

Endocrine System II: Adrenal, Pancreas, Pineal, Cardiac, Fat, GI

Gwen V. Childs, Lecturer

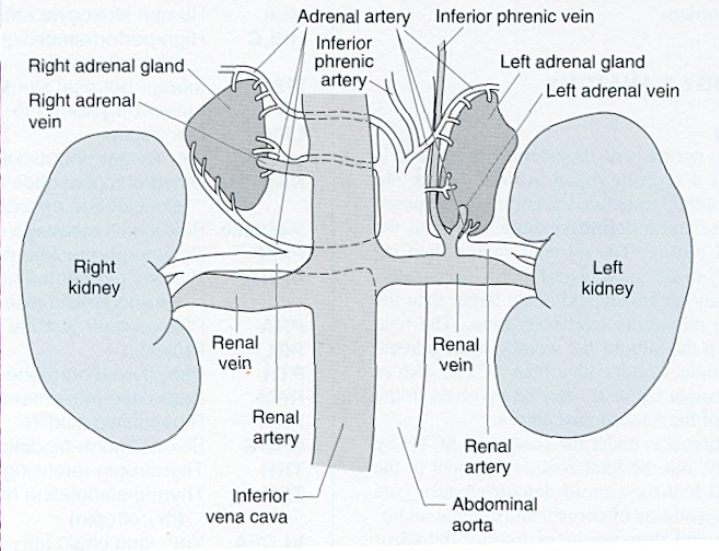
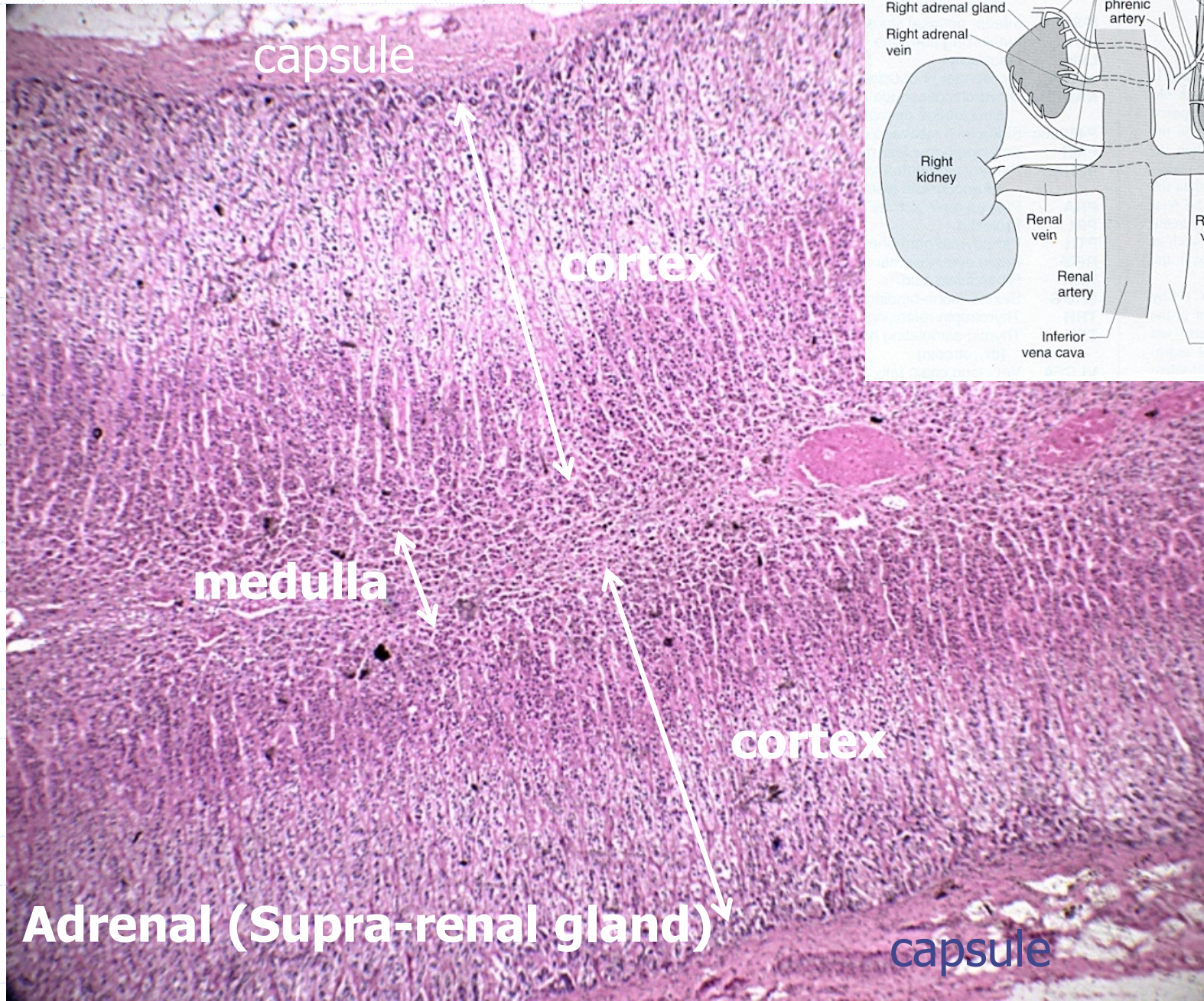
Objectives

Adrenal

- ◆ Locate the adrenal/suprarenal gland, define the histological regions, and the blood supply. (Slides 3-5)
- ◆ Correlate the structure and function of the zones in the cortex, including hormones produced, regulatory hormones, and target cells. (Slides 6—9)
- ◆ Distinguish the organelles used to produce steroid hormones from those used to produce protein hormones. (Slide 10)
- ◆ Correlate the structure and function of the adrenal medullary cells.(Slides 11, 12)

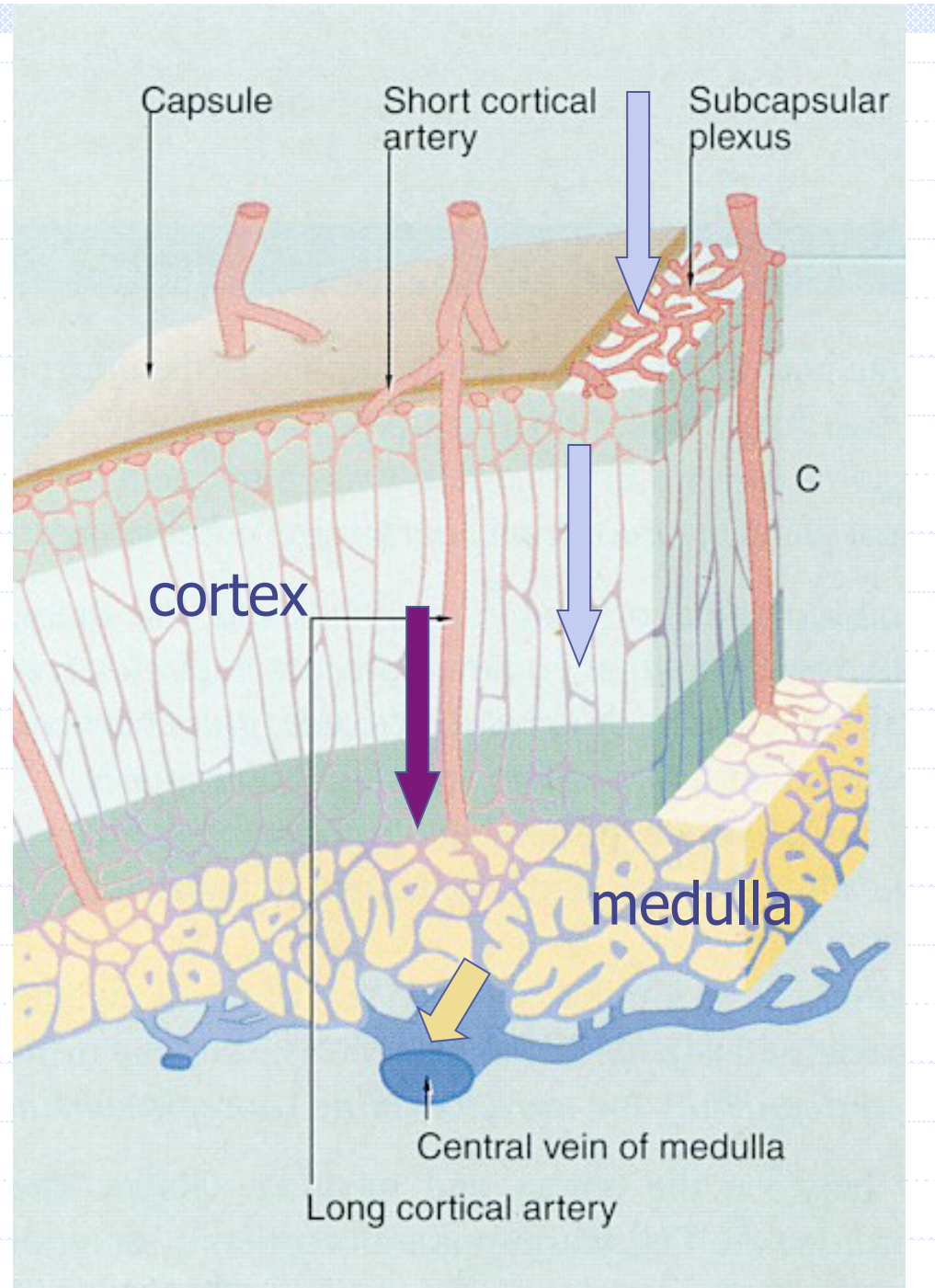
Pineal, Cardiovascular endocrine, Endocrine Pancreas, and Adipocyte

