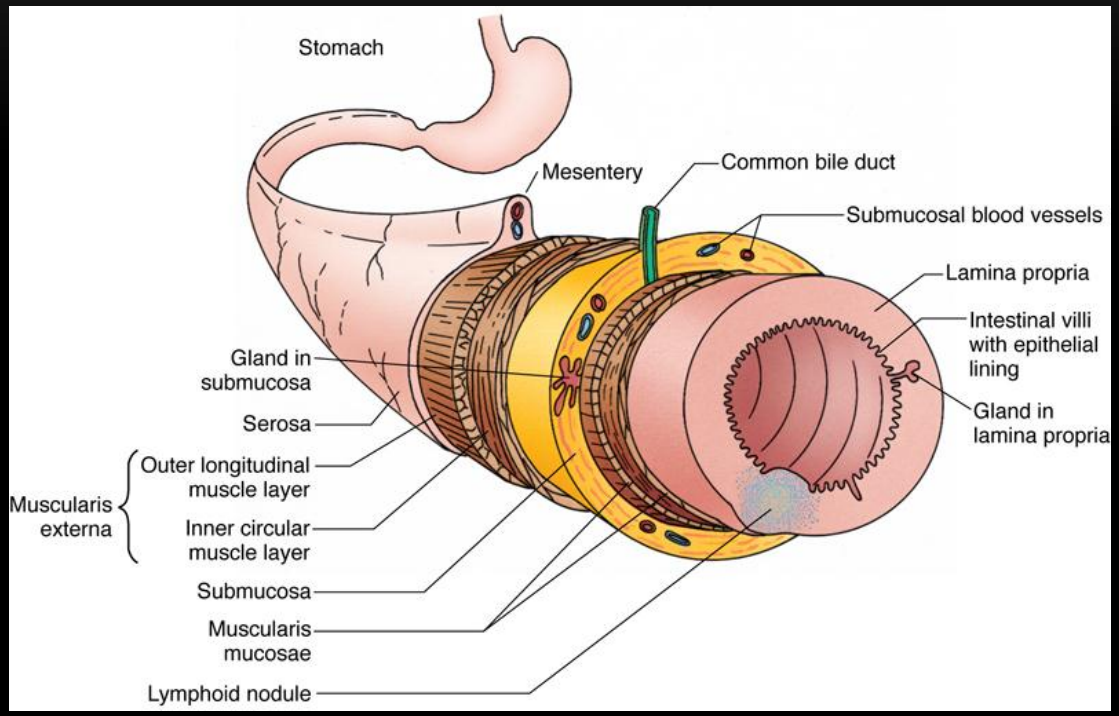
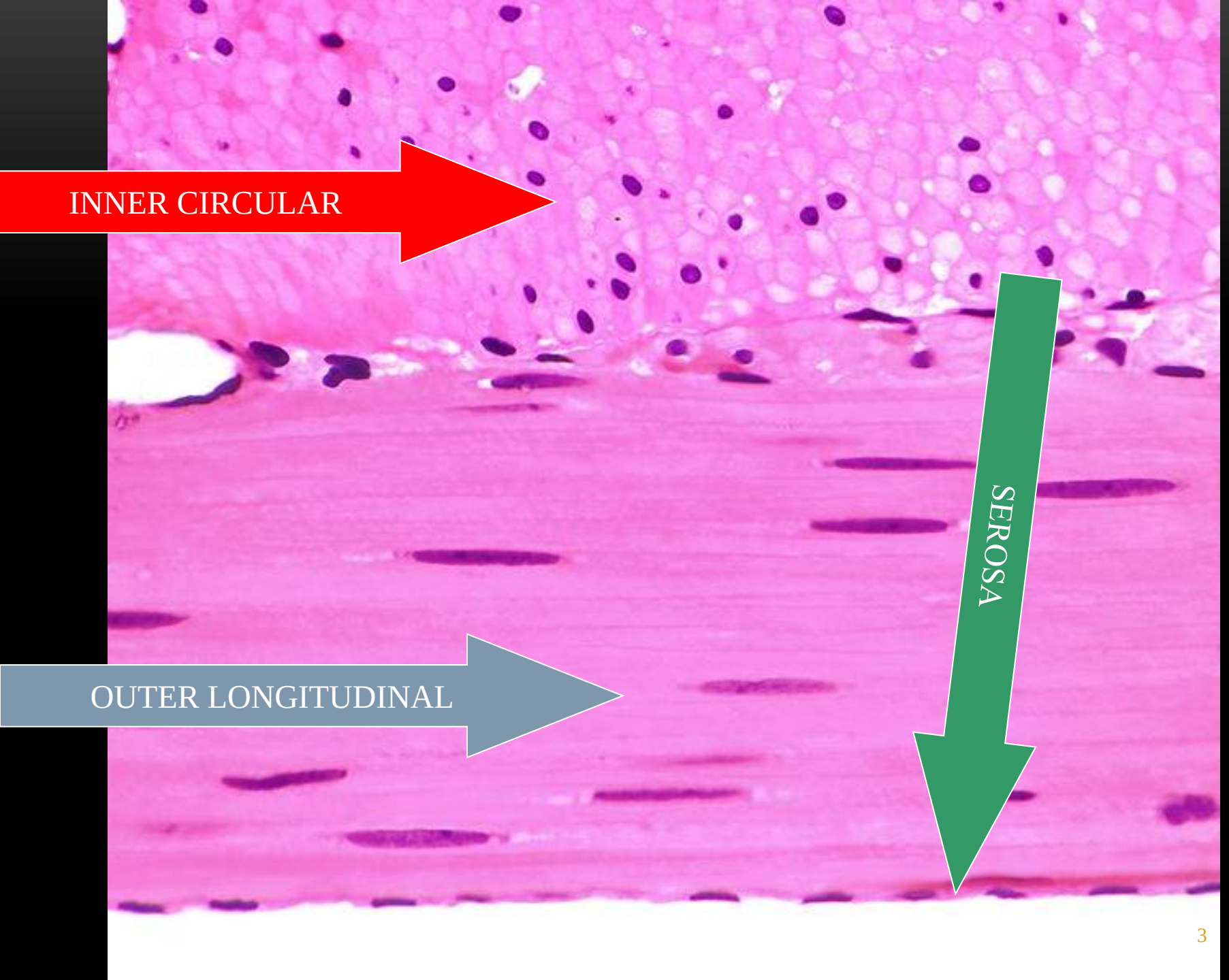
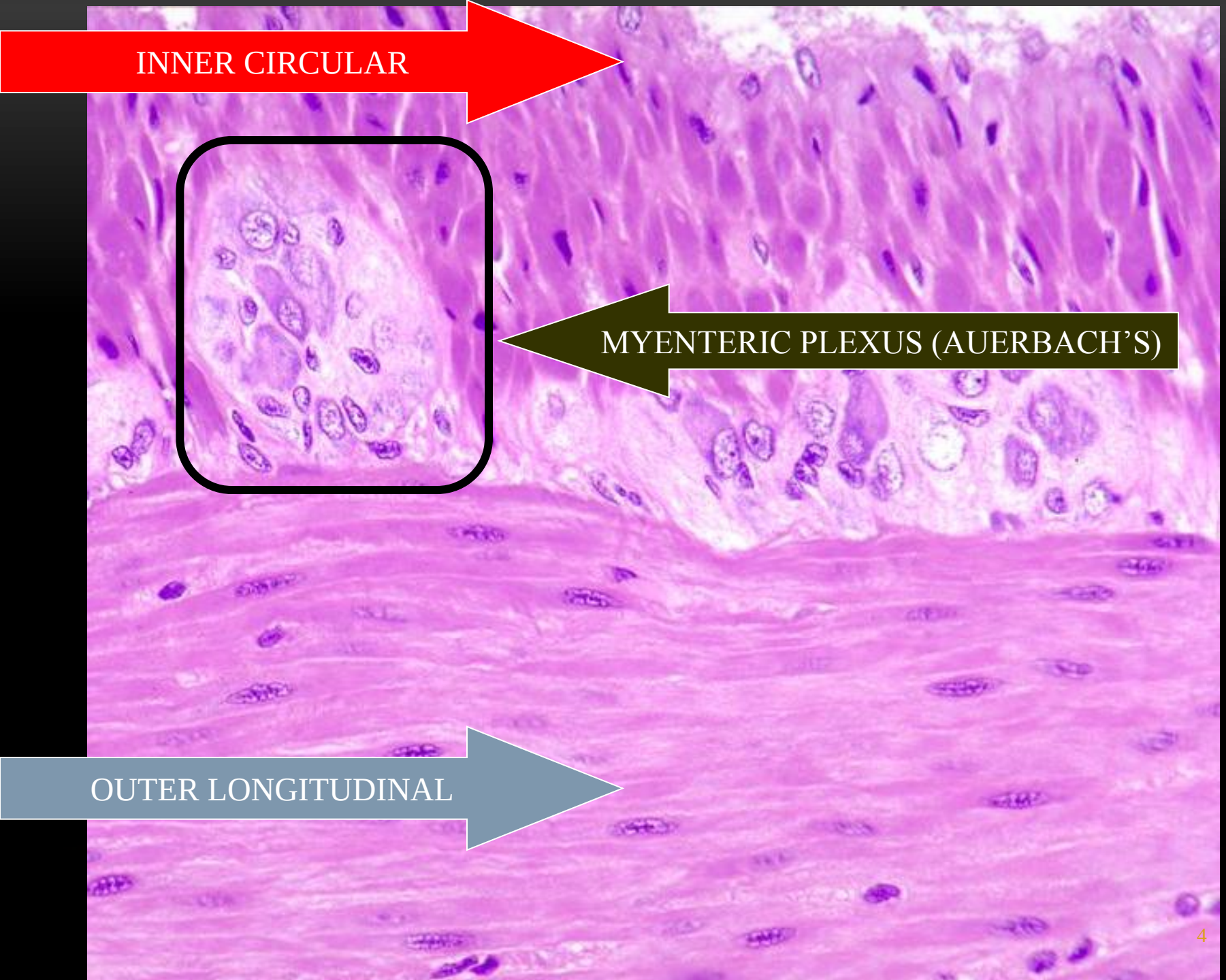
Histology of the Digestive System

THE WALL OF THE ALIMENTARY TRACT:

- **Mucosa**:
  - Epithelium
  - Lamina propria
  - Muscularis mucosa
- **Submucosa**:
  - Connective tissue
  - Submucosal plexus (Meissner's plexus).
- **Muscularis externa**:
  - Inner circular
  - Outer longitudinal
  - Auerbach's myenteric plexus.
- **Serosa or adventitia**




INNER CIRCULAR
OUTER LONGITUDINAL
SEROSA


INNER CIRCULAR
MYENTERIC PLEXUS (AUERBACH'S)
OUTER LONGITUDINAL

NEW TERMS

- Villi
- Plica Circularis
- Parietal (Oxyntic) cells
- Chief (Zymogenic) cells
- Paneth cells
- Brunners' glands
- Crypts of Lieberkuhn

ESOPHAGUS

Fibromuscular tube extending from the pharynx (C6) to the stomach (T12).

Enters the superior mediastinum between the trachea and vertebral column.

Inclines to the left at its beginning, pushed to the midline in the superior mediastinum.

Epithelium:

- Stratified squamous non-keratinized epithelium.
- Langerhans cells are present in the epithelium.
- The epithelium distends during swallowing.

Lamina propria:

- Contains **esophageal cardiac glands** (mucus) in its upper and lower parts.

Muscularis mucosa:

- Contains one layer of longitudinal fibres.
- Becomes more thick near the stomach.

Submucosa:

- Dense fibroelastic connective tissue.
- Contains esophageal glands proper.
  - Tubular glands contain two types of cells:
    - Mucous: basal flat nucleus, apical mucous
    - Serous cells: round central nucleus, contain pepsinogen and lsozyme.

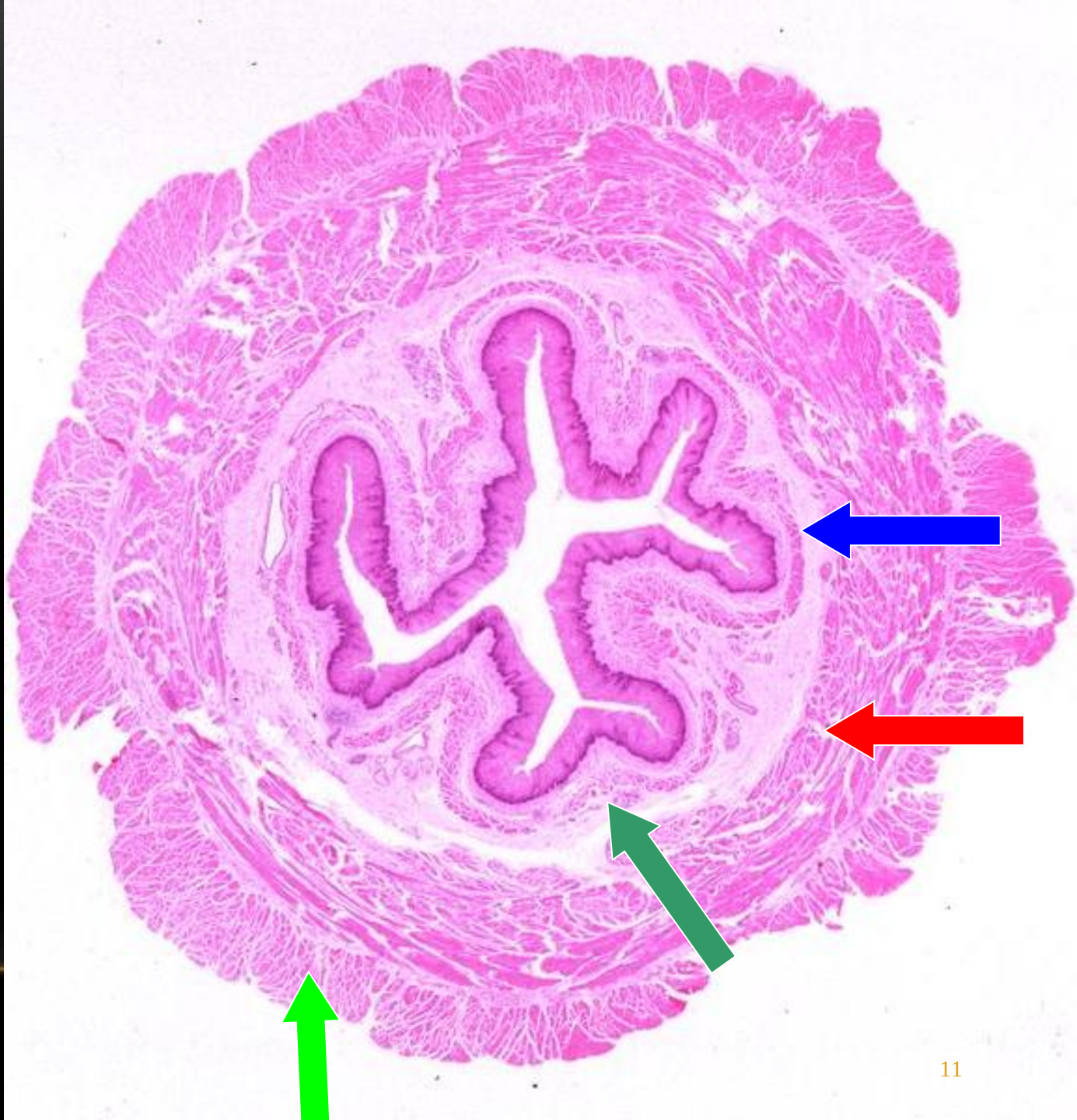
Muscularis externa:

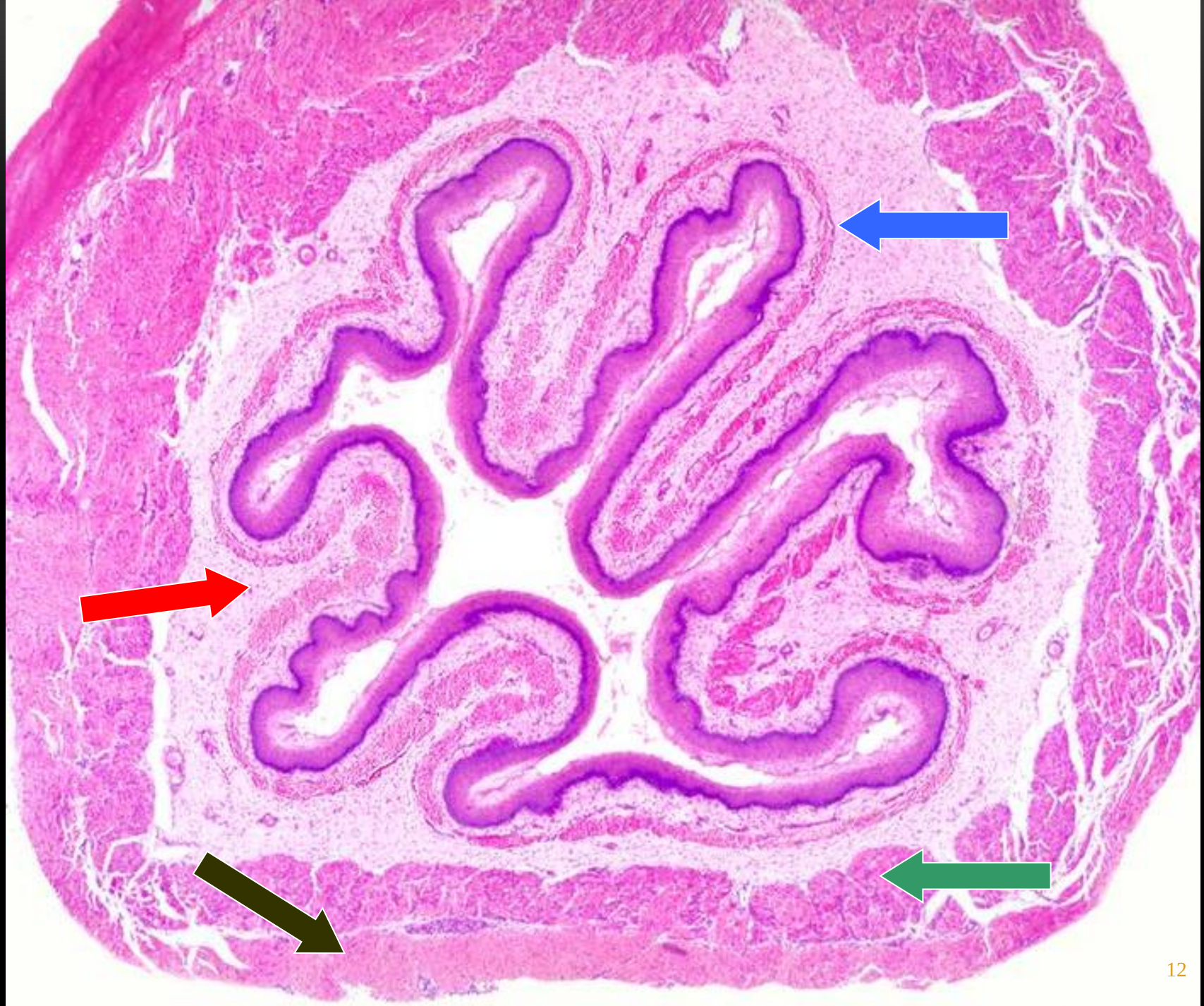
- Inner circular and outer longitudinal.
- Skeletal muscle in the upper third.
- Skeletal and smooth muscles in the mid third.
- Smooth muscles in the lower third.

