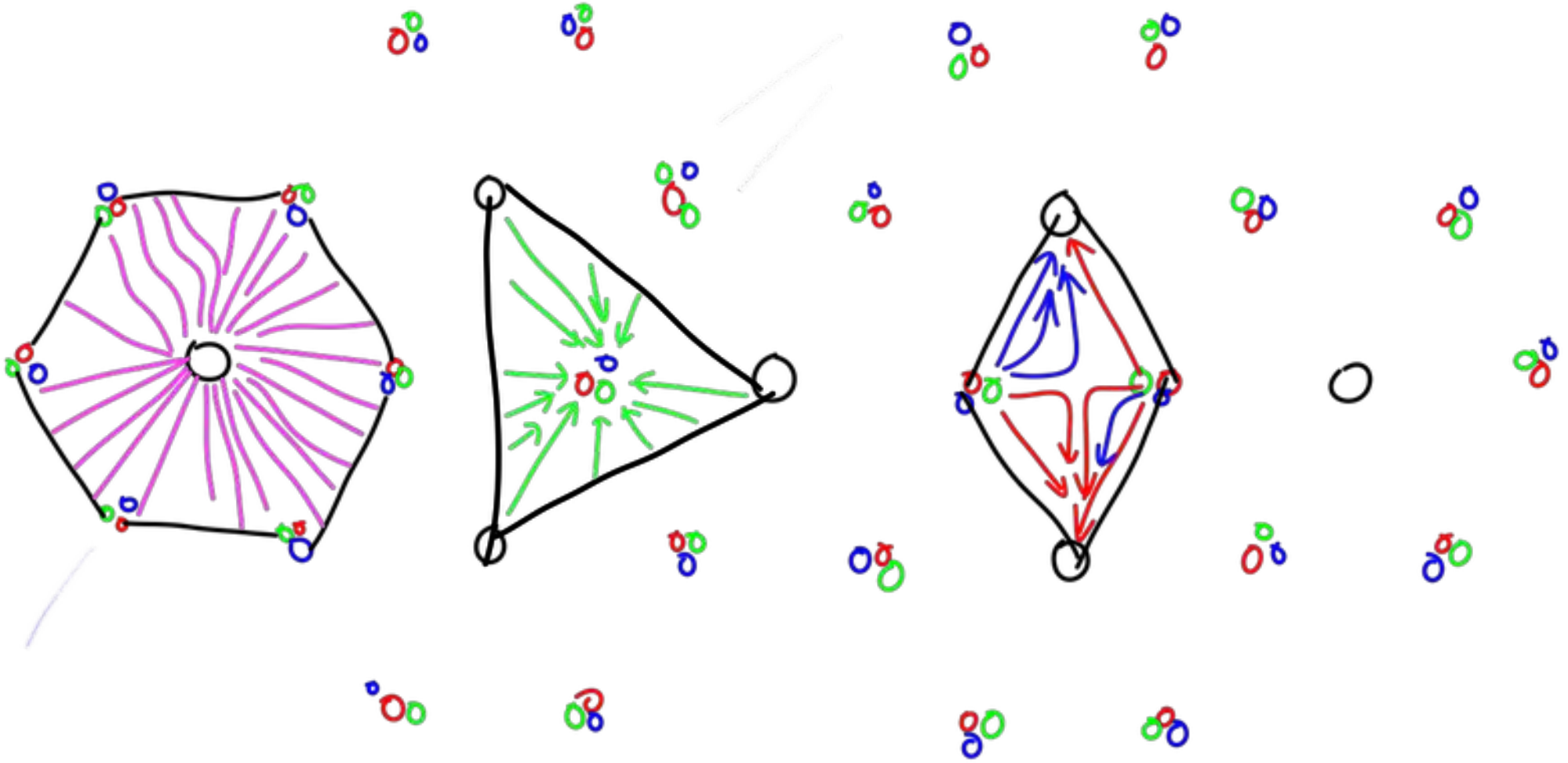


Portal lobule

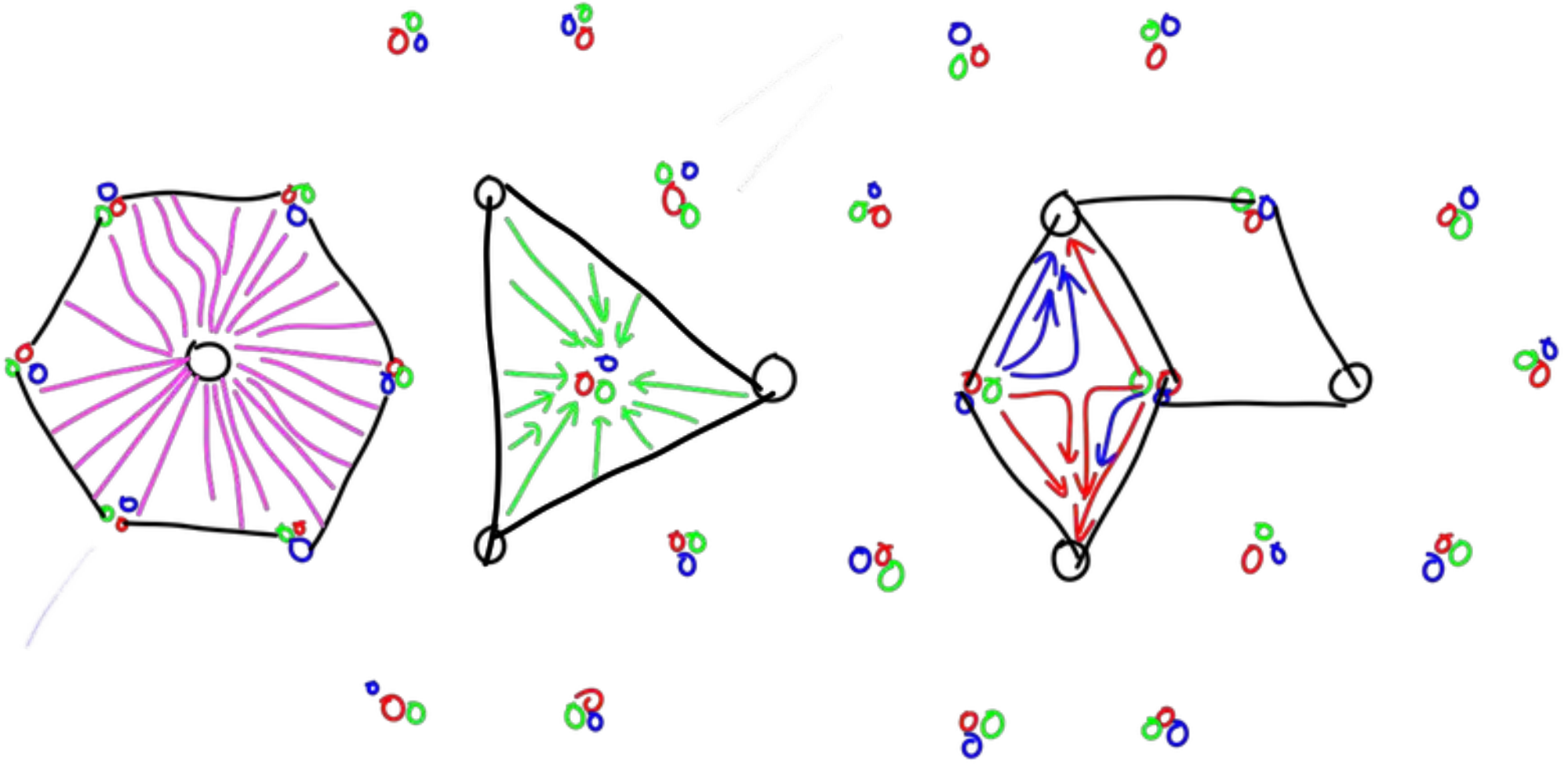




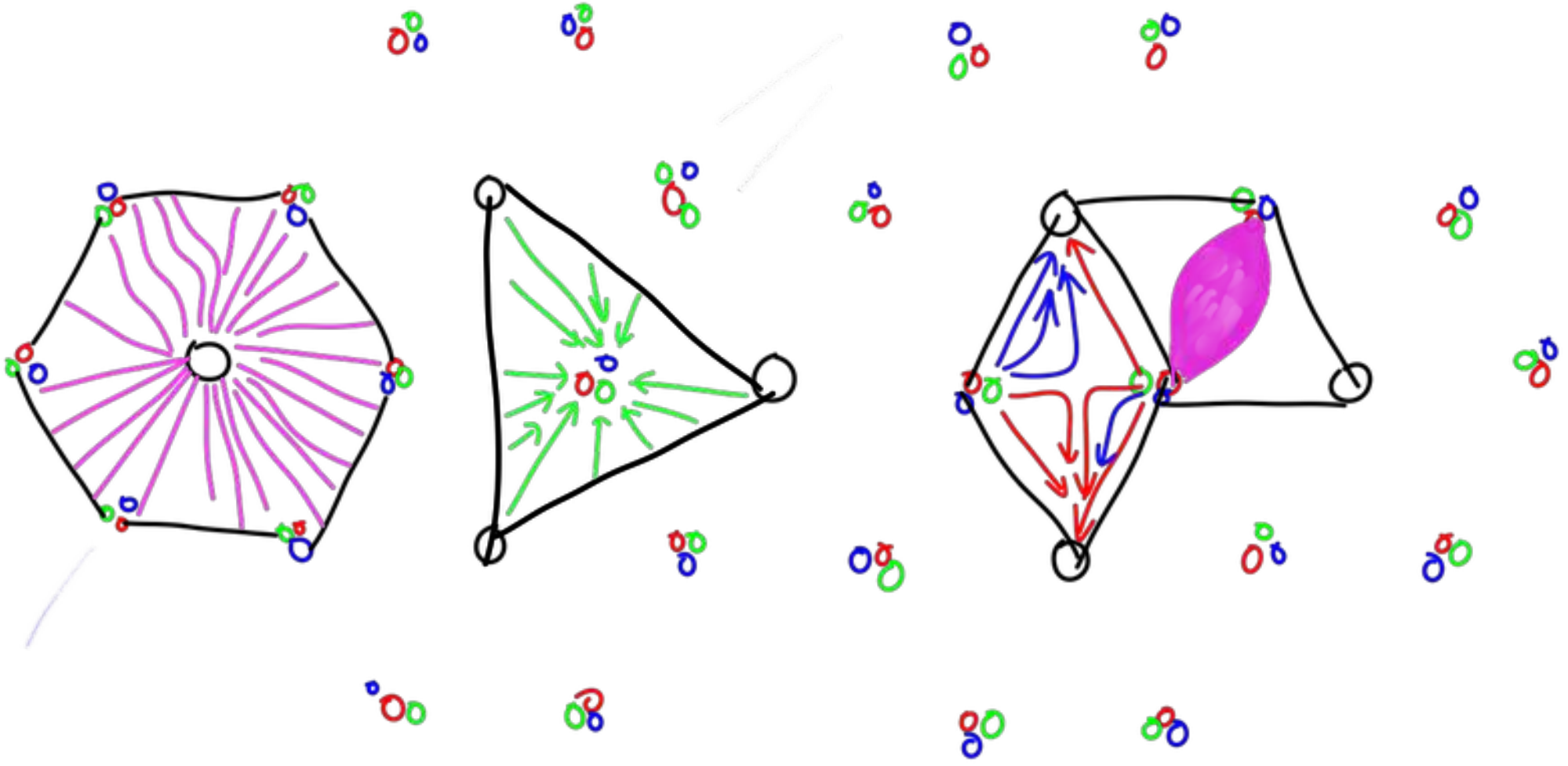
Acinus



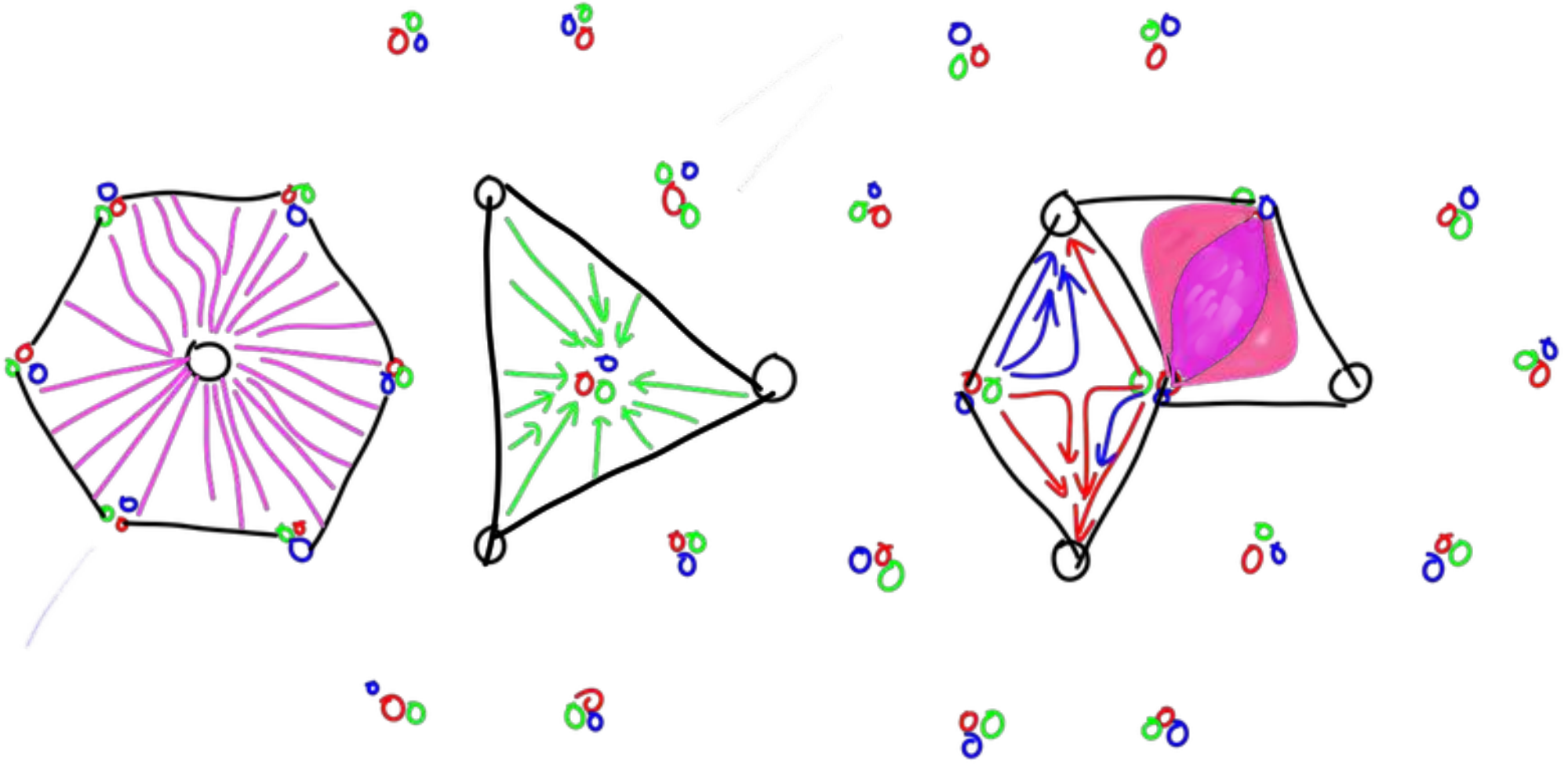
And another acinus



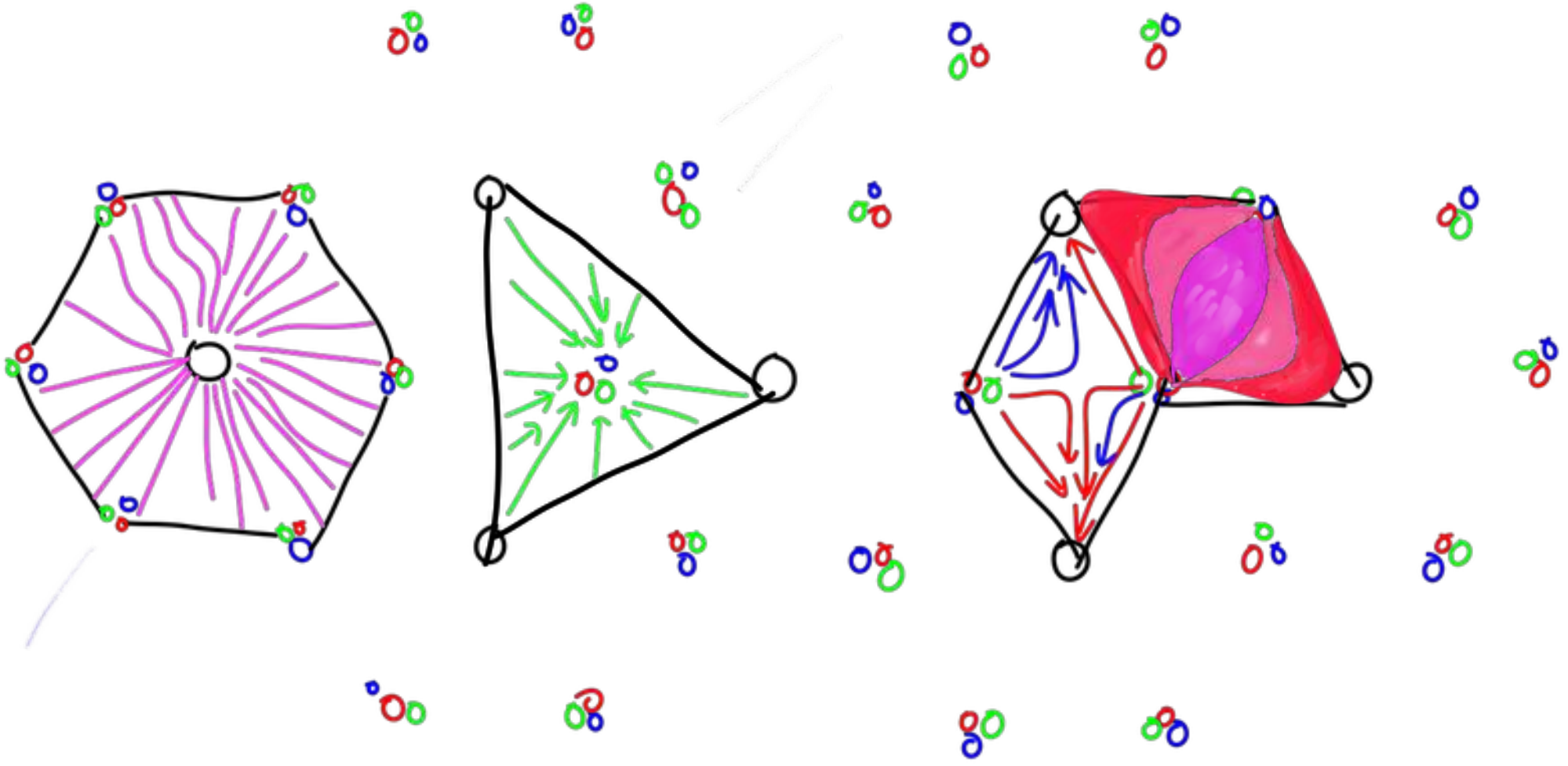
Zone 1



Zone 2



Zone 3



Liver

Five tasks

Liver task 1

1. Label two diagrams.
2. Give the definition of each labelled structure.

Liver task 2

Draw diagram of:

Classic lobule
Portal lobule
Liver acinus

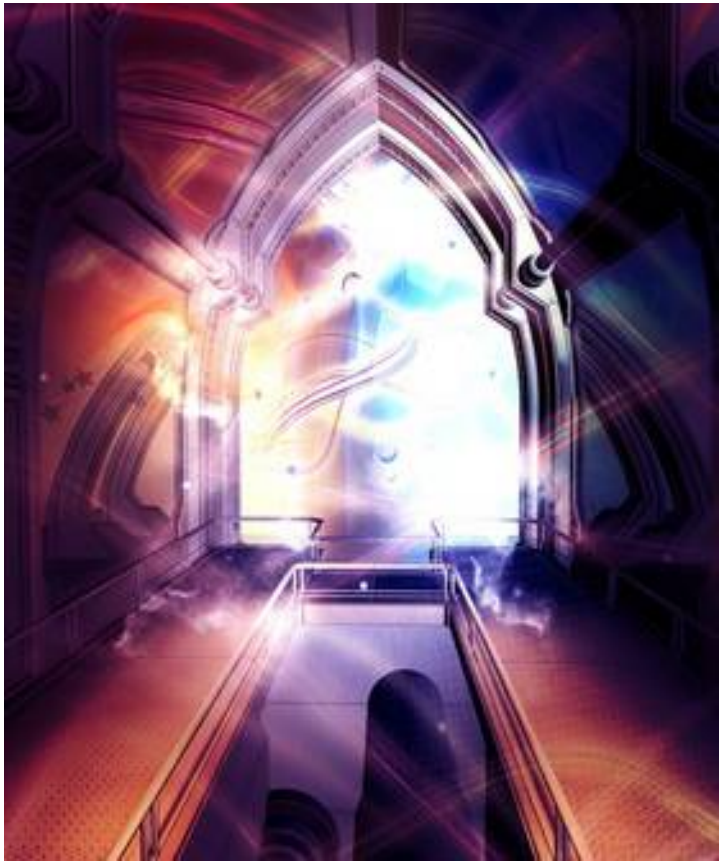
On diagram 3

Liver

- Classic lobule

Liver

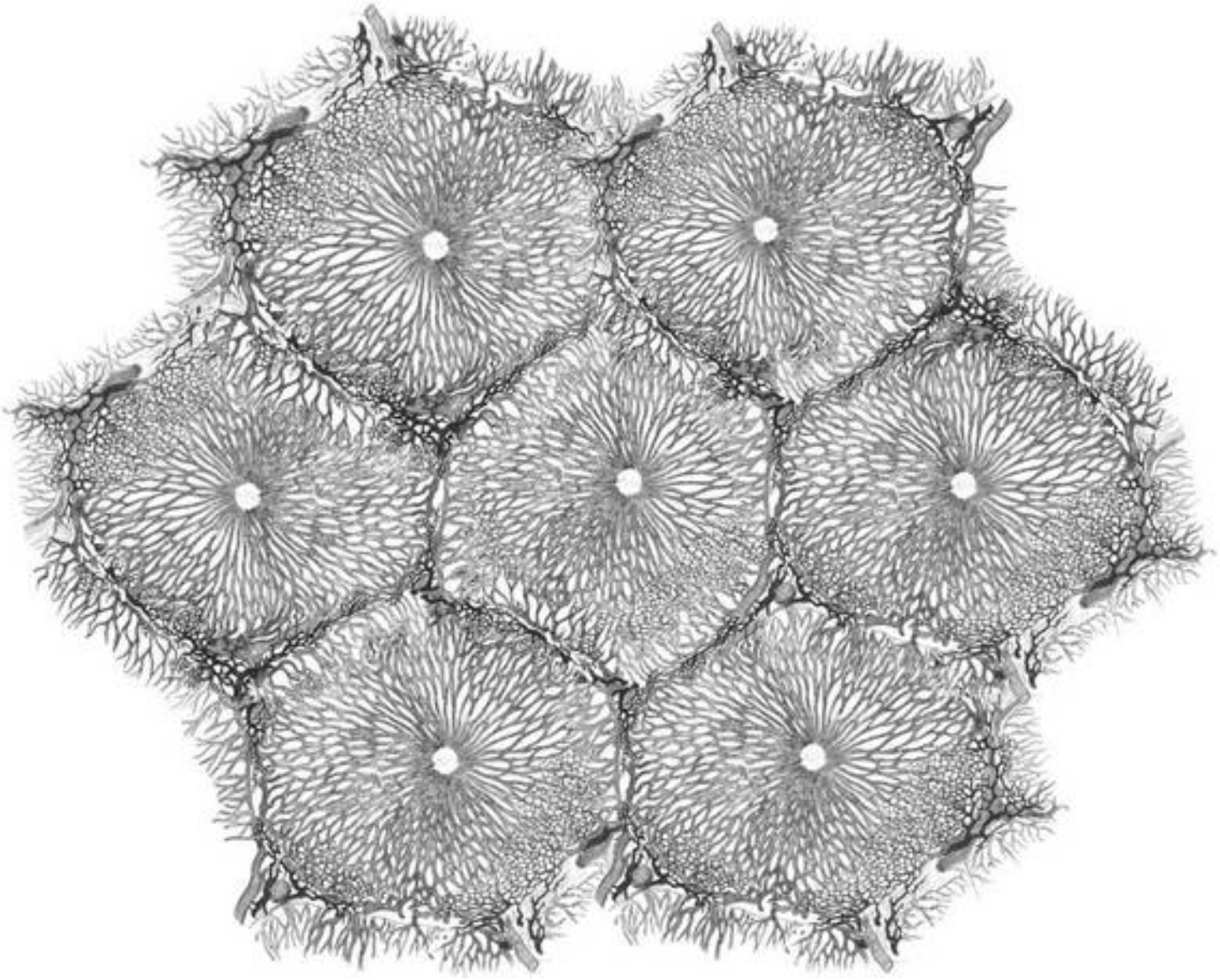
- Portal lobule



Liver

- Liver acinus

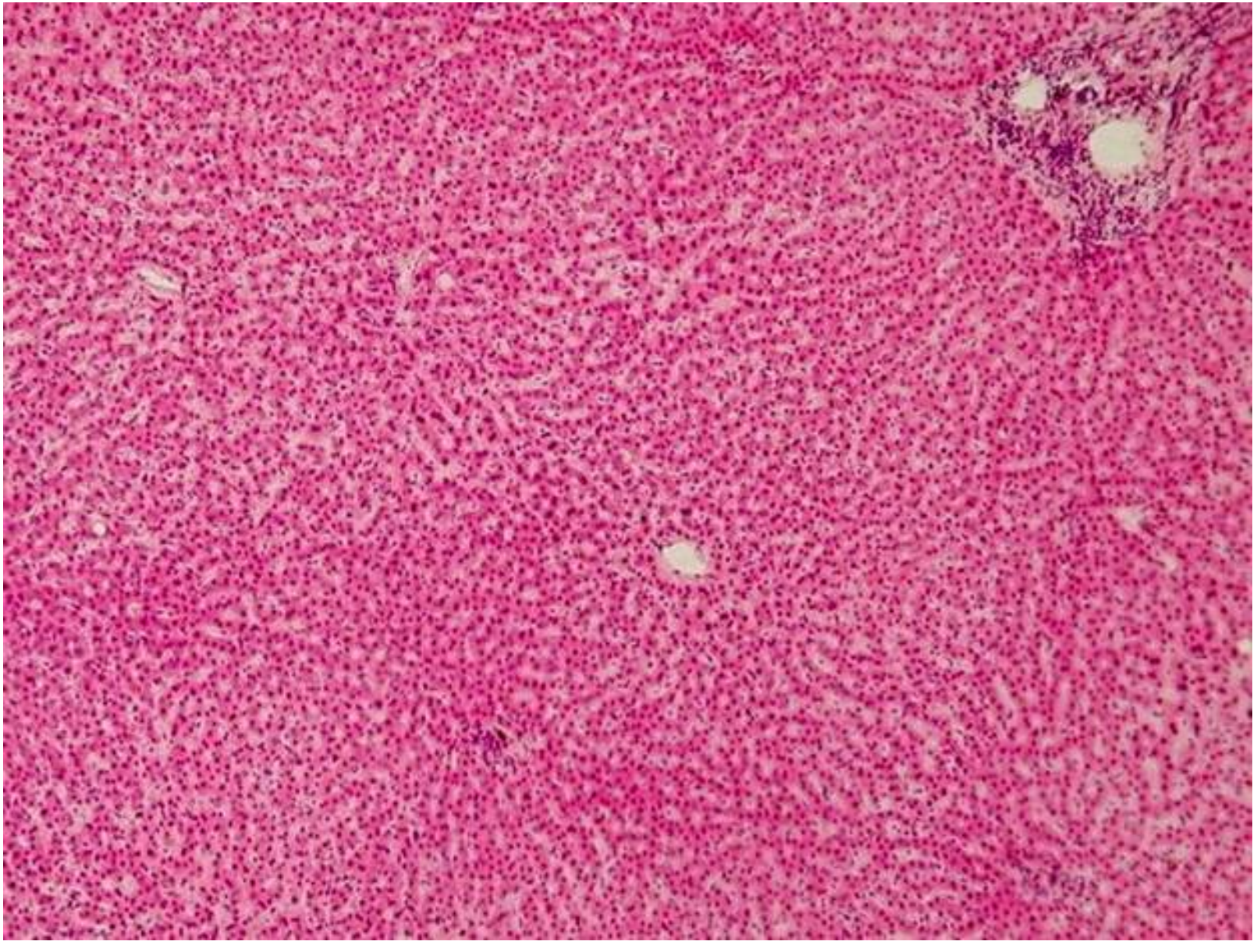
Diagram 3



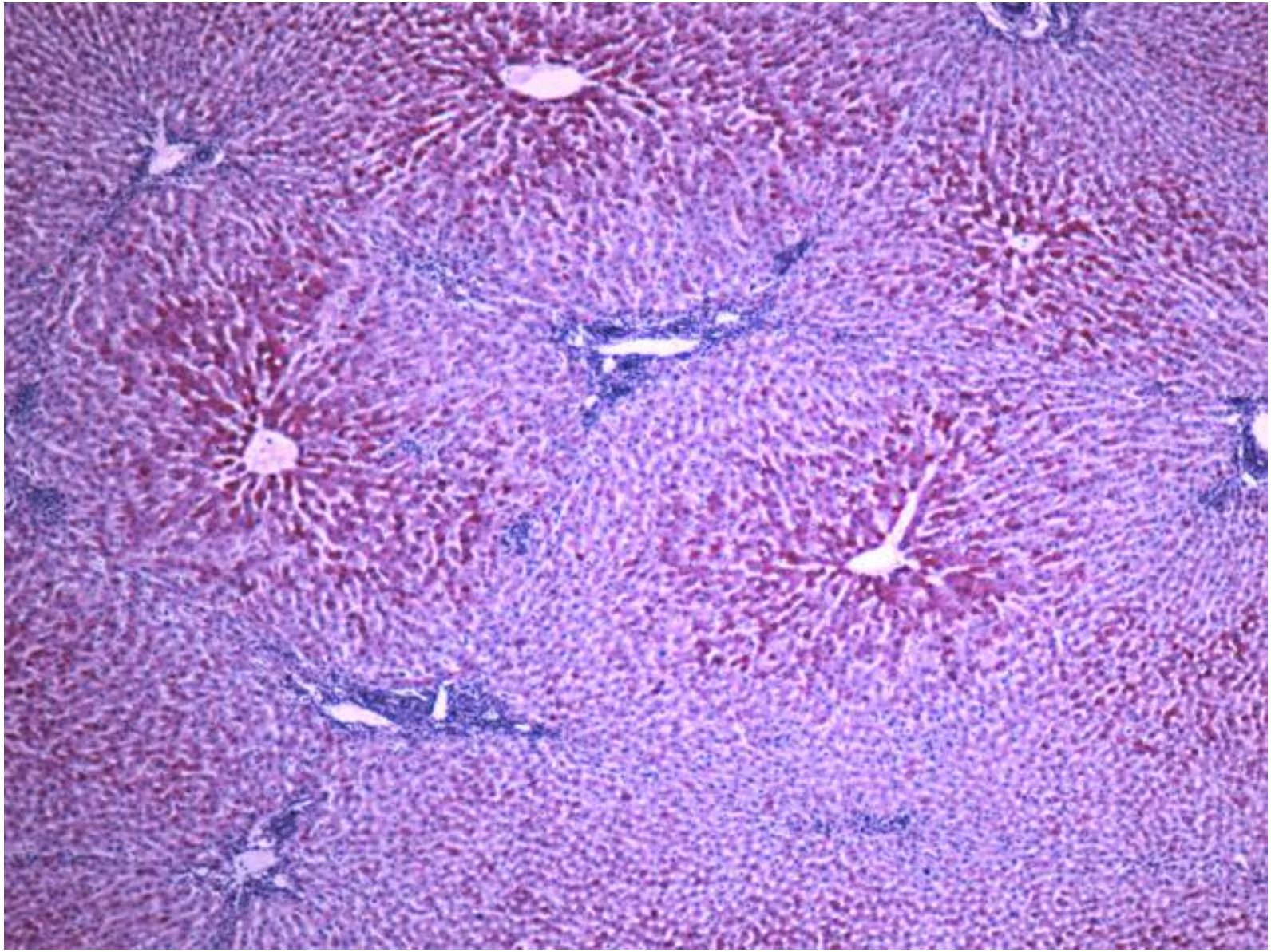
Liver task 3

Annotate 2 liver slides

slide 1



Or slide 2



Liver task 4

Cross-correlate

Diagrams
Slide

You decide how

Cross-correlate

What part of the drawing correspond to which part of the slide?