- ◆ Be able to Identify and Correlate the structure and endocrine function of the following:
 - A. Cardiovascular endocrine cells Slides 13, 14
 - B. Cells in the Islets of Langerhans Slide 15
 - C. Adipocytes Slide 16
 - D. Pinealocyte Slide 17-24

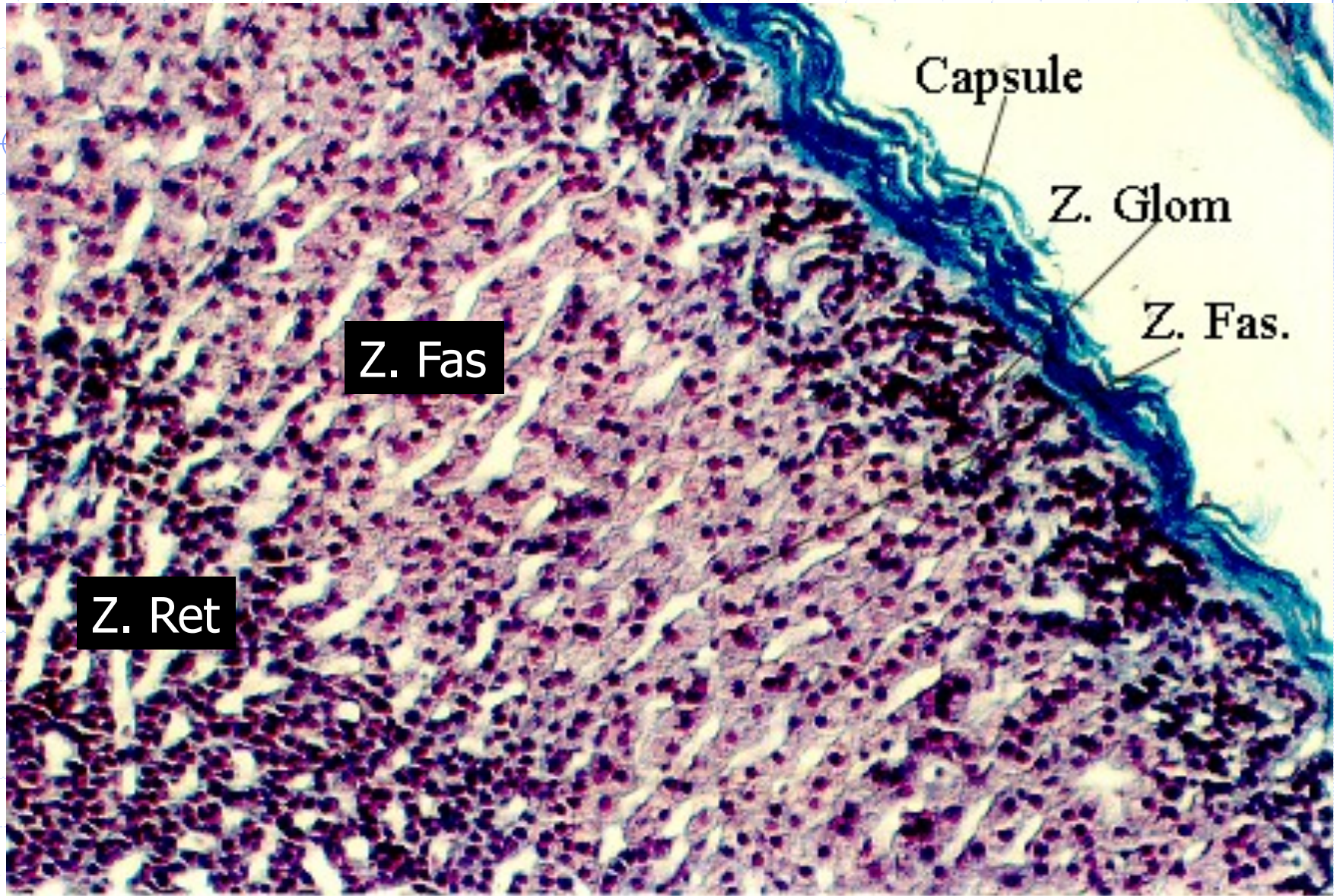


Vascular supply:

- ◆ Adrenal artery branches and penetrates cortex at multiple sites
- ◆ Short cortical A. breaks up into capillaries under the capsule.
- ◆ Then, capillaries descend to the medulla through the cortex.
- ◆ Long cortical A. descends directly to medulla.
- ◆ Both cortical A. empty into capillary supply of medulla and ultimately into Central vein