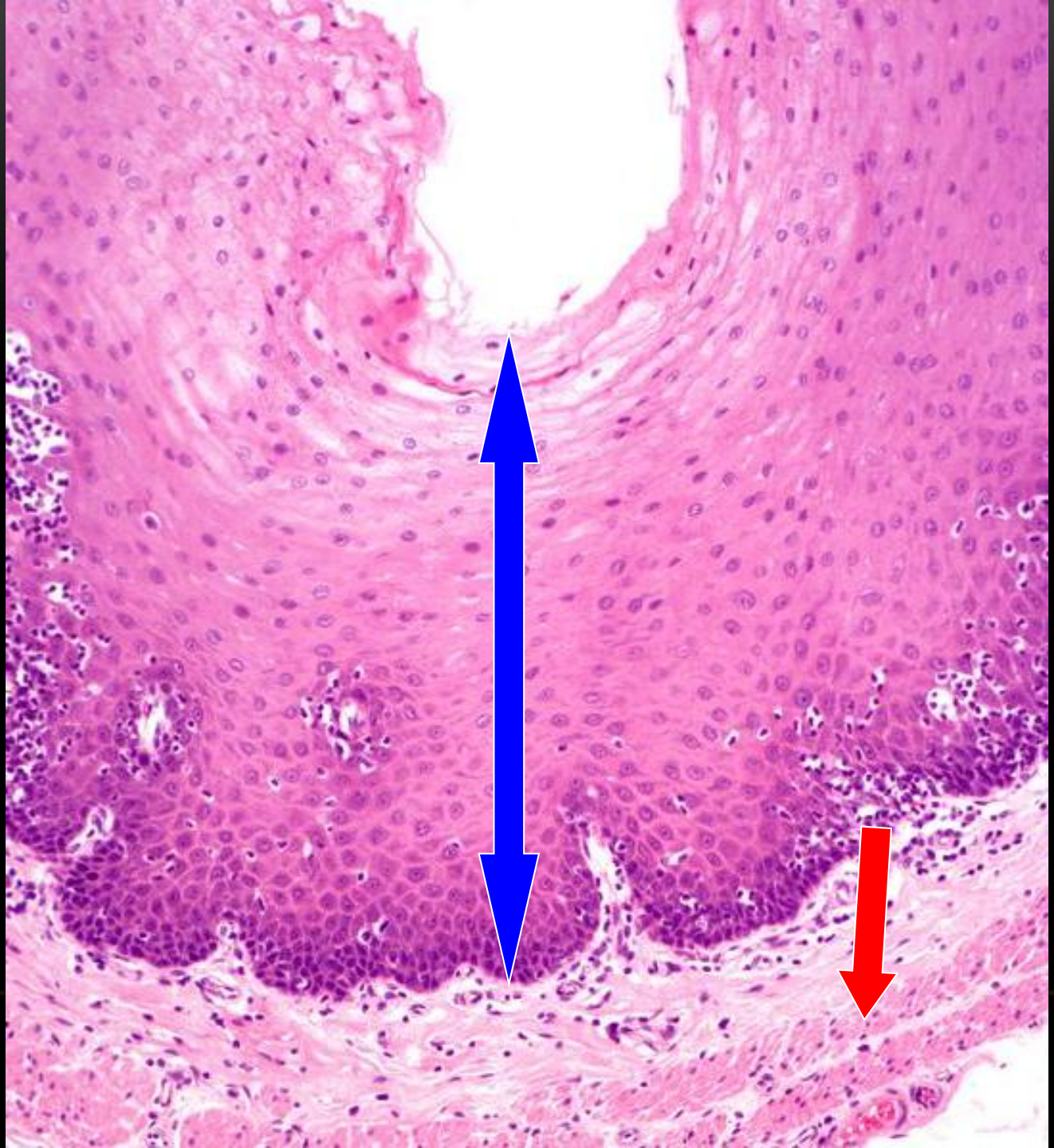
Serosa and adventitia:

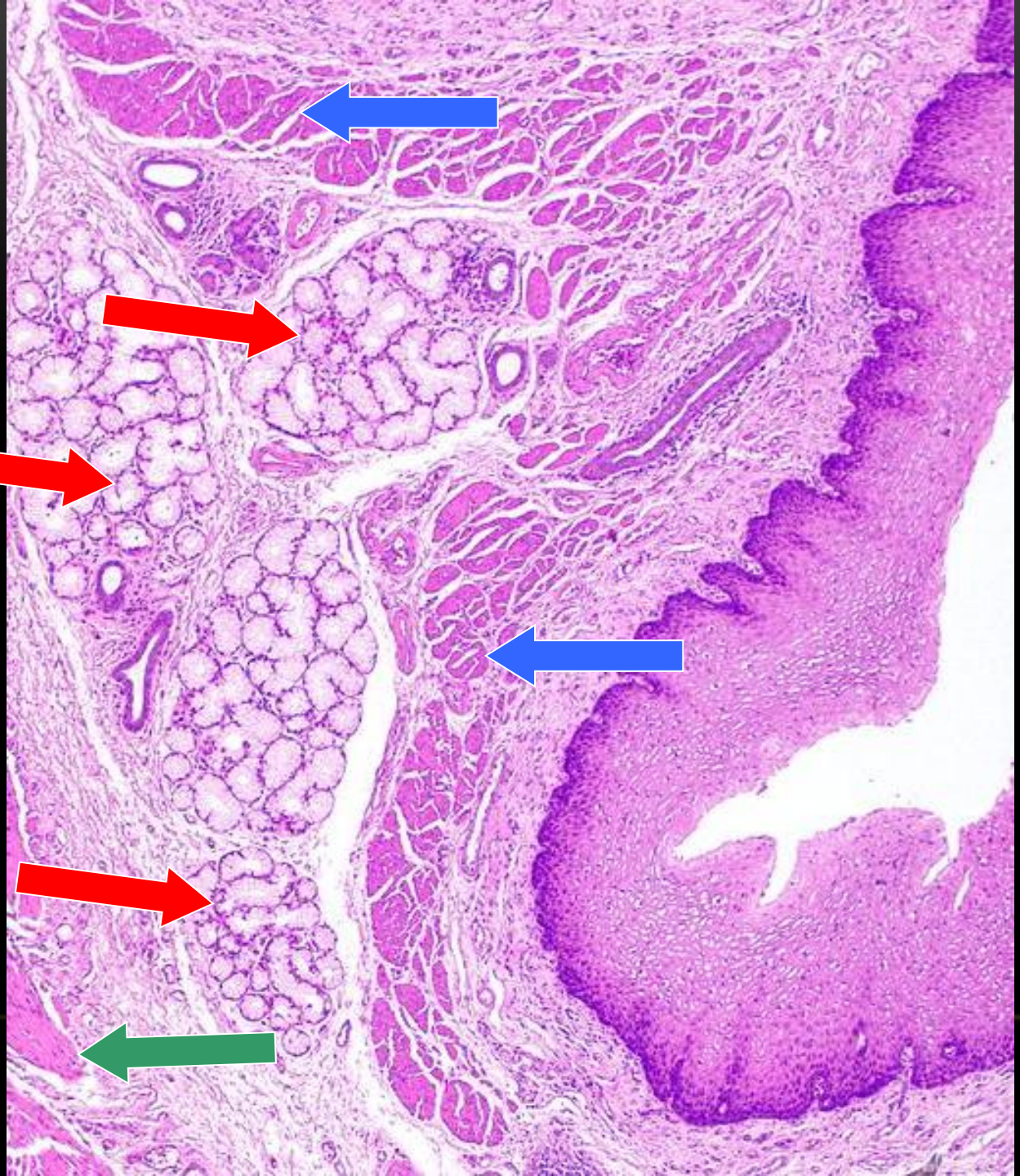
- Adeventitia all through.
- Serosa in the intra abdominal part only.

Esophagus

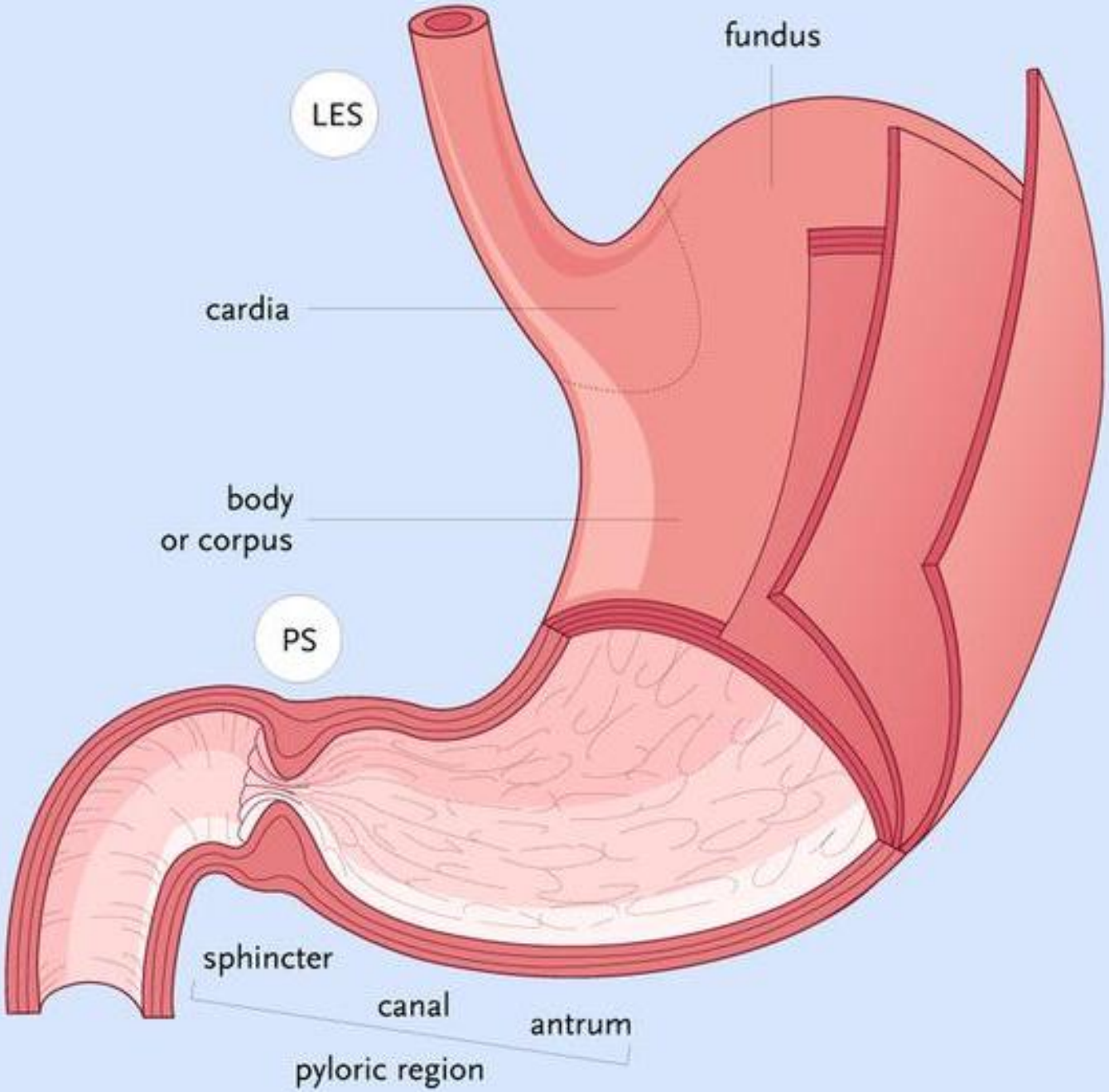








STOMACH


fundus
LES
cardia
body
or corpus
PS
sphincter
canal
antrum
pyloric region

Histologically is formed of 3 parts:

- Cardiac region
- Fundus
- Pylorus

Fundus of the Stomach - Mucosa

Epithelium: simple columnar epithelium:

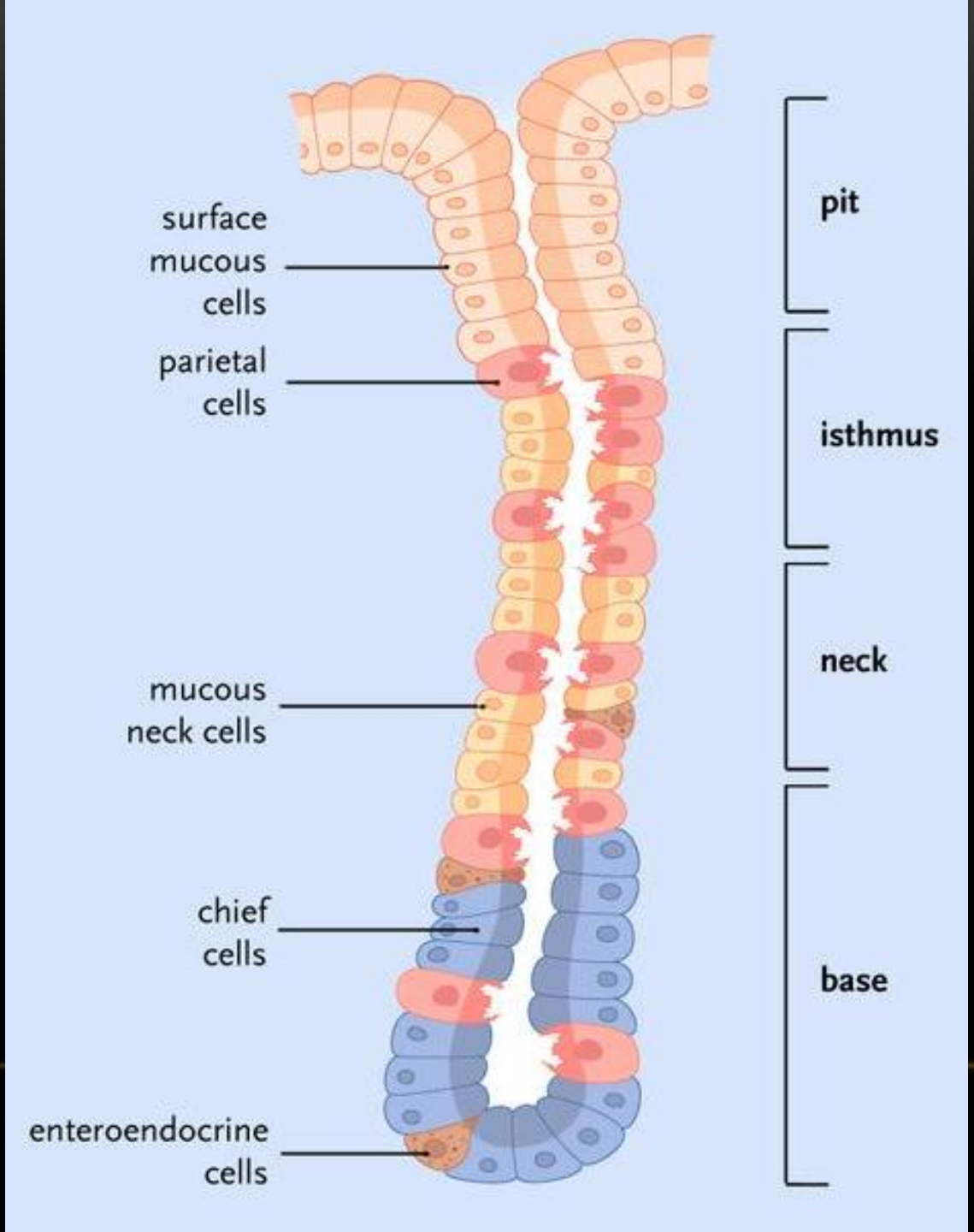
- **Surface mucus cells**: secrete visible mucus that traps HCO_3 and maintains ~ neutrality.
- **Stem (regenerative) cells**: present in the basal part of the gastric pits.

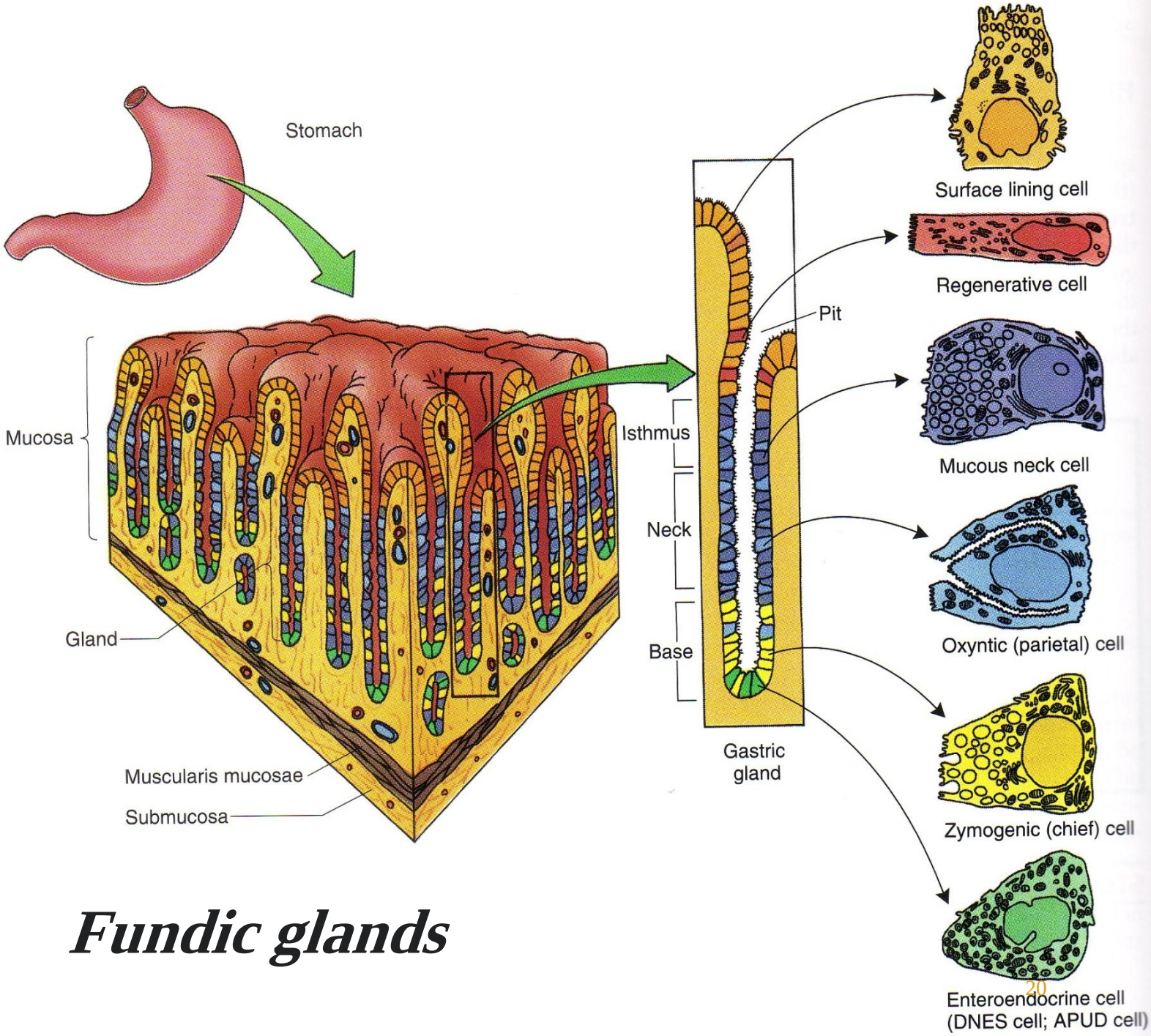
Lamina propria:

- Highly vascularized loose connective tissue.
- Infiltrated by WBC's, plasma cells, fibroblasts, and occasional smooth muscles.
- Occupied by ***fundic glands***.