Task 5

Describe how we get from normal healthy liver to fibrosis/cirrhosis Via obesity.

Cells and tissues involved.

Hepatic Portal System

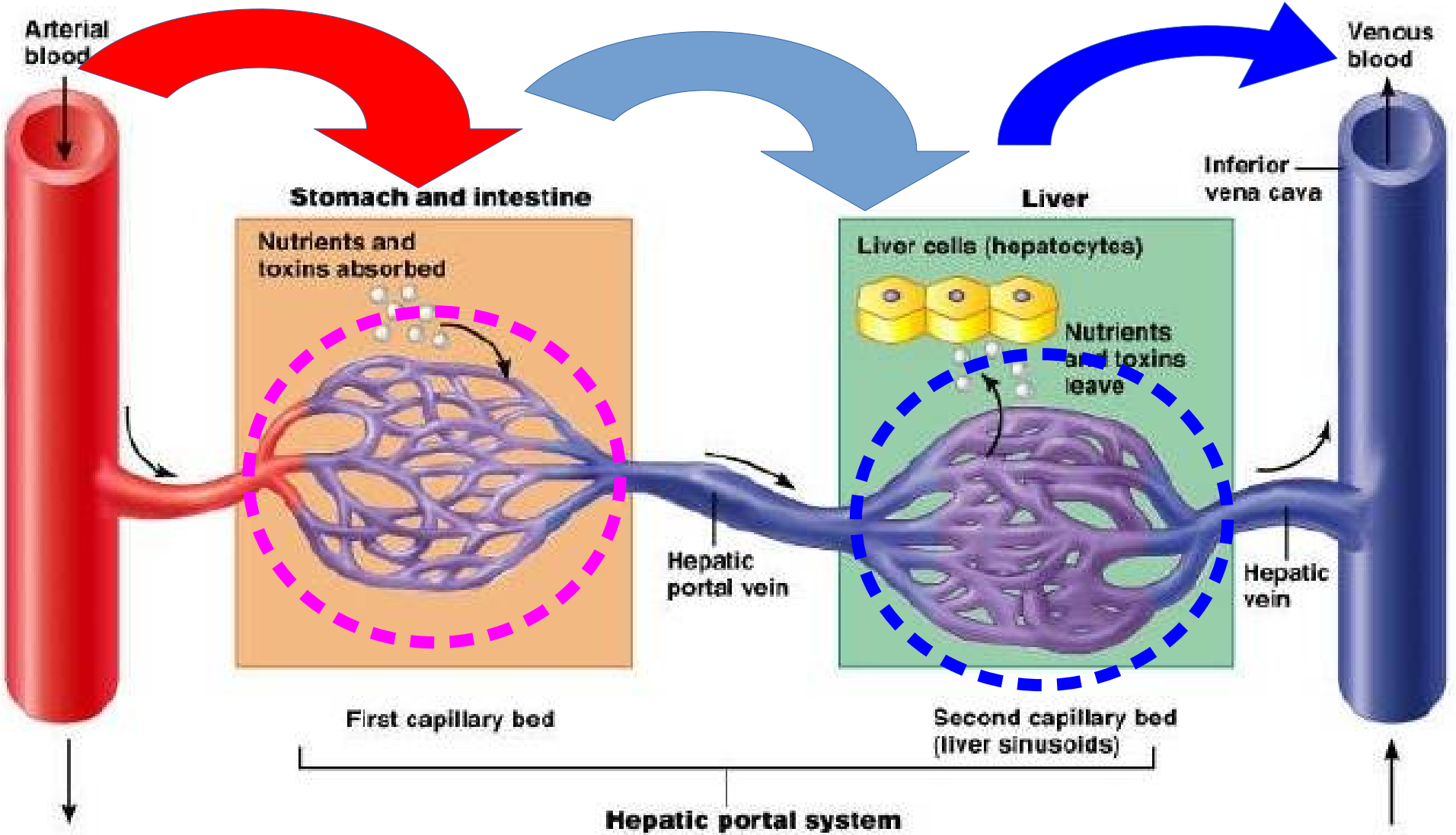
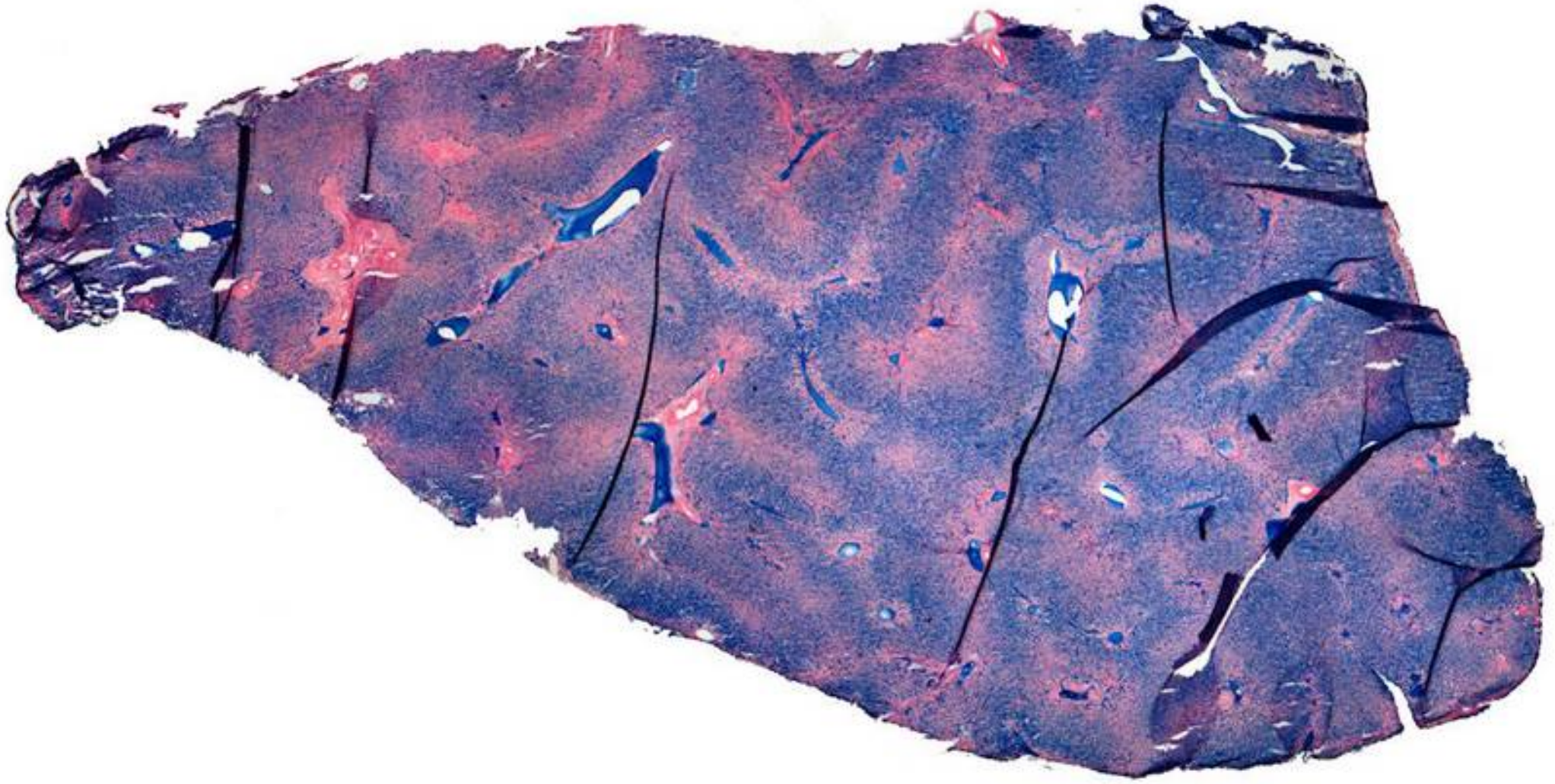


Figure 19.22

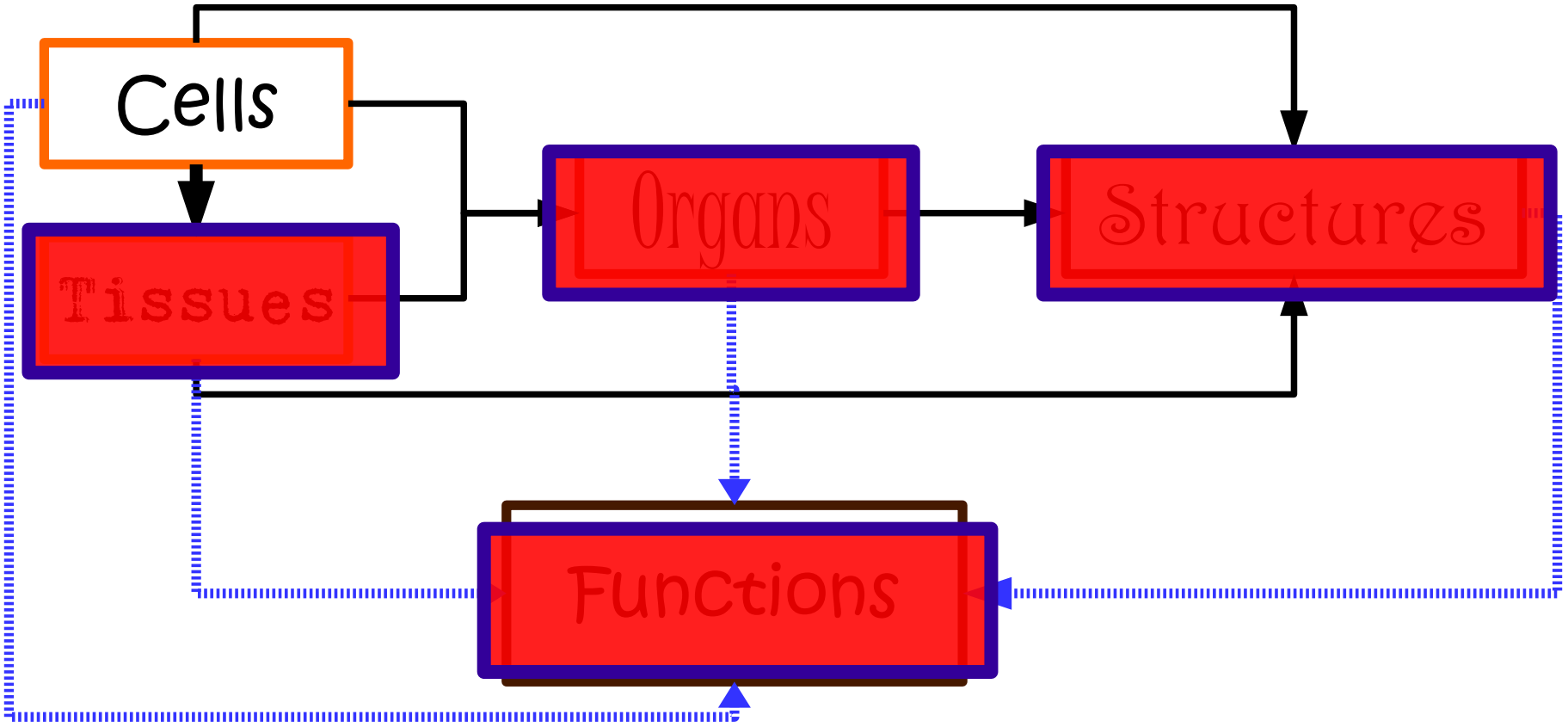
Identify the **STUFF** on the slide.



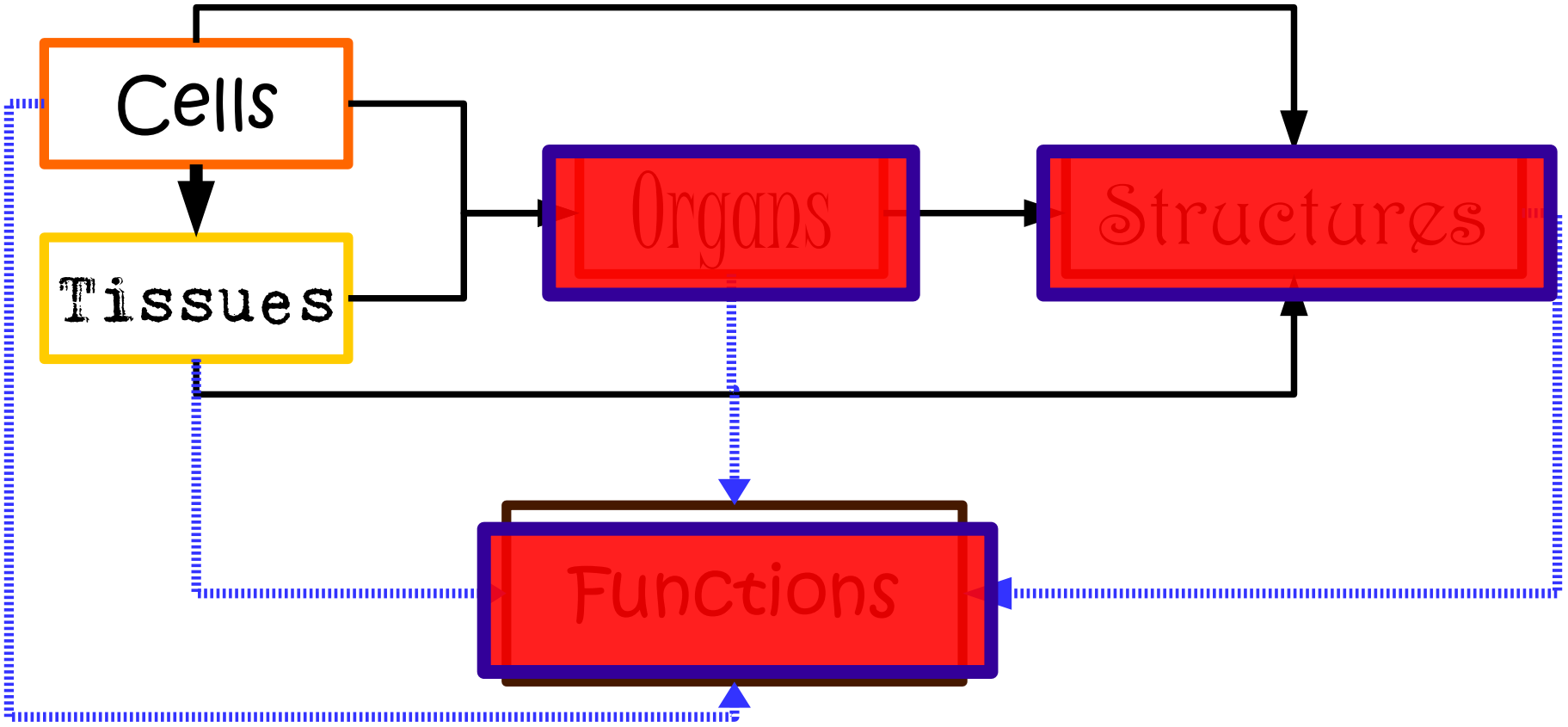
Cells + Tissues
make
.
v
Organs
which contains
.
v
Structures

What stuff could there be?

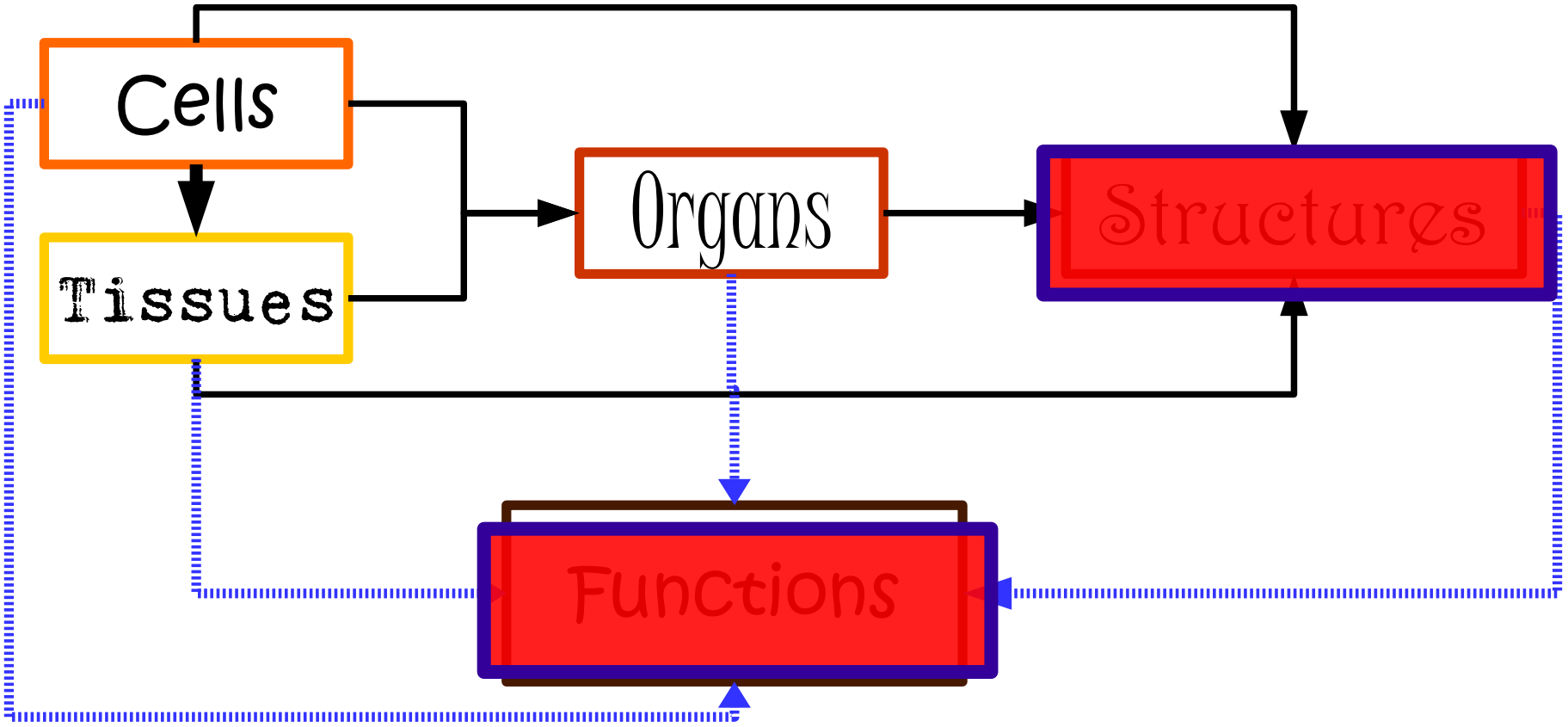
What stuff could there be?



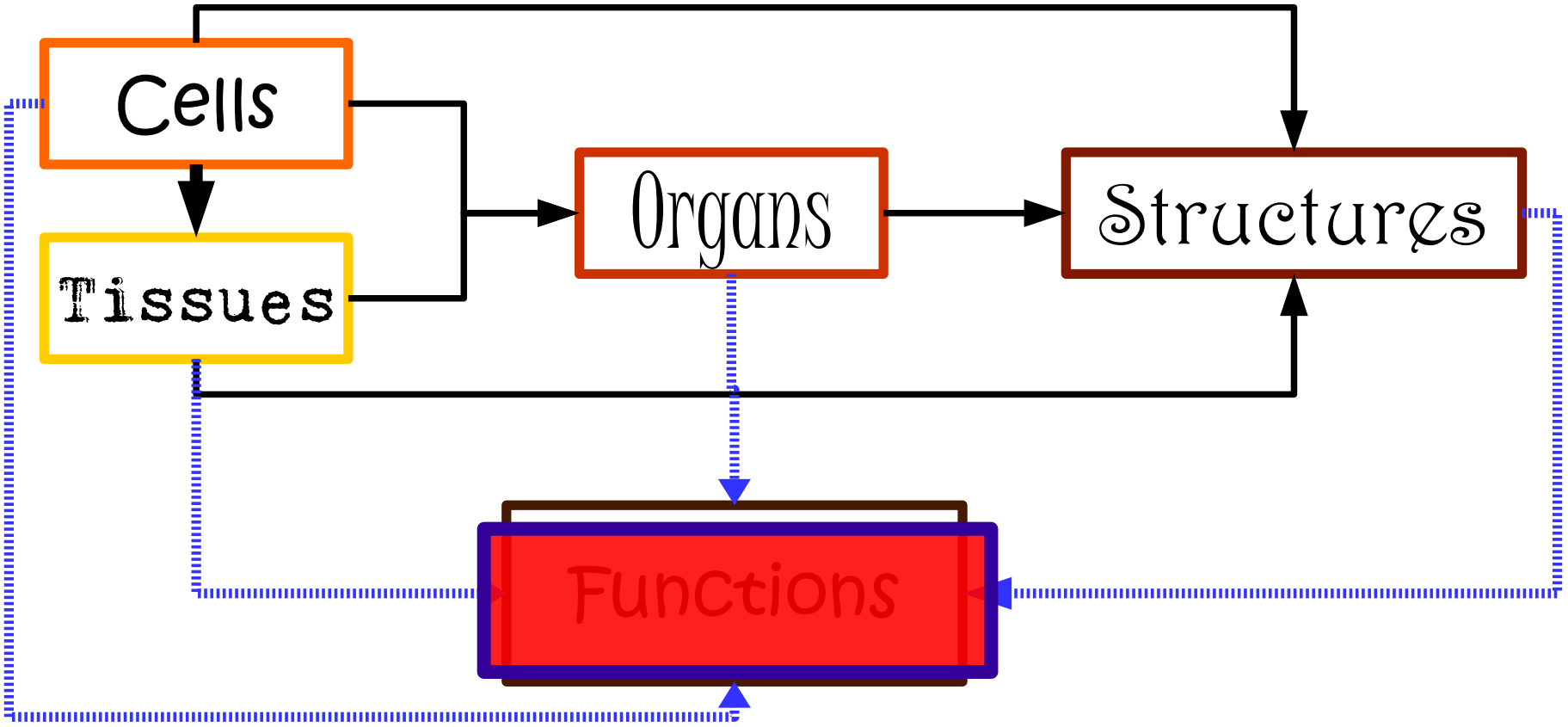
What stuff could there be?



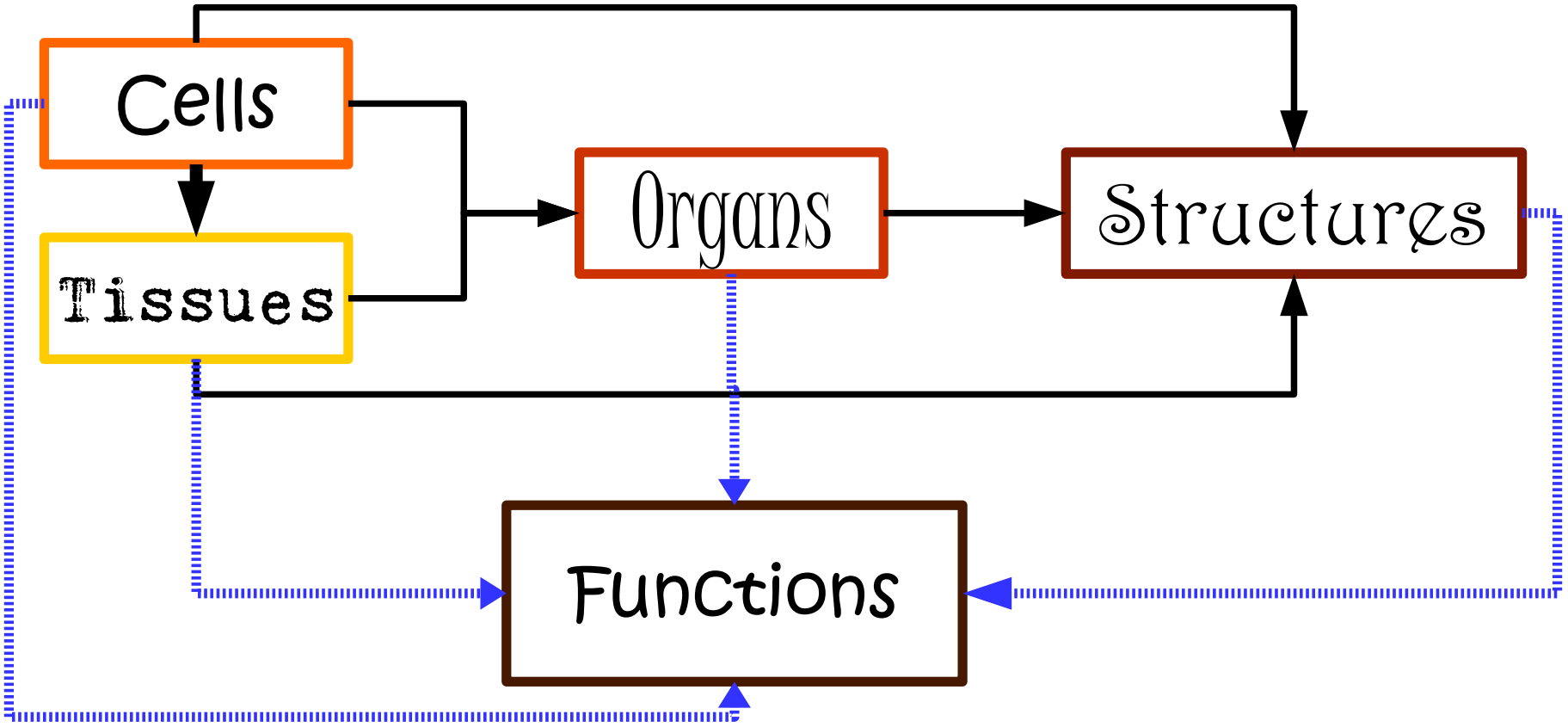
What stuff could there be?



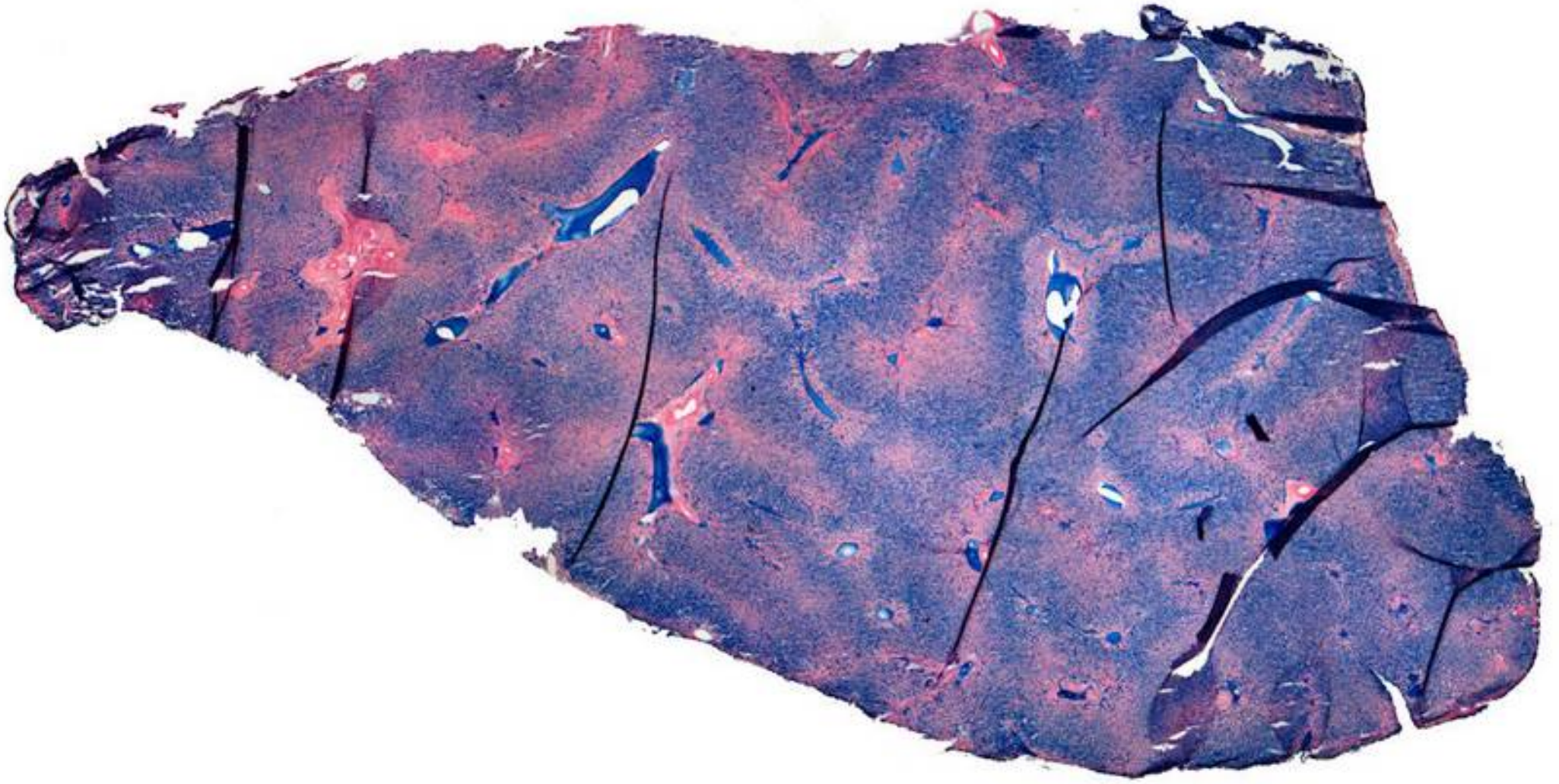
What stuff could there be?