Adrenal Cortex: Three distinct zones

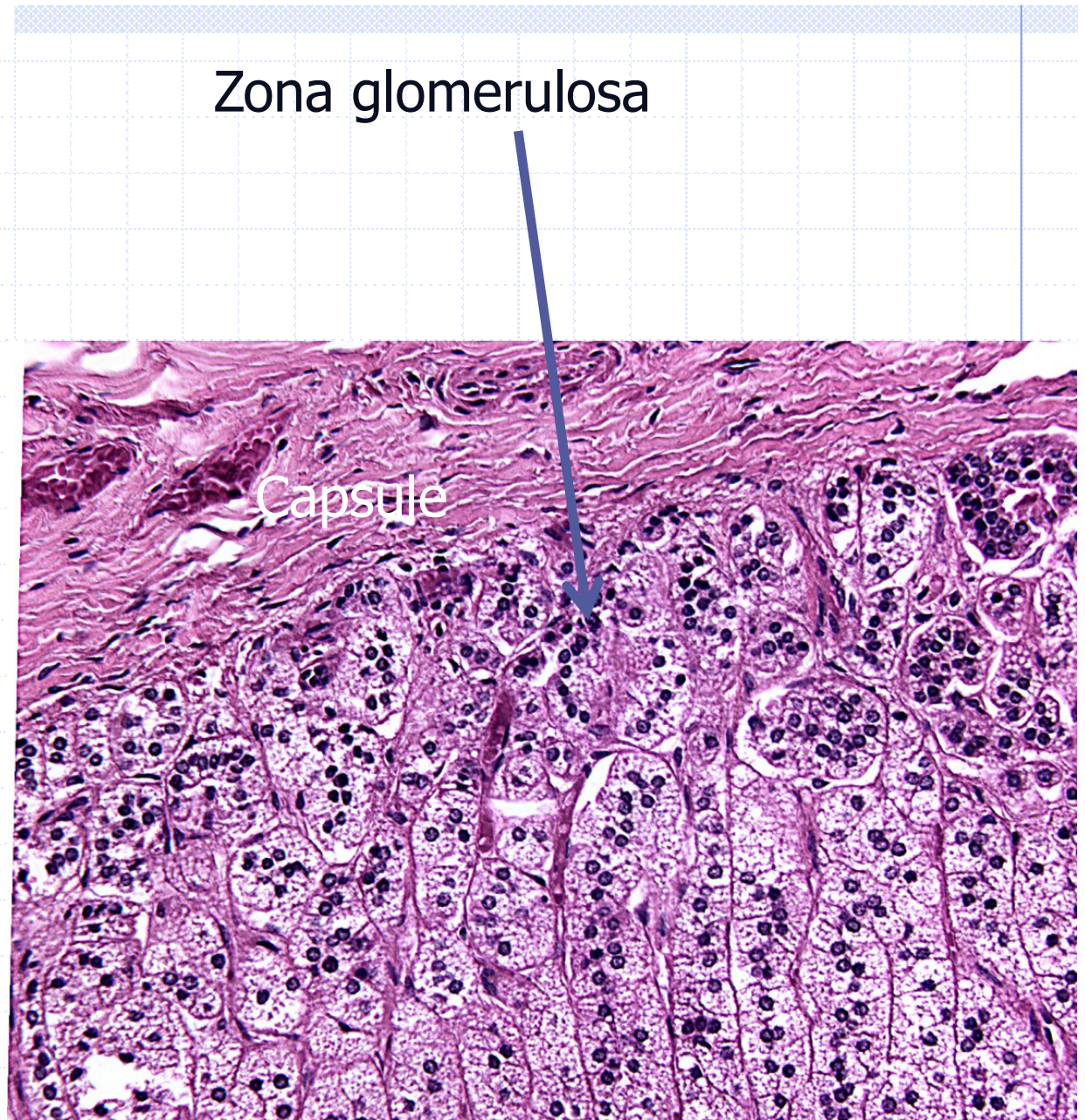


Zona Glomerulosa (Z. Glom); Zona Fasciculata (Z. Fas.); Zona reticularis (Z. ret.)

Zona glomerulosa=
Outermost
Cortical cells
arranged in “balls”
or clusters
Cells produce
aldosterone

Aldosterone helps
conserve both water
and sodium.

Ultimately,
aldosterone will raise
blood pressure and
extracellular fluid
volume.



Middle Adrenal Zone
Zona Fasciculata: cells
arranged in parallel
straight cords.

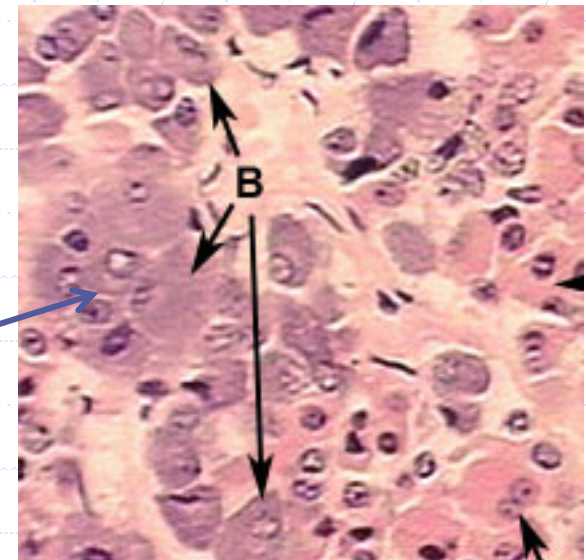
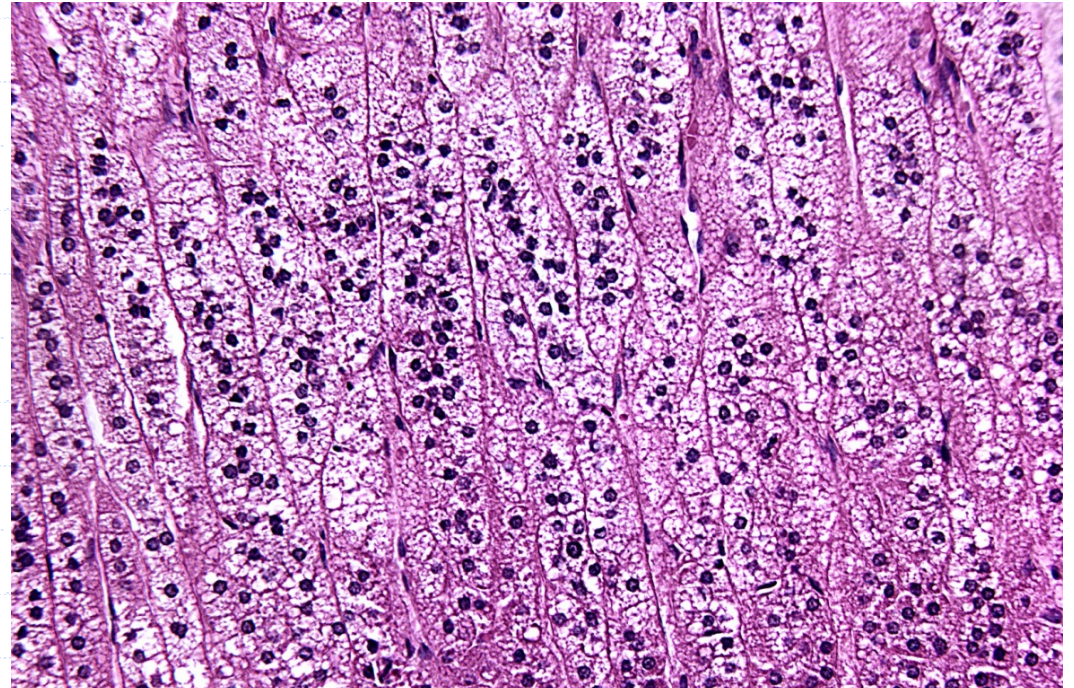
Cells produce
glucocorticoids (cortisol)

Produced in response to
Stress, illness, injury:
“Flight or Fight”

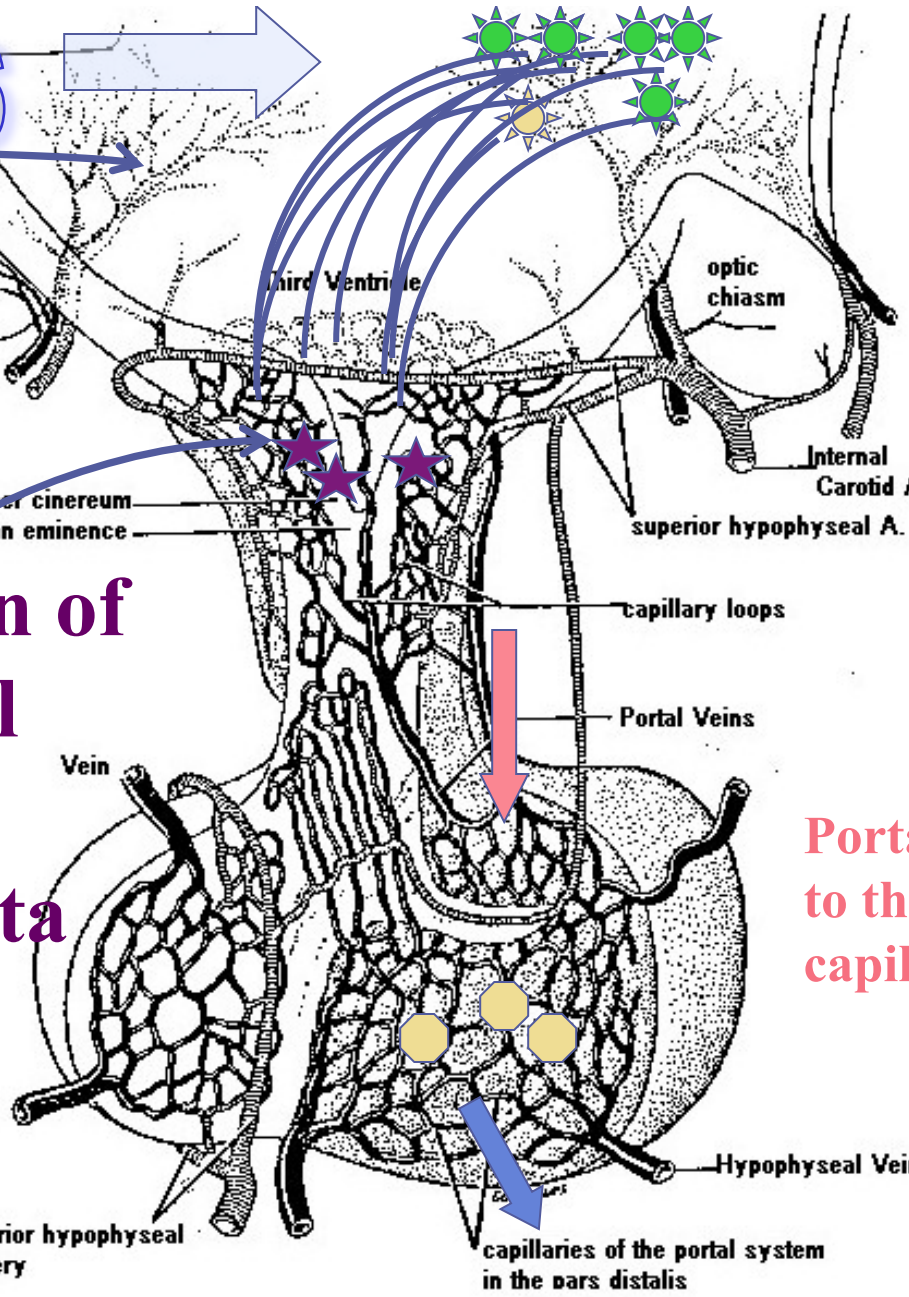
Regulated by

- **Corticotropin releasing hormone from the hypothalamus.**
- **Adrenocorticotropin from pituitary basophil**