Muscularis mucosa:

- 2- 3 of smooth muscle fibres


surface mucous cells
parietal cells
mucous neck cells
chief cells
enteroendocrine cells
pit
isthmus
neck
base



Fundic glands

Fundic Glands

Extends from the gastric pit to the muscularis mucosa.

Divided into 3 regions:

- Isthmus
- Neck
- Base

Formed of 6 cell types.

Cells of Fundic Glands

Surface mucous cells

Mucous neck cells:

- Columnar and resemble surface cells.
- Produce soluble mucous.
- Nucleus: basally located.
- Cytoplasm: well developed Golgi, rER, basal mitochondria.
- Apical cytoplasm is filled with secretory granules.
- Their mucous secretion is water soluble.
- Shows tight junctions with nearby cells.

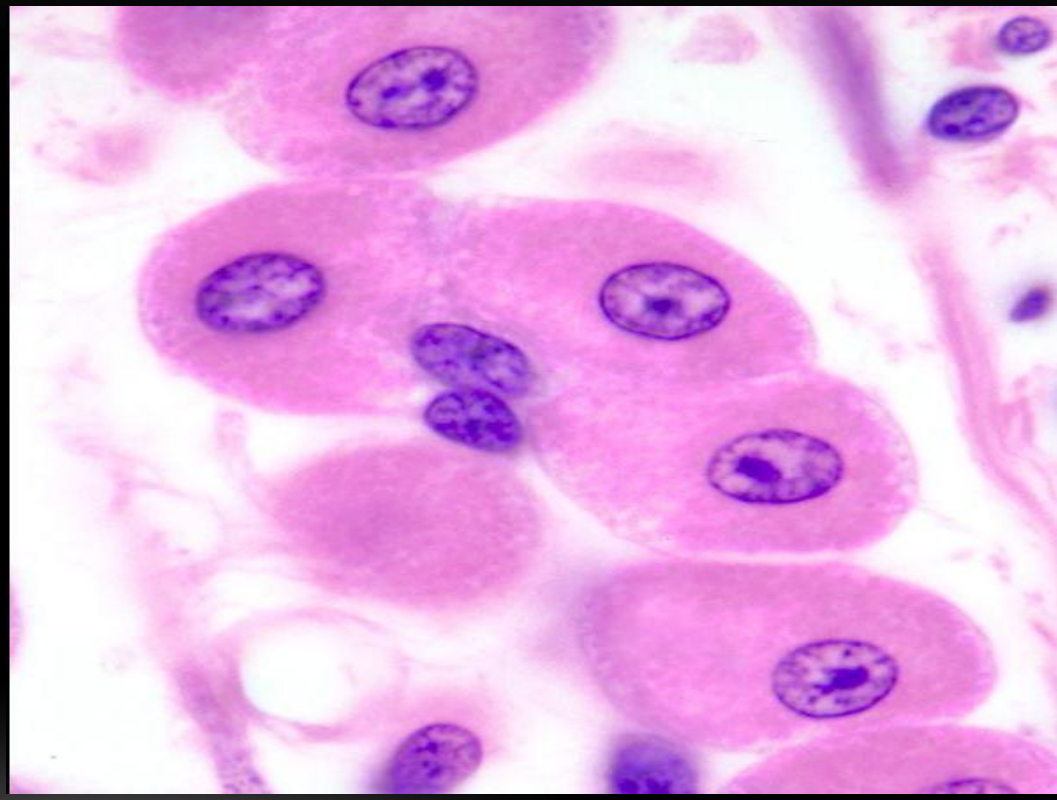
Cells of Fundic Glands

Stem cells:

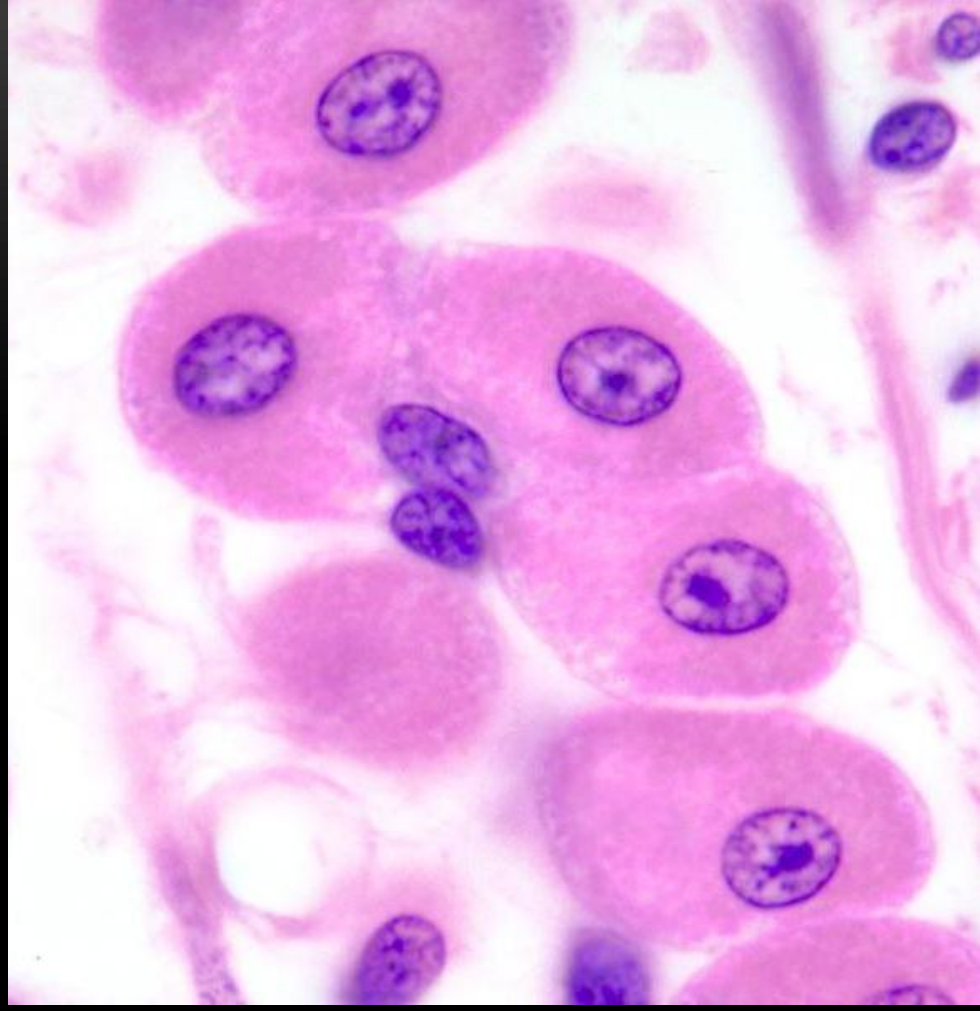
- Few in number, but with high regenerative power.
- Organelles are few except for many ribosomes.
- Nuclei are heterochromatic and basally located, with prominent nucleolus.
- Forms tight junctions with nearby cells.
- They replace all other cell types in the gland and on the surface.

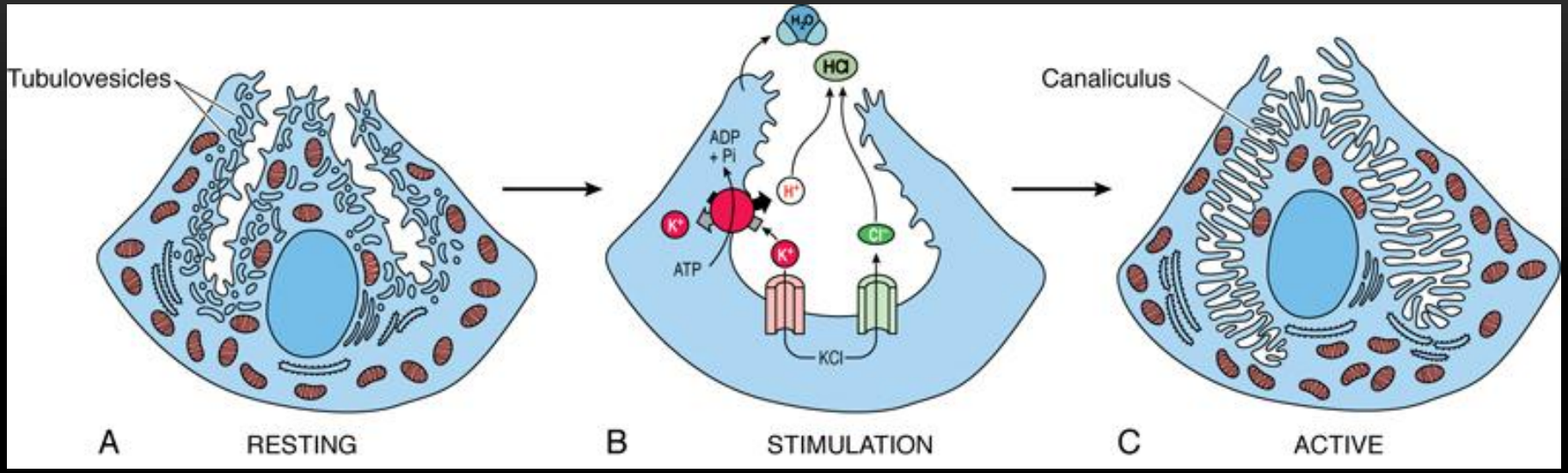
PARIETAL (OXYNTIC) CELLS

- Located in the upper ½ of fundic glands.
- They are large and occupy a peripheral position.
- Secrete HCl and gastric intrinsic factor.
- Have round basal nuclei.



- Cytoplasm: **eosinophilic.**
- **Intacellular canaliculi with microvilli**.
- The cytoplasm around canaliculi is rich in tubular vesicles.
- Cytoplasm is rich in mitochondria, few rER, and small Golgi.





- Tubulovesicular system varies with HCl secretory activity.
- ↑HCl activity → ↑ number of microvilli **and** ↓ tubulovesicular system.

Cells of Fundic Glands

Chief cells:

- Form most of the cells in the basal part of the gland.
- Nucleus is basally located.
- Cytoplasm is basophilic, with apical secretory granules.
- The granules contain: ***pepsinogen***, ***gastric lipase***, and ***renin***.
- E.M: many microvilli, many rER, many Golgi, few lysosomes and apical granules.

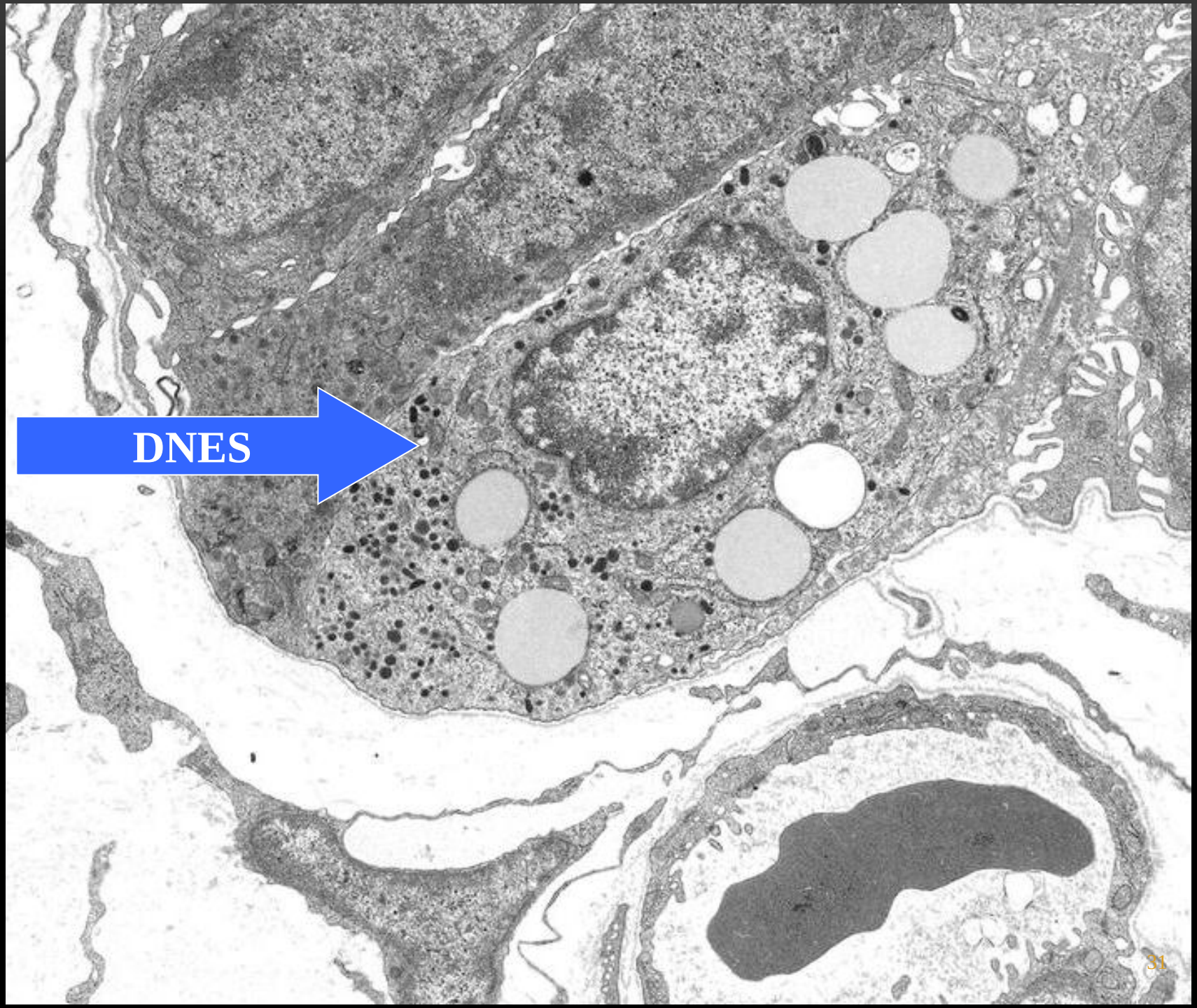
Cells of Fundic Glands

DNES cells:

- Widely scattered among other cells.
- Immunologically they can be classified into many types.
- All cells release their secretion to the lamina propria.
- Their secretion is either ***paracrine*** or ***endocrine***.
- Some cells reach the lumen (open type).
- Some cells do not reach the lumen (closed type)

Cell	Location	Hormone Produced	Hormonal Action
A	Stomach and small intestine	Glucagon (entroglucagon)	Stimulates glycogenolysis by hepatocytes, thus elevating blood glucose levels.
D	Stomach ,small and large intestine	Somatostatin	Inhibits release of hormones by DNES cells in its vicinity
EC	Stomach, small and large intestine	Serotonin Substance **P**	Increases peristaltic movement
ECL	Stomach	Histamine	Stimulates HCI secretion
G	Stomach and small intestine	Gastrin	Stimulates HCI secretion, gastric motility (especially contraction of the pyloric sphincter to regulate stomach emptying), and proliferation of regenerative cells in the body of the stomach
GL	Stomach ,small and large intestine	Glicentin	Stimulates hepatocyte glycogenlysis, thus elevating blood glucose levels

Cell	Location	Hormone produced	Hormonal Action
I	Small intestine	Cholecystokinin	Stimulates the release of pancreatic enzymes and contraction of the gallbladder
K	Small intestine	Gastric inhibiotry	Inhibitis HCI secretion
Mo	Small intestine	Motilin	Increases intestinal peristalsis
N	Small intestine	Neurotensin	Increases blood flow to ileum and decreases peristaltic action of small and large intestine
PP (F)	Stomach and large intestine	Pancreatic P olypeptide	Stimulates release of enzymes by chief cells; depresses release of HCI by parietal cells; inhibits exocrine release of pancrease
S	Small intestine	Secretin	Stimulates release of bicarbonate-rich fluid from pancrease
VIP	Stomach ,small and large intestine	Vasoactive intestinal peptide	Increase peristaltic action of small and large intestine and stimulates elimination of water and ions by GI tract


DNES

Submucosa of the Stomach

- Dense irregular connective tissue.
- Highly vascular.
- The nerve plexuses are close to the muscularis externa.
- Drains lymphatic vessels of the lamina propria.