What stuff could there be?



Making sense of this



Liver Structure

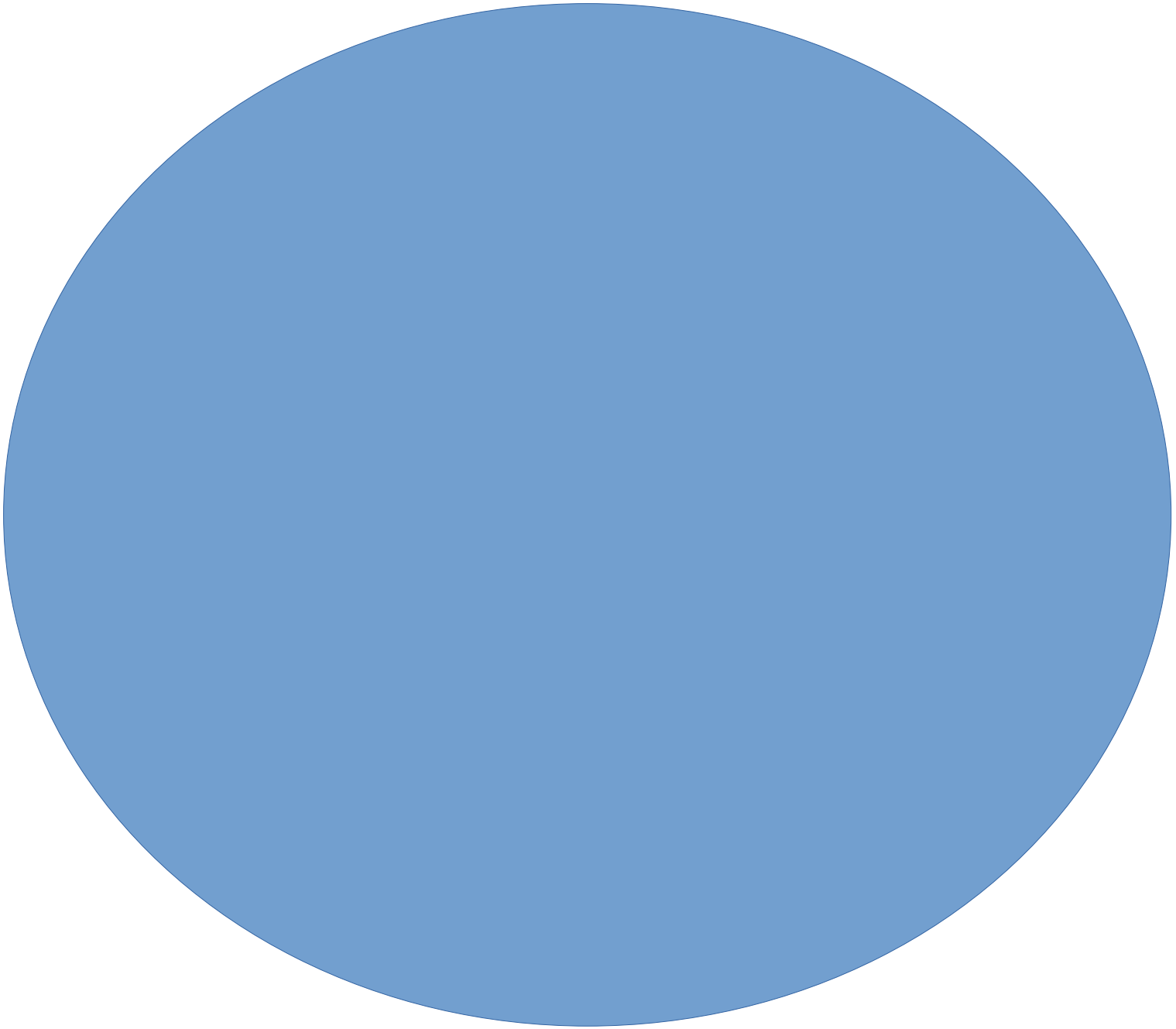
3 Views

Histology

What do we know about the liver?

Think in general

Dissection?



What do we know?

Stuff in

Stuff out

What stuff goes in and out?

What do we know?

Blood in
Arterial + Venous

Blood out
Venous

Bile out

What do we know?

Blood in

From where – Arterial - heart

From where – Venous - GIT

Blood out

Where to – Venous - heart

Where to - Bile out – gall bladder

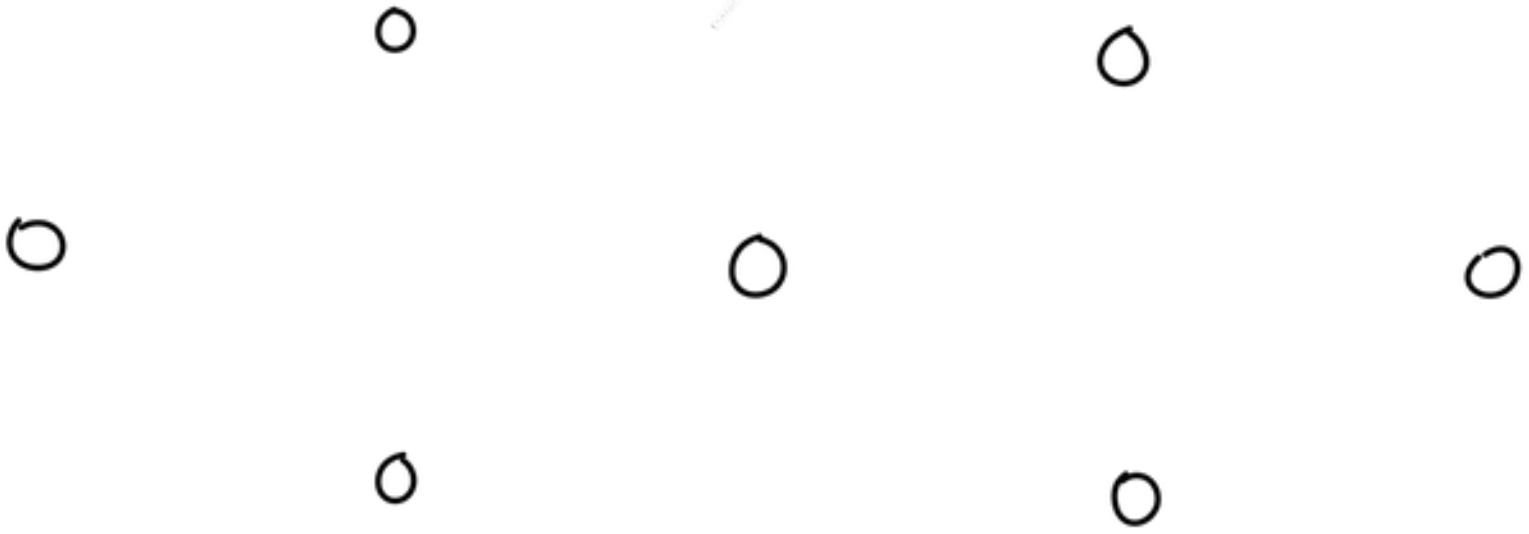
Compare

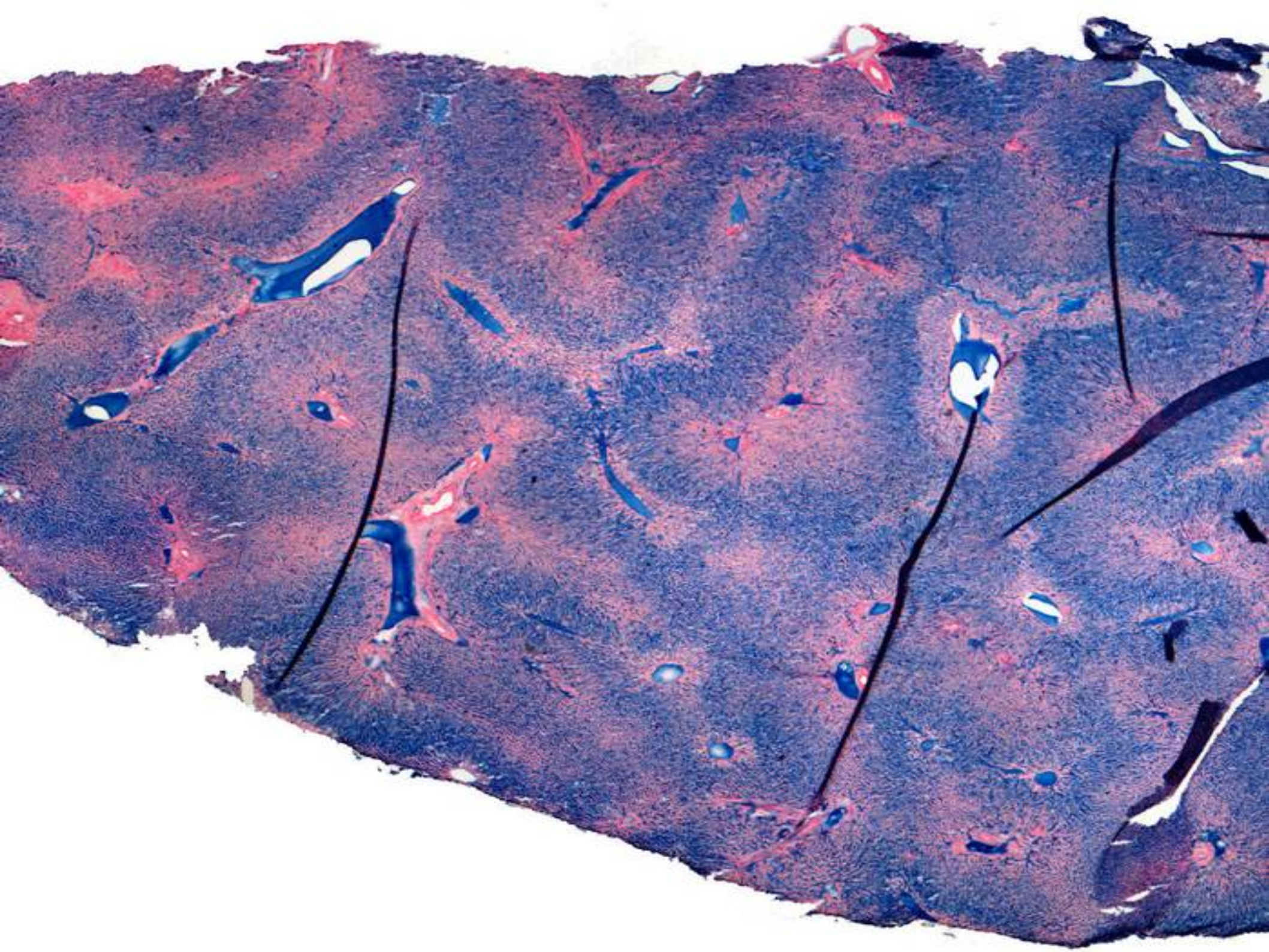
Theoretical view

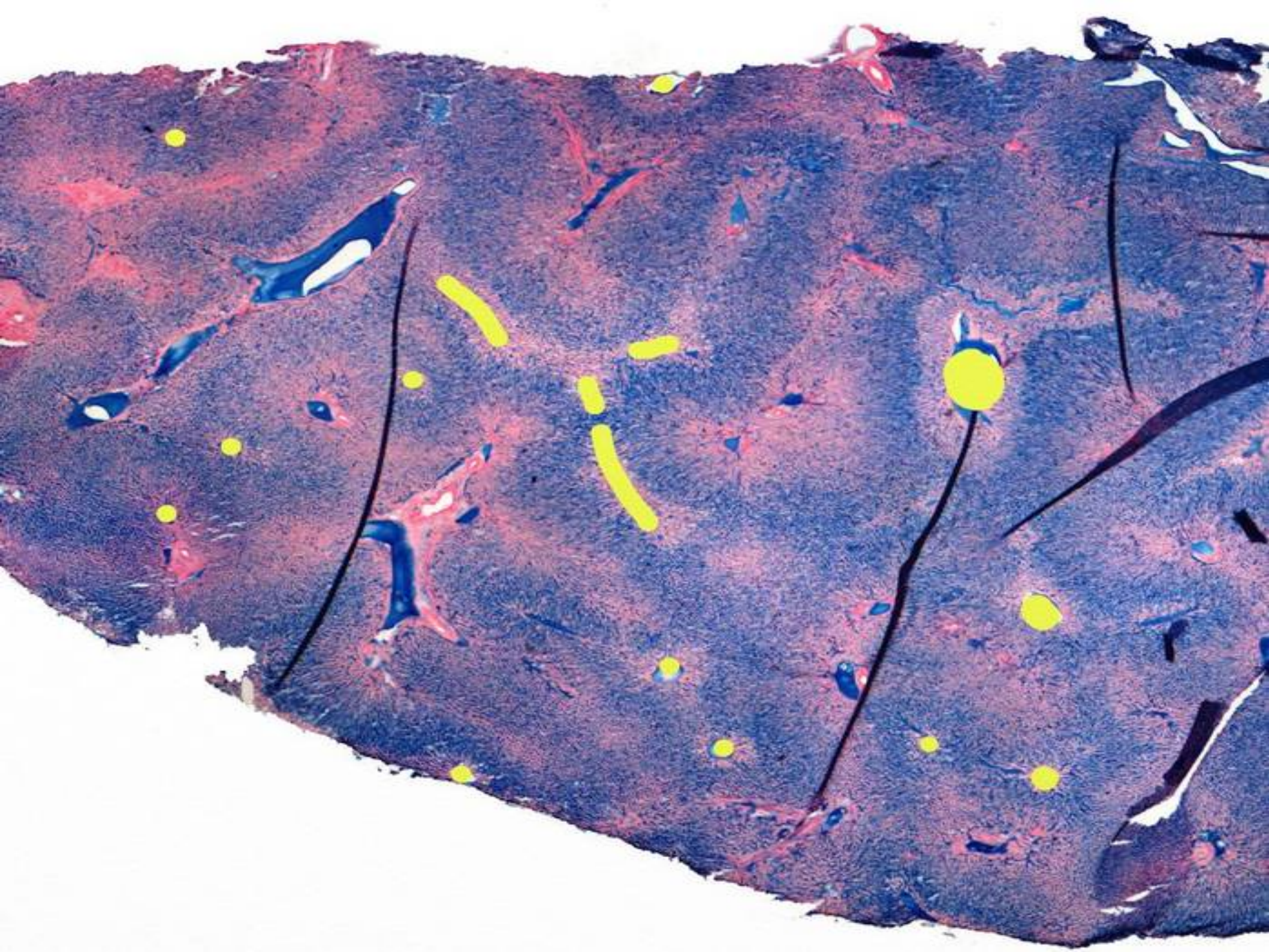
and related

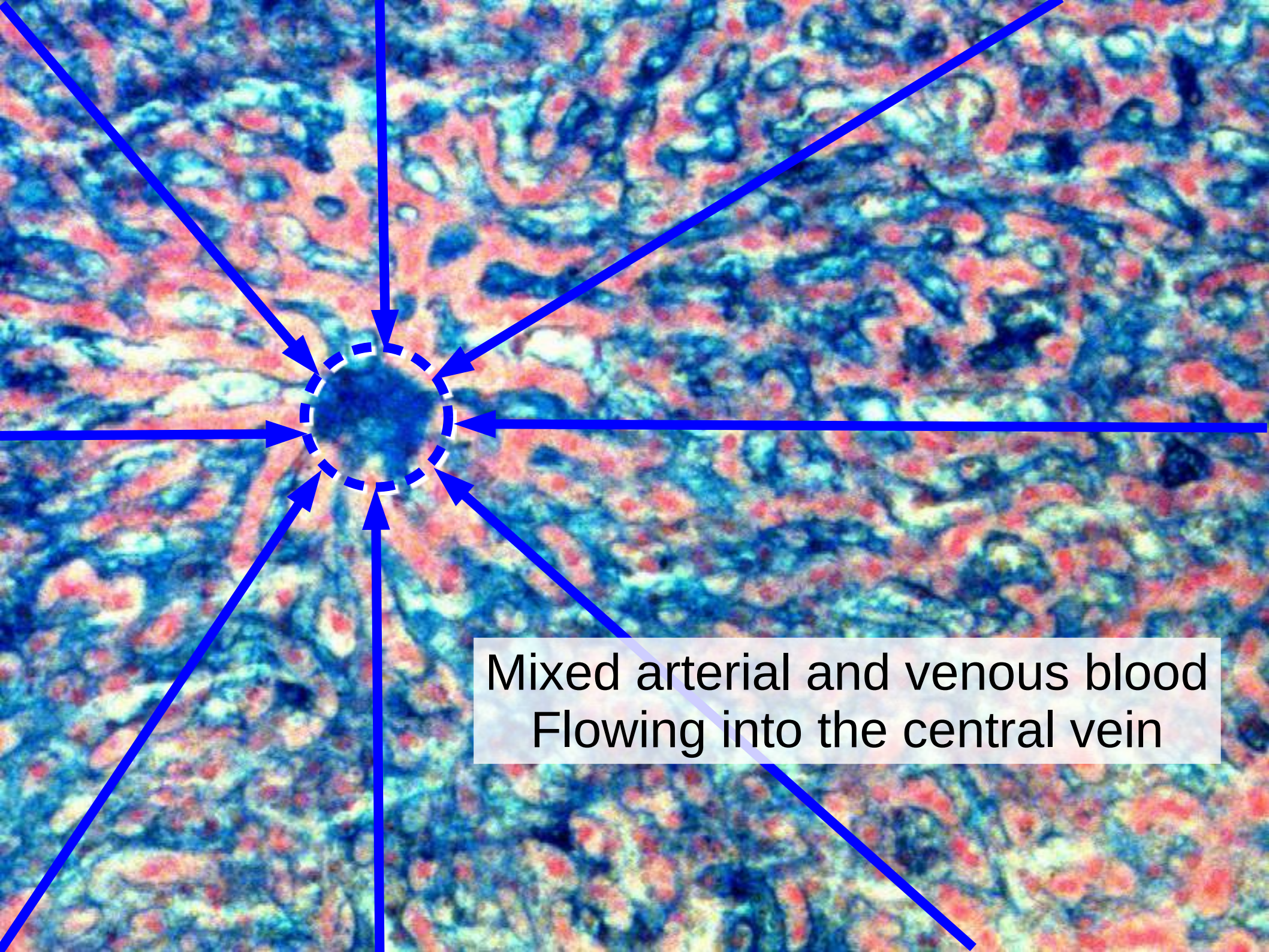
Microscopic view

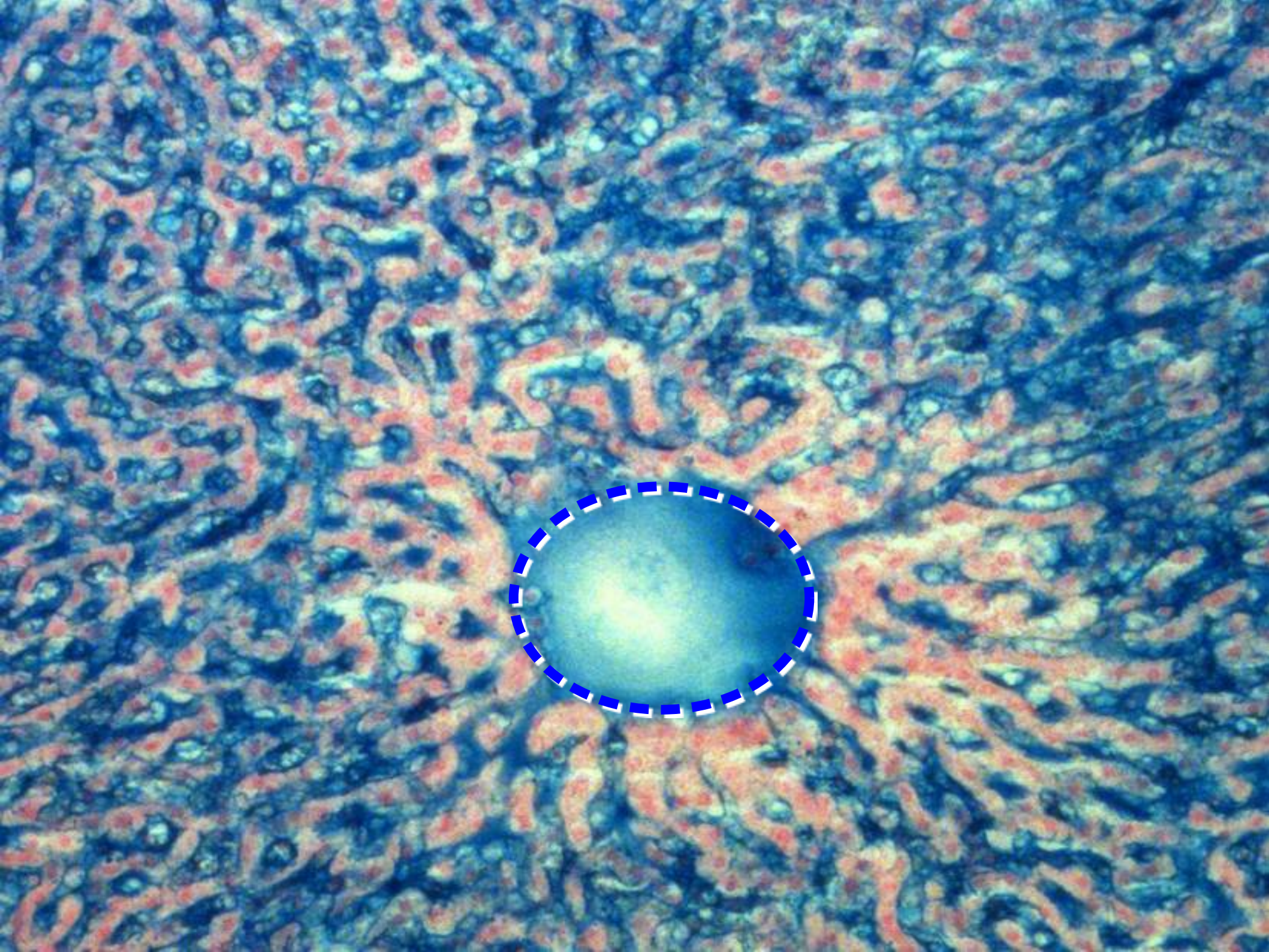
Vena centralis



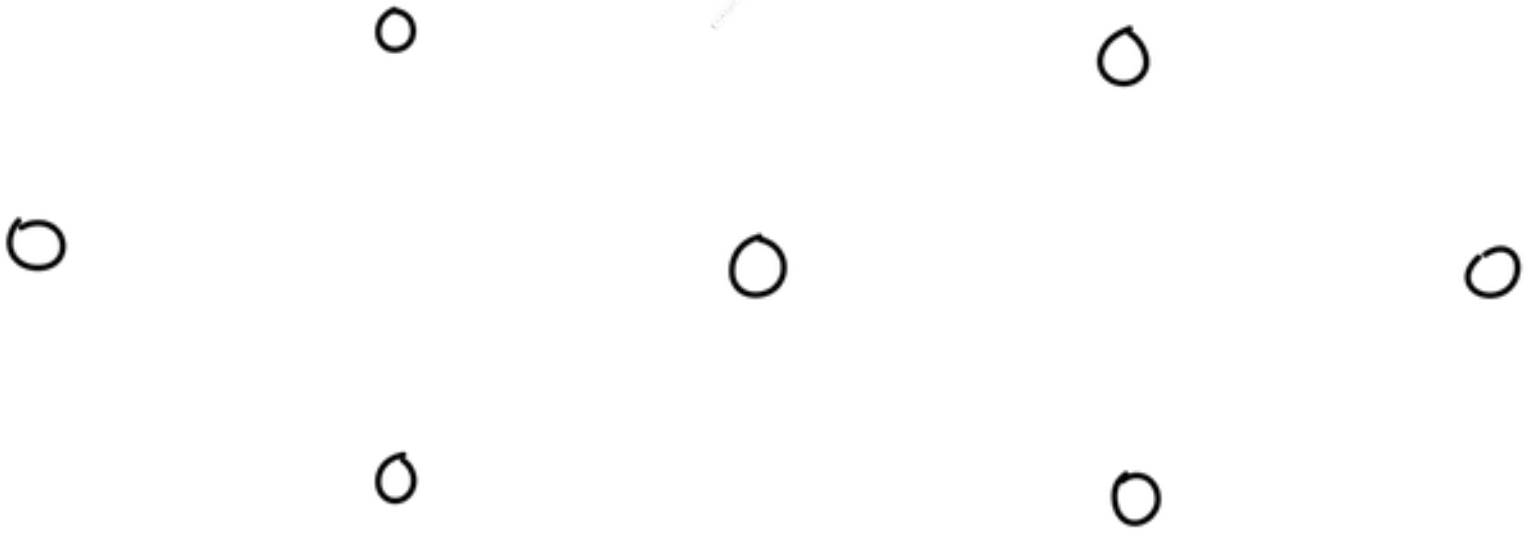


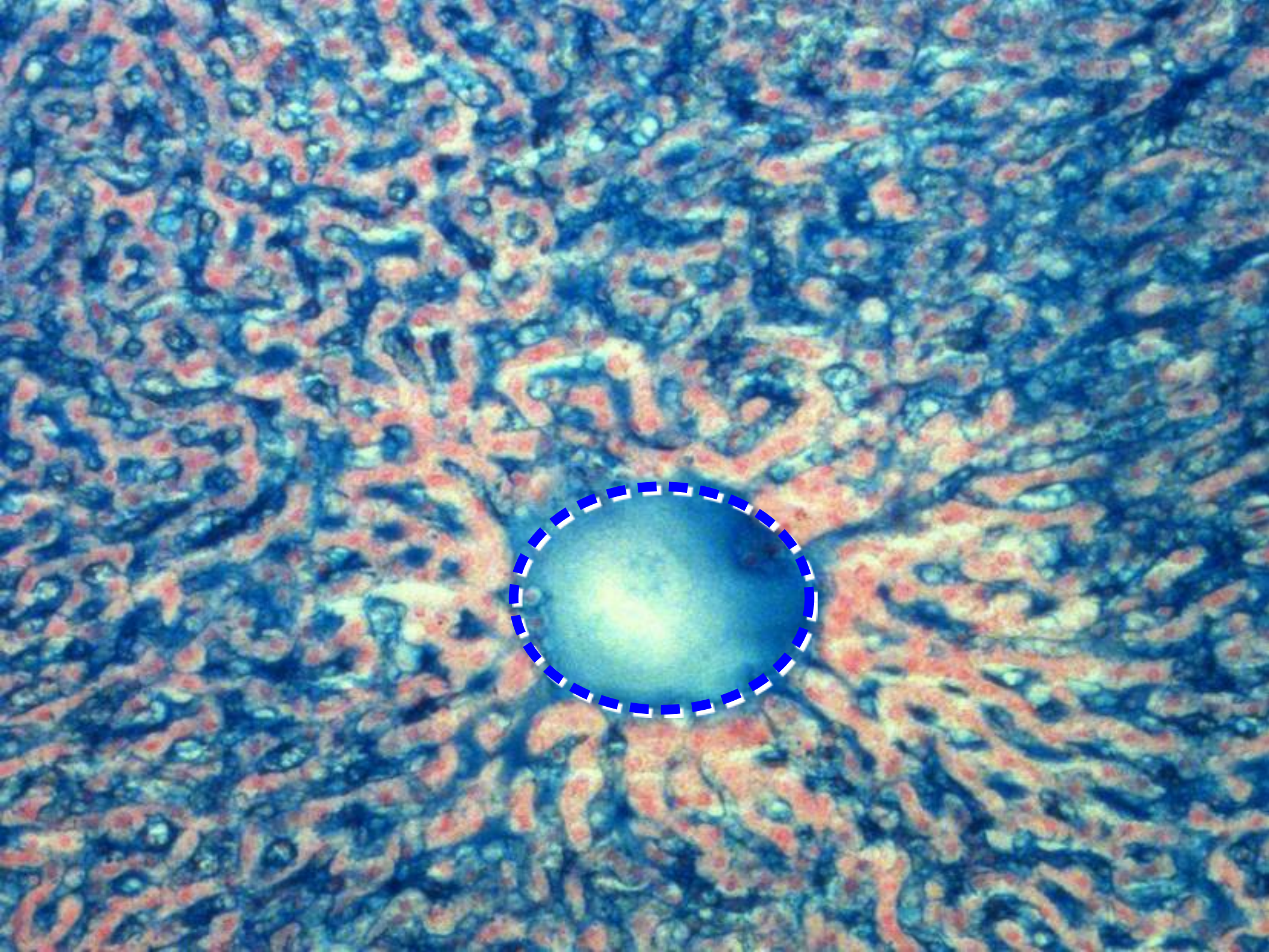



Mixed arterial and venous blood
Flowing into the central vein



Vena centralis





What is with the vena centralis?

What is with the vena centralis?

Arteries – Yes/No?
Bile ducts – Yes/No?
Lymph vessels – Yes/No?

What is with the vena centralis?

Arteries – No
Bile ducts – No
Lymph vessels – No

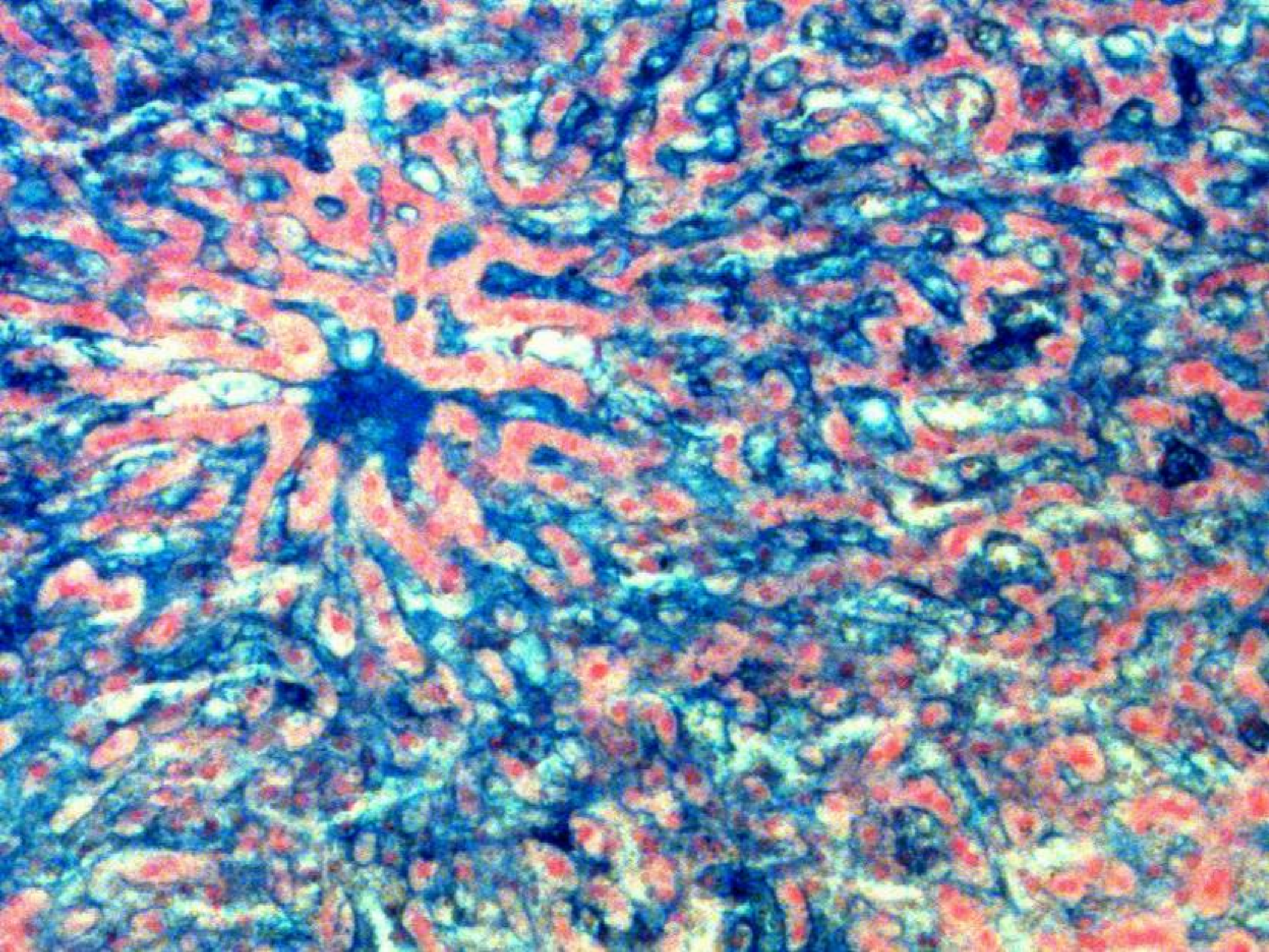
Where do we find these 3 structures?