Zona Fasciculata



Stress →



Regulation of Adrenal Zona Fasciculata

Neurons produce corticotropin Releasing hormone (CRH)

Send CRH, in axons to Stalk - Median eminence region. Release CRH in capillary bed

Portal veins send CRH to the anterior lobe capillary plexus.

CRH stimulates ACTH cells to synthesize and secrete ACTH Pituitary basophils

ACTH is released through Pituitary Venous system; Stimulates Cortisol release ---Cortisol negative feedback

Adrenal Cortex: innermost zone

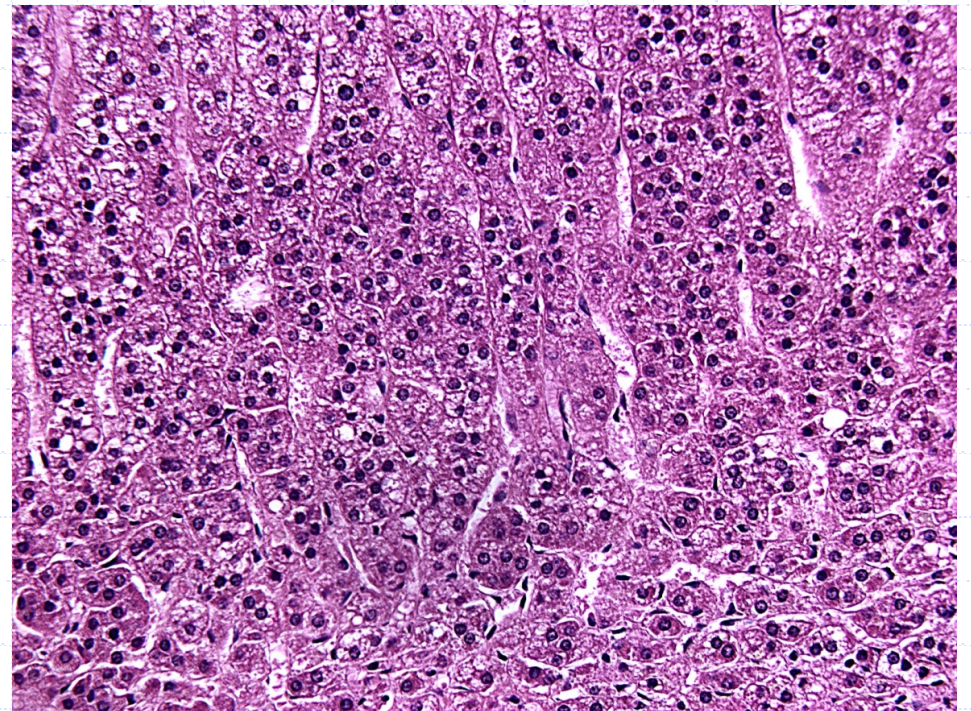
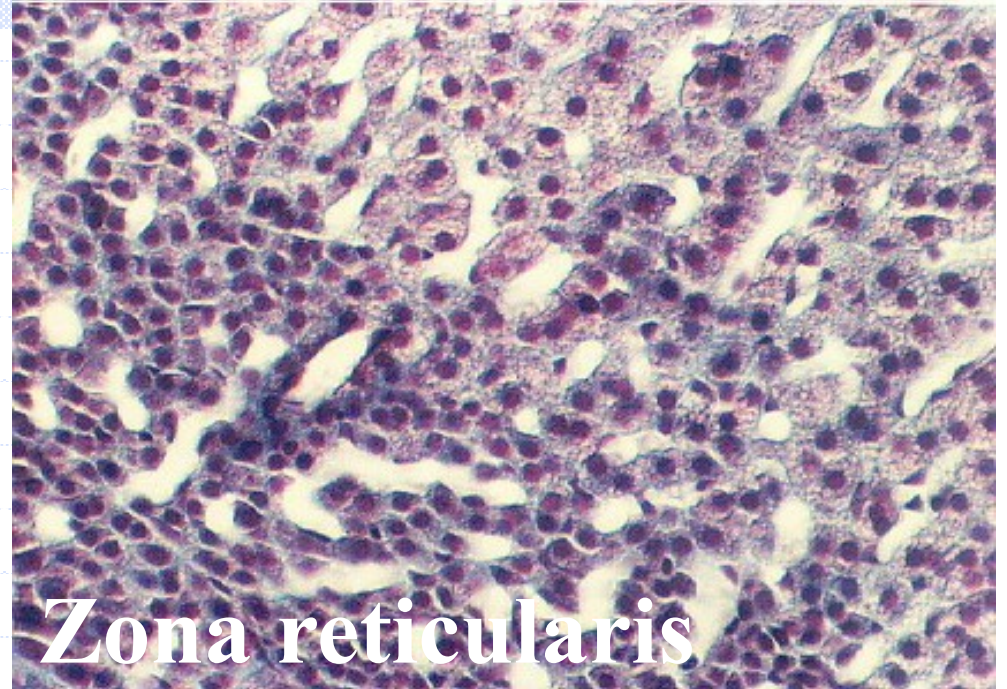
Zona reticularis

Network of cells, branching cords. Cells produce precursors to androgen hormones.

Secretes DHEA

(dihydroepiandrosterone) and DHEA sulfate, which is a precursor for testosterone (T) and dihydrotestosterone (DHT)