Muscularis Externa of the Stomach

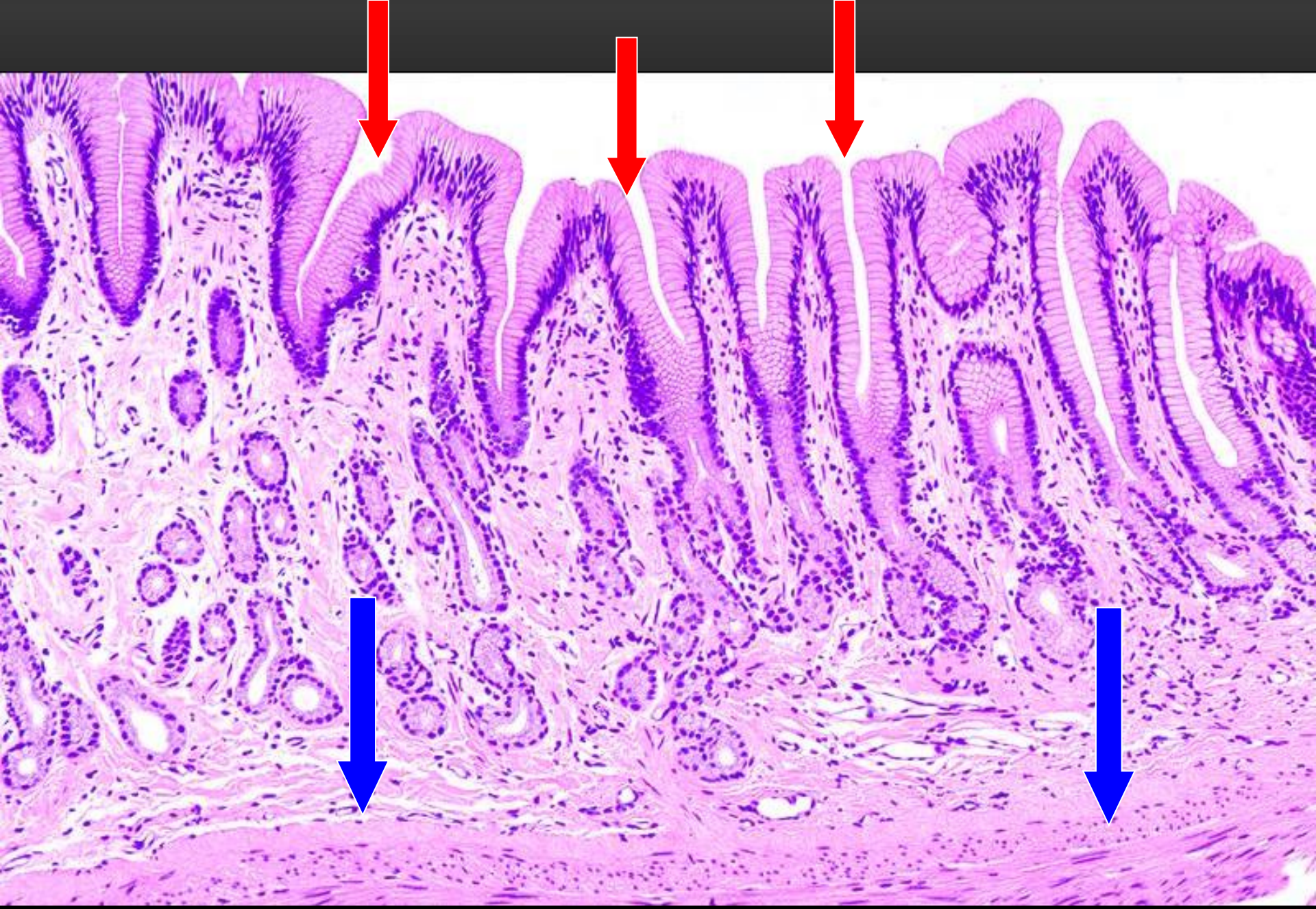
Innermost oblique (ill defined).

Middle circular, becomes thicker in the pyloric region ➡ pyloric sphincter.

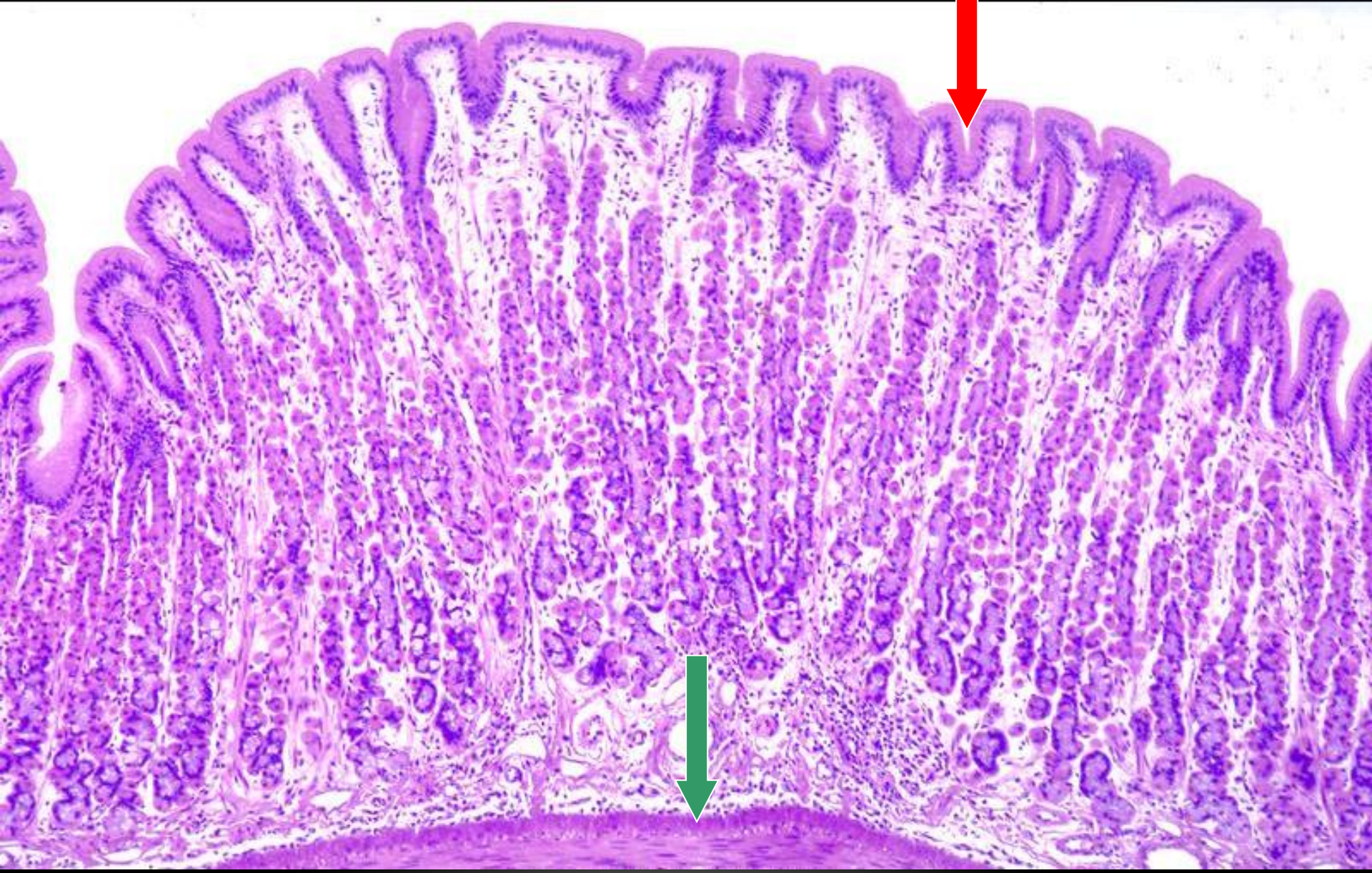
Outer longitudinal, poorly developed in the pyloric region.

The entire stomach is enclosed in serosa.

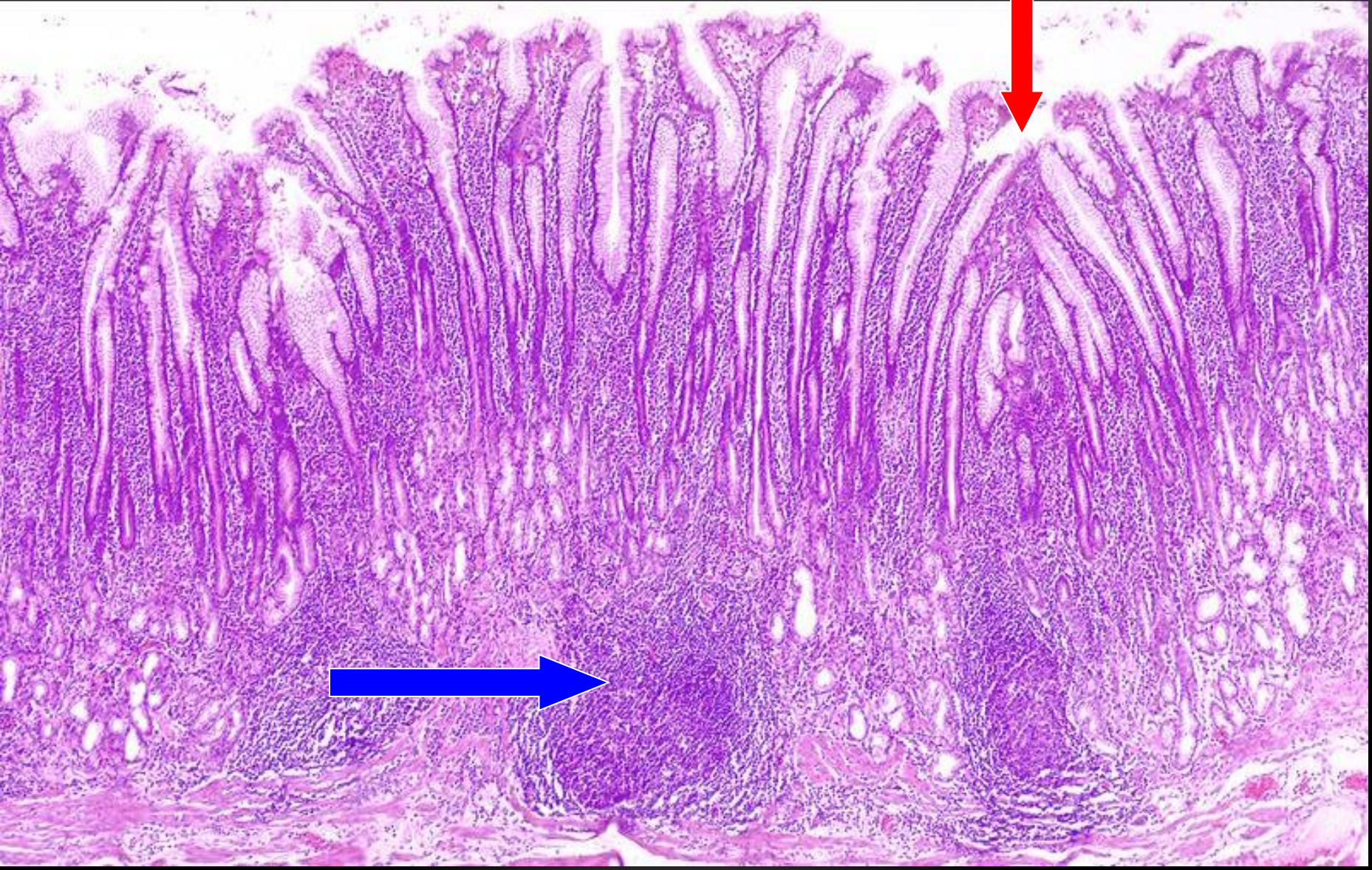
	Cardiac	Fundus and Body	Pyloric
Epithelium	Same	Same	Same
Cells ** Surface mucous	Cover entire luminal surface	Same	Same
** Neck mucous	Line neck region	Same	Same
** Chief	Absent	Abundant in the basal part	Absent
** Parietal	Absent	Abundant in the upper part of body of glands and between mucous neck cells	Few
** DNES	Rare	Rare	Rare
Mucosal glands	Wide deep, gastric pits with short slightly coiled simple tubular glands; pits extend less than1/2 of mucosa	Narrow shallow pits with straight, branched tubular glands; pits extend less than 1/5 of mucosa	Wide, deep pits with coiled, branched, tubular glands, pits extend > ½ mucosa
Muscularis externa	Present	Present	Present
Serosa	Present	Present	Present