What is with the vena centralis?

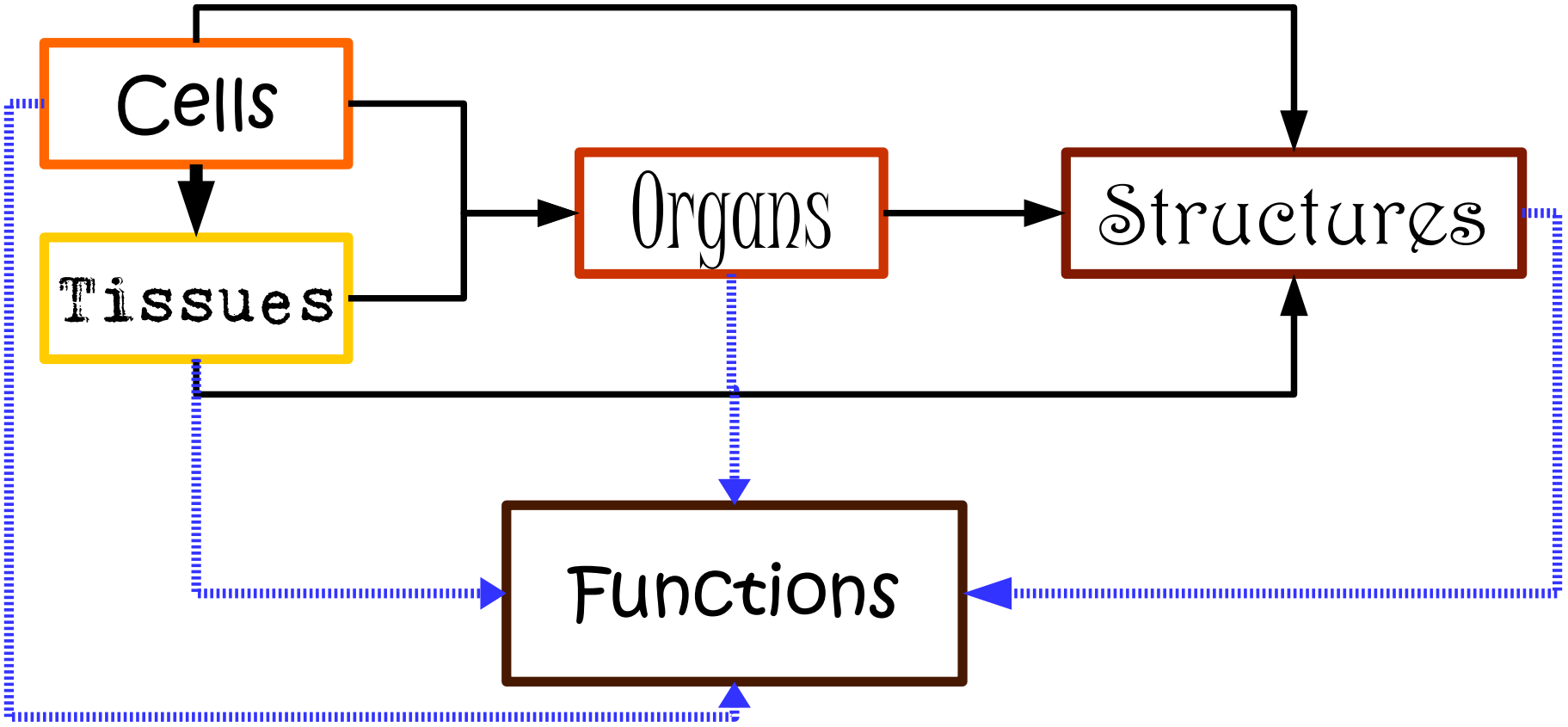
Arteries – No
Bile ducts – No
Lymph vessels – No

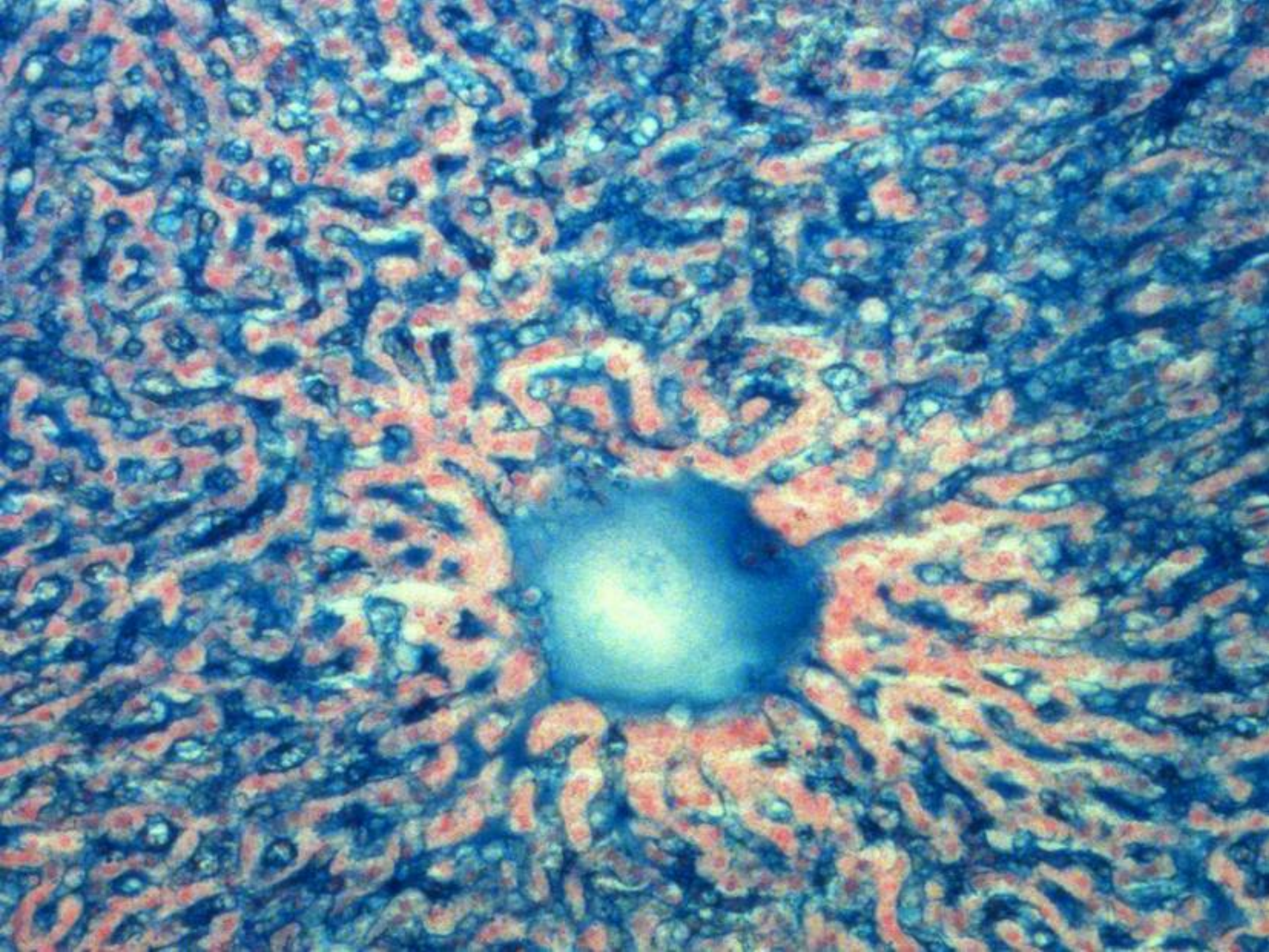
Where do we find these 3 structures?

Portal Triad

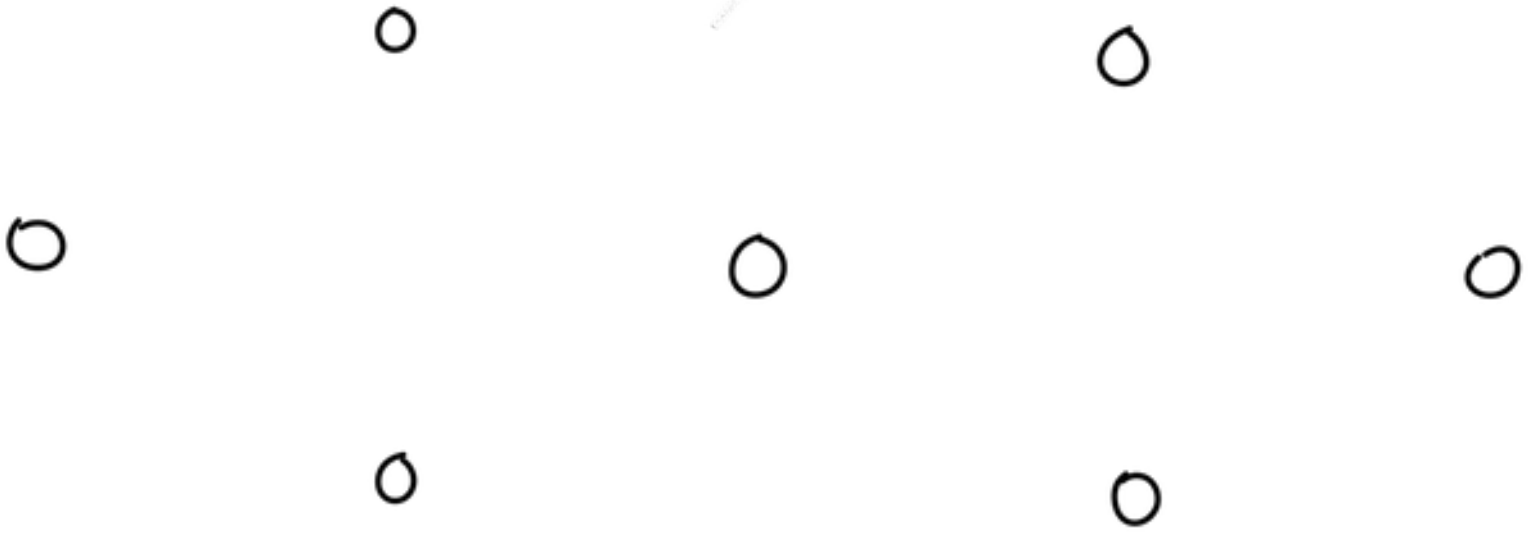


What stuff could there be?





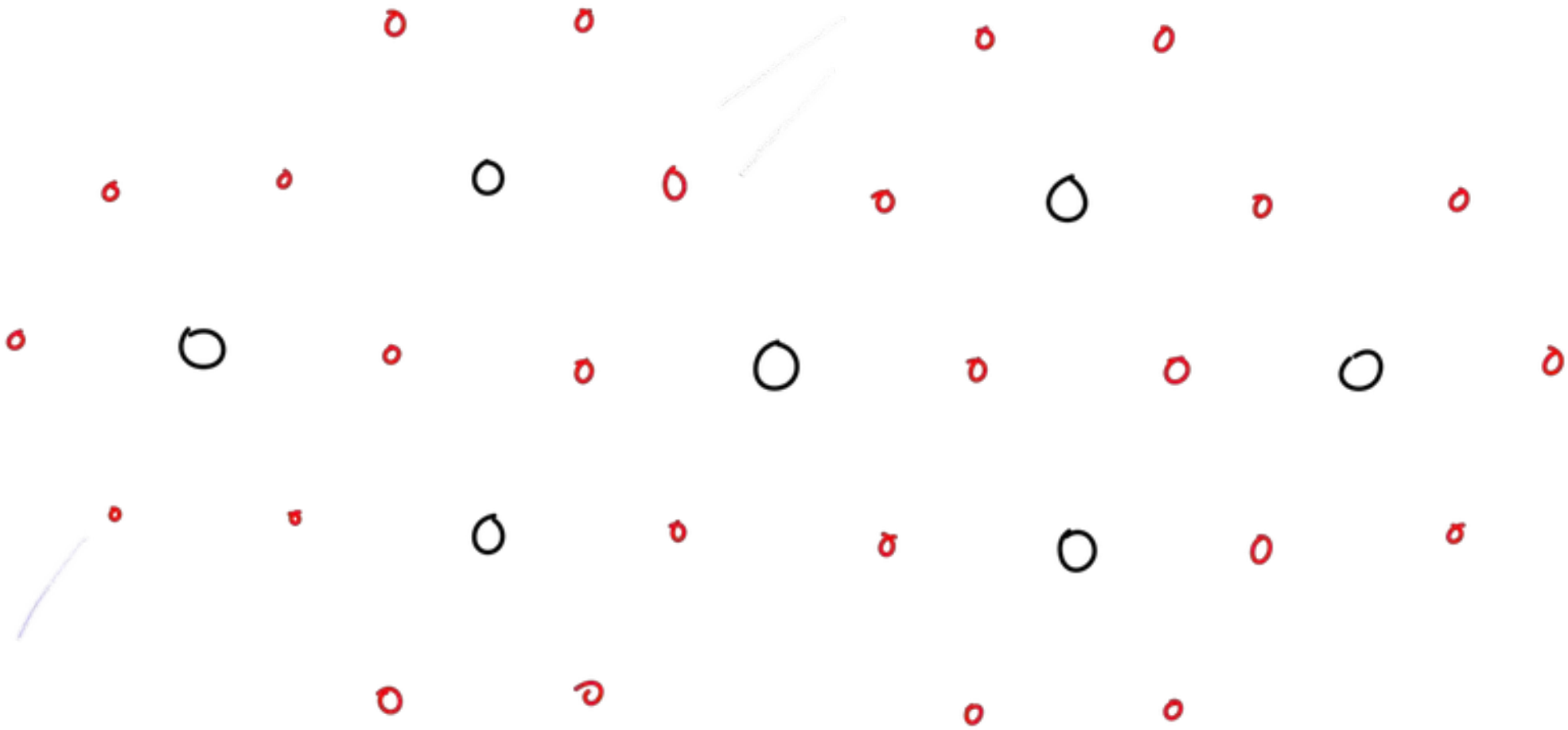
Vena centralis



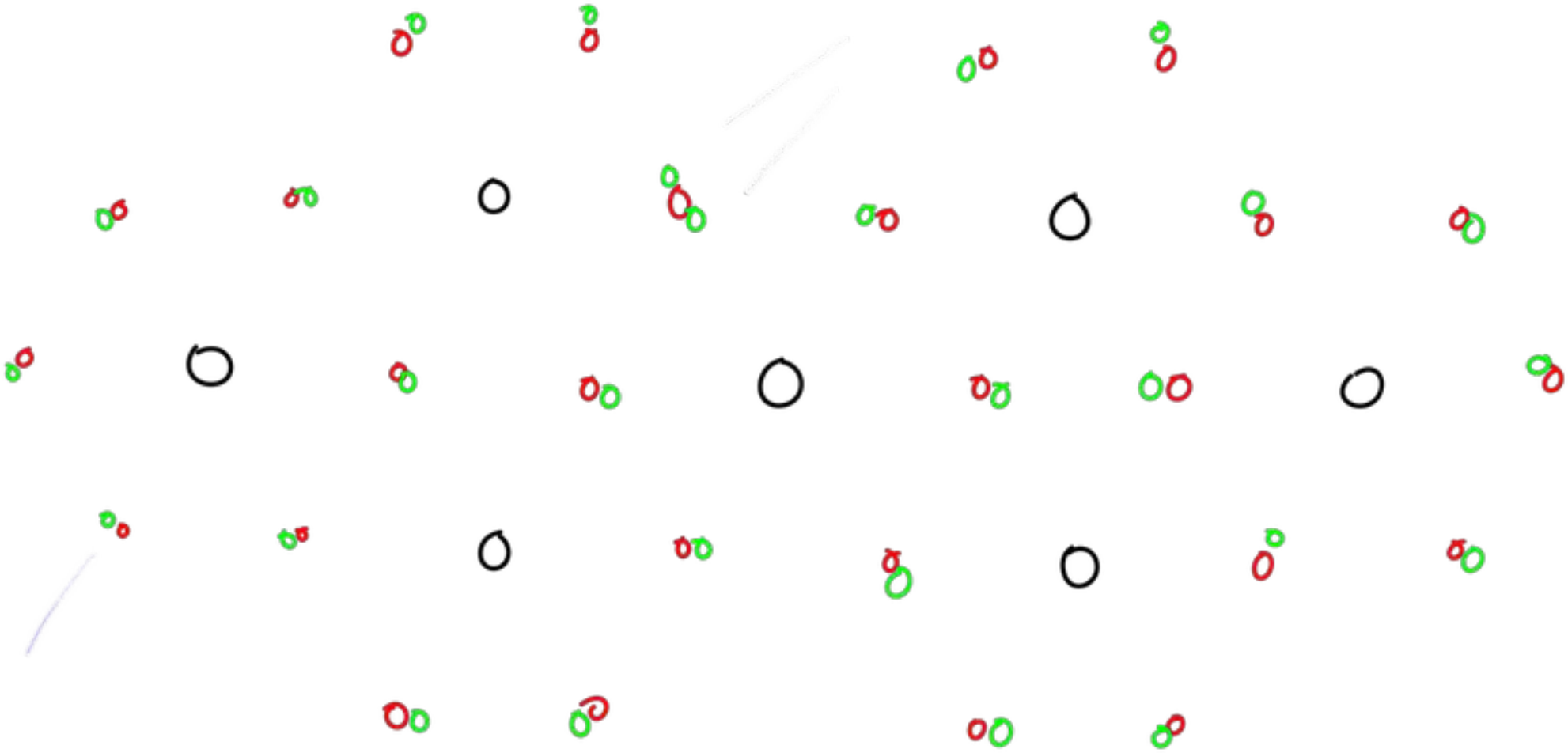
So what about the portal artery, vein, bile duct?