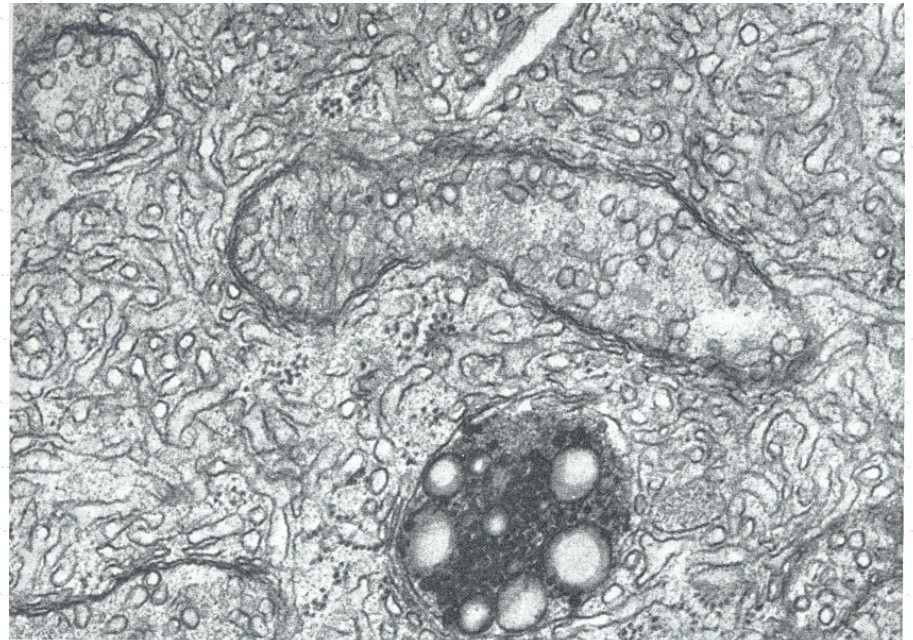
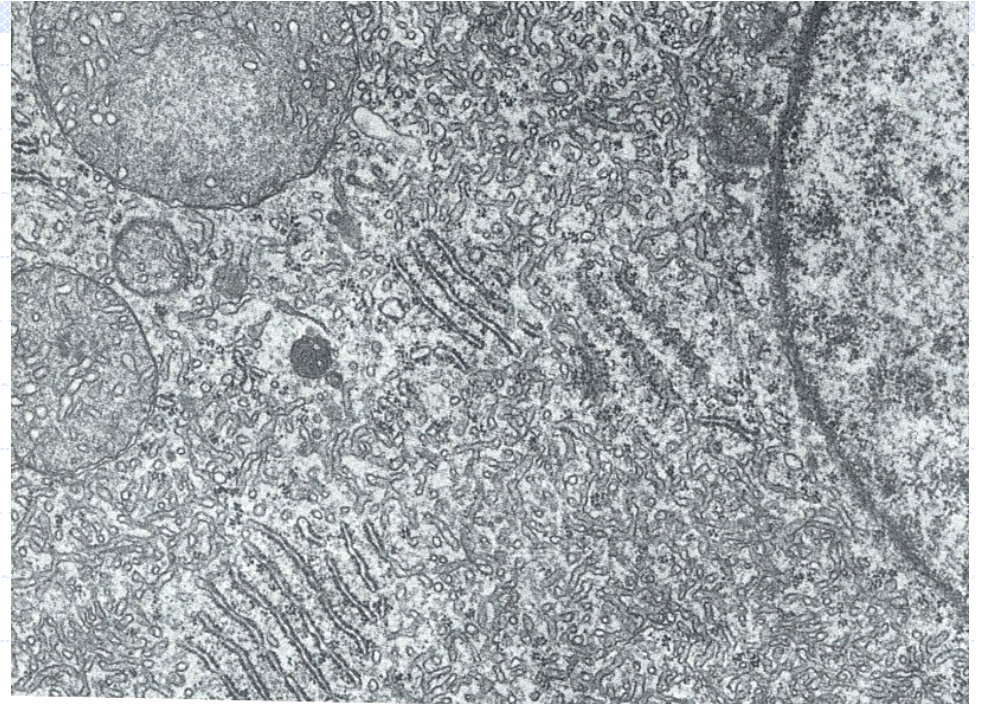
Impact in females: can masculinize (cause hair growth, etc). ACTH can stimulate!



Adrenal cortex cells make steroid hormones

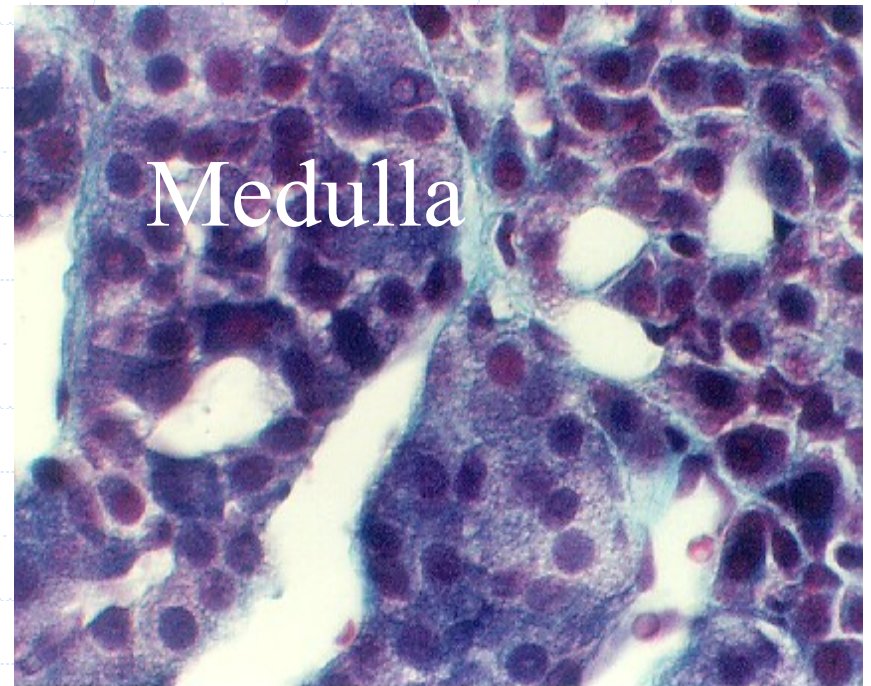
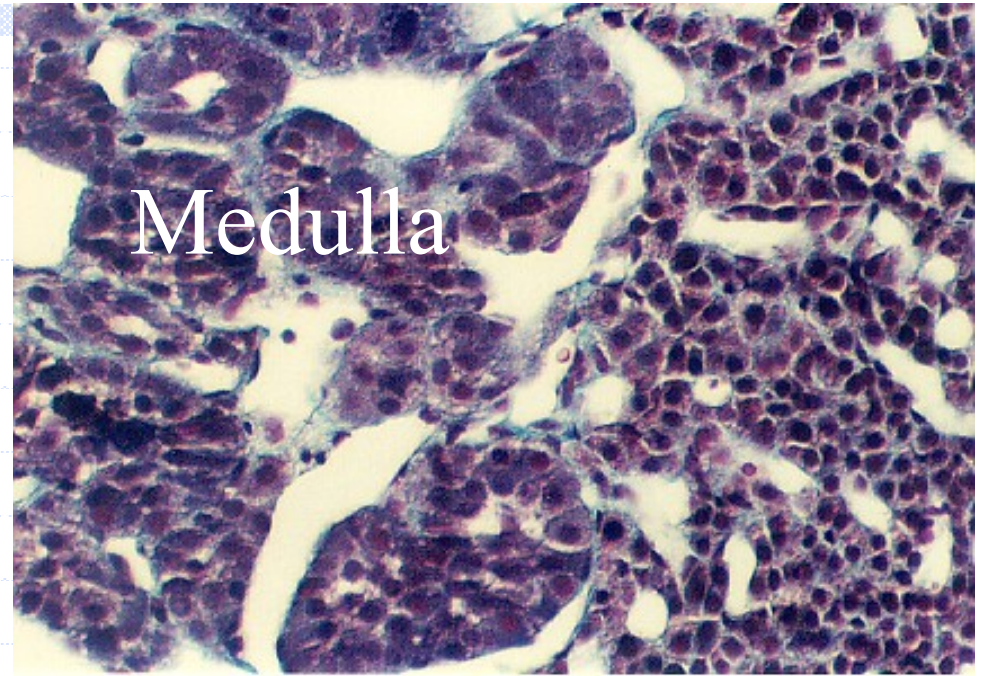
Organelles involved:

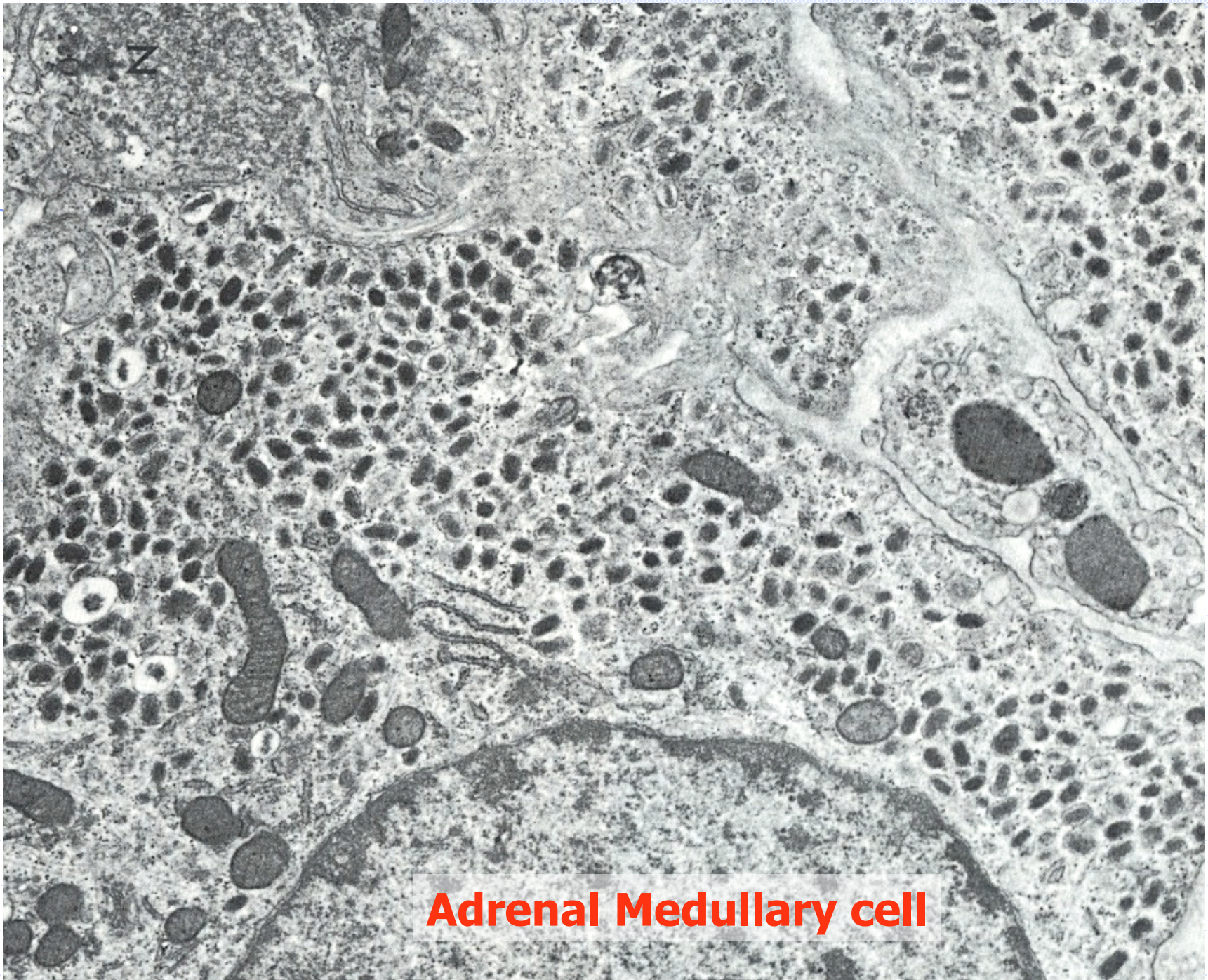
- ◆ Mitochondria with tubular cristae
- ◆ Smooth Endoplasmic reticulum
- ◆ These two organelles have special enzymes that modify the steroid molecules to make the product of that particular cell:
 - E.g. Aldosterone, Cortisol, DHEA
- ◆ All start with the same precursor molecule:
 - Cholesterol



What is the function of the adrenal medulla?

- ◆ Part of the autonomic NS.
- ◆ The cells are neurons that have lost their axonal processes.
- ◆ They have become neuroendocrine cells
- ◆ Produces
 - Norepinephrine (noradrenaline)
 - Epinephrine (adrenaline)
- ◆ Involved in the flight or fight response





Adrenal Medullary cell

Cardiovascular muscle endocrine cells

- ◆ Specialized cells in atrial wall sense changes in blood volume as pressure on the atrial wall (baroreceptors)
- ◆ Produce hormones that act at various places to decrease blood volume and blood pressure.

**Atrial natriuretic peptide (ANP);
Atriopeptins;
cardiodilatin
and
cardionatrin.**

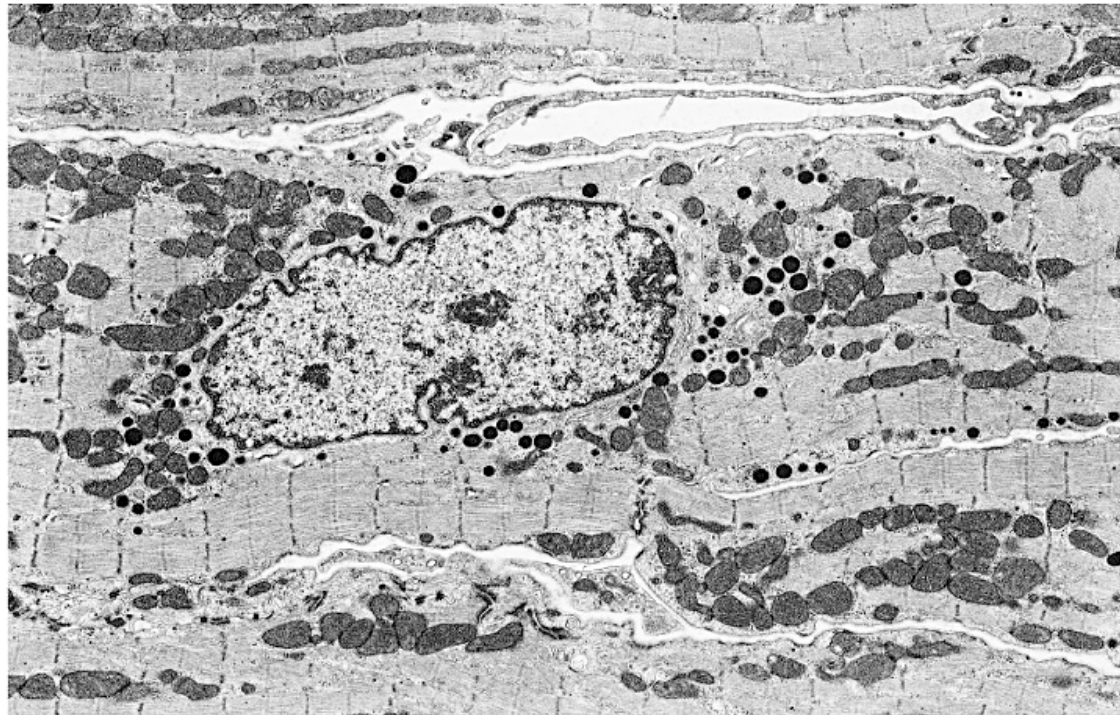


Figure 11-18 Electron micrograph of a cardiac muscle cell containing clusters of vesicles with atrial natriuretic peptide (ANP). (From Mifune H, Suzuki S, Honda J, et al: Atrial natriuretic peptide (ANP): A study of ANP and its mRNA in cardiocytes, and of plasma ANP levels in non-obese diabetic mice. *Cell Tissue Res* 267:267-272, 1992. Copyright Springer-Verlag.)

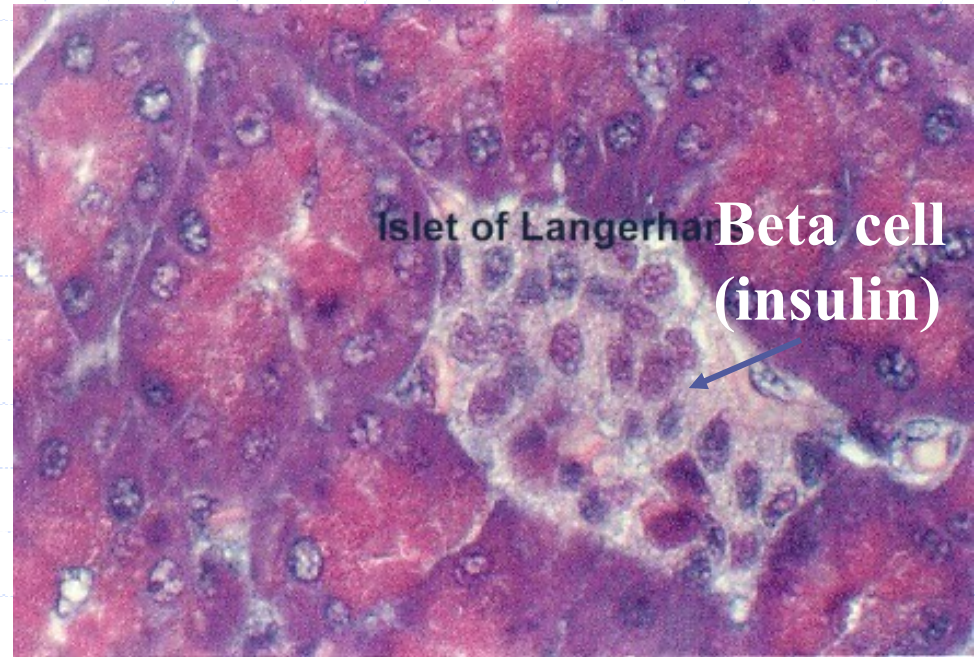
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Cardiac hormones produced