Cardiac region of the stomach

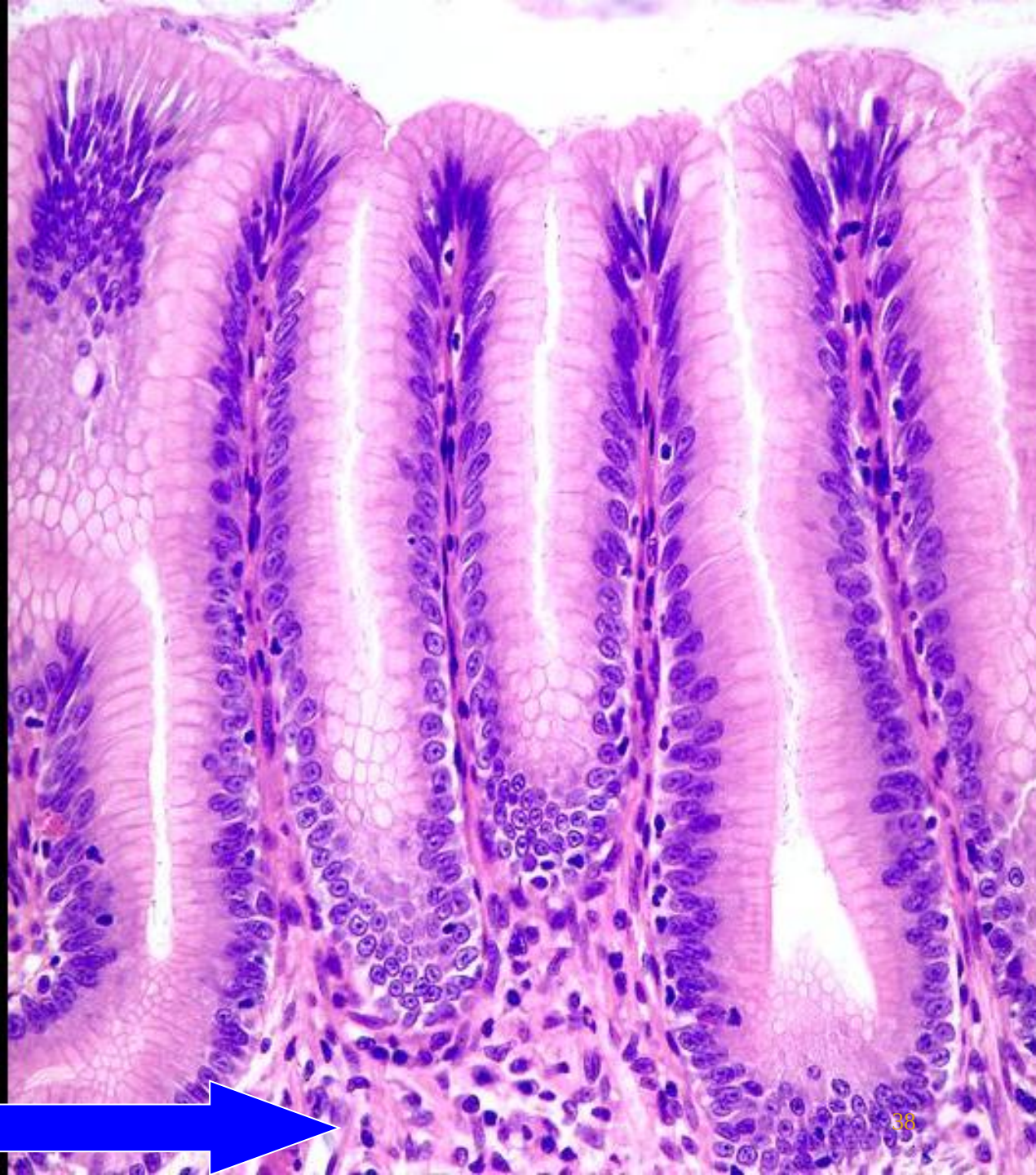


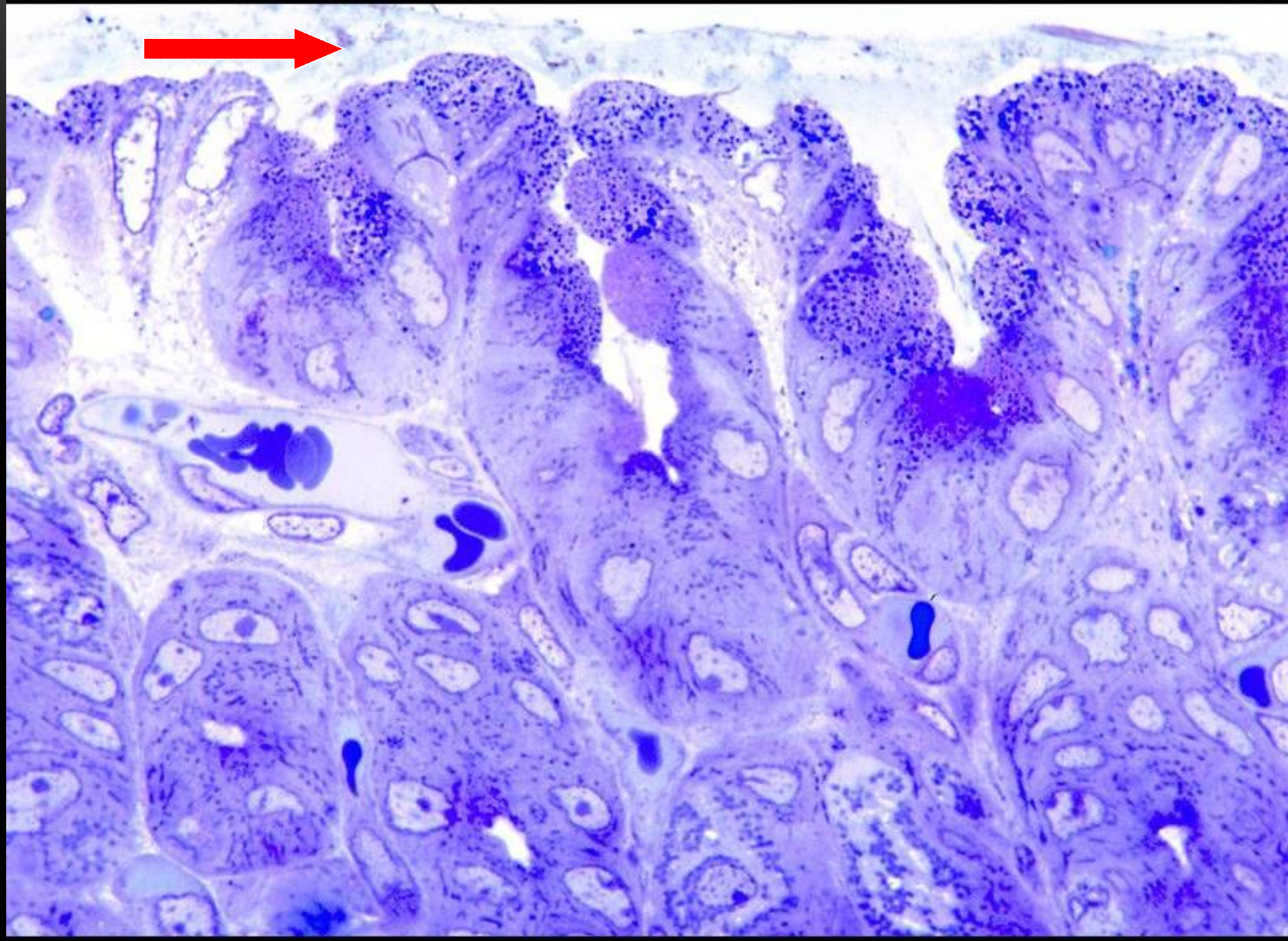
Fundus of the stomach

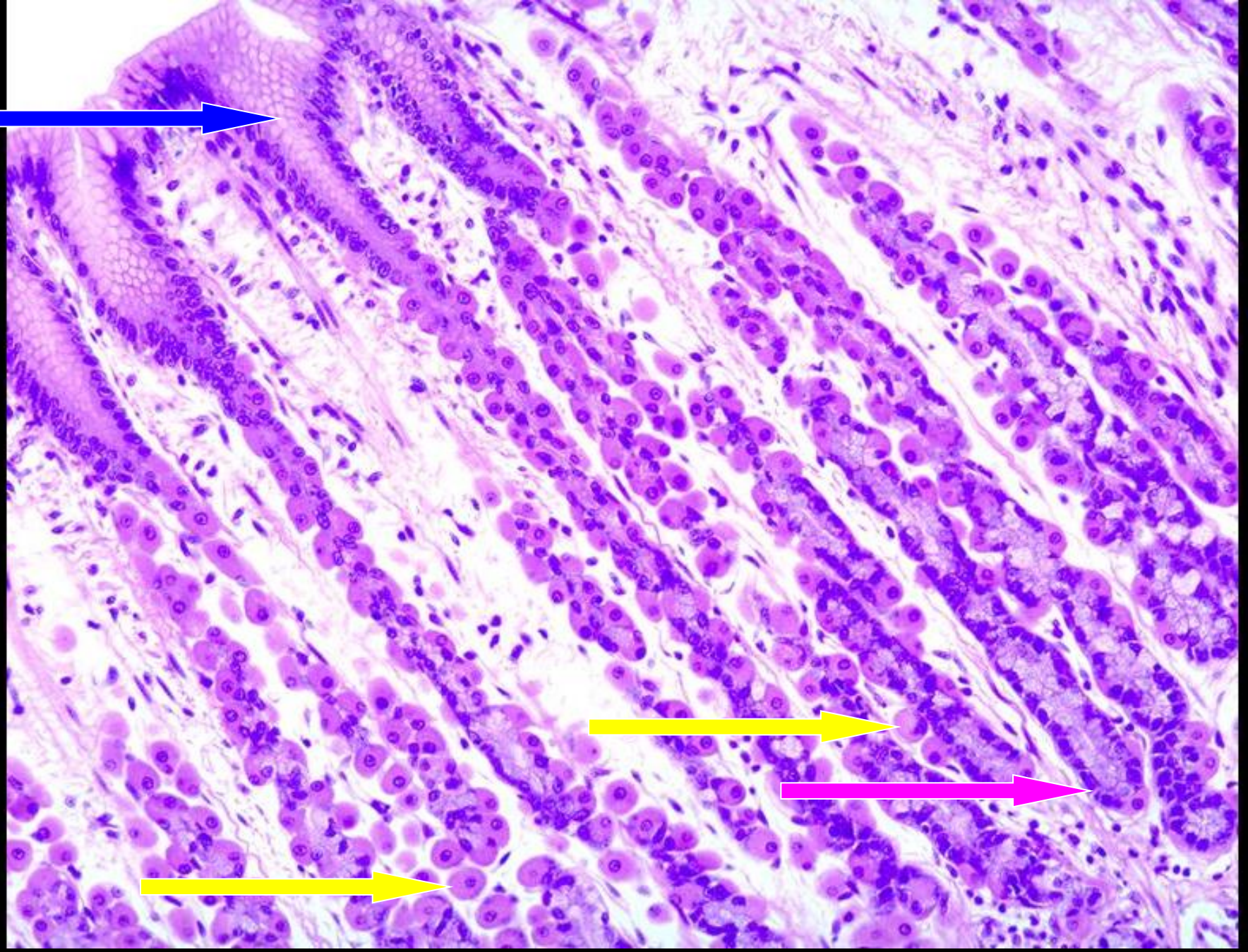


Pyloric antral mucosa

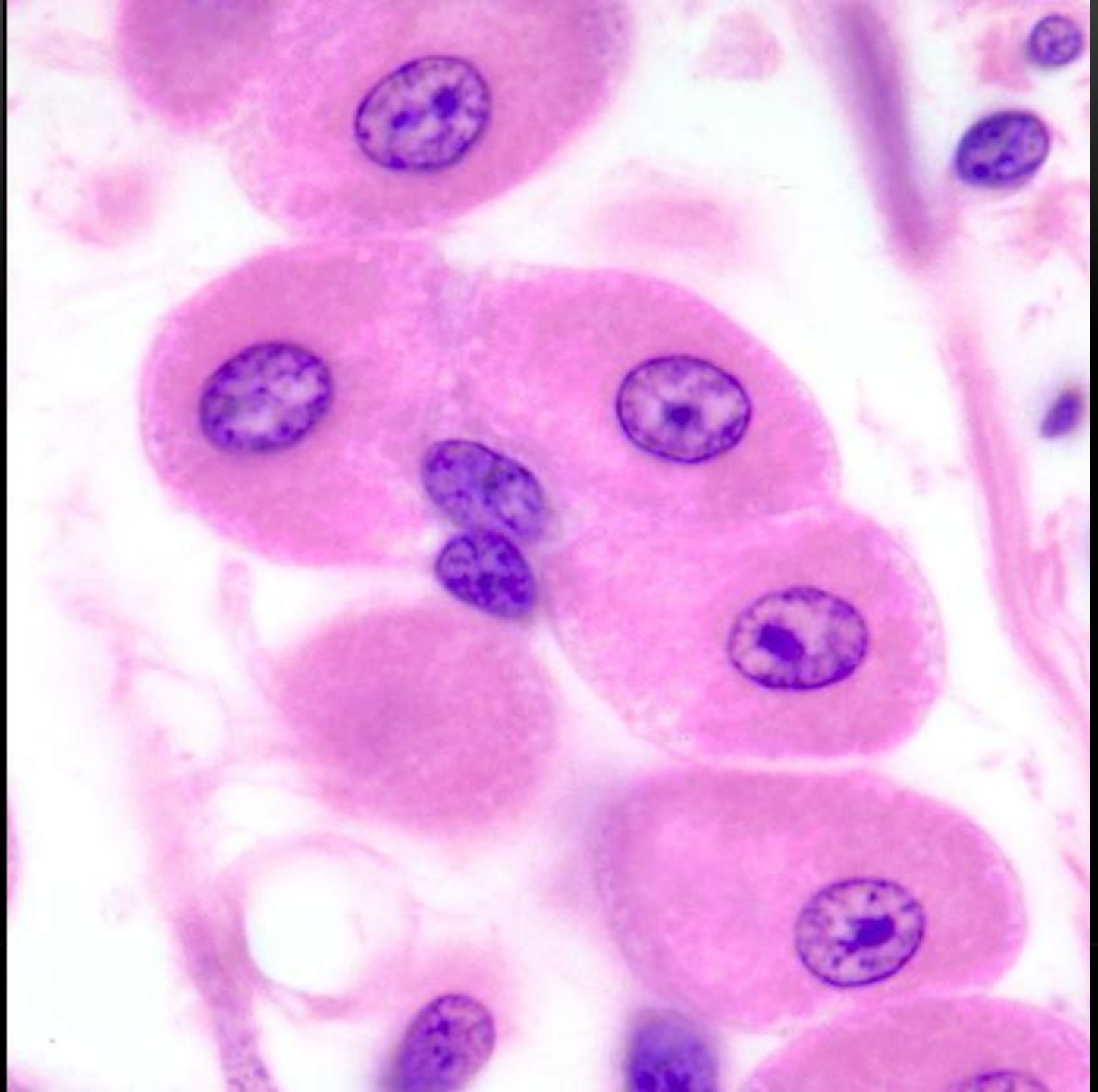
Surface mucous cells

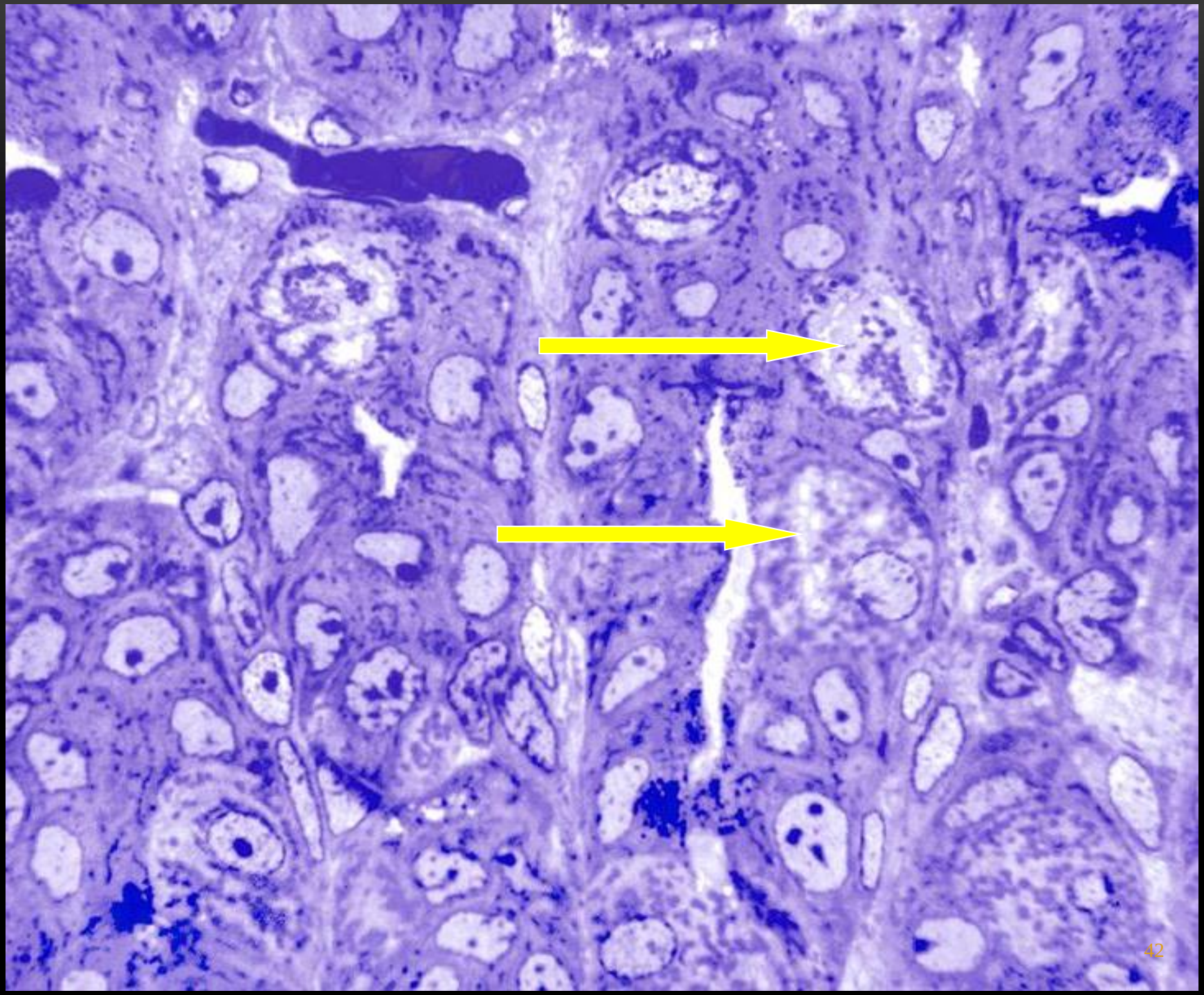




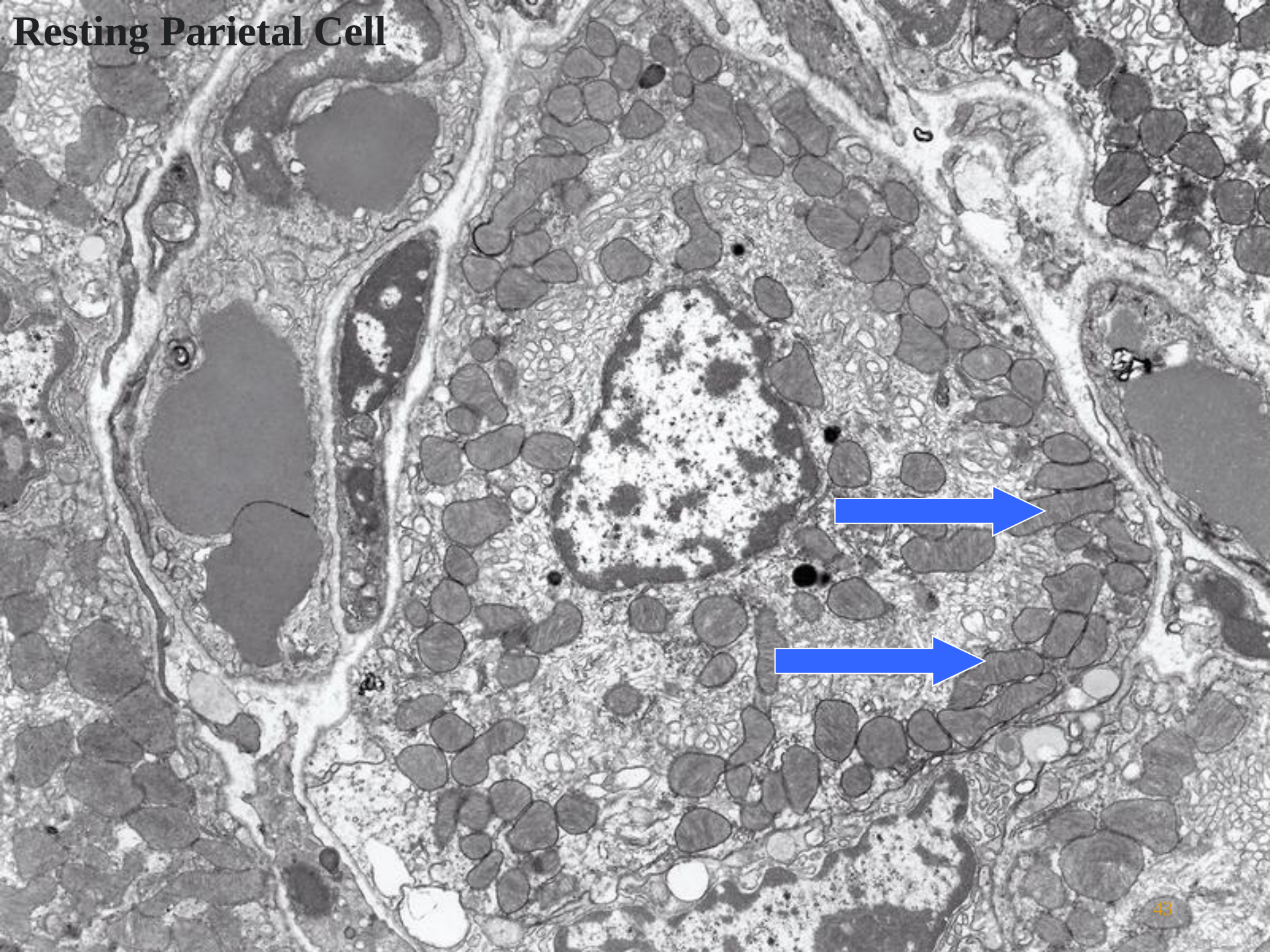


Body of gastric mucosa

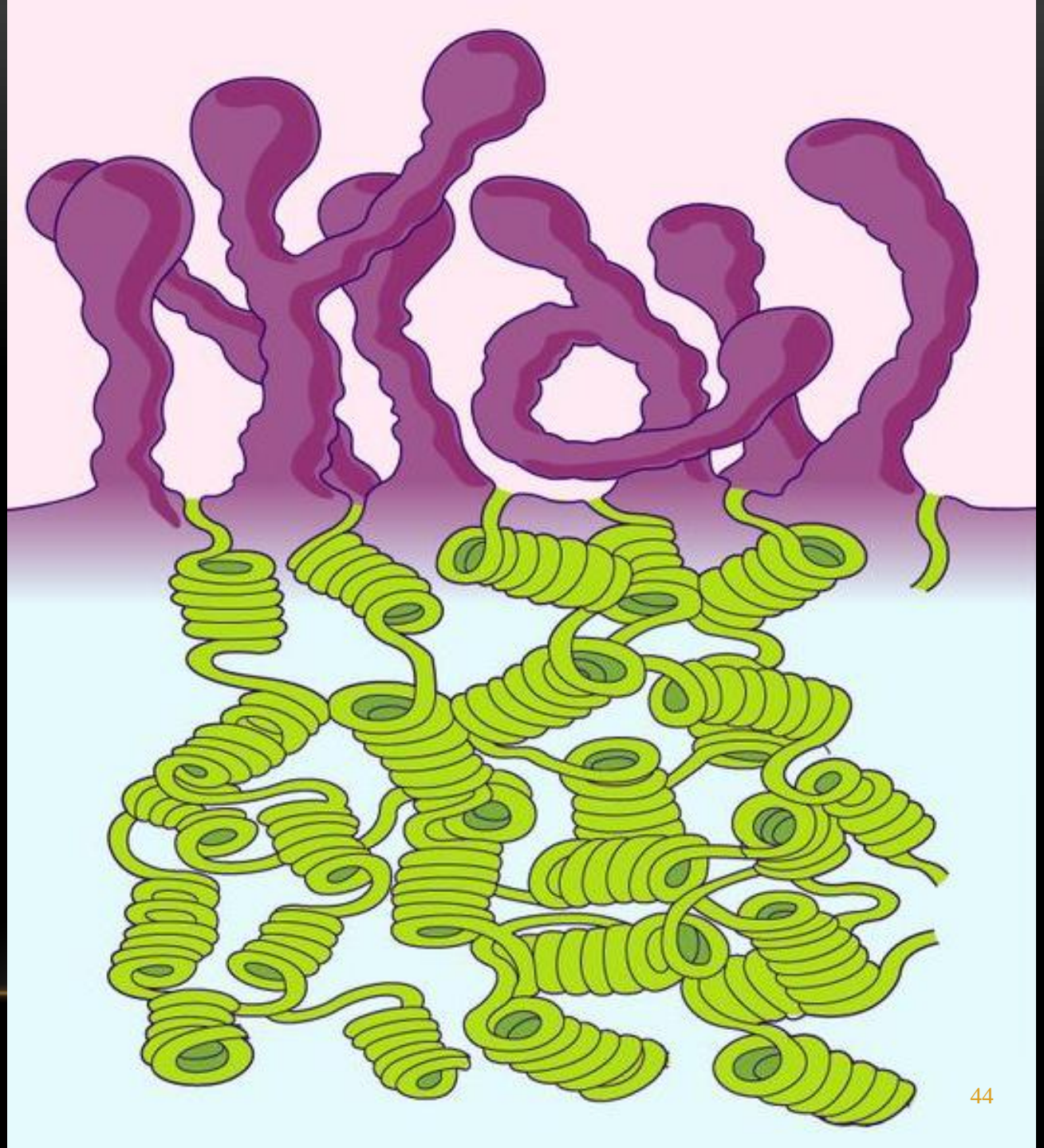




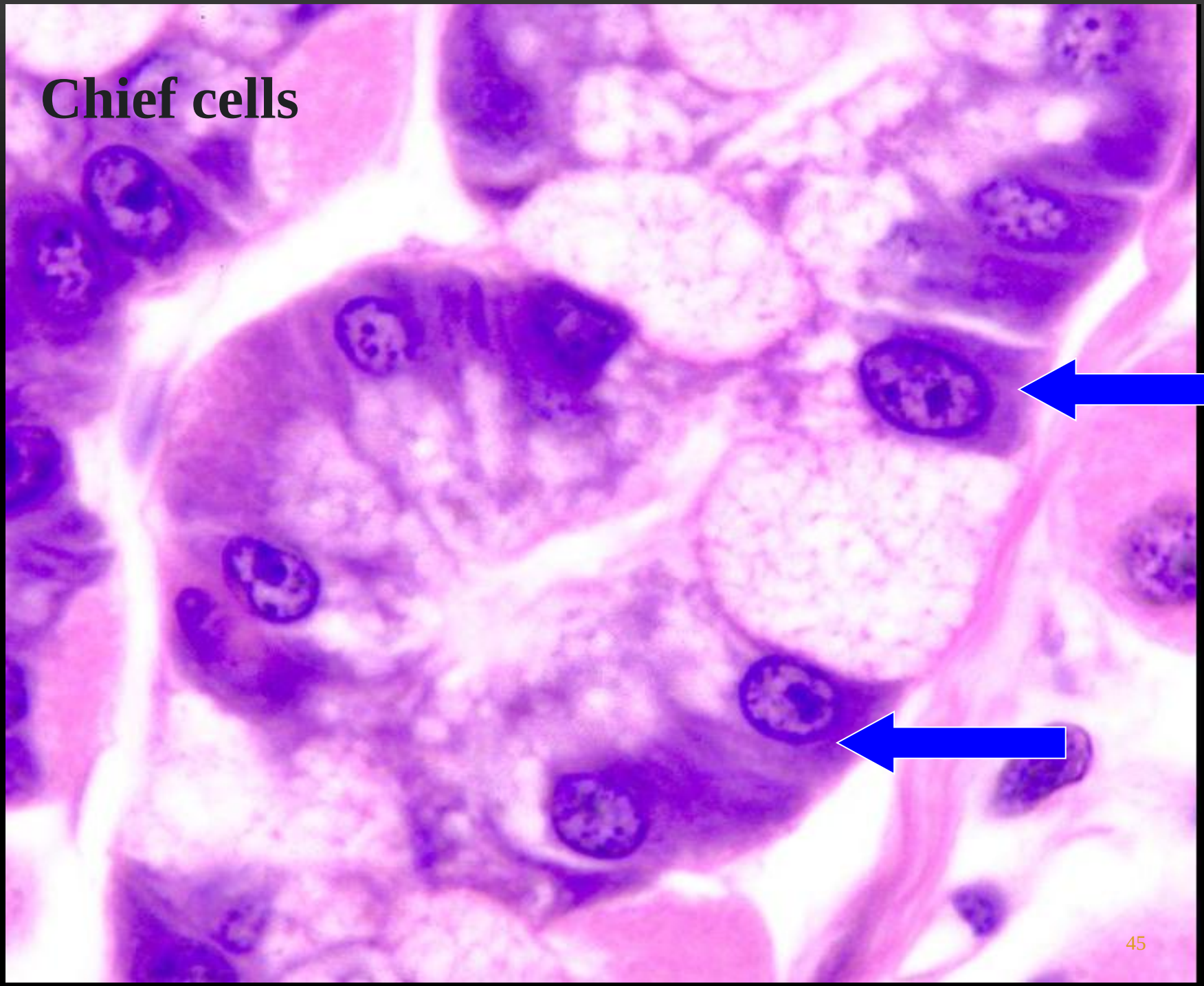
Resting Parietal Cell



Parietal cell and intracellular canaliculi

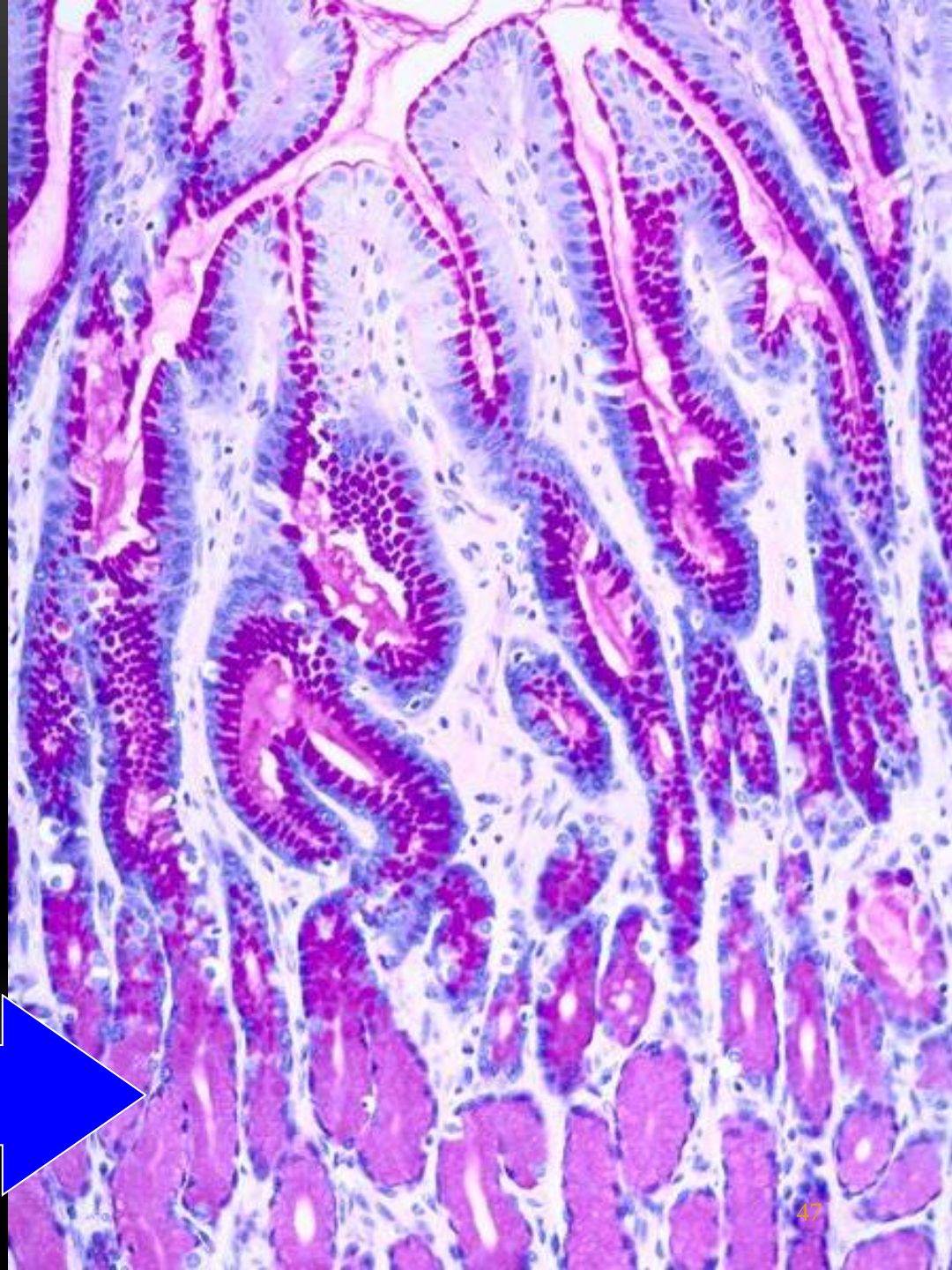


Chief cells



Pyloric antrum

PAS stain of the antrum
Mucous cells in the pits stain darker than those in the glands



SMALL INTESTINE

Modifications of the Luminal surface

Plicae circularis: permanent elevation of the mucosa and submucosa, seen mostly in the jejunum. (also known as ***valves of Kerckring***)

Villi: Finger-like protrusions of the lamina propria and epithelium. They are much frequent and taller in the duodenum.

Microvilli: Apical plasmalemmal modifications of columnar epithelial cells of the GIT.

Intestinal glands are known as ***crypts of Lieberkühn***.

Intestinal Epithelium
Surface Absorptive Cells (Enterocytes)

Tall columnar cells with basal oval nucleus.

Apical surface presents brush border.

E.M:

- Numerous microvilli covered with glycocalyx.
- Microvilli have a core of actin.
- Cytoplasm rich in organelles specially endosomes, sER, rER and Golgi.
- Junctional complexes are seen on the lateral aspect of plasmalemma.

Intestinal Epithelium

Goblet cells: increase in number distally.

DNES cells:

M cells (Microfold cells):

- Squamous – like cells overlying lymphatic nodules.
- They are antigen presenting cells.

Crypts of Lieberkühn

Invaginations of the surface epithelium into the lamina propria.

Increase the surface area of the intestine.

Open into the intervillar spaces.

The upper part of the crypts is occupied by enterocytes, goblet cells.

Other cells in bottom of the crypts are: stem cells, DNES cells, and Paneth cells.

Paneth Cells

Pyramidal cells occupying the basal part of the crypt.

Cytoplasm shows large eosinophilic apical secretory granules.

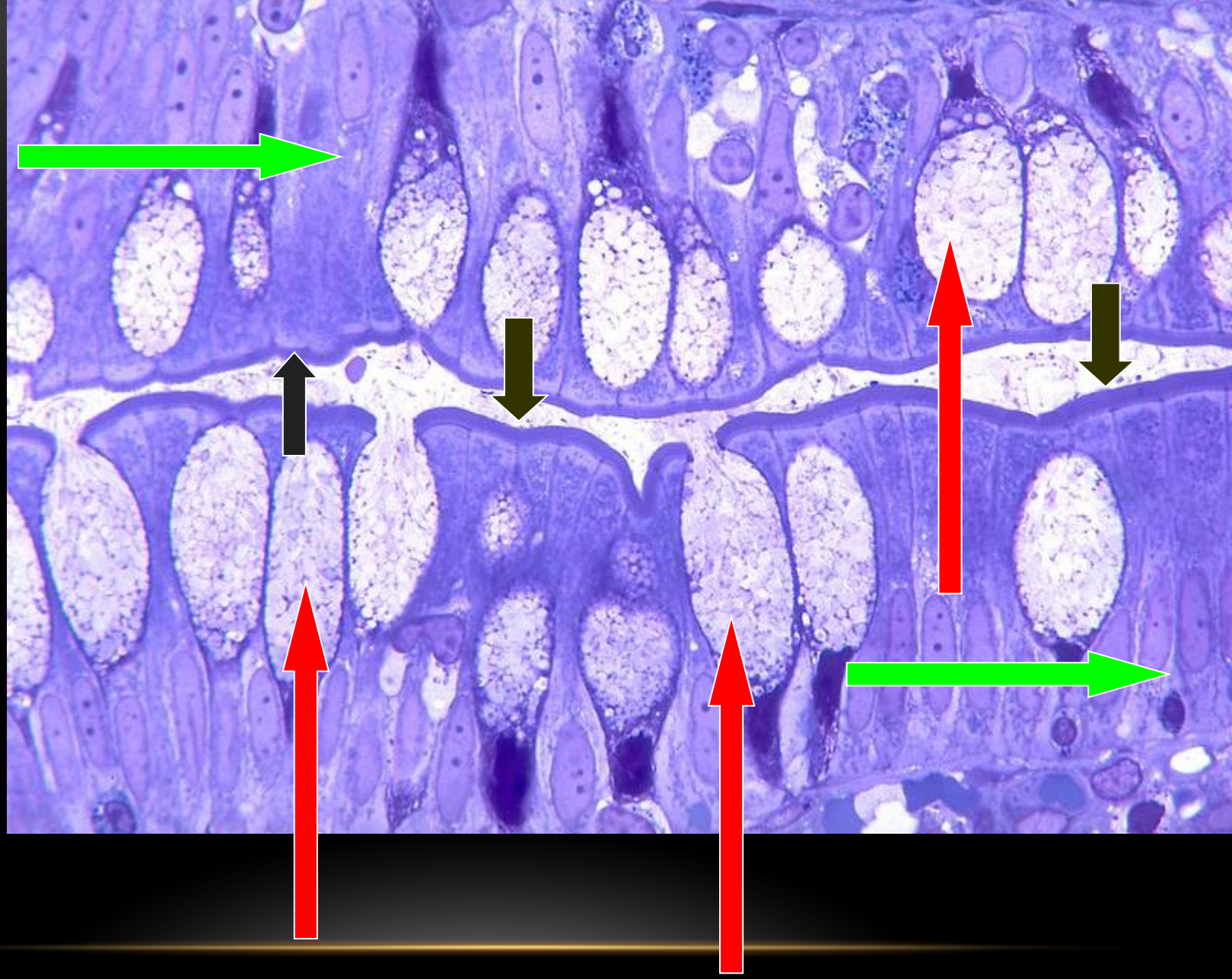
Their life span is 15-30 days.

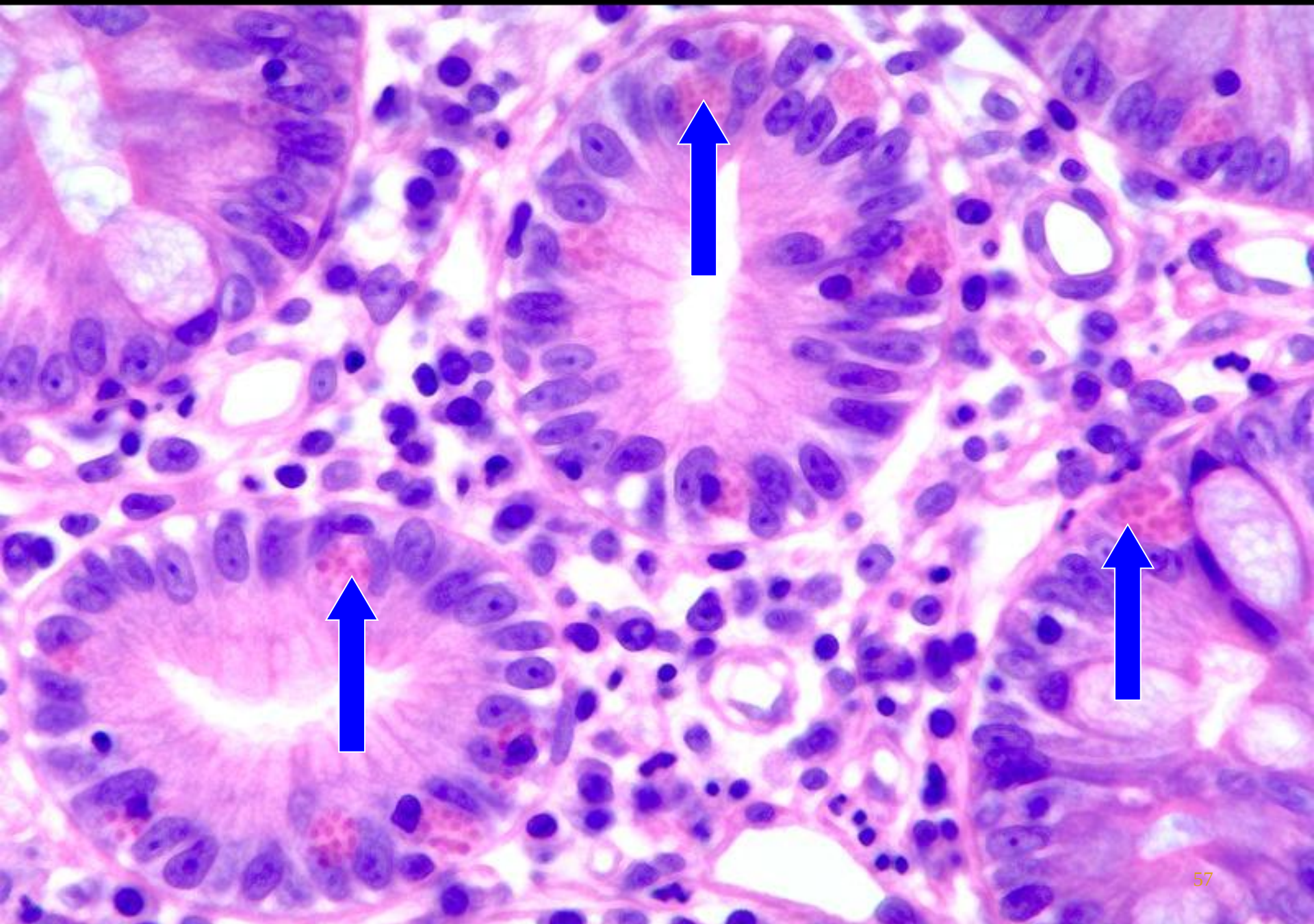
They secrete lysozyme that maintains intestinal flora.

E.M: large apical secretory granules, many rER, many mitochondria, lysosomes and well developed Golgi.

Inestinal villus

Enterocytes and Goblet cells





Brunner’s Glands

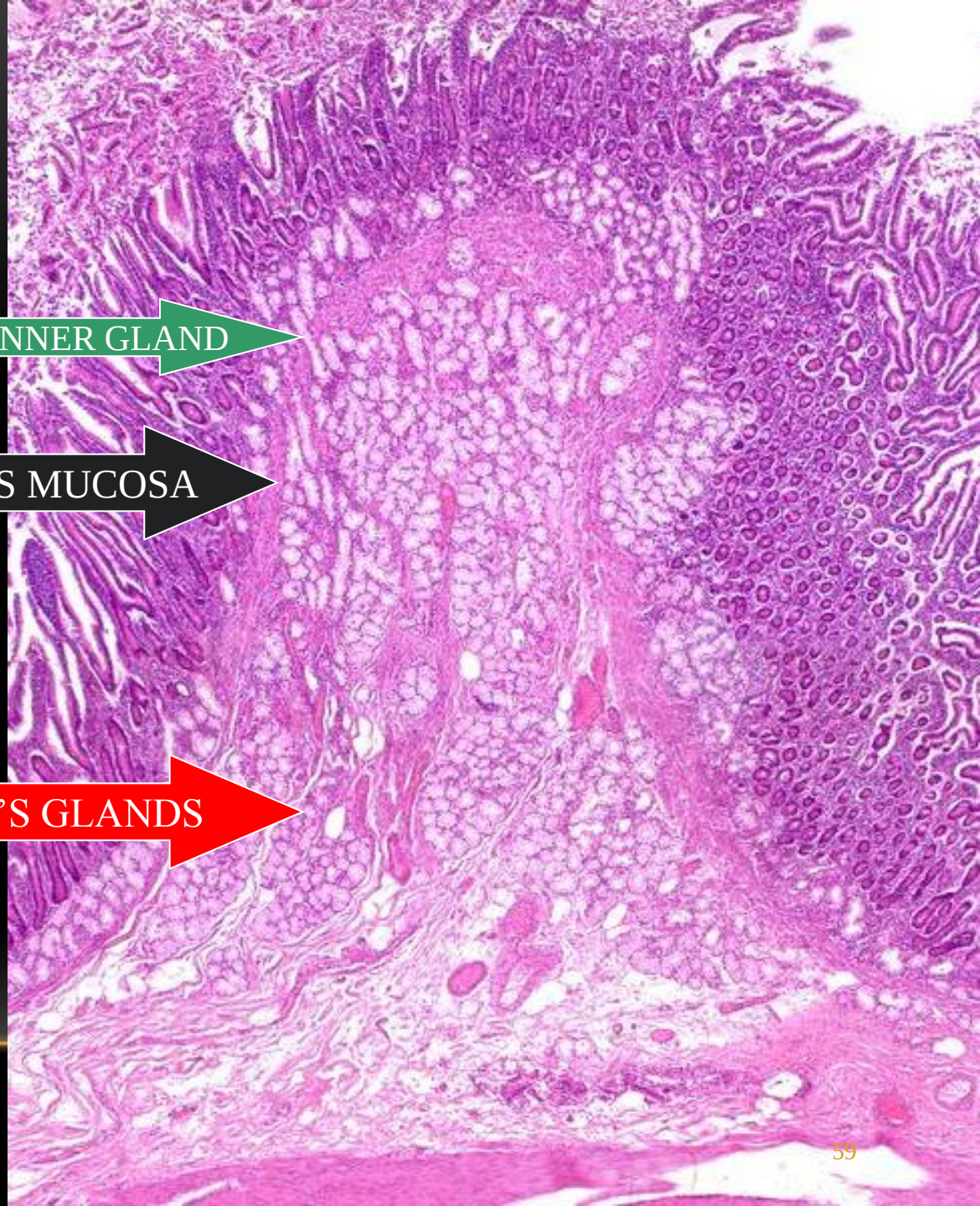
Branched tubulo-alveolar glands in the submucosa of the duodenum.