PS: There is a lymph vessel as well

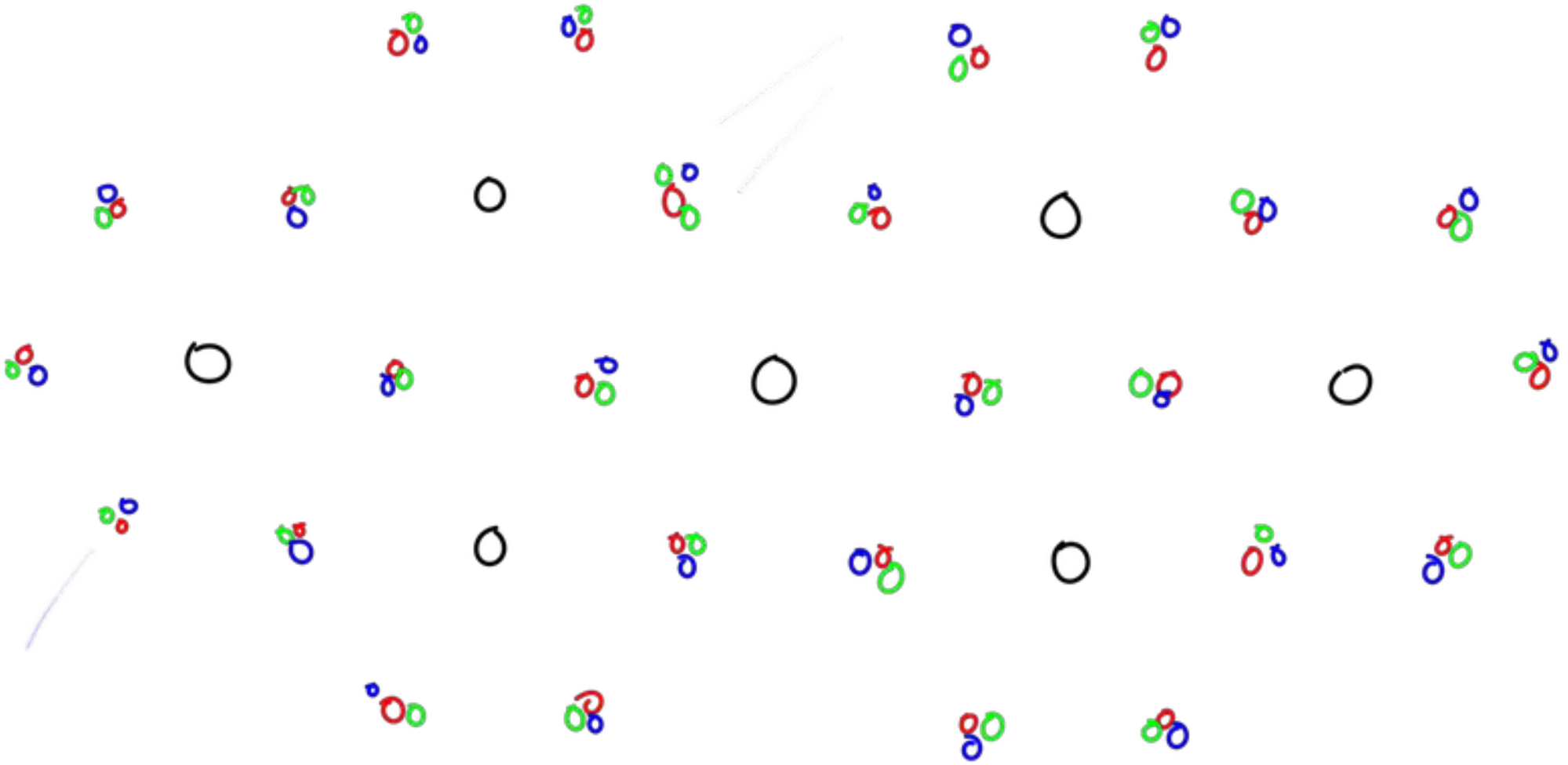
Portal artery

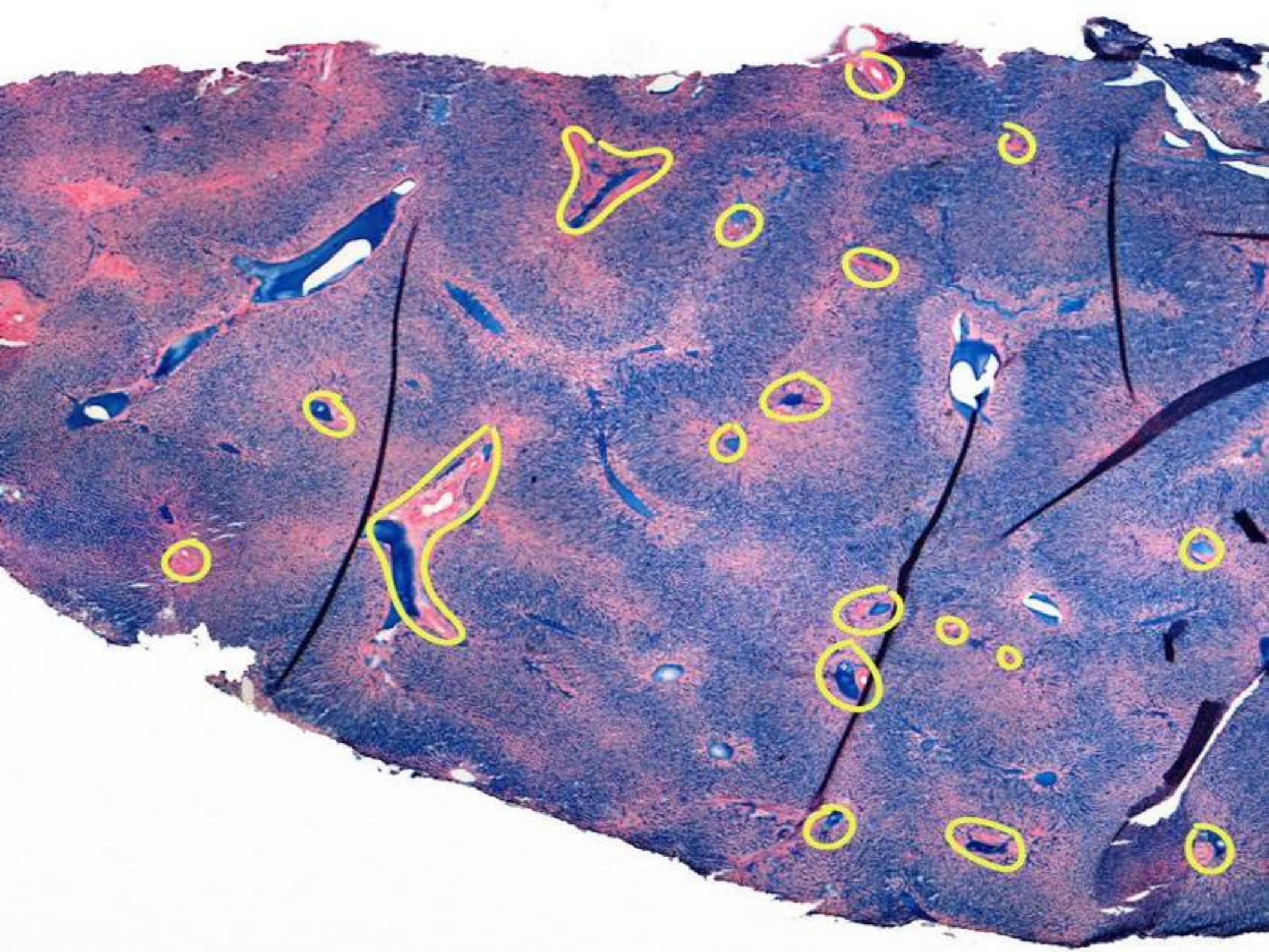


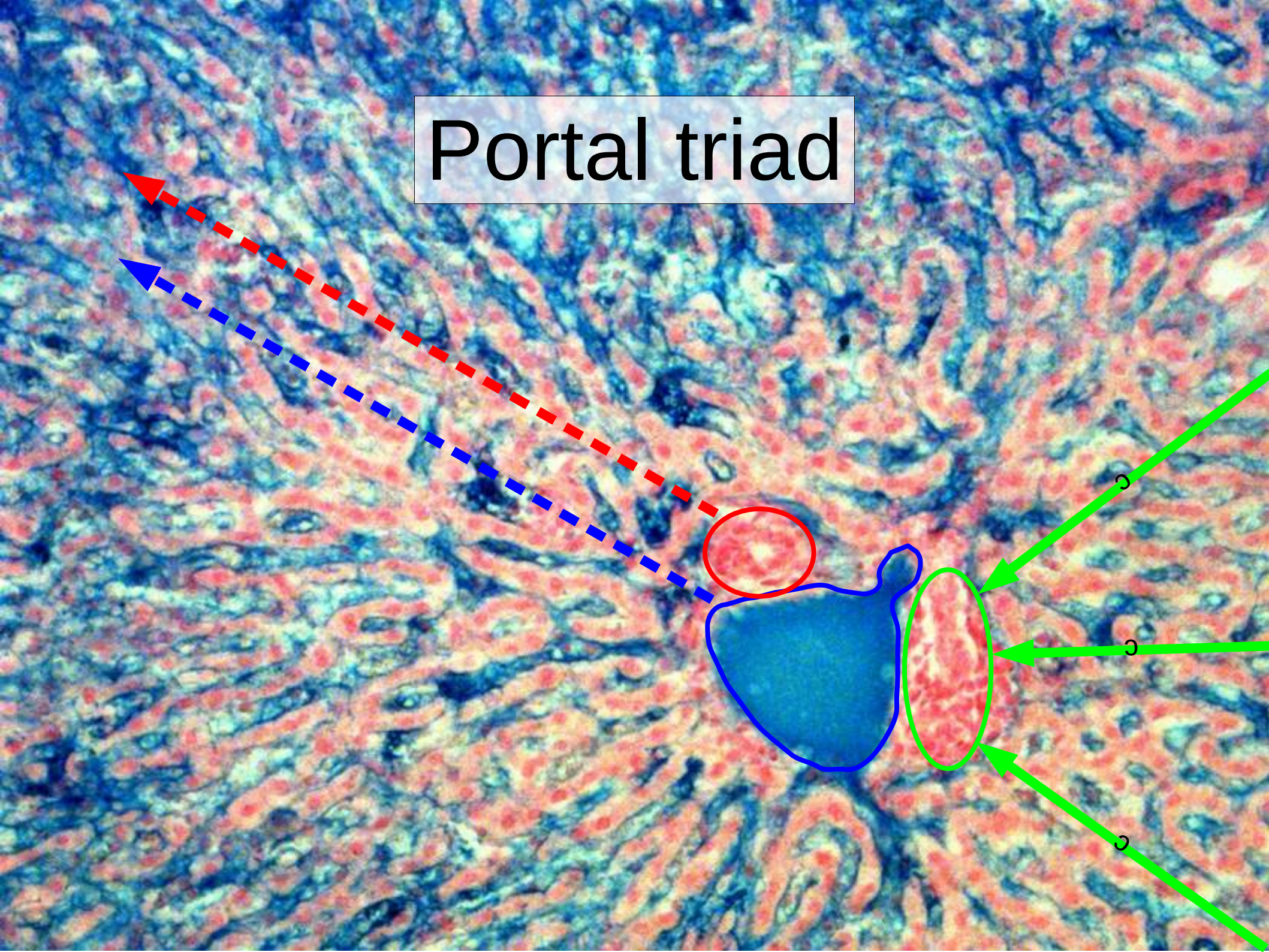
Bile ducts



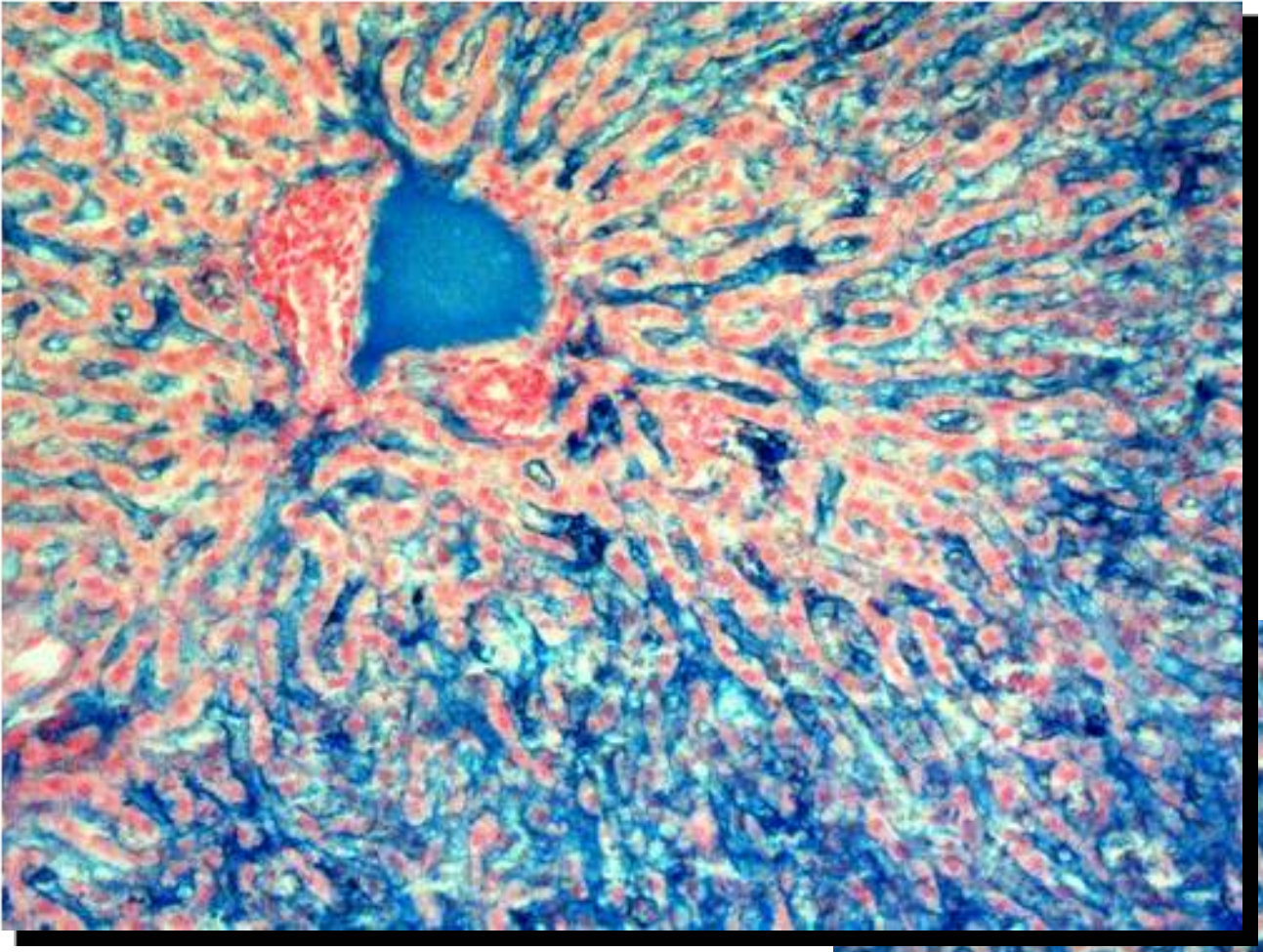
Portal veins

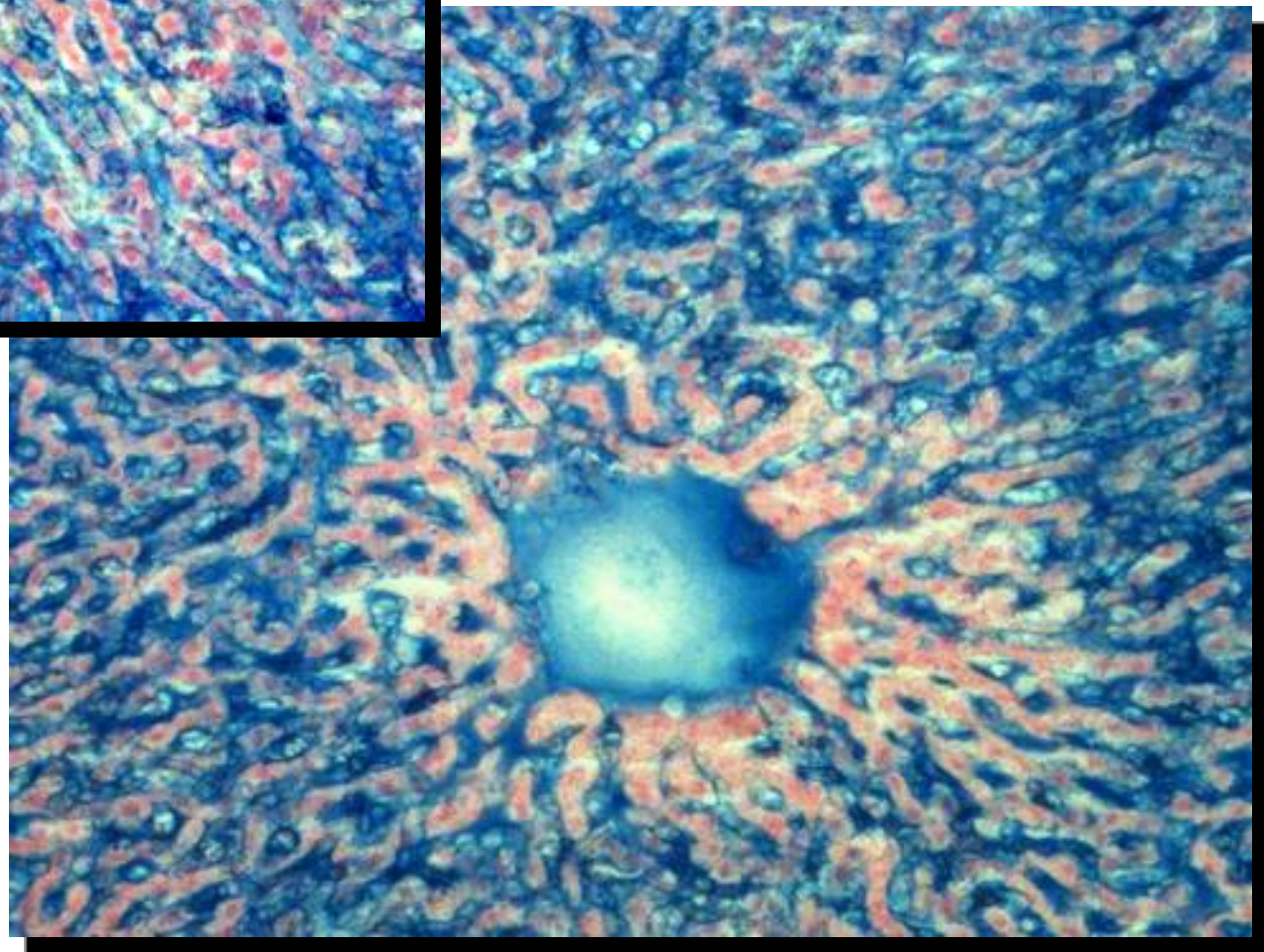


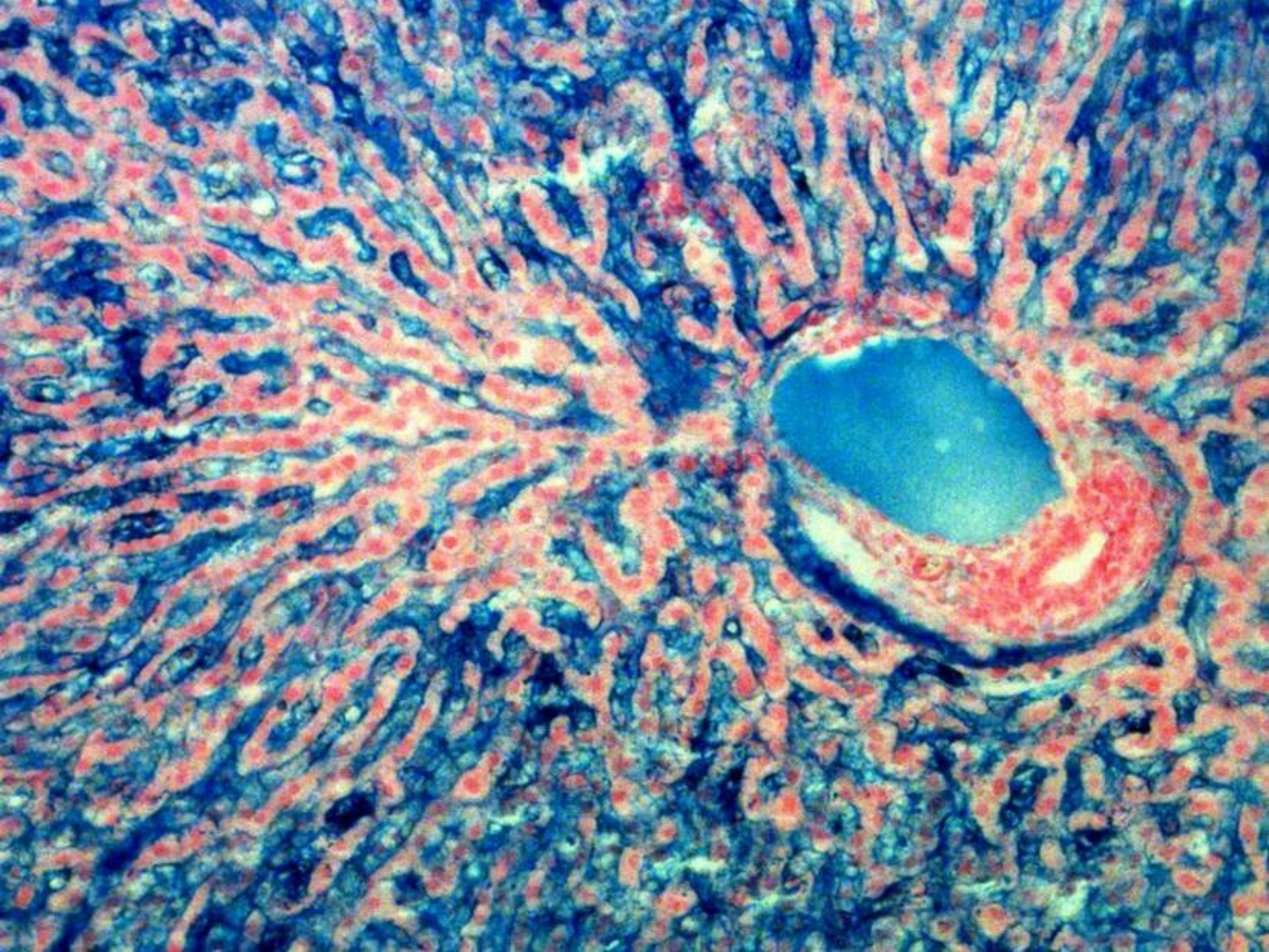



Portal triad

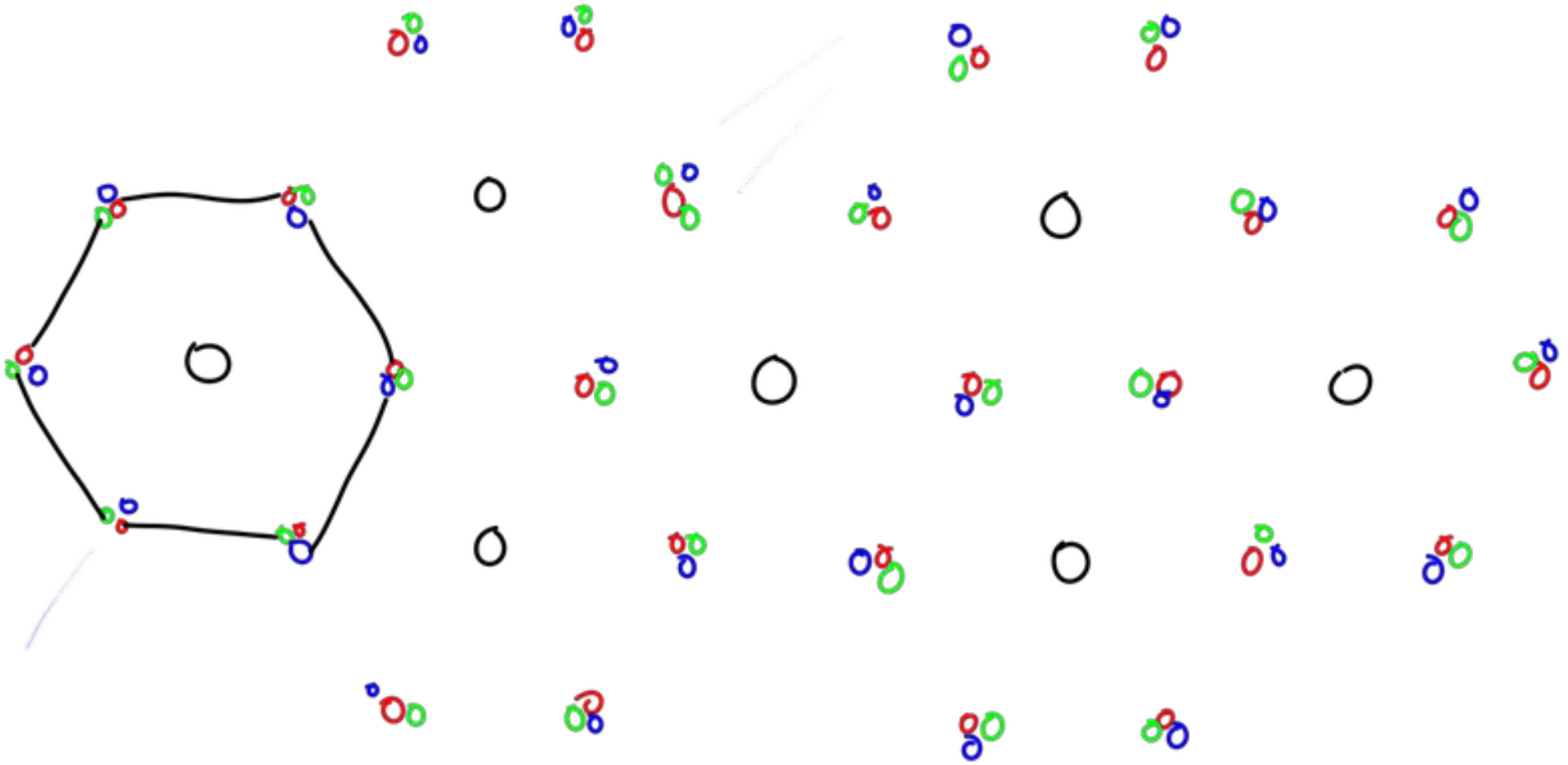
Compared to the central vein...



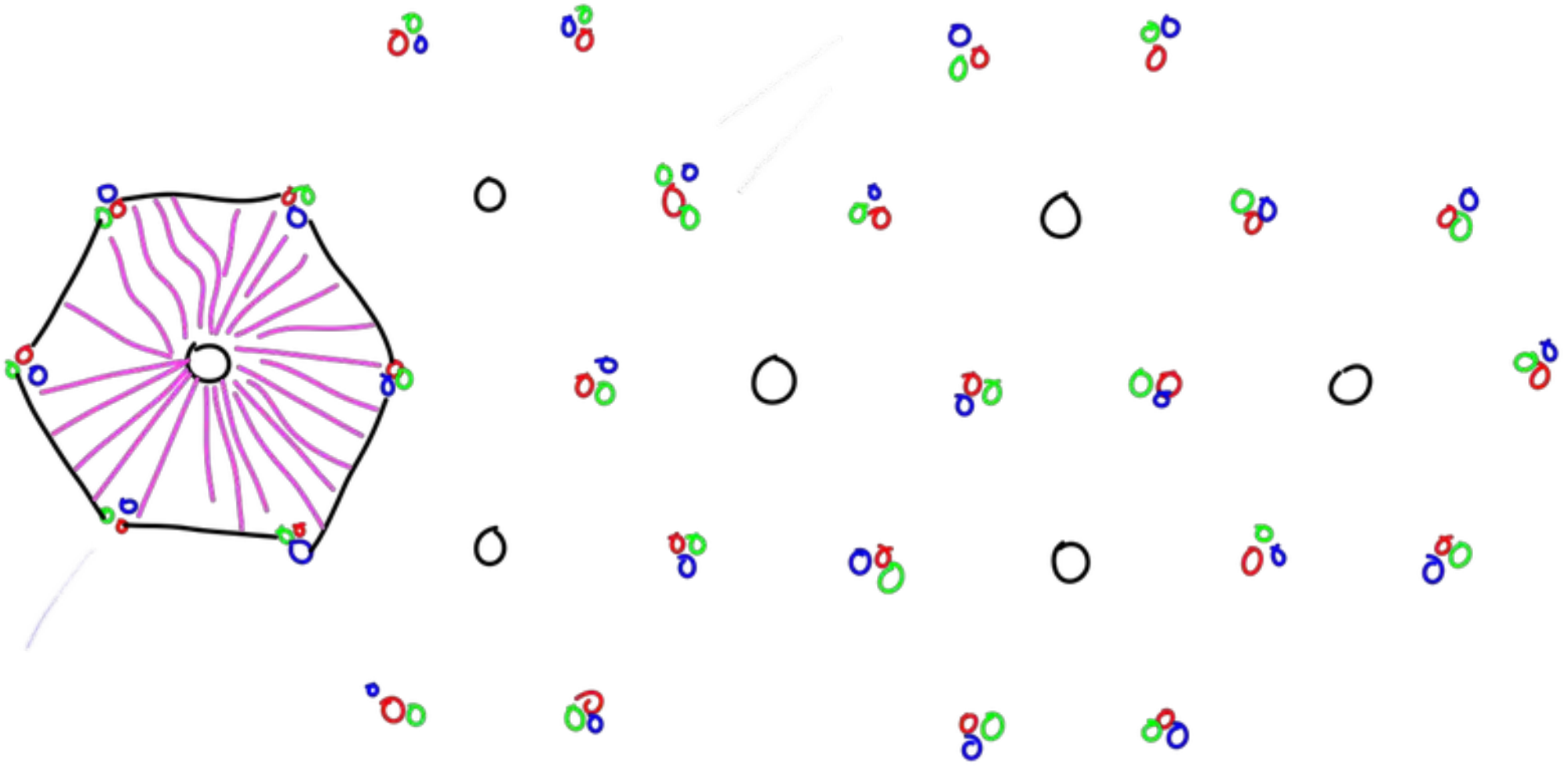


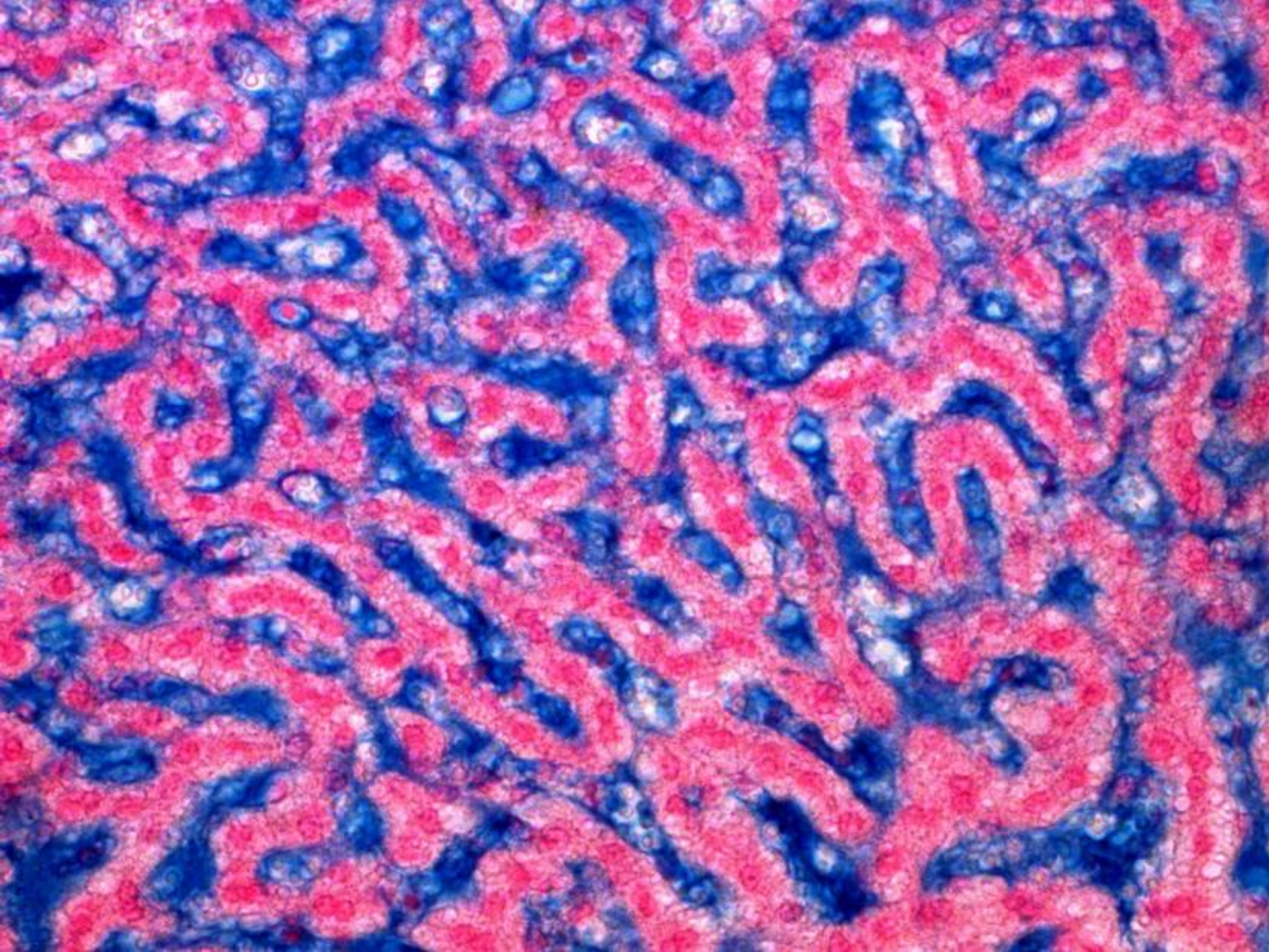


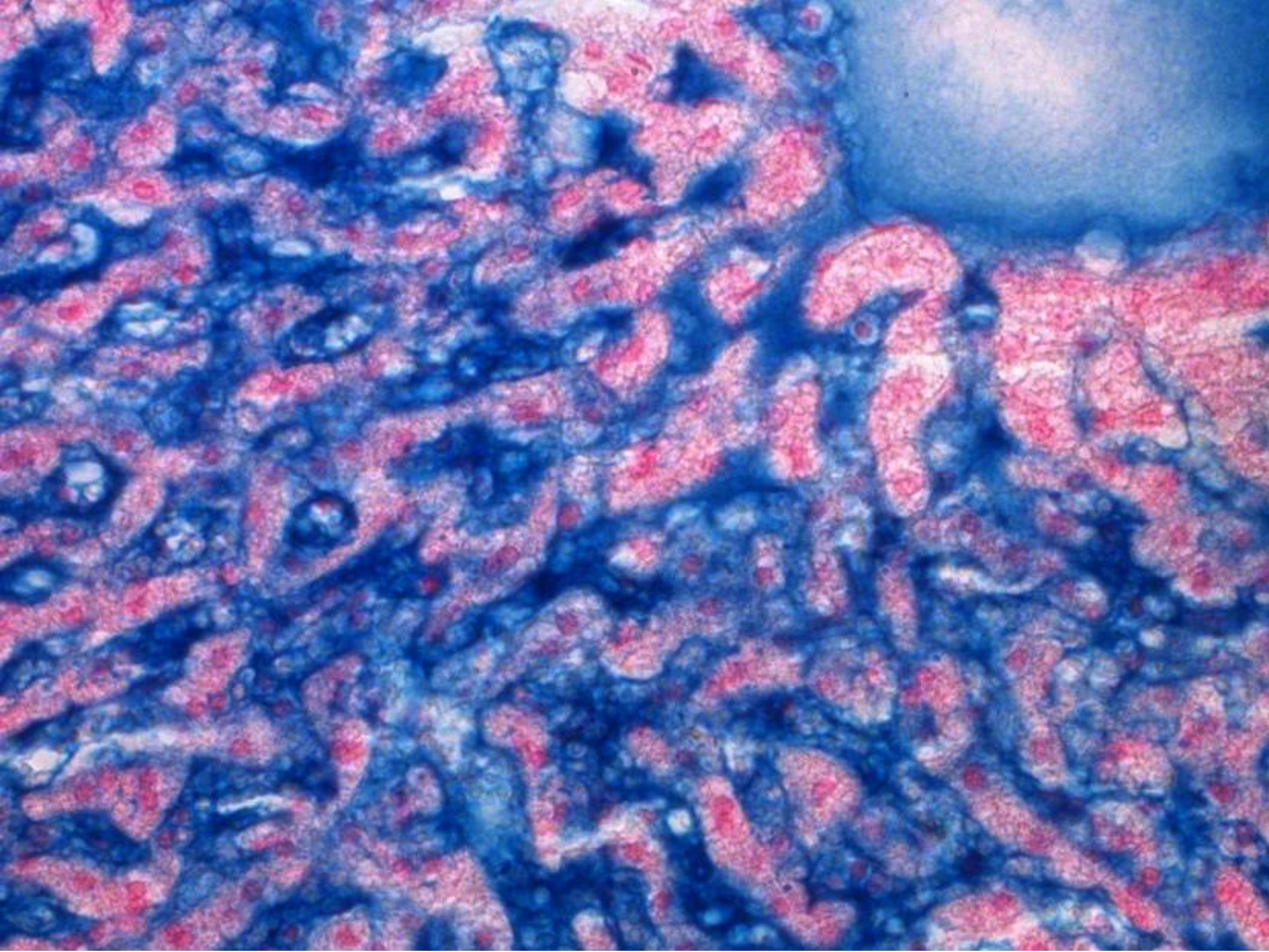
Classic lobule



Classic lobule







What is the function of liver cells?

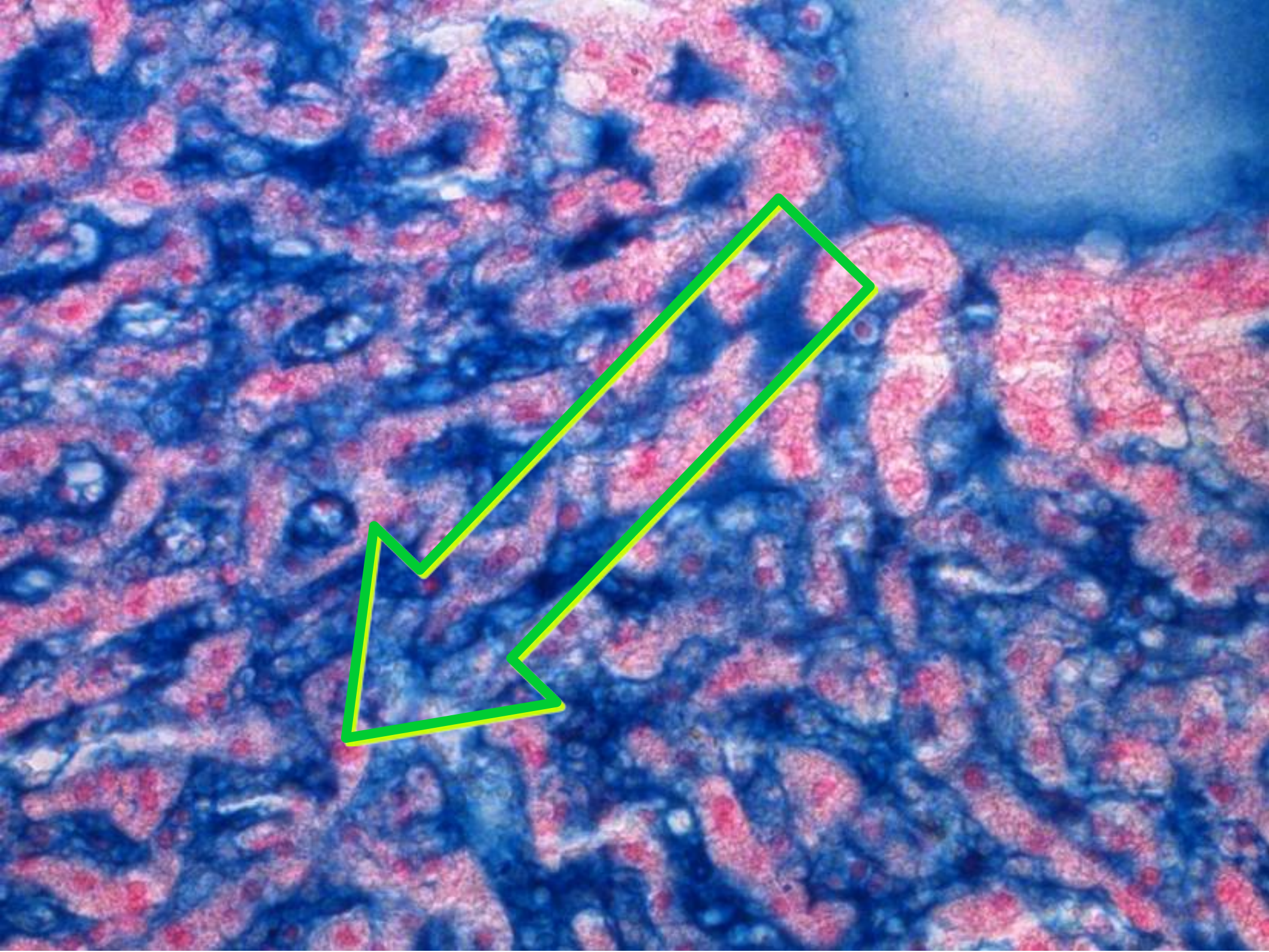
What is the function of liver cells?