- ◆ **Atrial natriuretic peptide (ANP); Atriopeptins; cardiodilatin and cardionatrin.**
 - Family of peptides; same precursor;
 - Counter renin angiotensin system
 - Decrease aldosterone (adrenal)
 - Decrease sodium and water retention at the level of the kidney
 - Relax smooth muscle (dilates vessels)
 - Inhibits vasopressin (antidiuretic hormone)
- ◆ **May be very important clinically in response to cardiac failure and high blood pressure.**

Histology of the Islet of Langerhans

- ◆ Purple cells in Islet of Langerhans are insulin containing beta cells.
- ◆ Promotes uptake and utilization of glucose. Especially needed by the brain
- ◆ Regulated by Glucose



Reddish cell=glucagon cell (alpha cell)

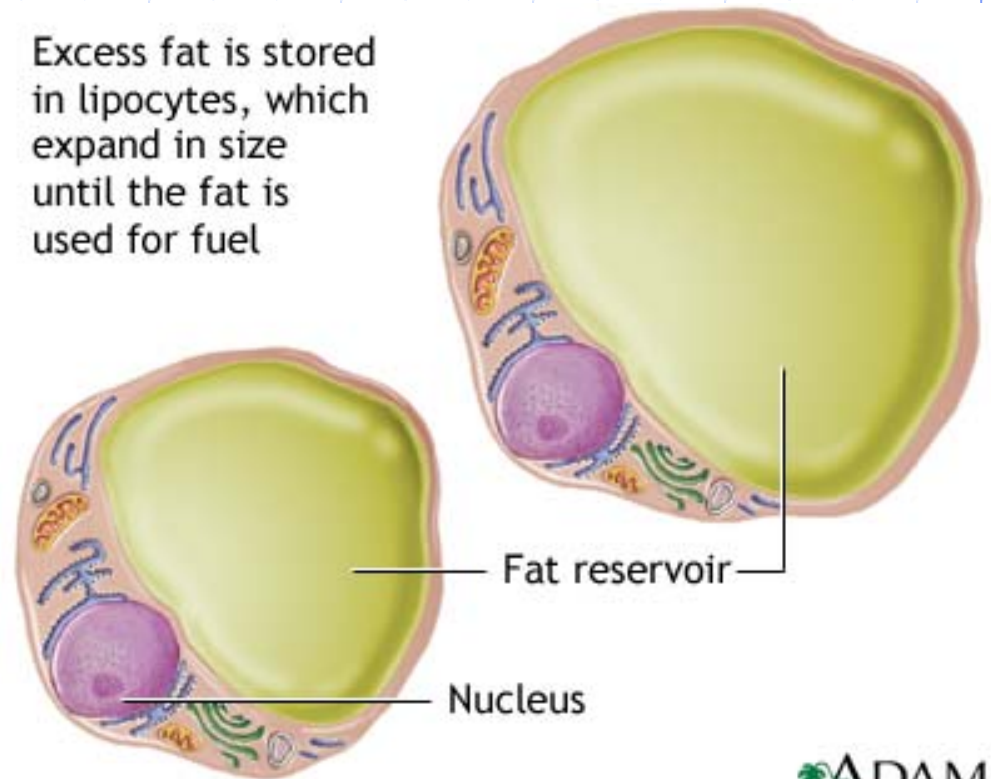
Stimulates digestive processes that elevate glucose

◆ **Leptin: 167 aa protein**

- Leptin from the Greek word "leptos" for thin.
- feeds back information to the satiety centers of the brain about levels of fat stores (arcuate nucleus; medial and lateral hypothalamus.)
- Obese individuals might become leptin resistant and do not respond. Not a great appetite regulator
- Is probably more important as a signal for starvation. (Permissive for puberty)

◆ **Resistin: 114 aa protein; make cells resistant to insulin**

Excess fat is stored in lipocytes, which expand in size until the fat is used for fuel



The adipocyte as an endocrine cell

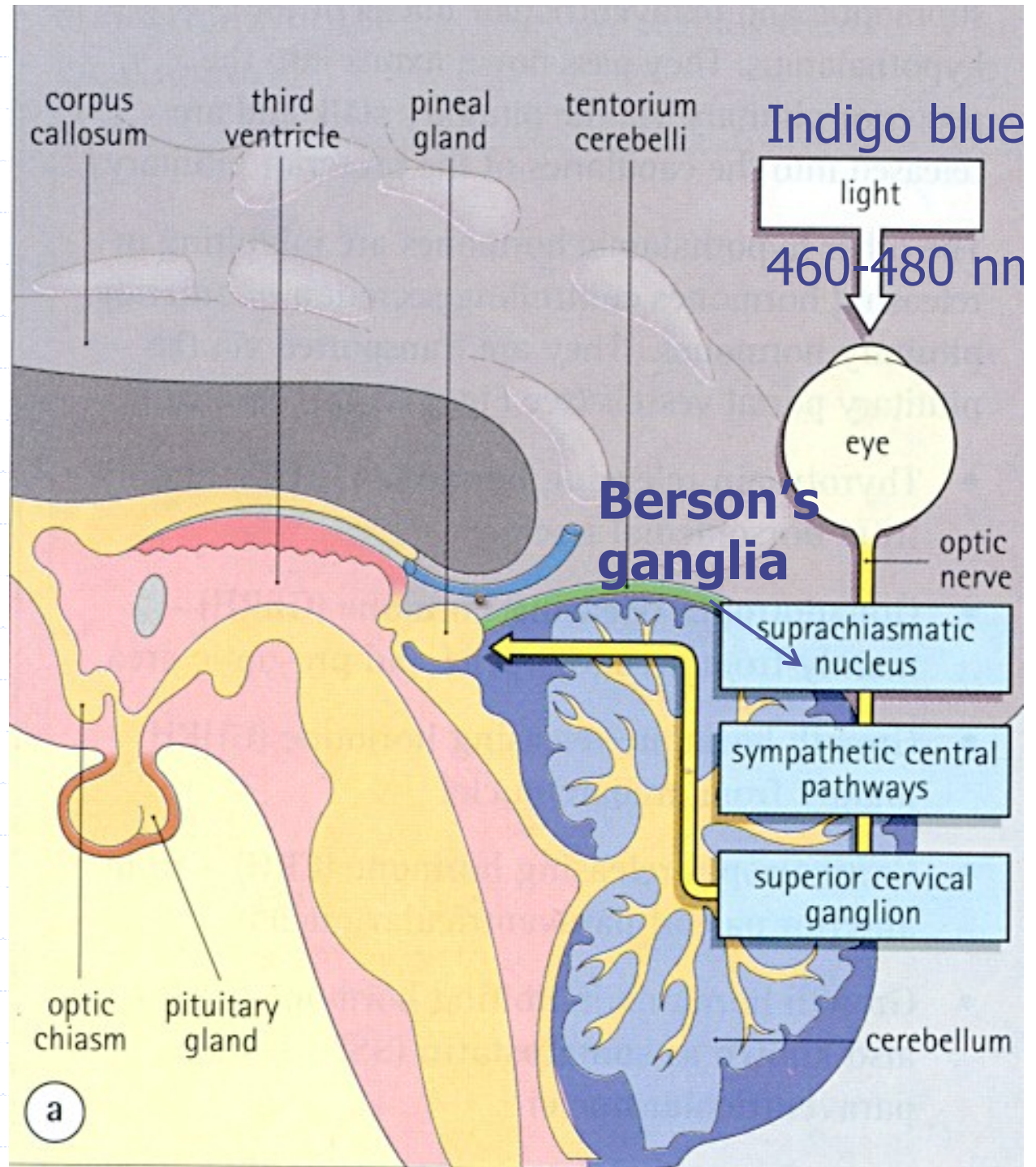
Fat cells regulated by growth hormone, epinephrine and norepinephrine; fat released after exercise; lipolytic

Location of Pineal

Connected to the back of the brain, just above the cerebellum.

Contains a group of "nerve cells" that have been transformed to be neuroendocrine cells

Pineal cells receive signals via a unique small group of photoreceptor cells that are sensitive to indigo blue light (460 nm).