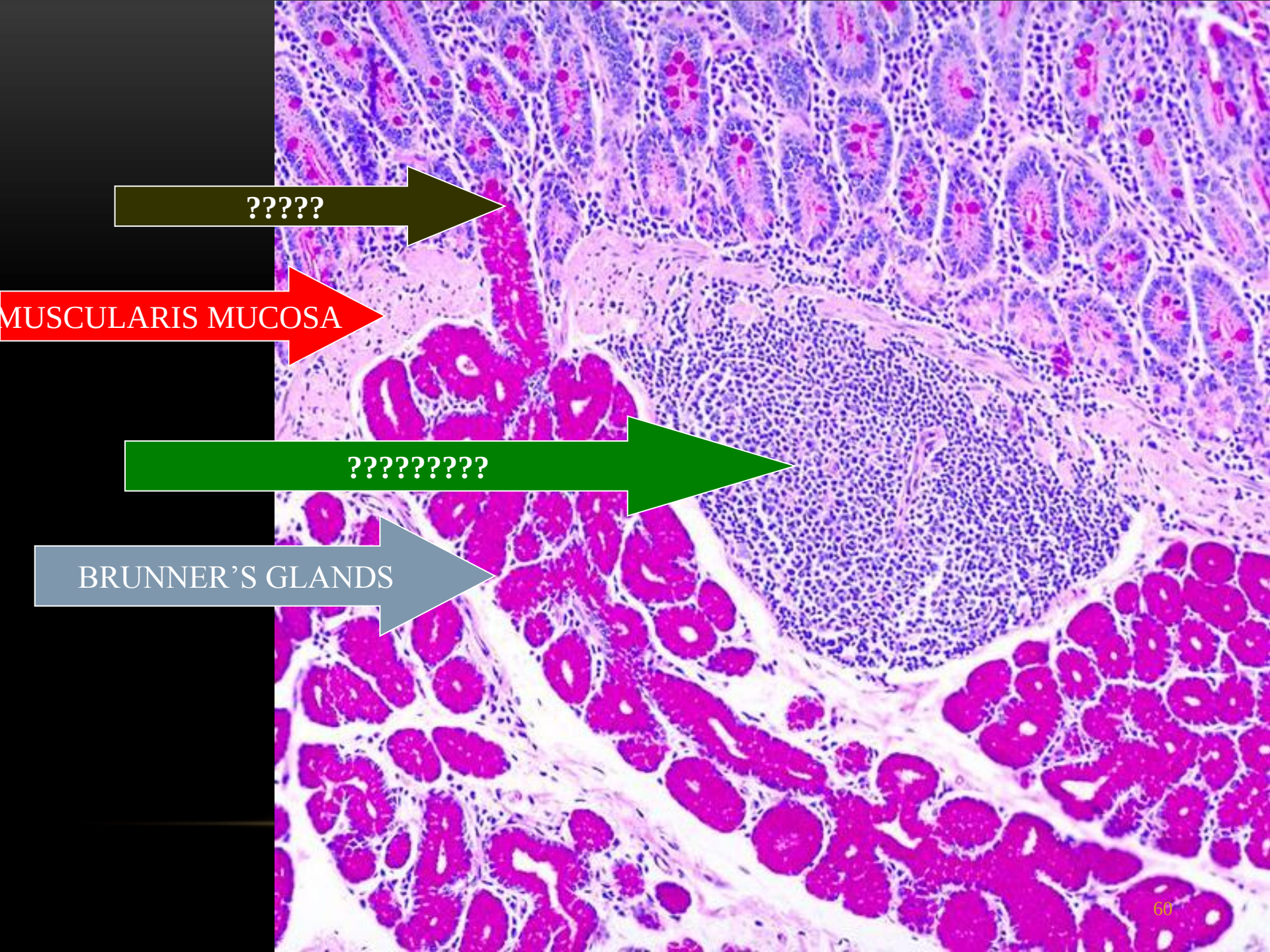
Secrete mucous rich in bicarbonate and the epidermal growth factor.

E.M: many rER, well developed Golgi, many mitochondria, flat-round nucleus.

They are stimulated by the parasympathetic system.

Plica circularis
Duodenum




?????
MUSCULARIS MUCOSA
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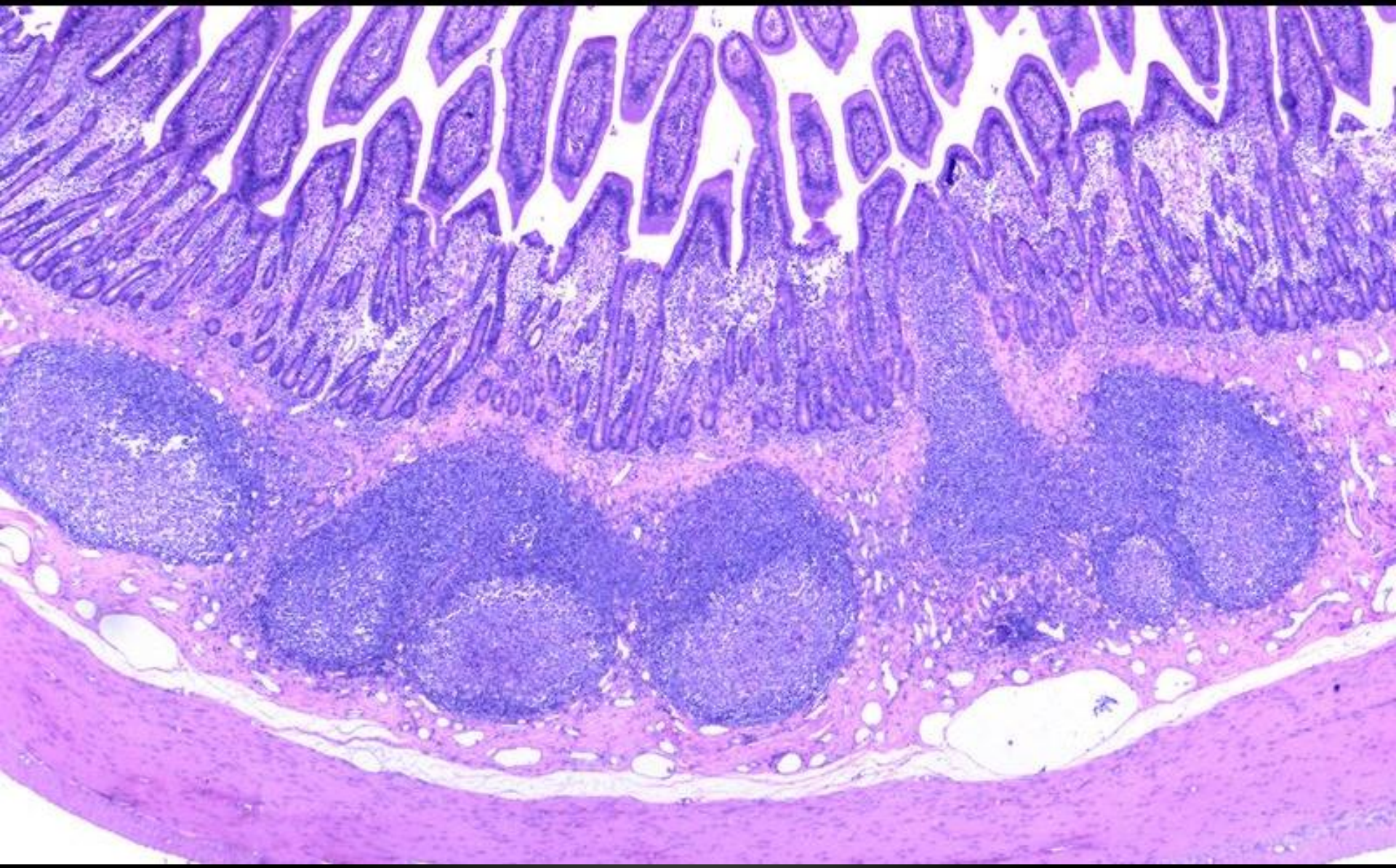
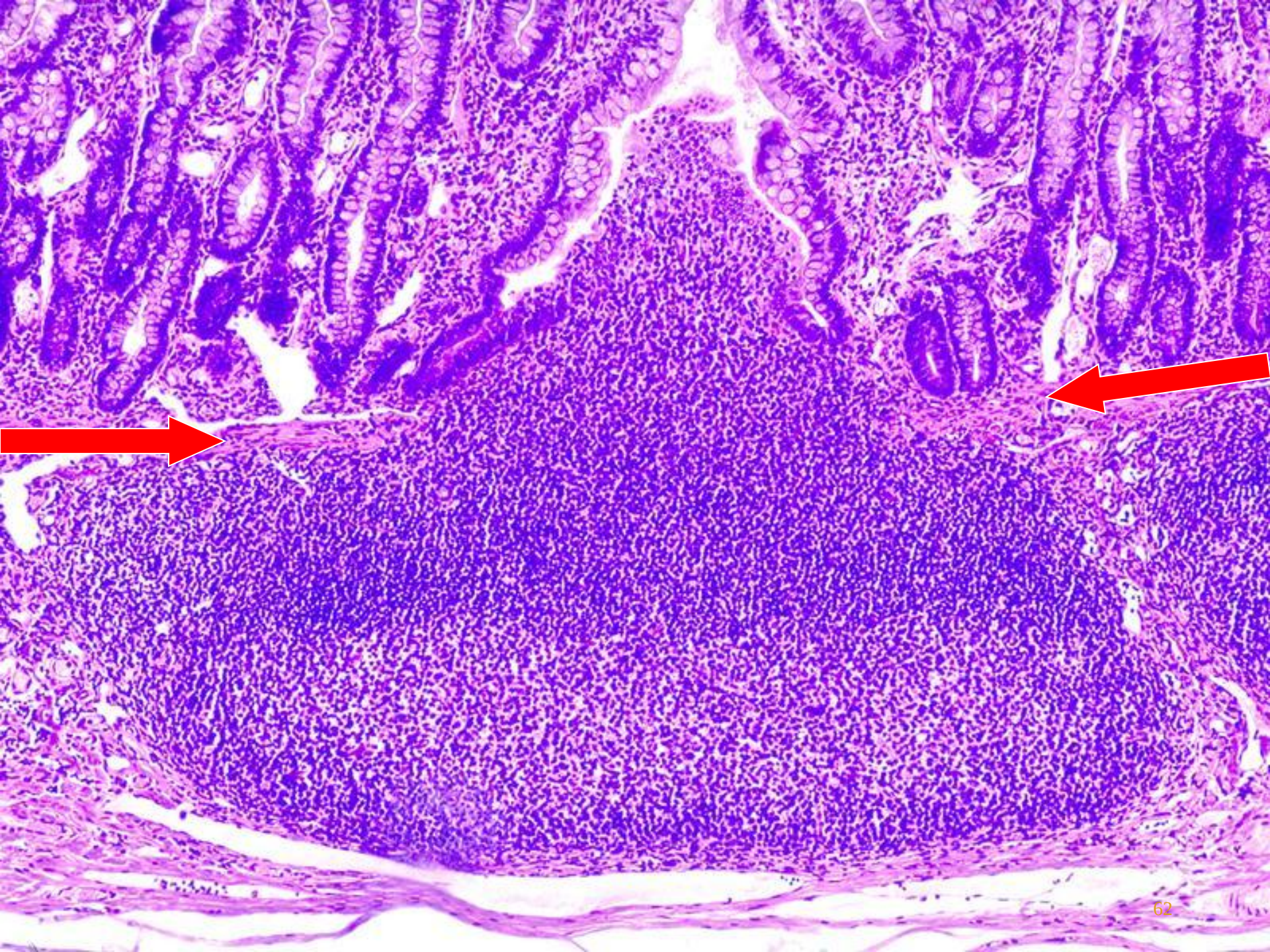
BRUNNER'S GLANDS