Detoxify
Make bile

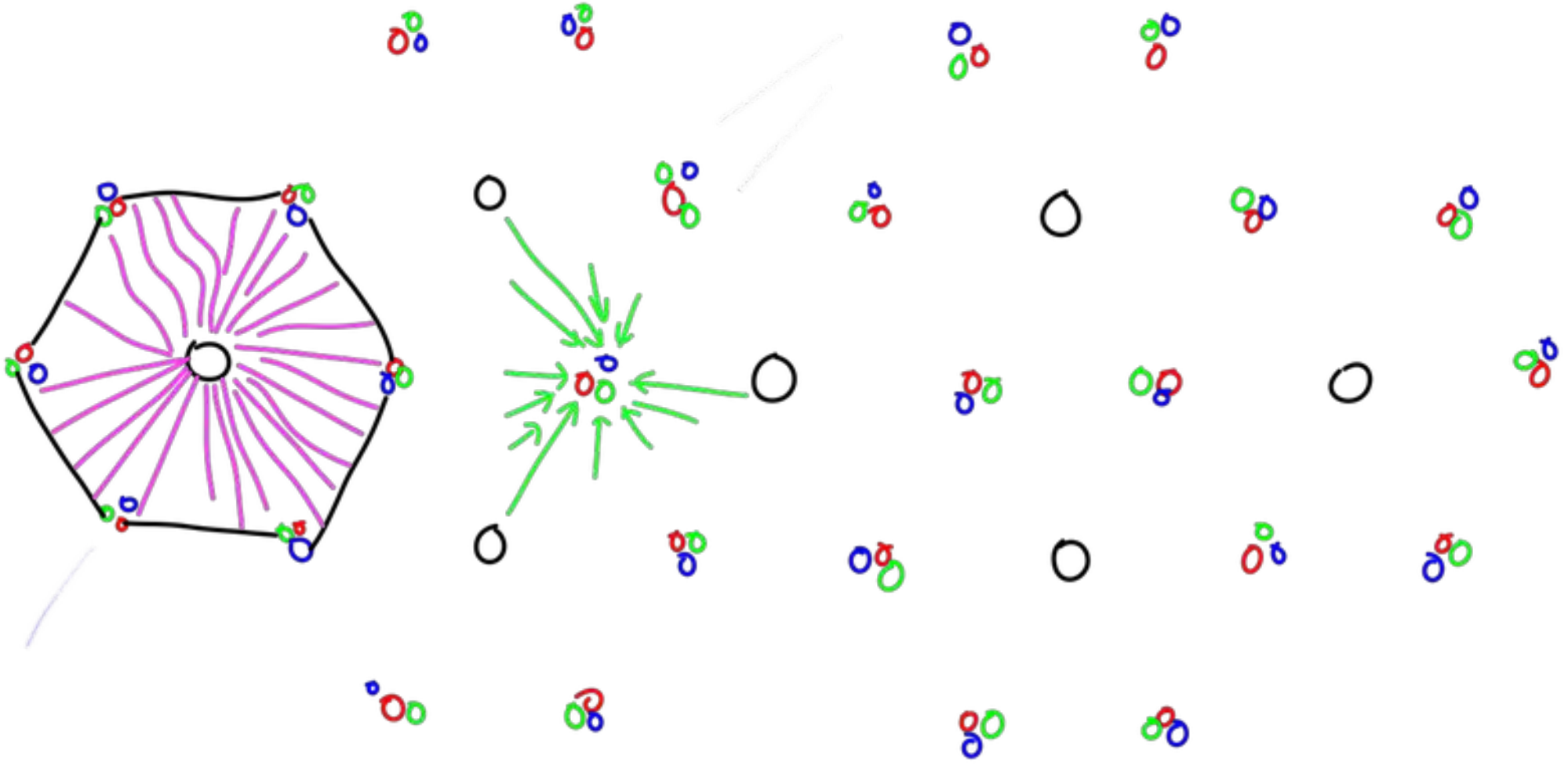
What is the function of liver cells?

Detoxify
Make bile

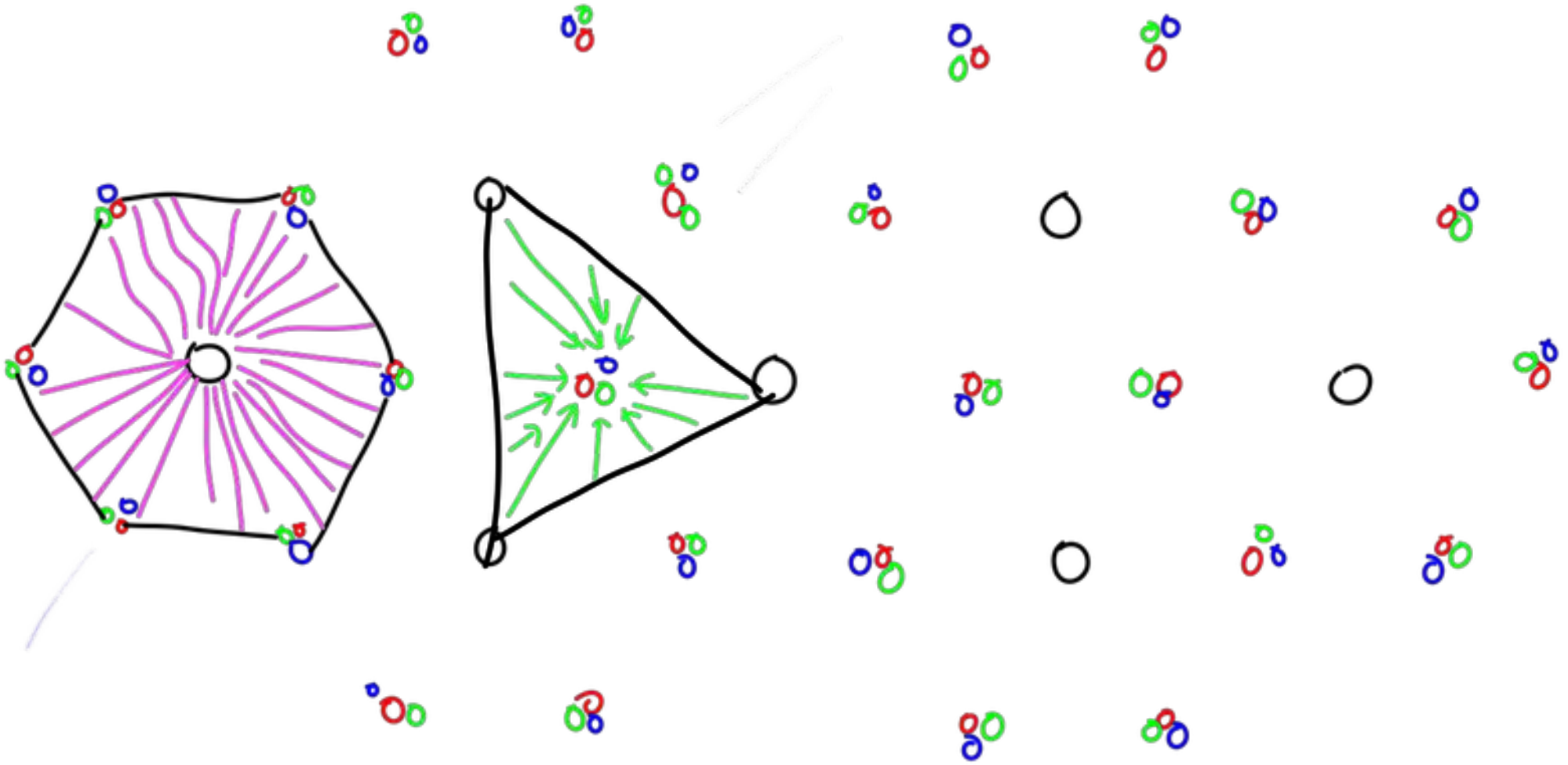
Where does the bile come from?
Where does bile go to?



Bile – away from V centralis



Portal lobule



Blood flow

What happens

to blood

going

into the liver?

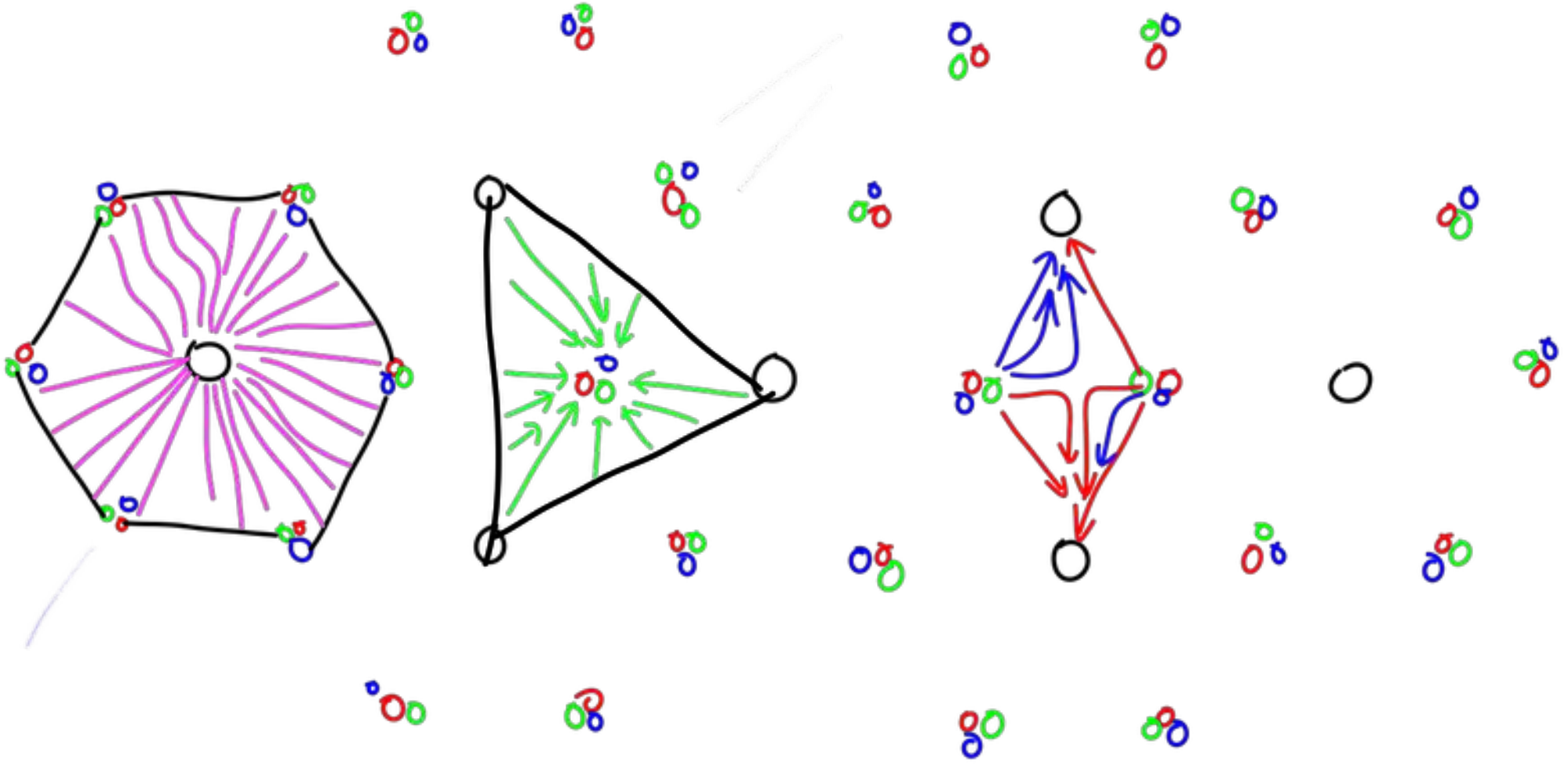
Blood flow

From A&V

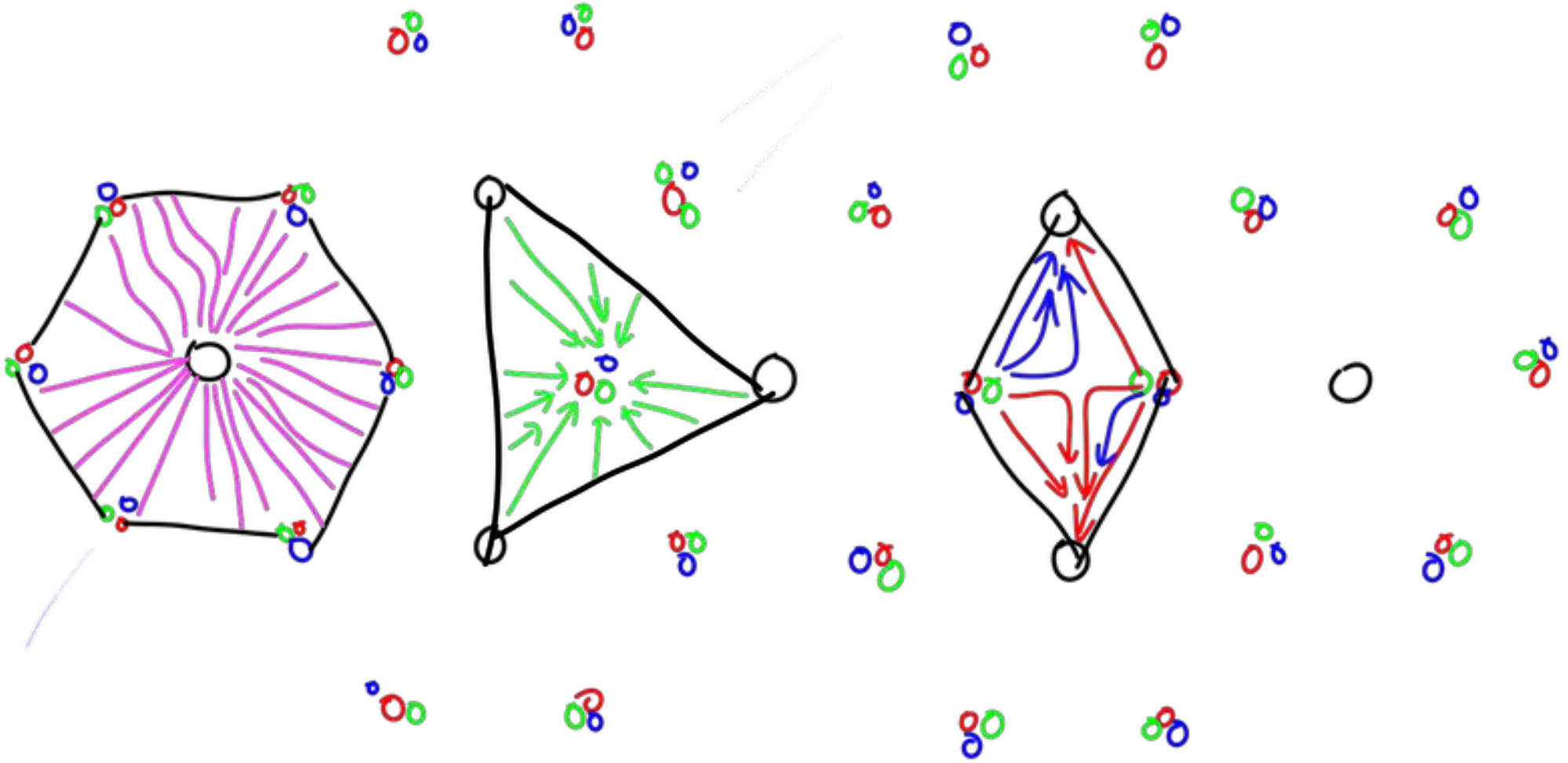
Mix

Towards central vein

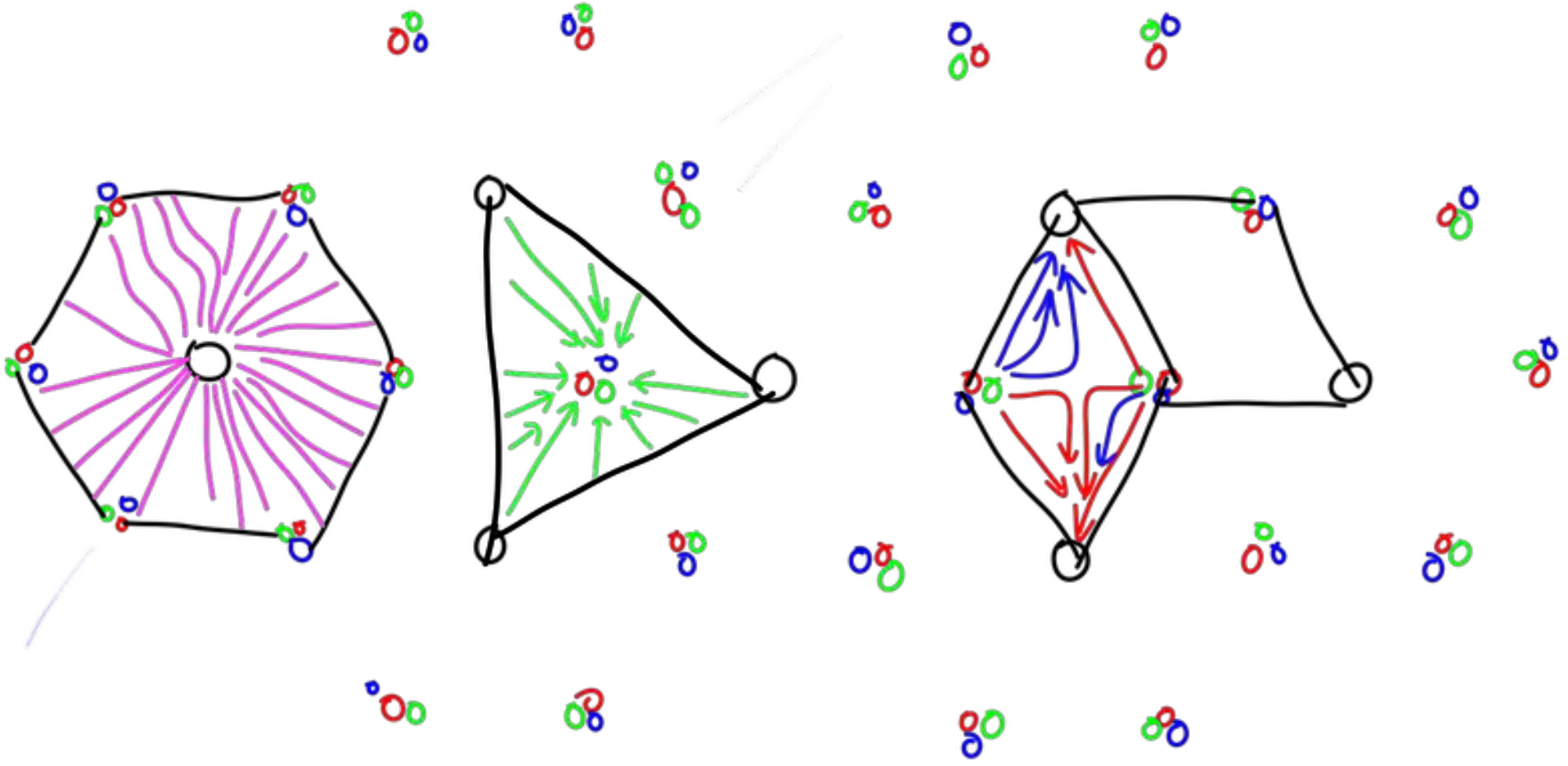
Artery & Vein -> Vein



Acinus



And another acinus

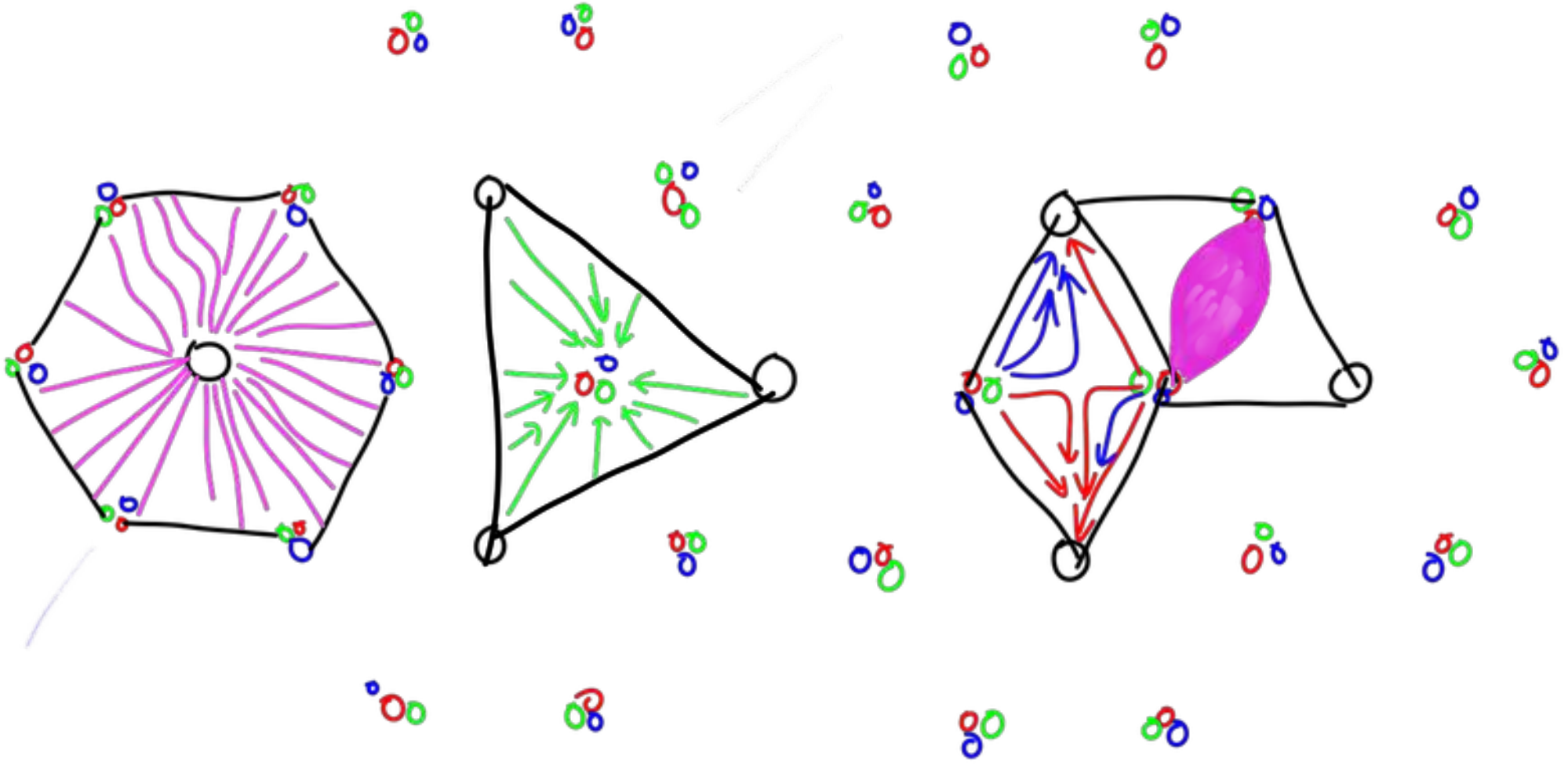


Blood flow

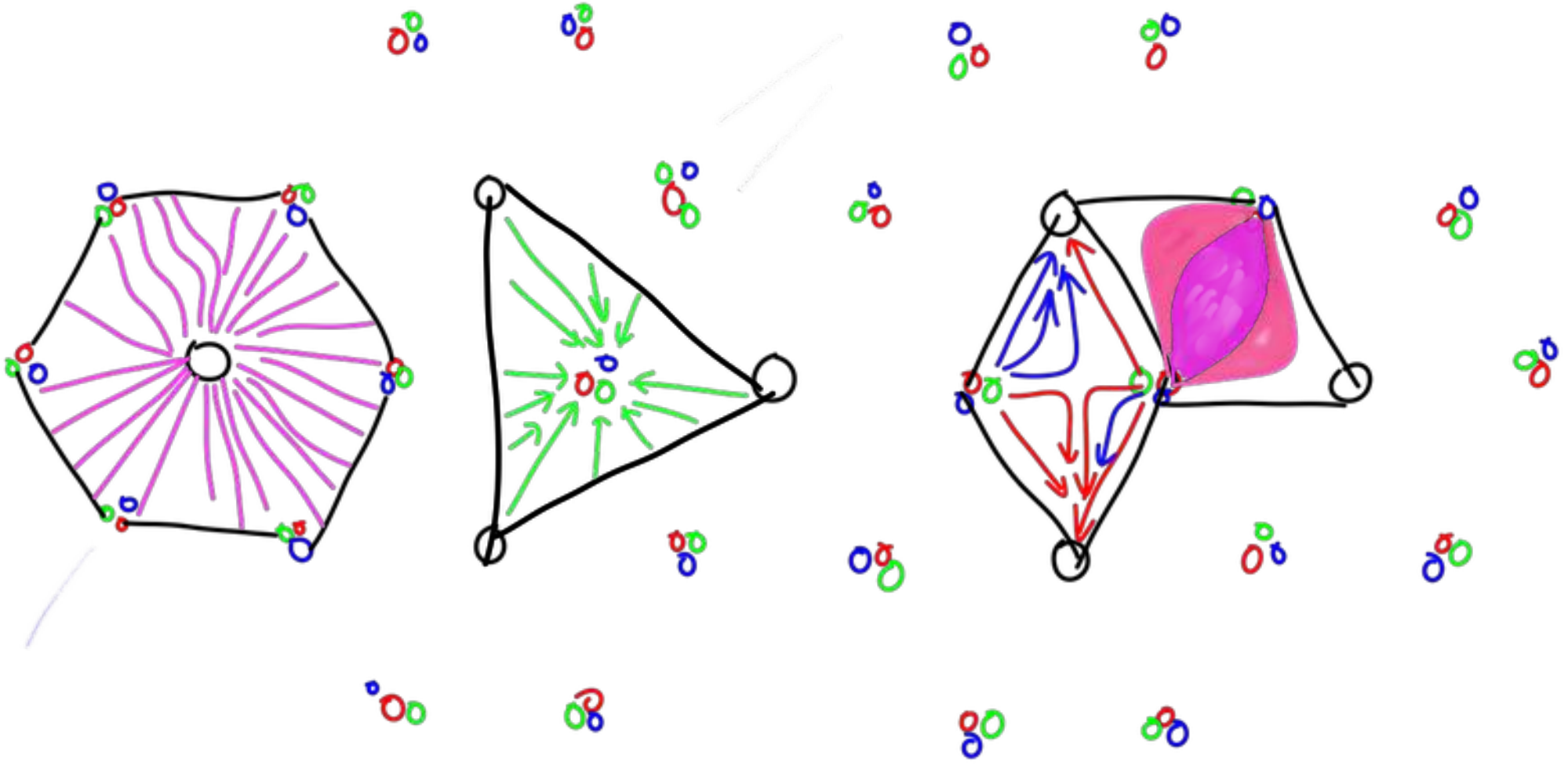
Clinical implications?

Critical concentrations

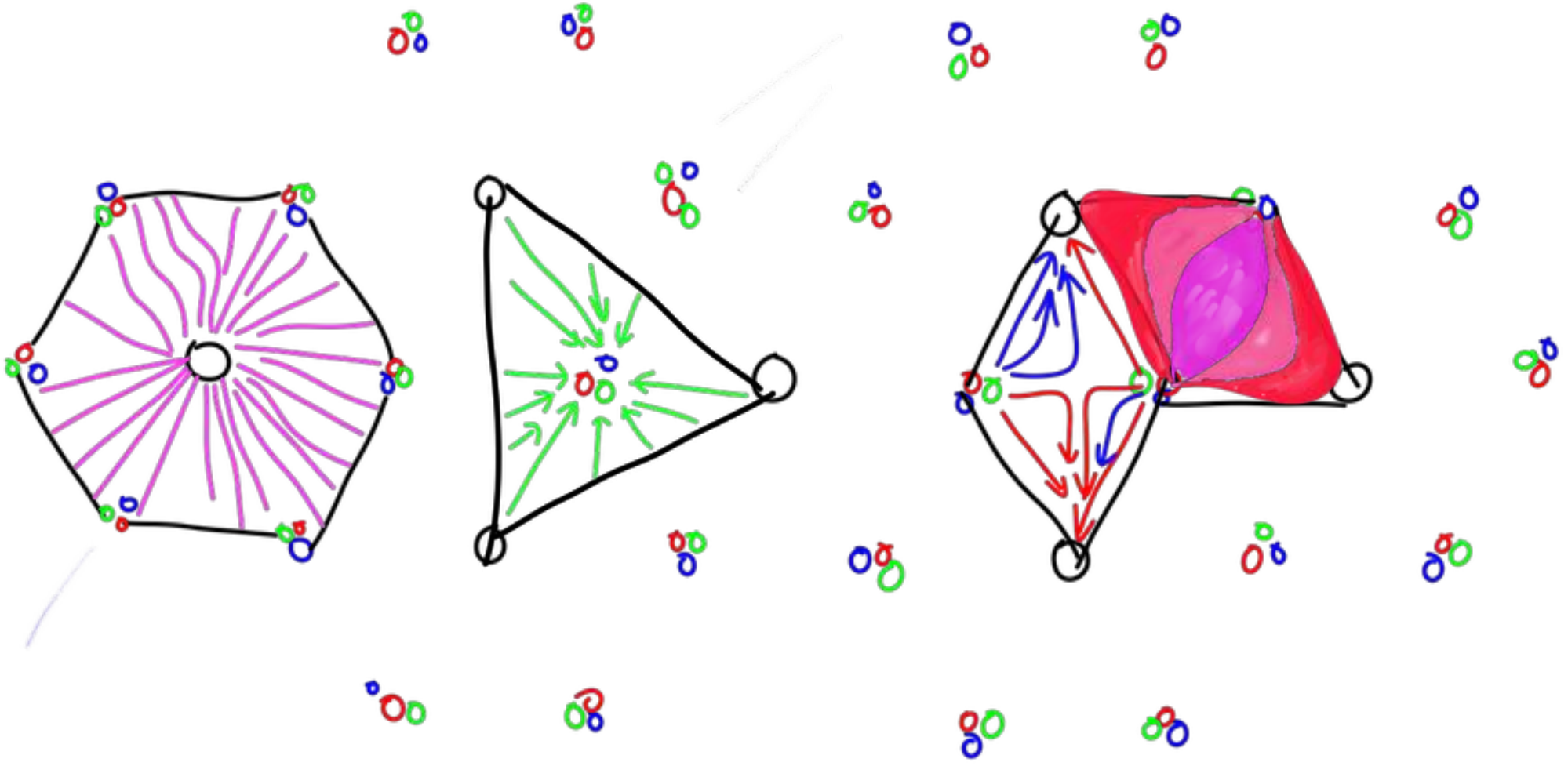
Zone 1



Zone 2

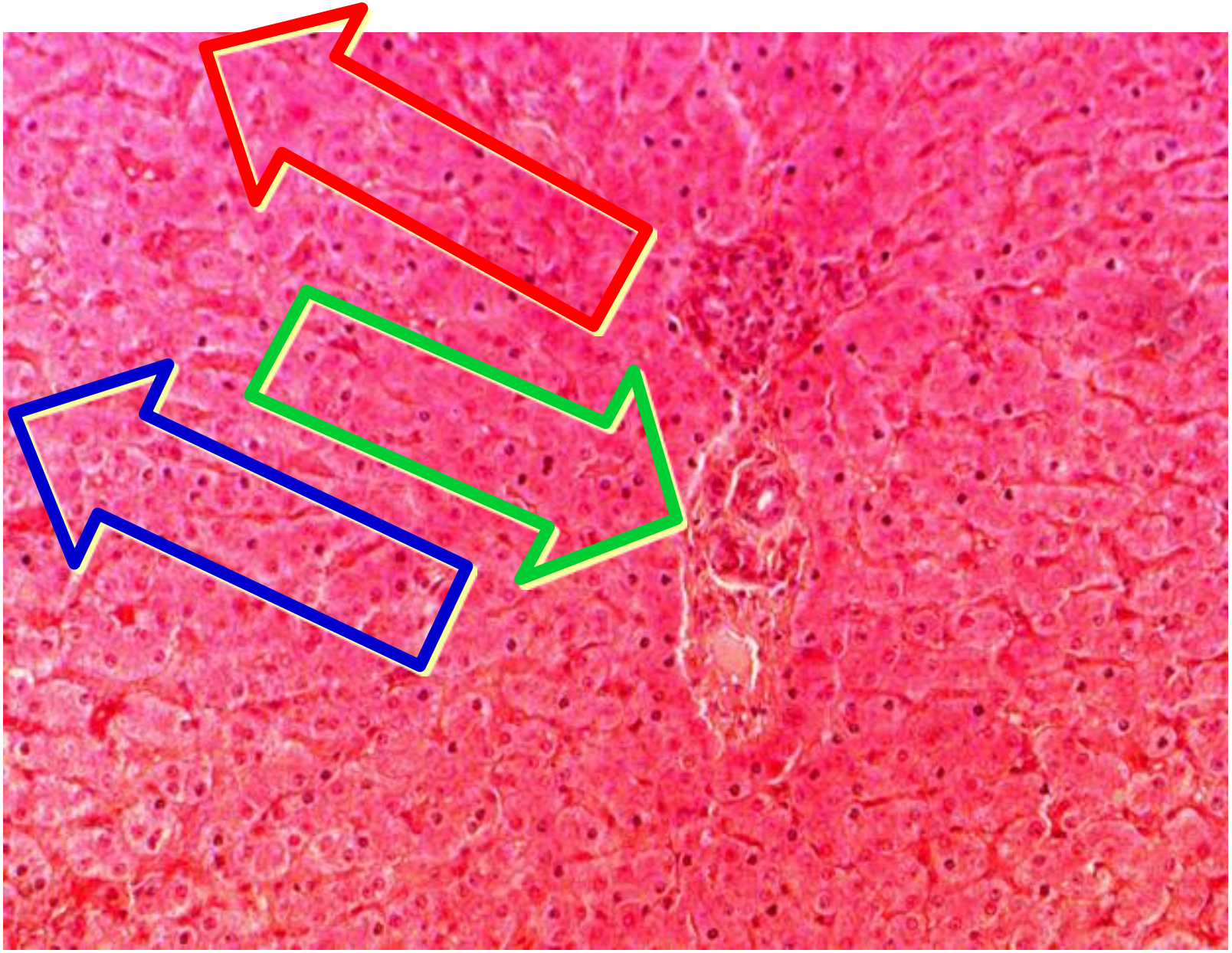


Zone 3

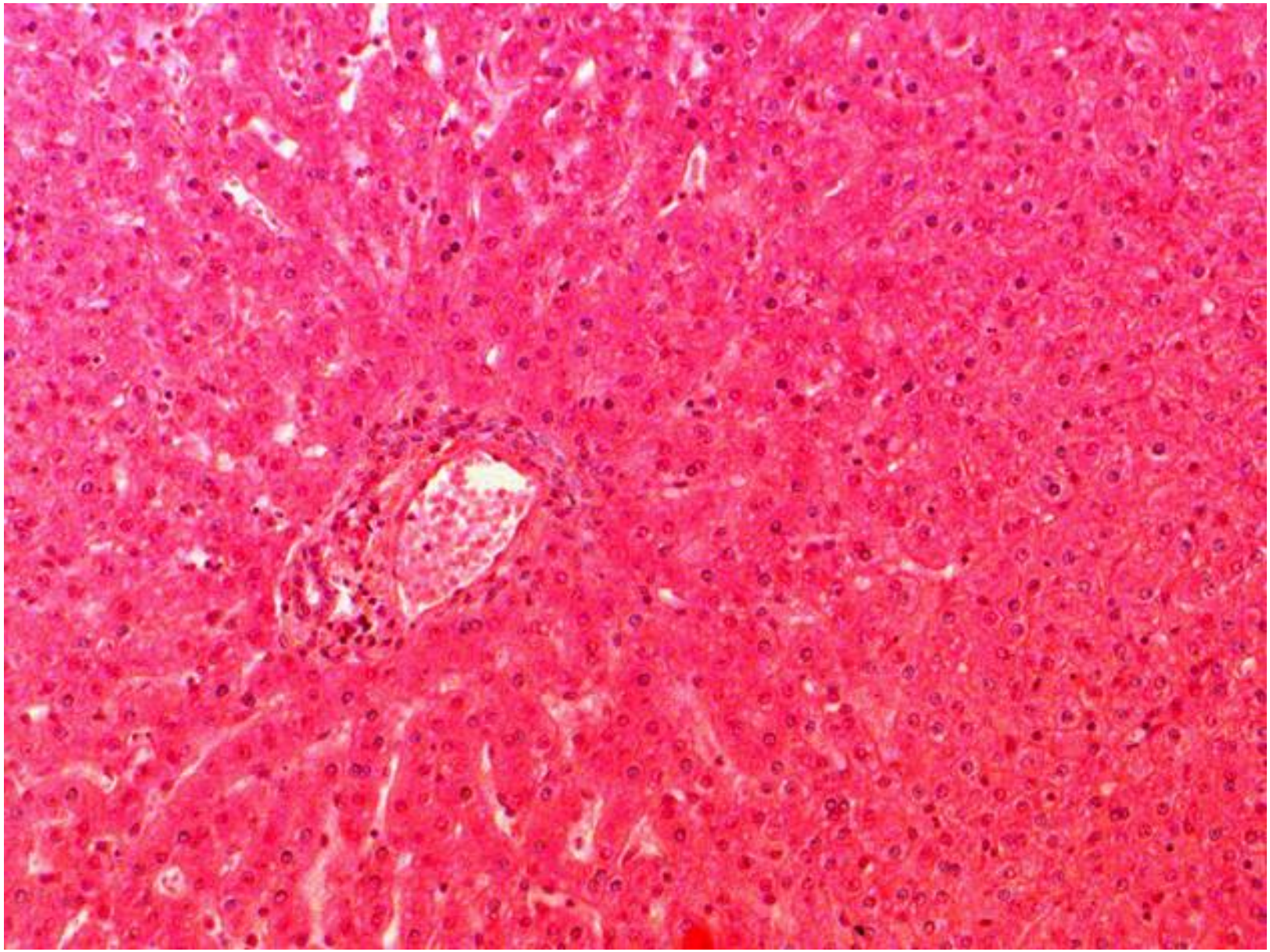


Imagine poison gas

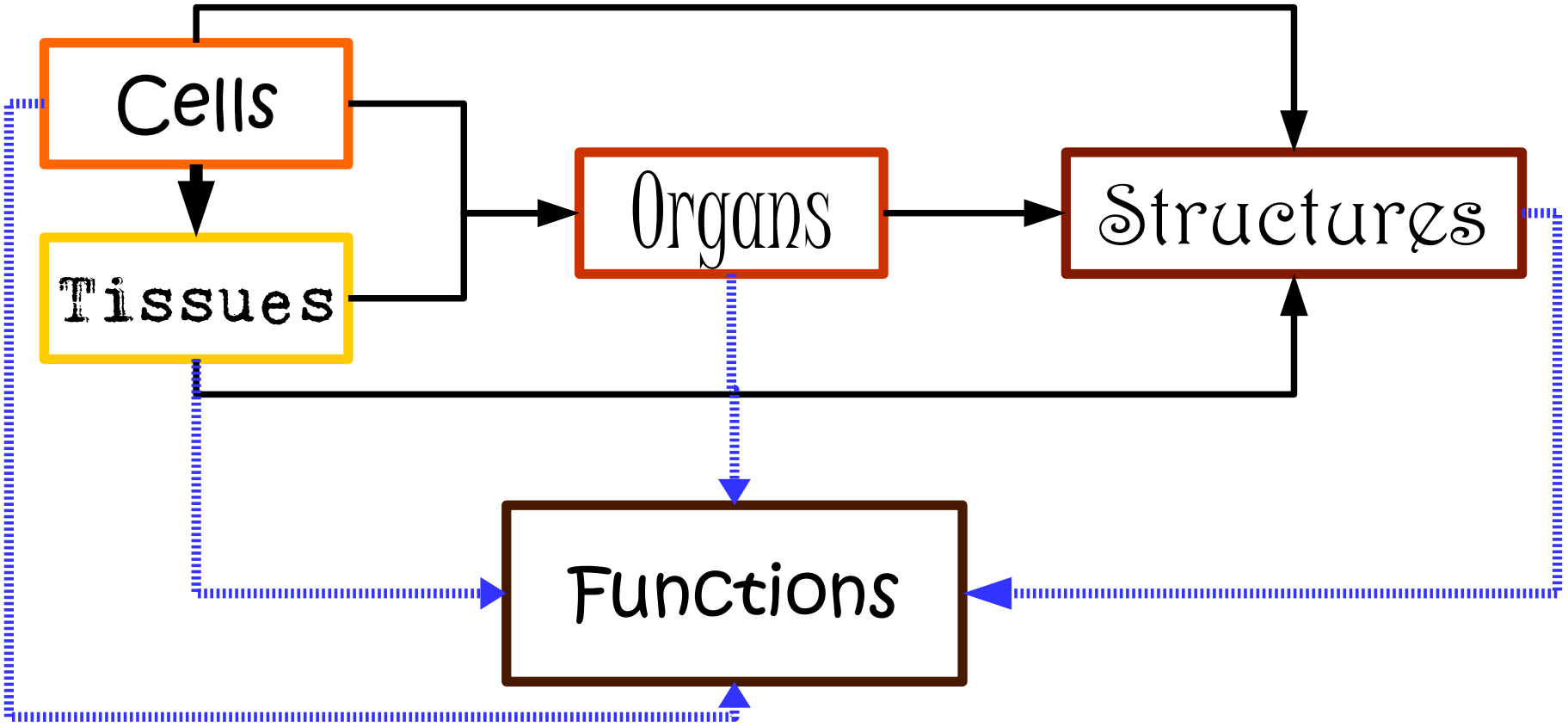
Portal triad



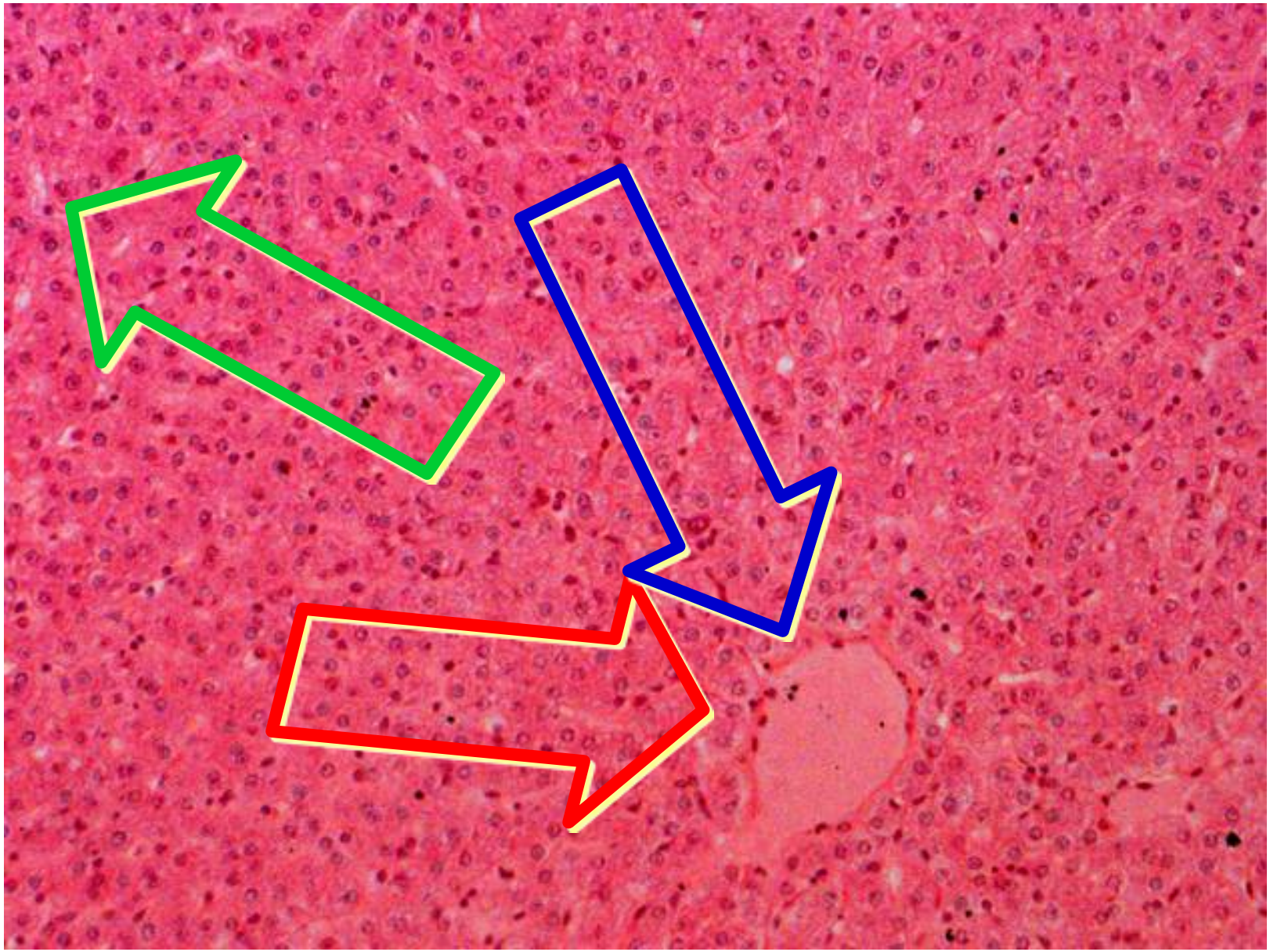
Portal triad



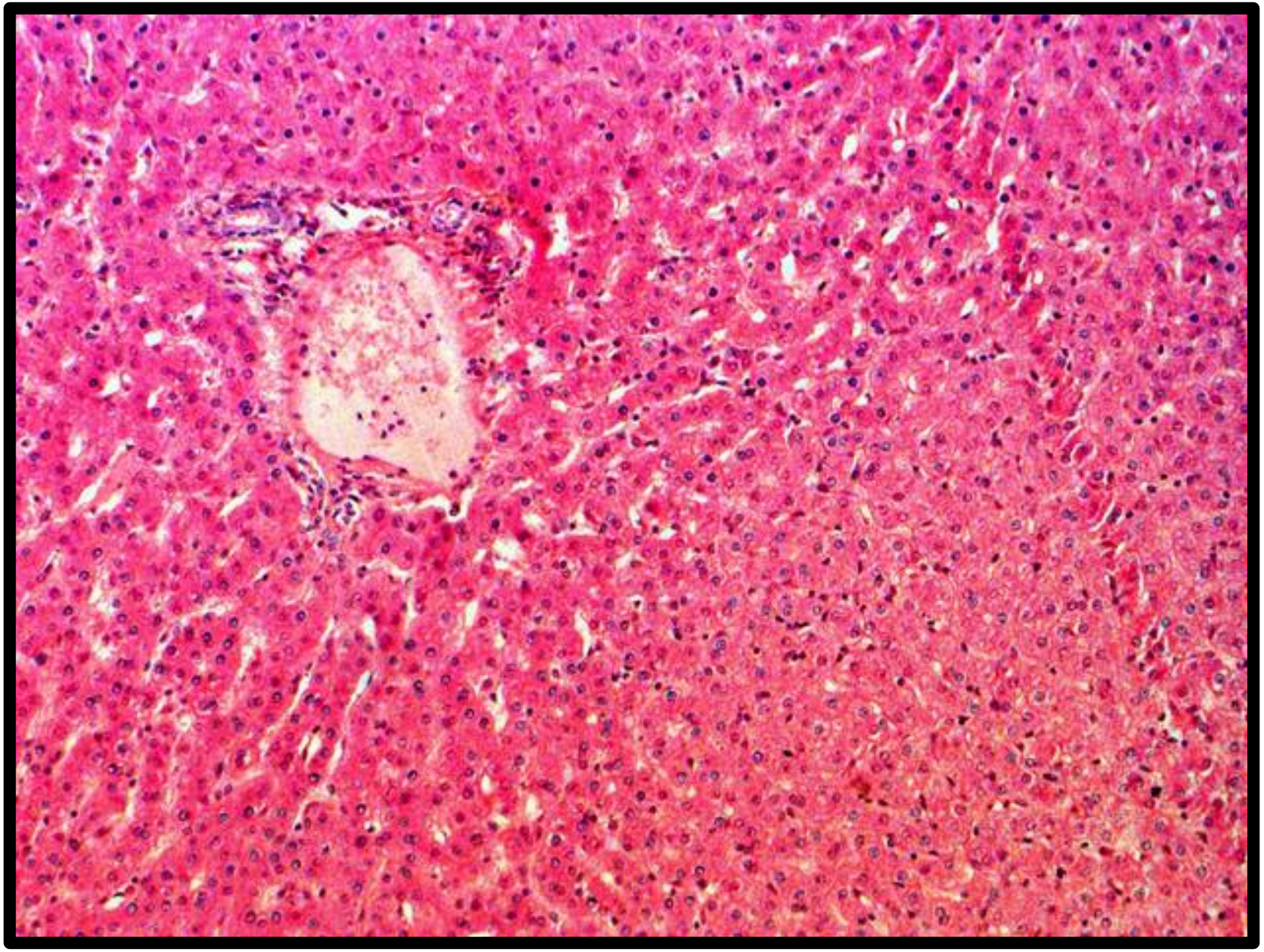
What stuff could there be?