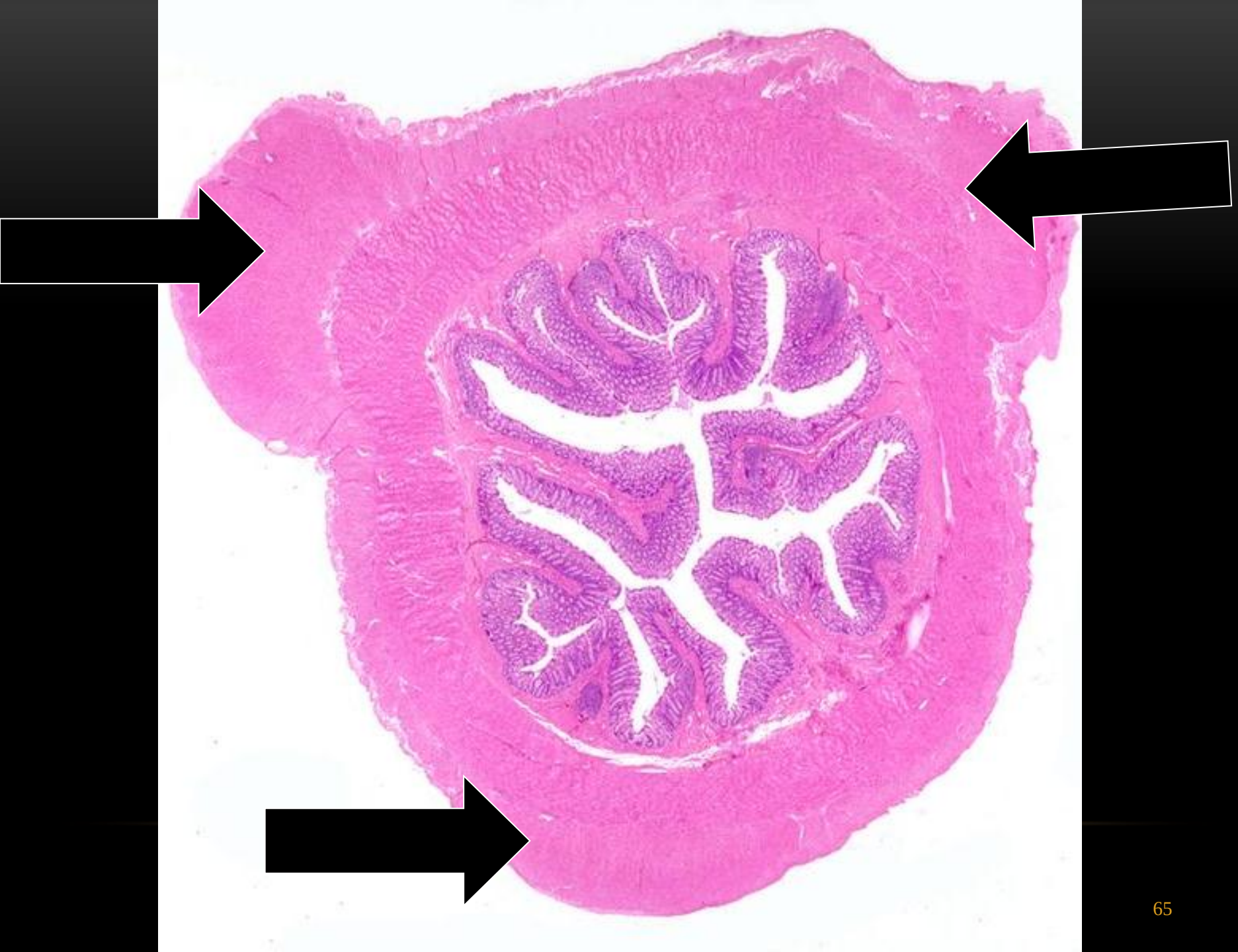
Ileum

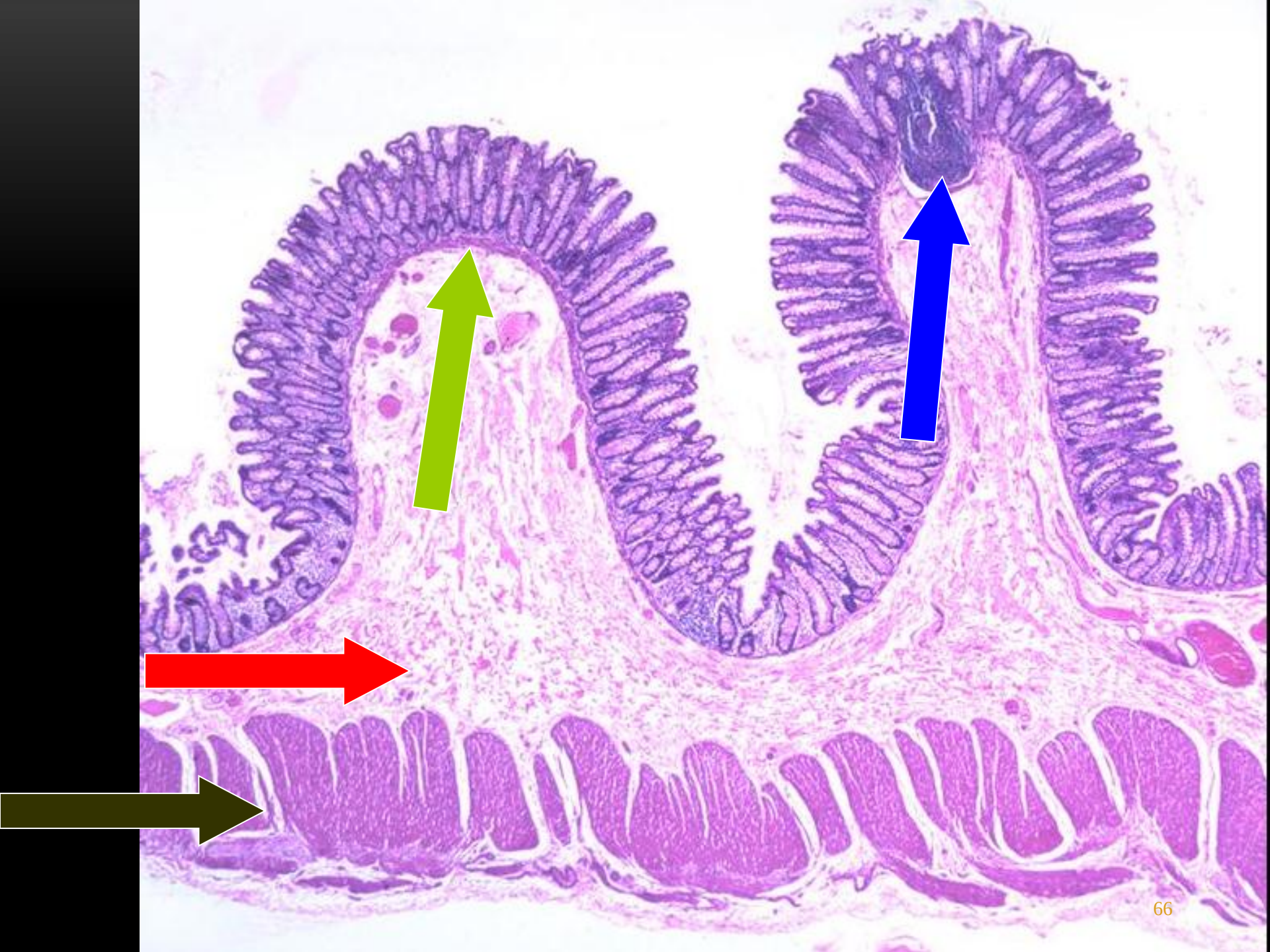


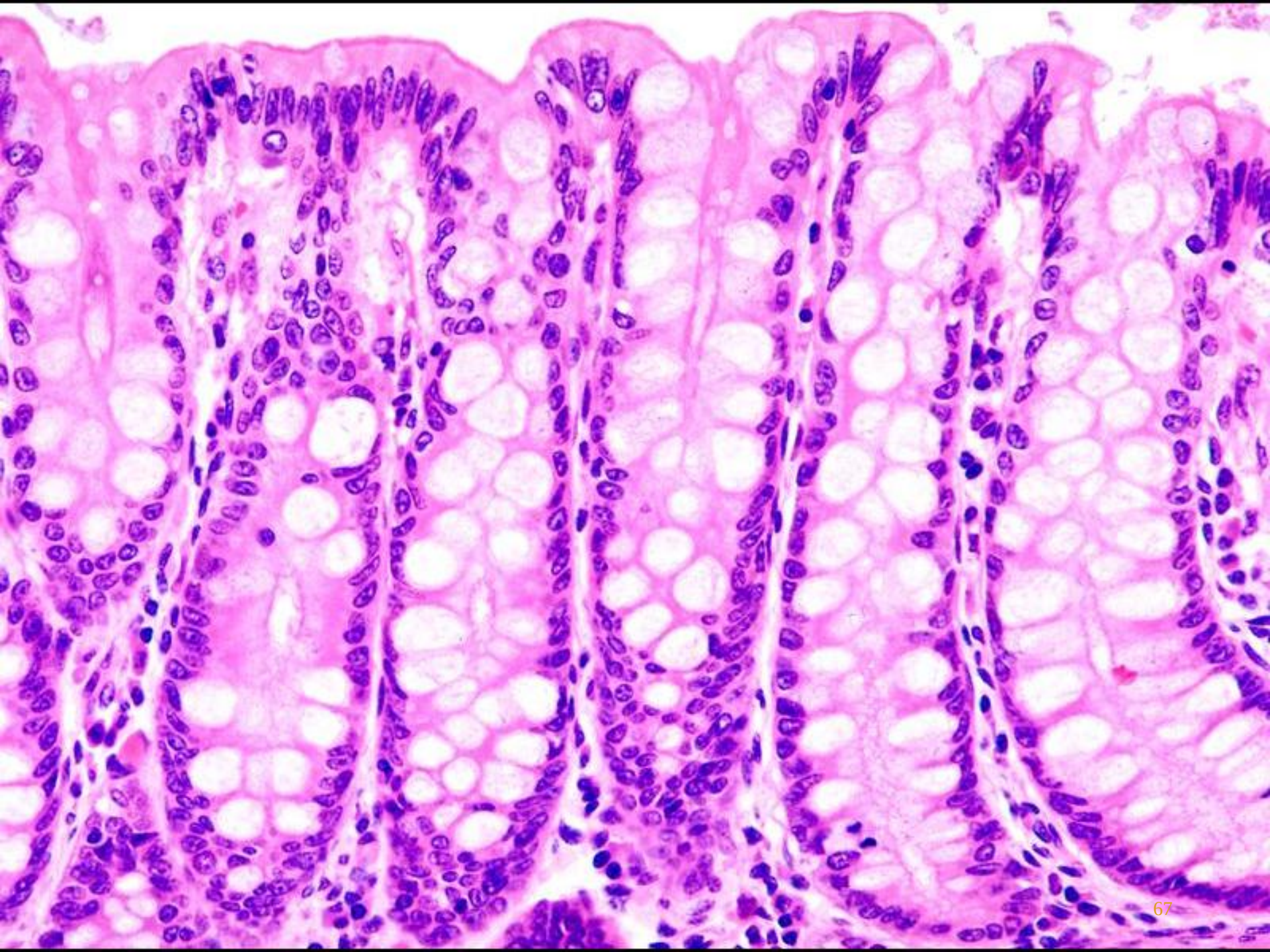
COLON

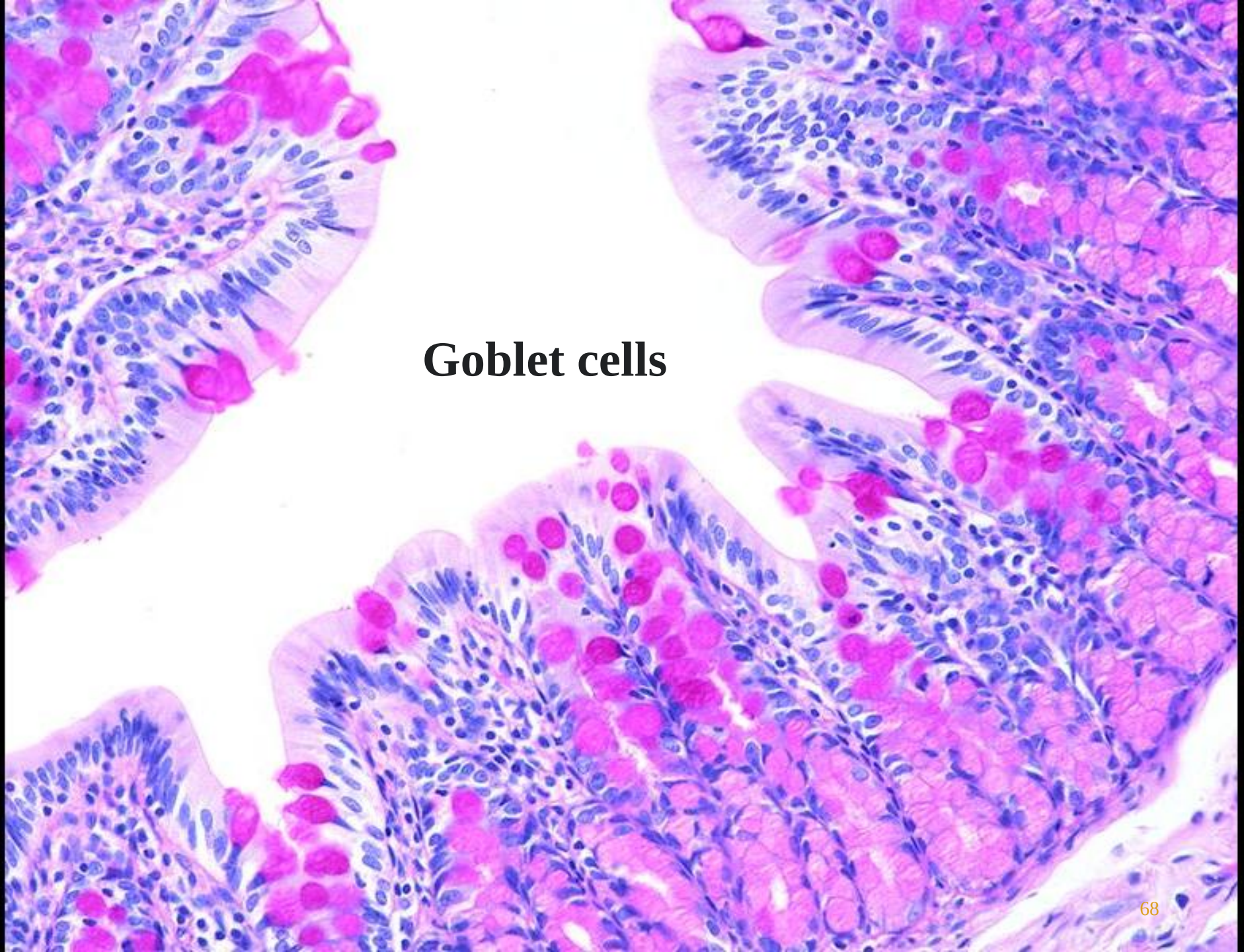
Histology of the Colon

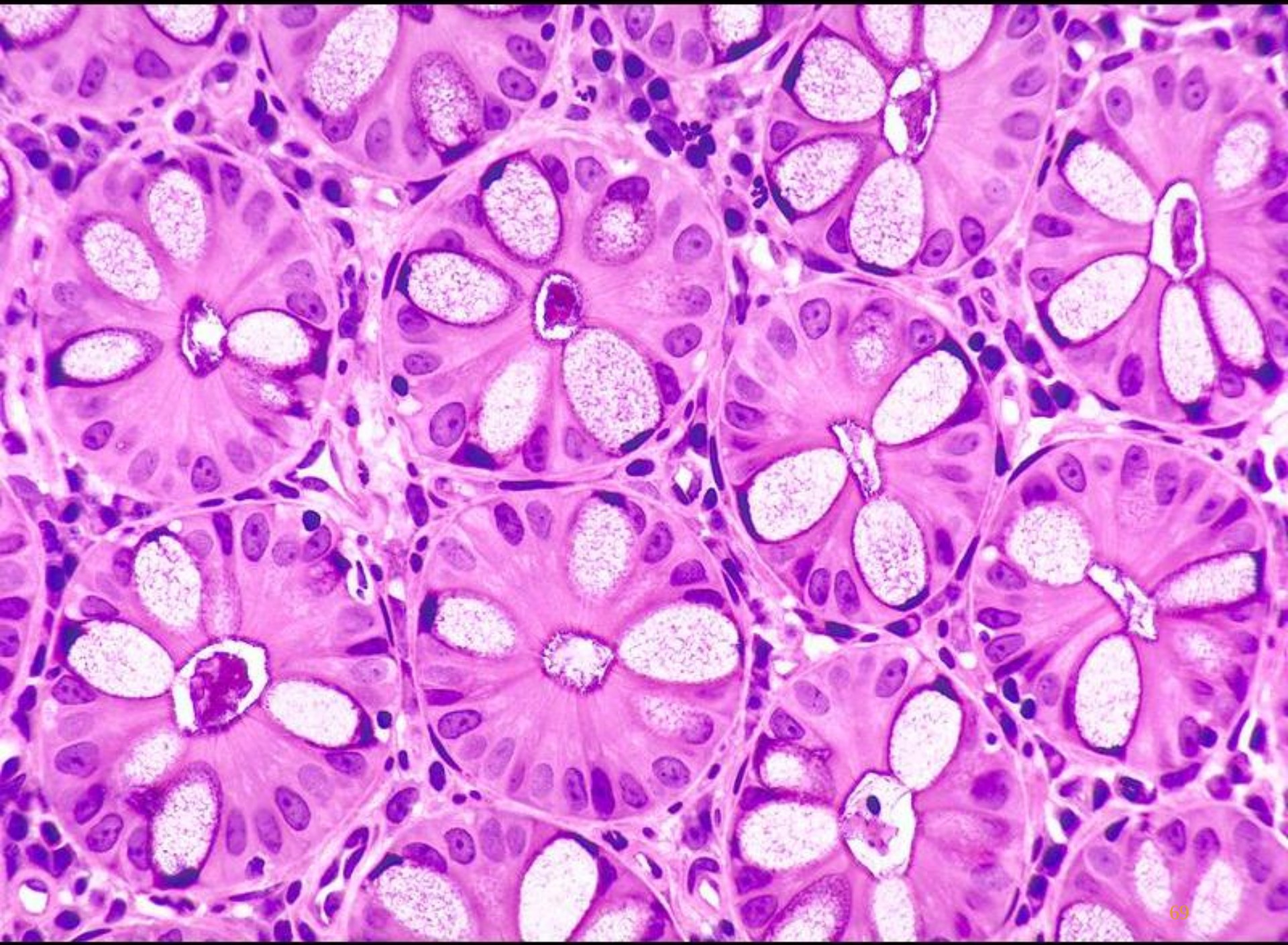
- Crypts of Lieberkuhn are similar but shorter than small intestine.
- Goblet cells are more numerous.
- DNES are fewer in number.
- Enterocytes are similar to small intestine.
- Stem cell are also present.
- Muscularis externa: trenia coli








Goblet cells



Vermiform Appendix

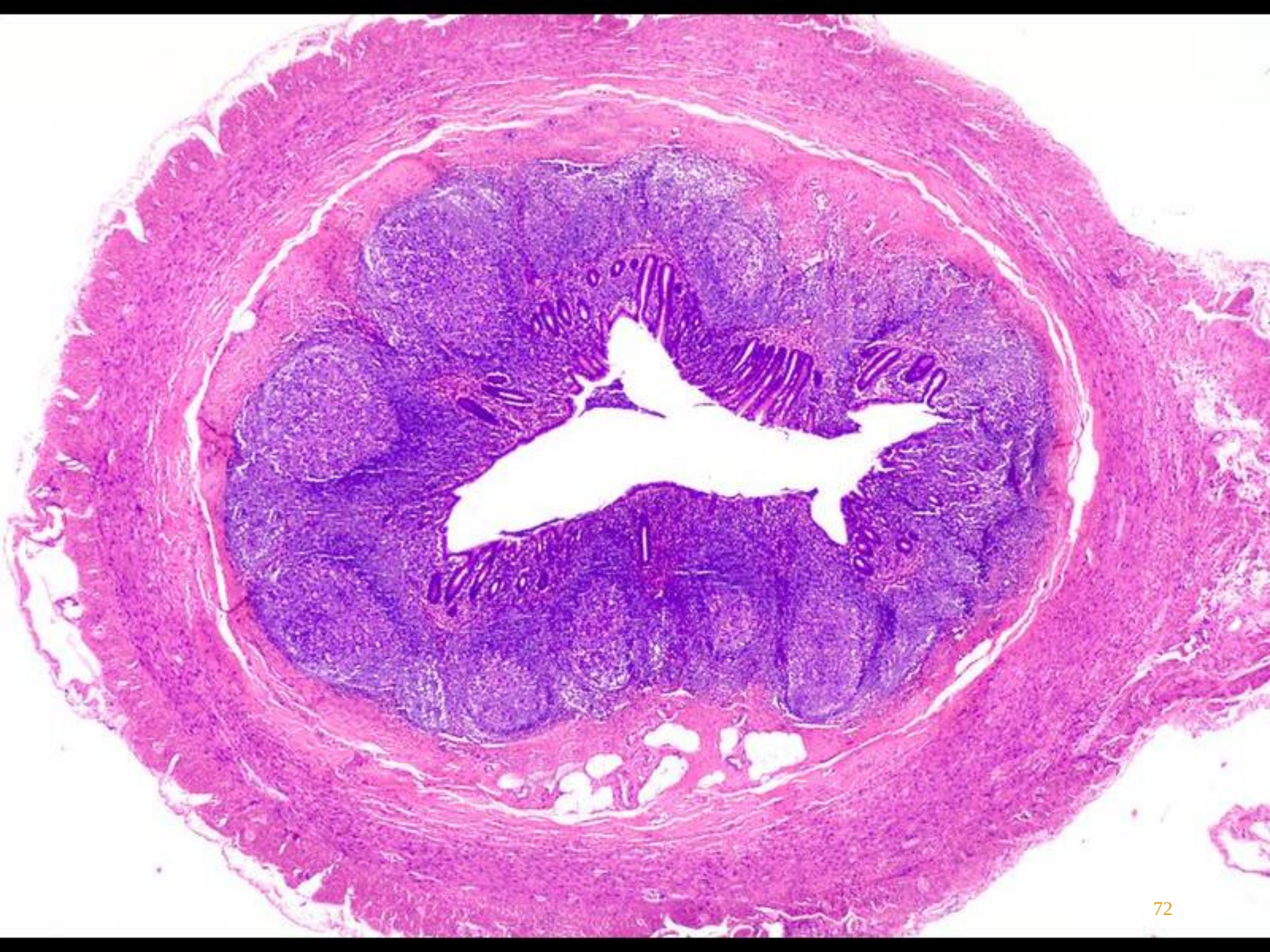
A diverticulum 5-6 cm from the posteromedial aspect of the cecum.

Lumen usually filled with debris.

Mucosa composed of:

- Simple columnar epithelium (absorptive, goblet & M cells)
- Lamina propria: Loose CT with numerous lymphoid follicles and shallow crypts.
- Different types of cells in the crypts.

Other layers are not significant.



Regional differences of small and large intestines

Mucosa

	Duodenum	Jejunum	ileum	Colon
Enterocytes	Simple columnar - striate border	Same	Same	Reduced microvilli
Goblet	+	++	+++	++++
Paneth	+	++++	+++	±
DNES	Scattered	Scattered, more numerous	Same as jejunum	Common in appendix, few elsewhere
Crypts of Liberkuhn	Very abundant, all cell types	Same	Same	Longer and more closely packed

Regional differences of small and large intestines

	Duodenum	Jejunum	ileum	Colon
Submucosal glands	Brunner's	Absent	Absent	Absent
Lymphoid tissue	Diffuse	Increase in nodules	Peyer's patches	Many nodules
Plica circularis	±	++++	++	Plica semilunaris
Muscularis externa	Well developed inner circular and outer longitudinal	Same	Same	Taenia coli
Serosa	Serosa at beginning and end	Present	Present	Present anteriorly and on sides
Villi	Lowest	Tallest	Medium	absent