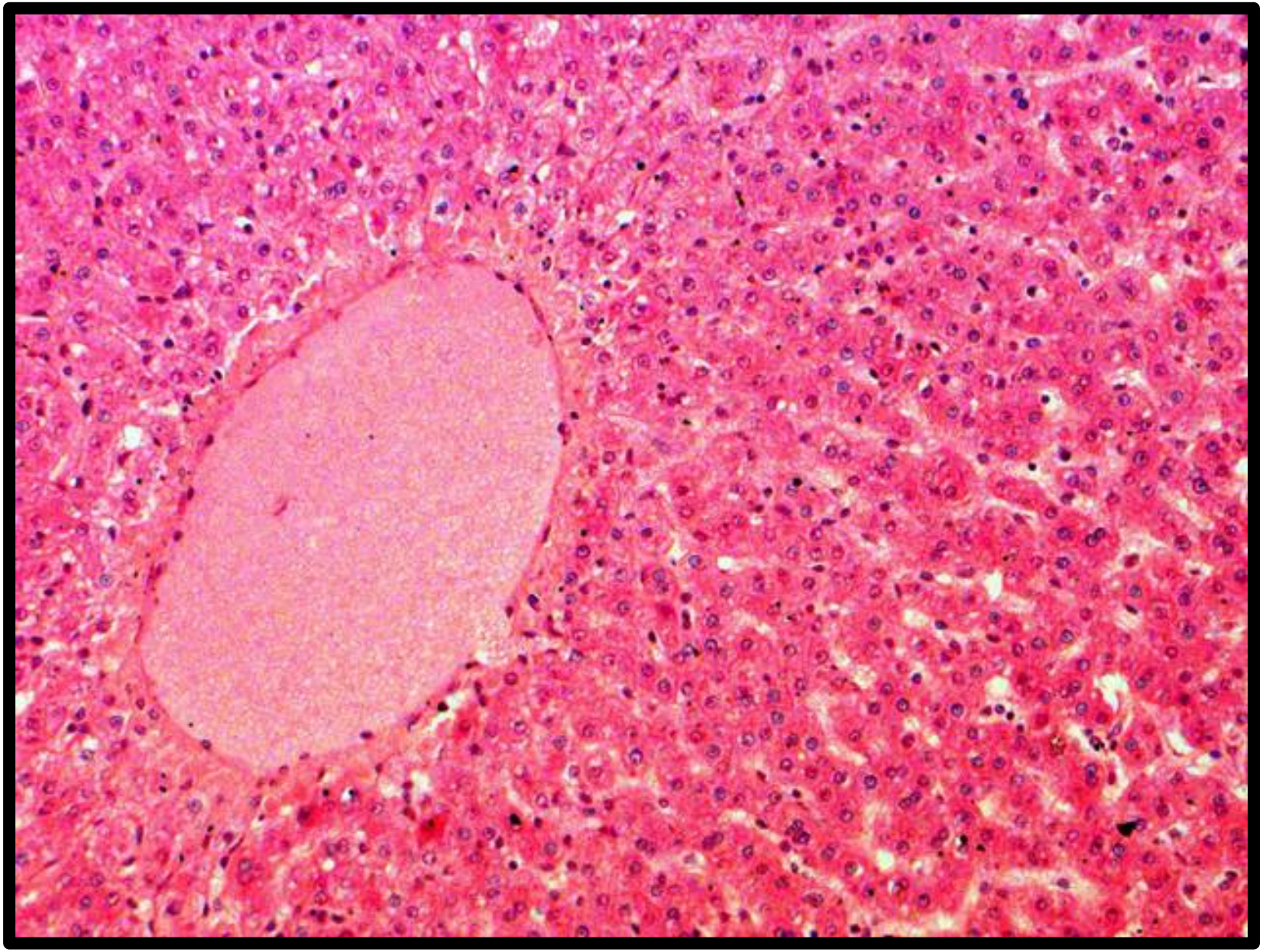
Central vein



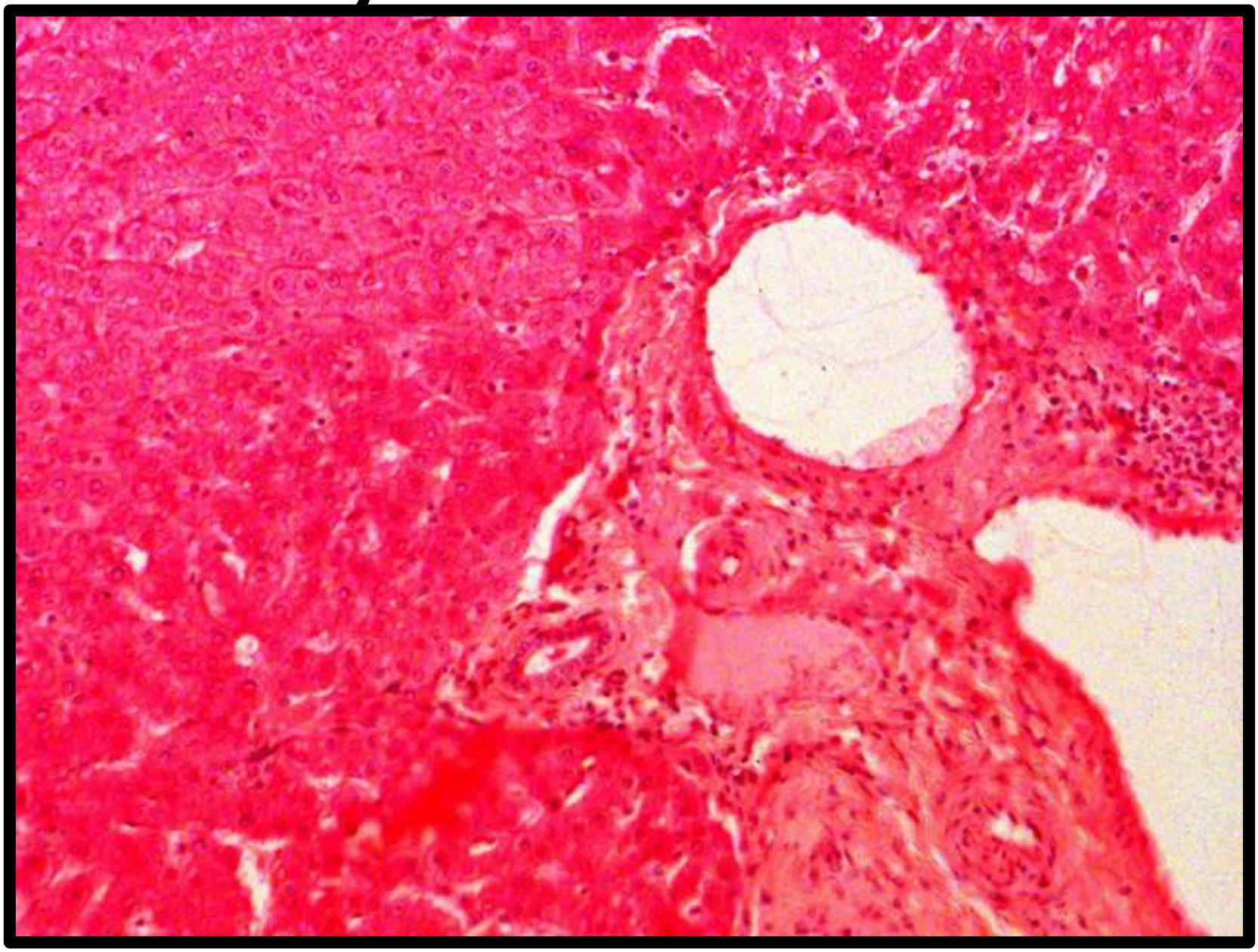
Portal triad

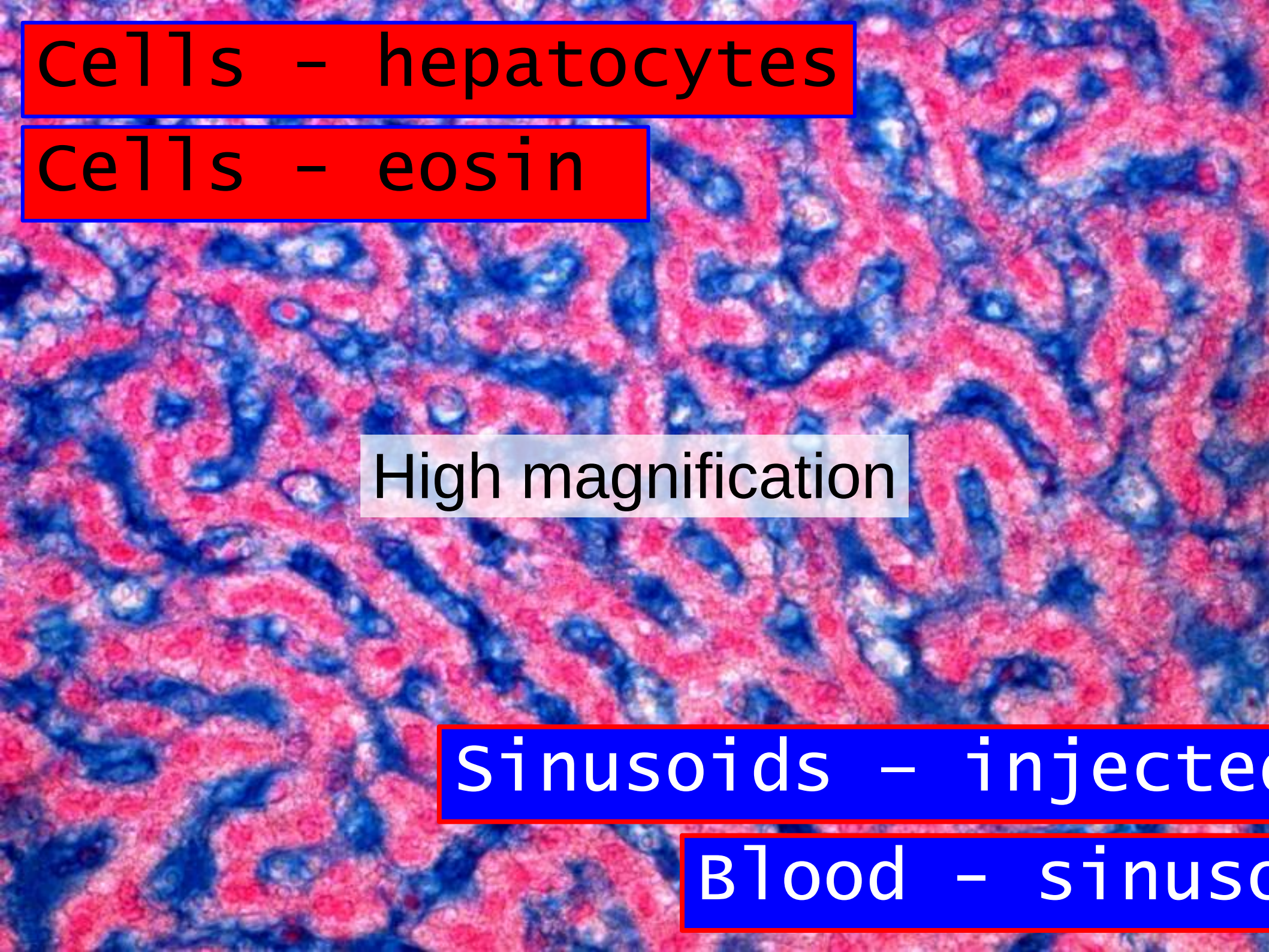


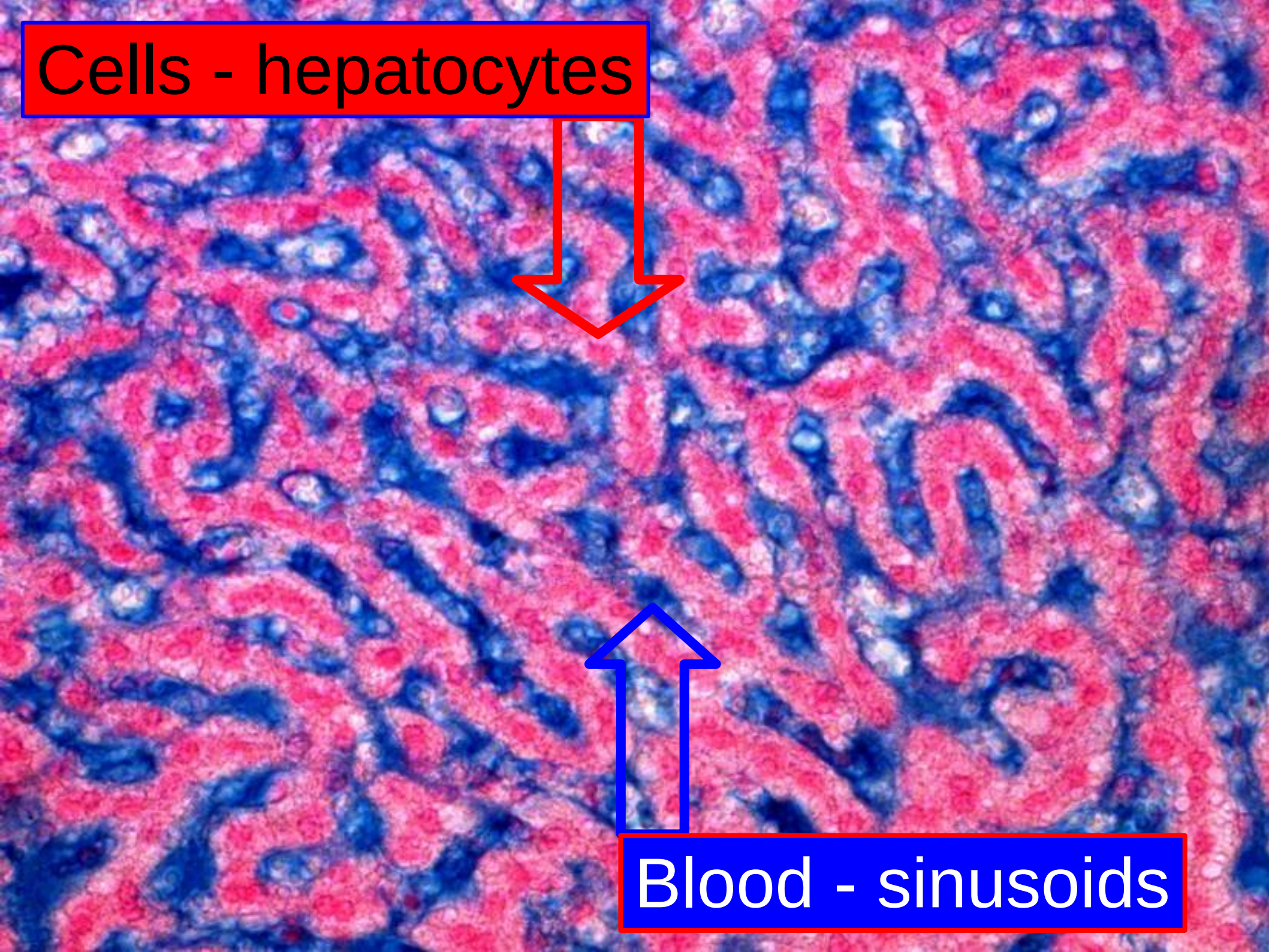
Portal vein

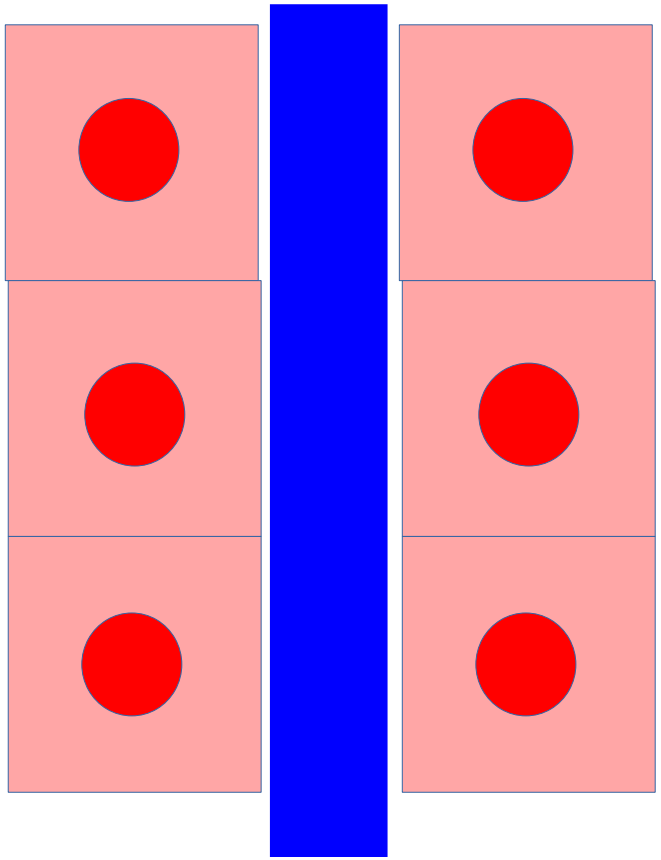


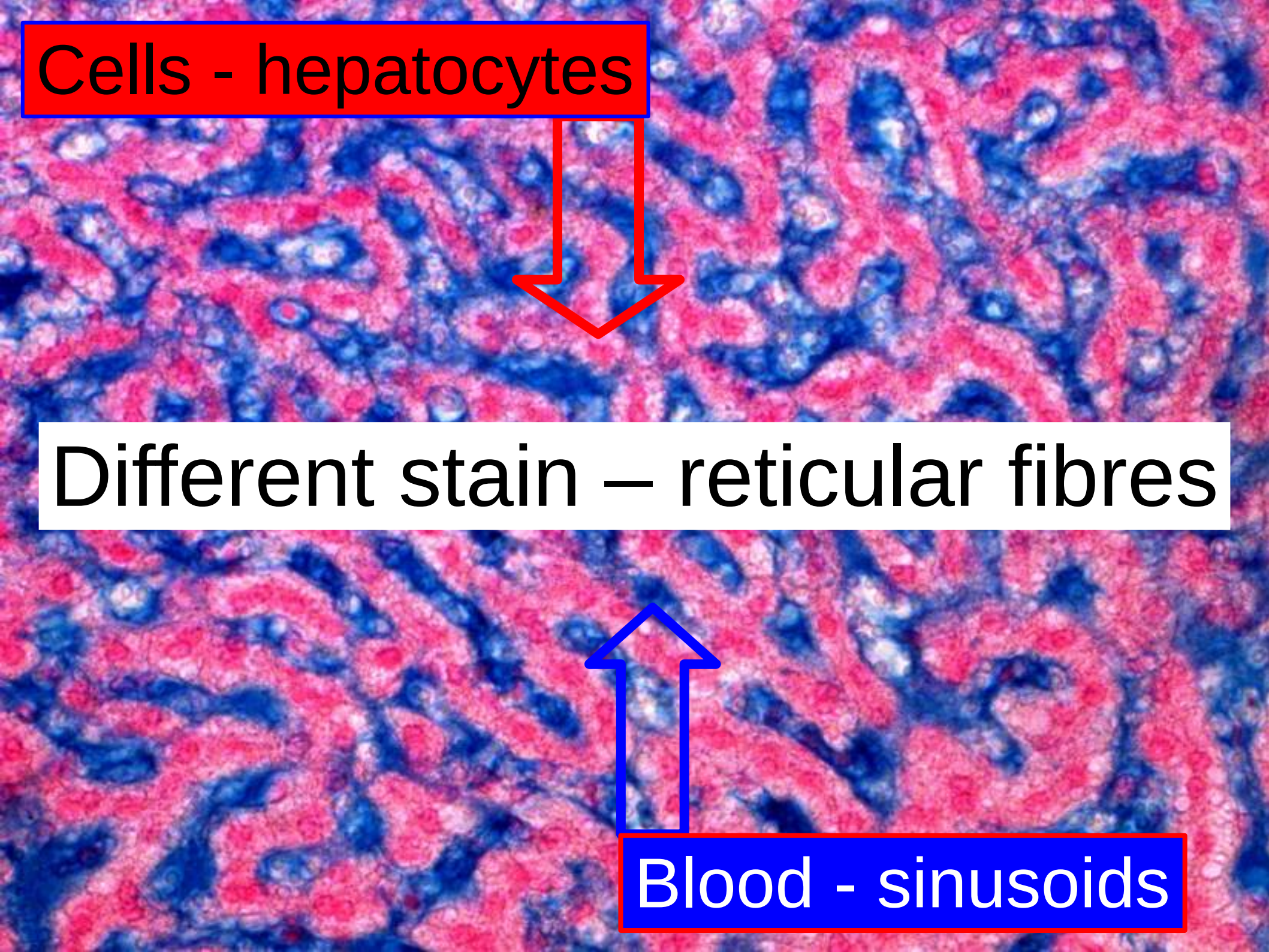
Portal triad – larger branches

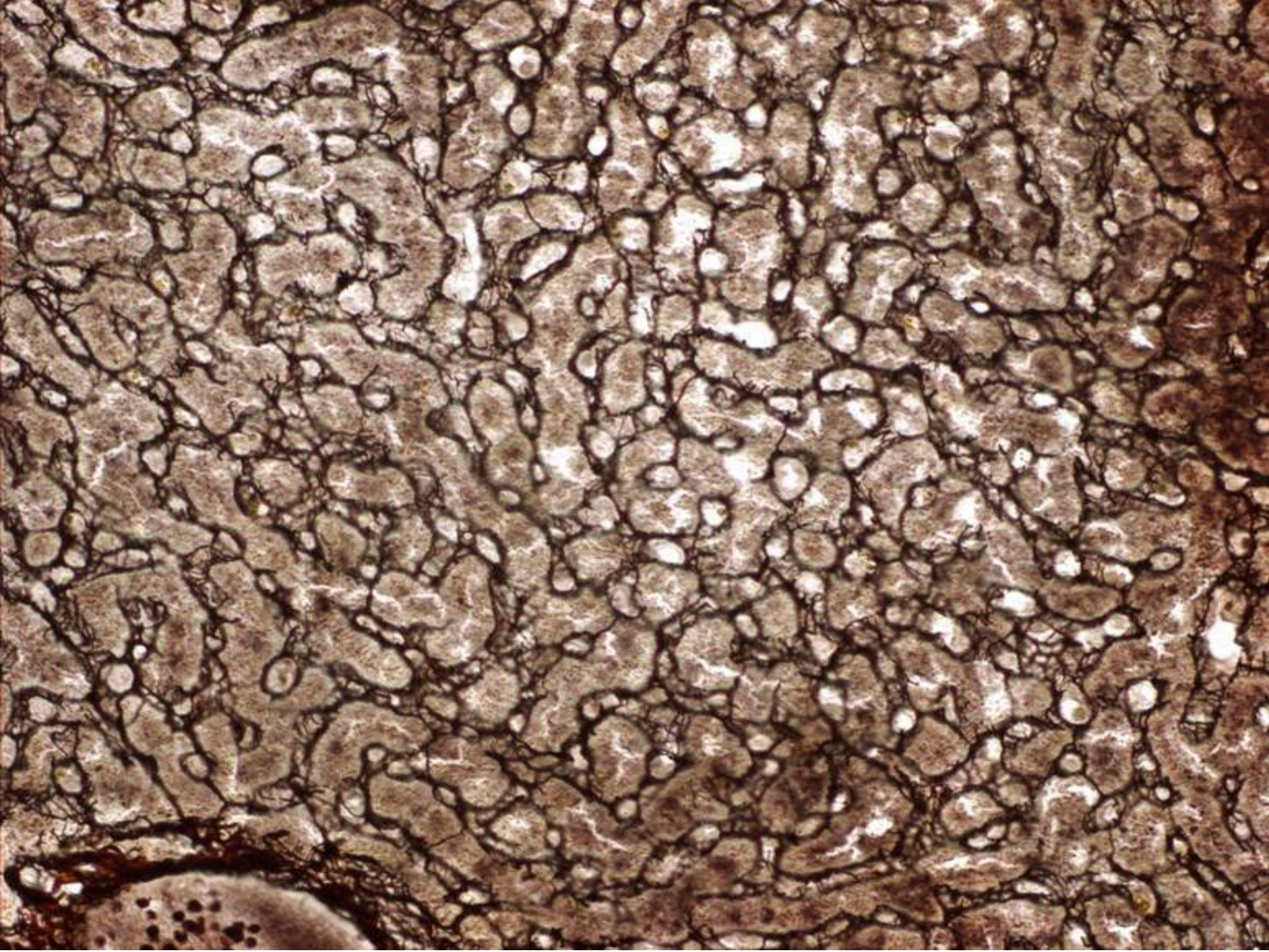


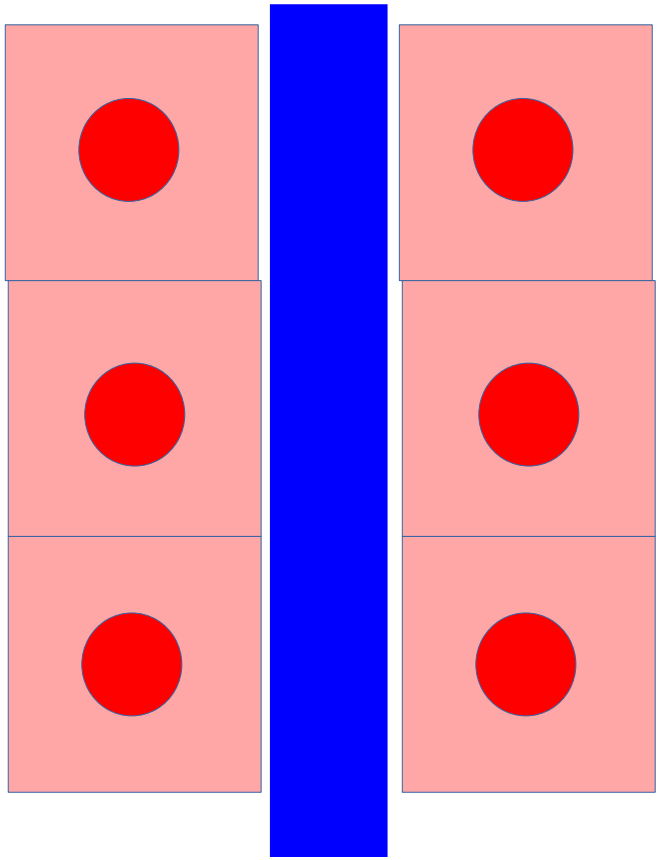

Cells - hepatocytes
Cells - eosin
High magnification
Sinusoids – injecte
Blood - sinuso

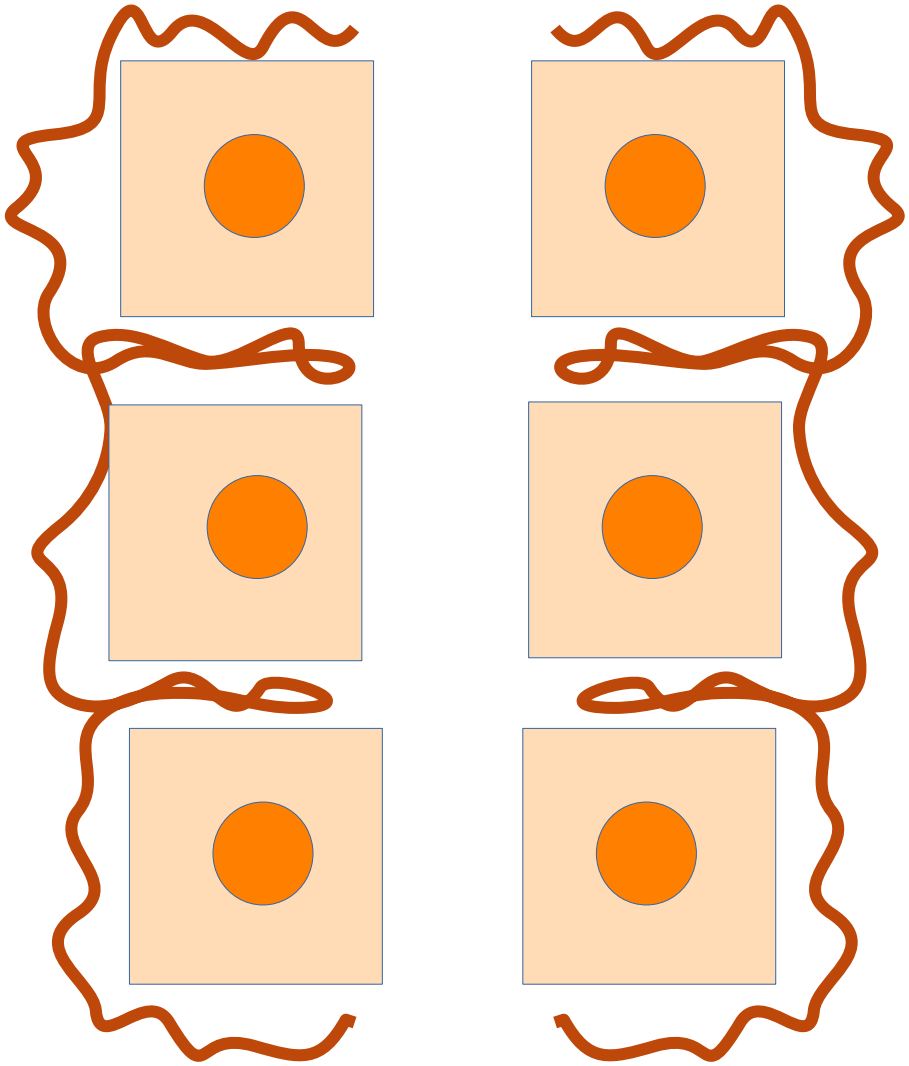

Cells - hepatocytes
Blood - sinusoids

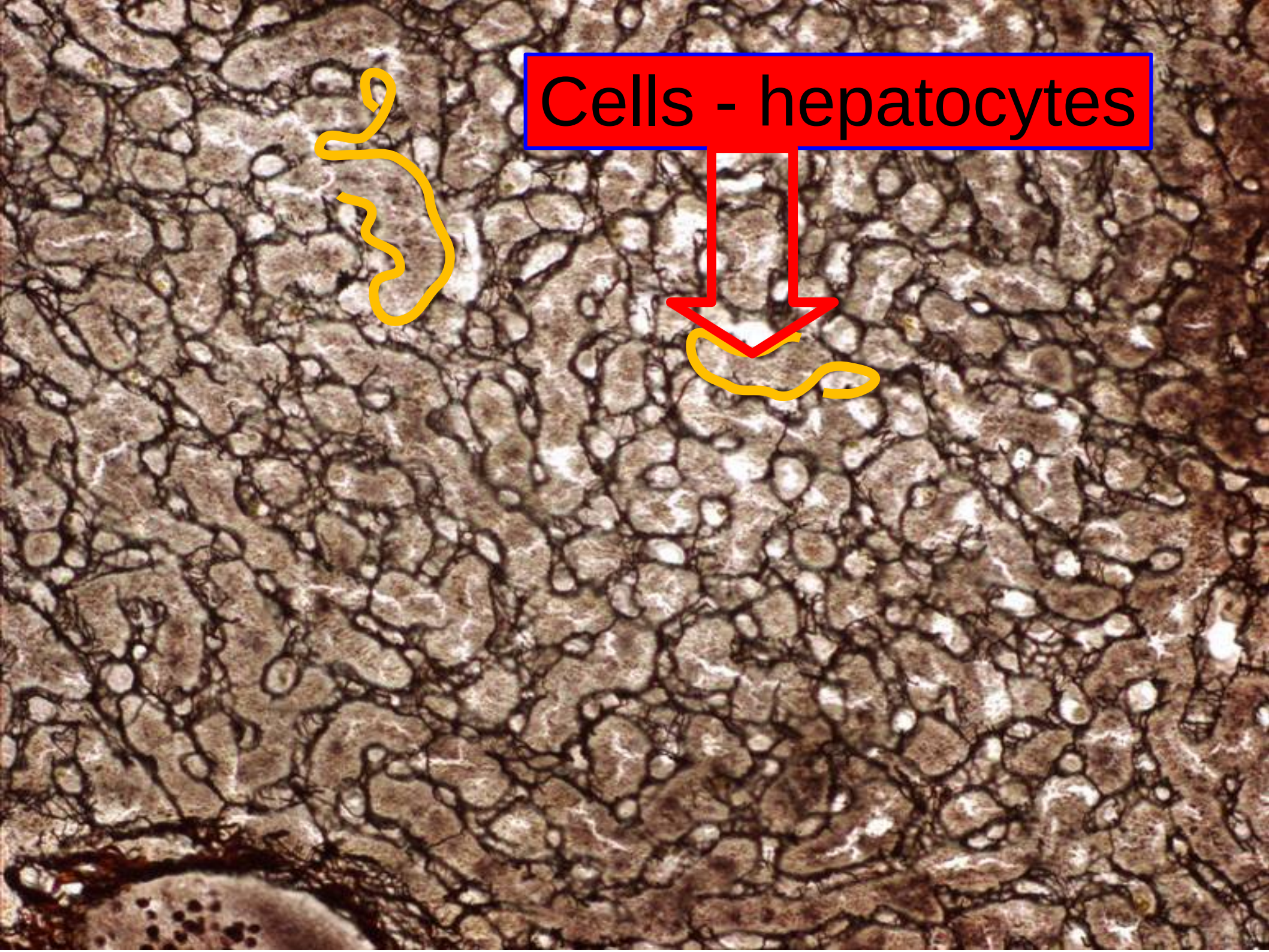



Cells - hepatocytes
Different stain – reticular fibres
Blood - sinusoids








Cells - hepatocytes

Traumatic events in the liver

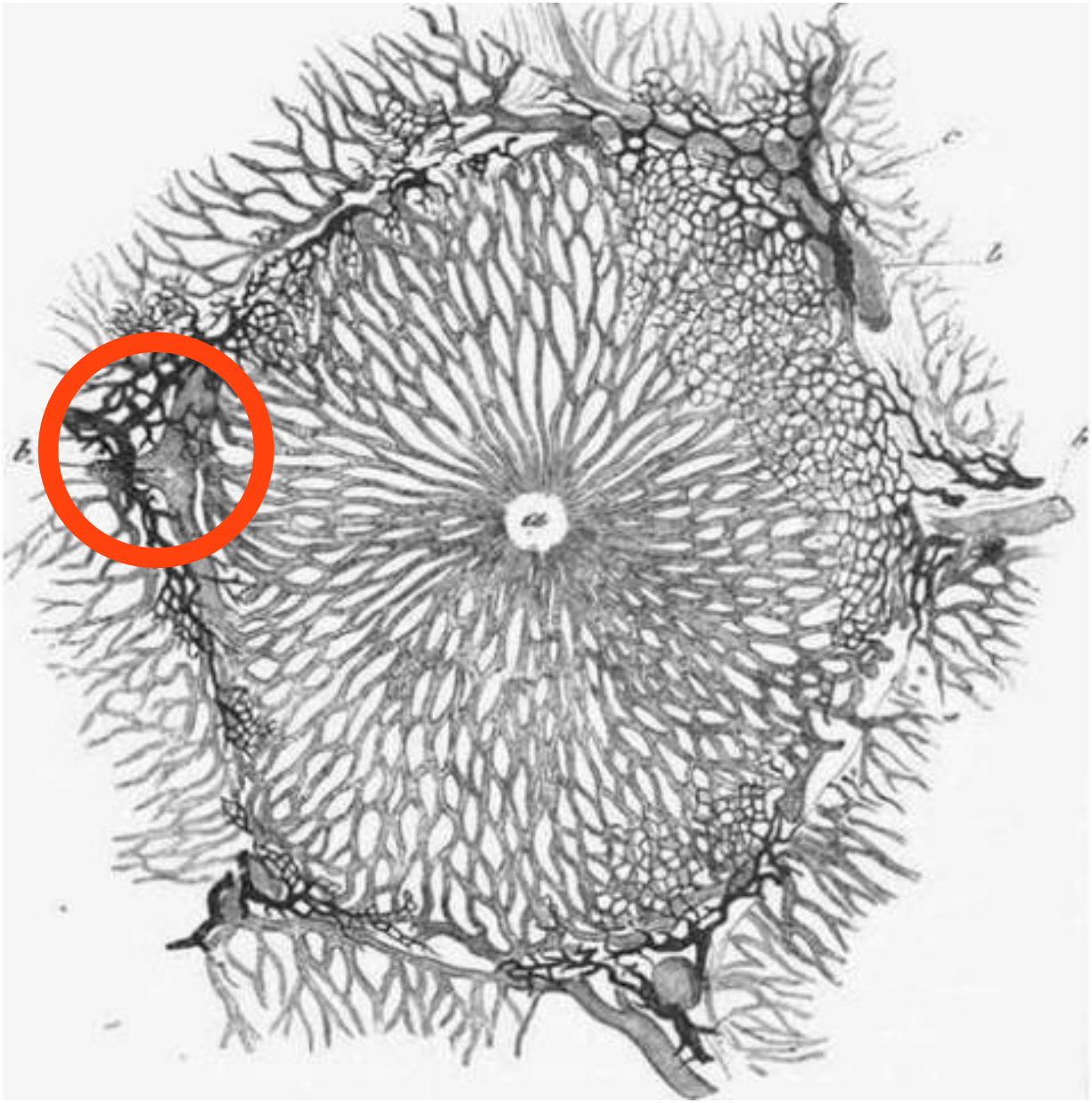
Illustrate the damaged area of Liver acinus

Visible histologically

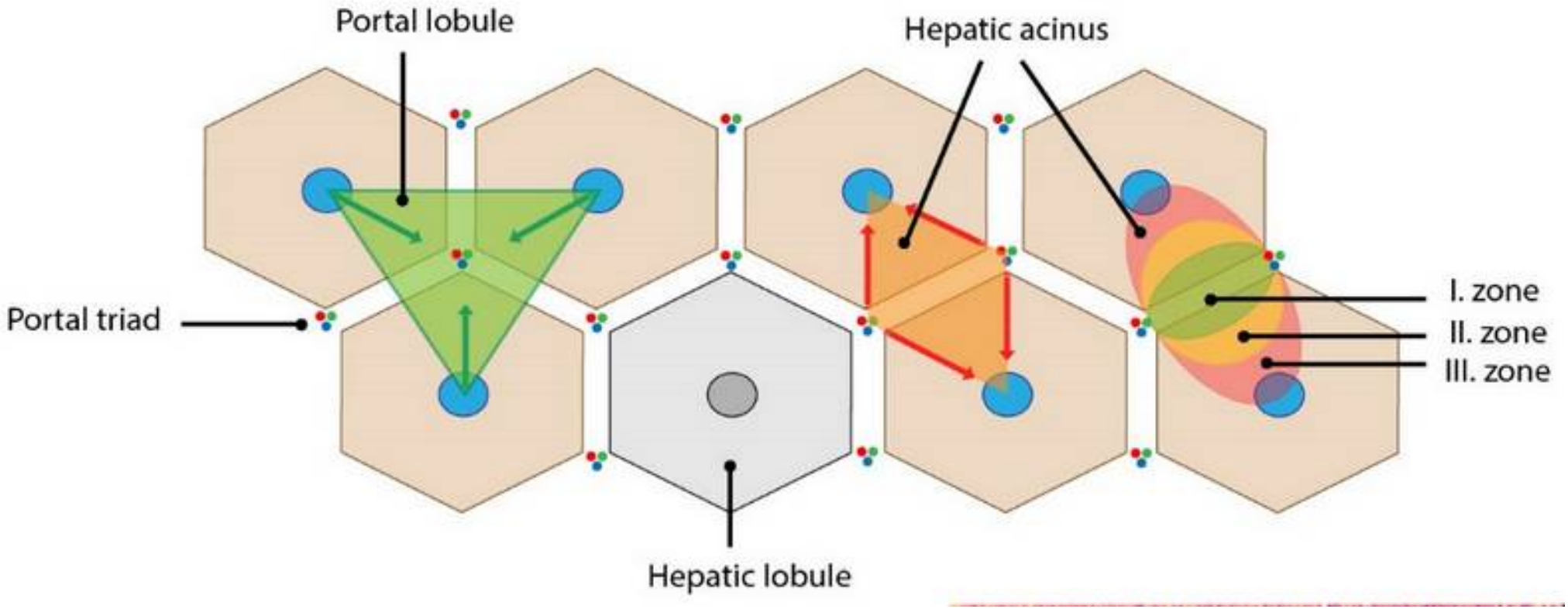
Caused By Various Agents / Diseases

- Describe the mechanism
- Identify and explain the area
- Indicate zones of damage on black and white sketch
- Correlate with slide

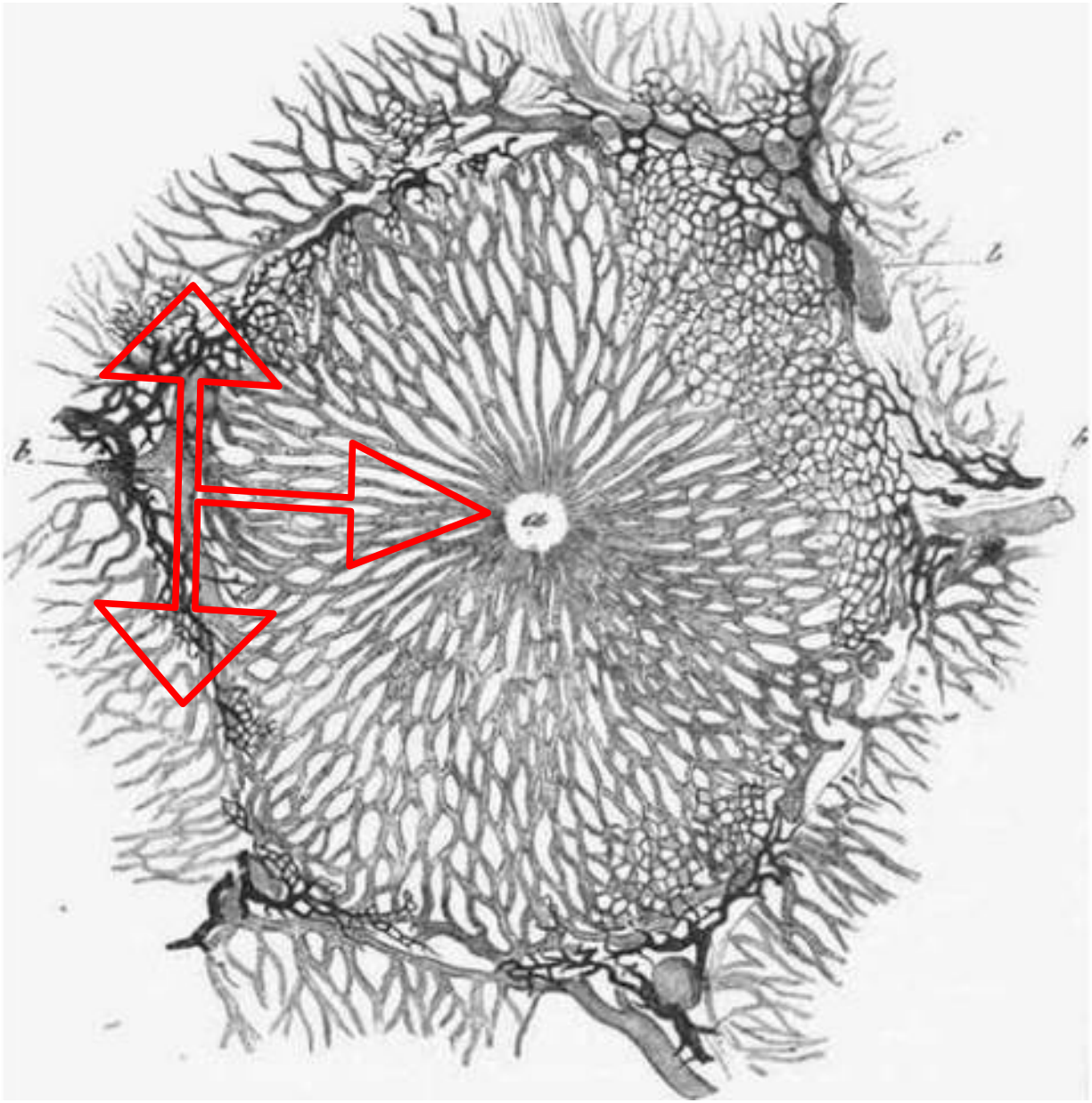
Liver damage



Liver damage



Liver damage



Toxic substances

Indicate areas sensitive to ingested toxic substances.

Ischemia

Indicate areas sensitive to ischemia.

Oxygen

Indicate areas least sensitive to ischemia.

Pathogens

Indicate areas susceptible to viral hepatitis.

Medication

Indicate areas susceptible to paracetamol.

Iron

In which area does haemosiderin accumulate?

Pathology

In which area will *Flavivirus* cause necrosis?