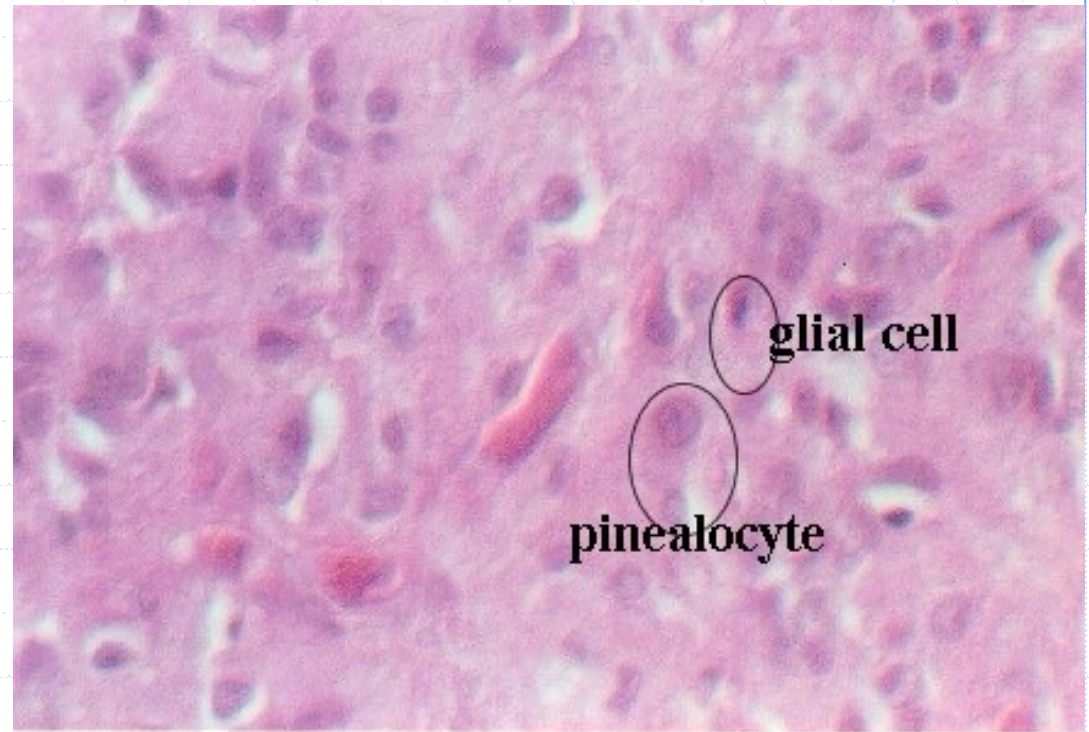
What cell types are in pineal?

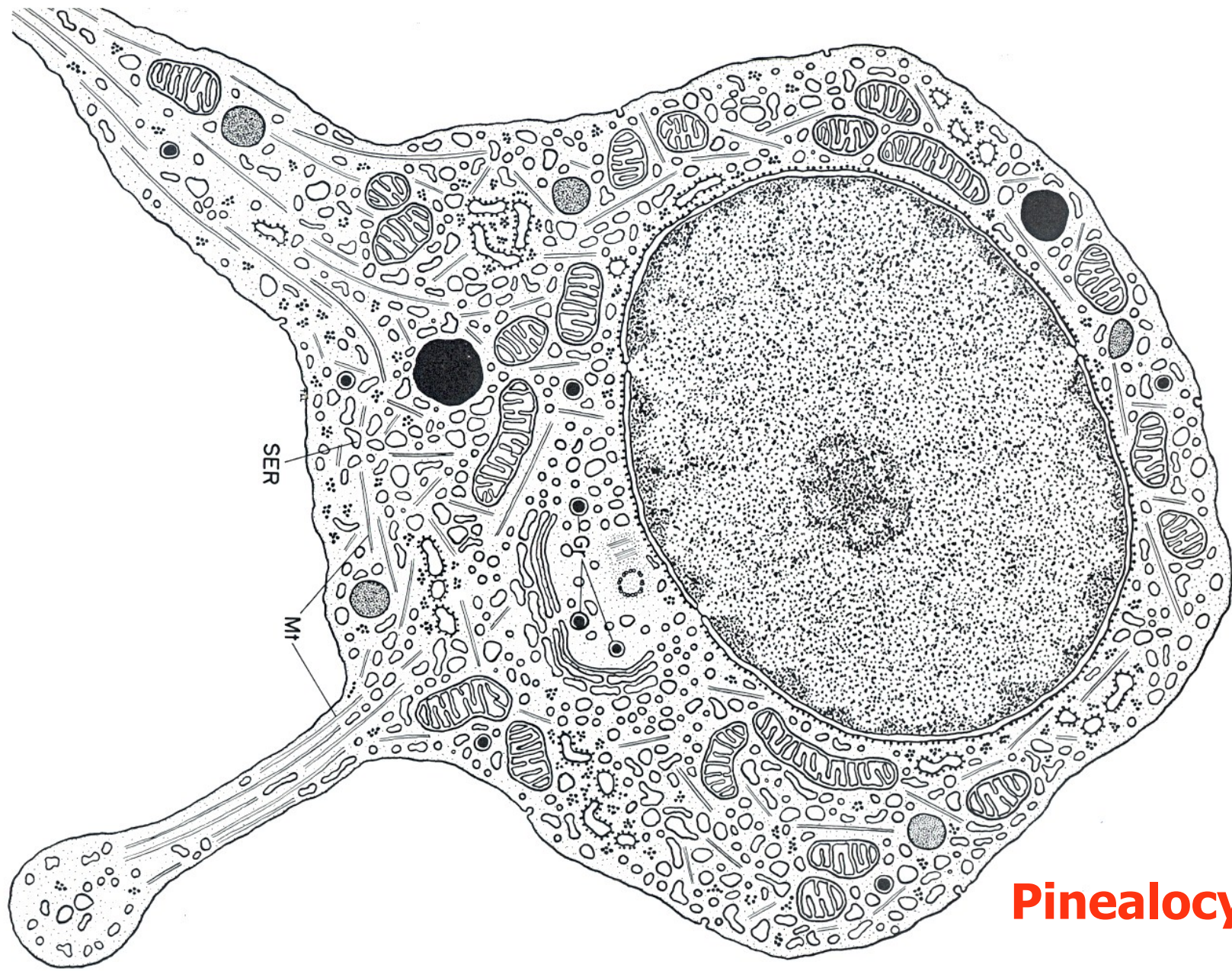
◆ Neuron-like pinealocytes:

- Stellate (star shaped)
- Microtubules, SER, a few granules
- Lie in clusters

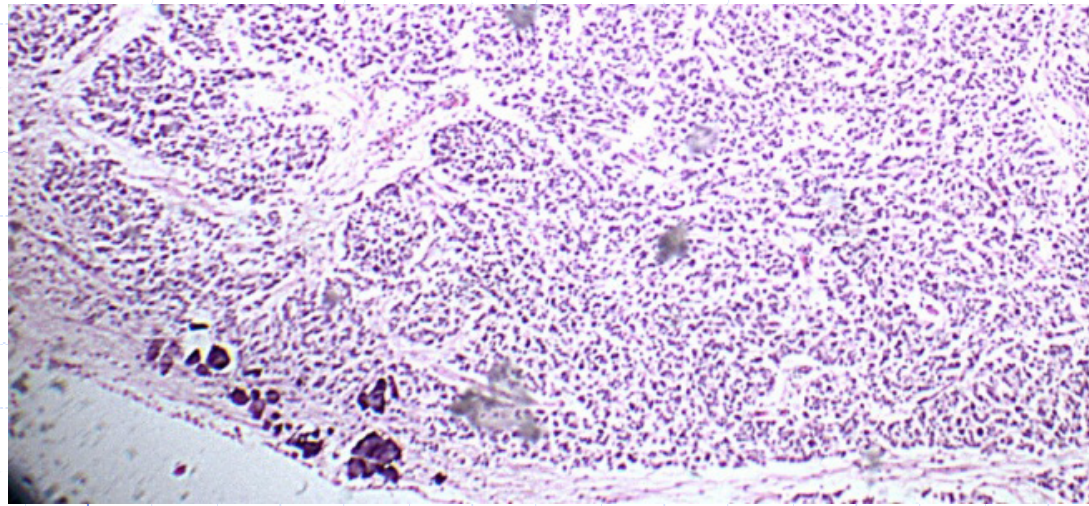
◆ Glial cells

- Dense nucleus
- Ovoid, run between clusters of pinealocytes.

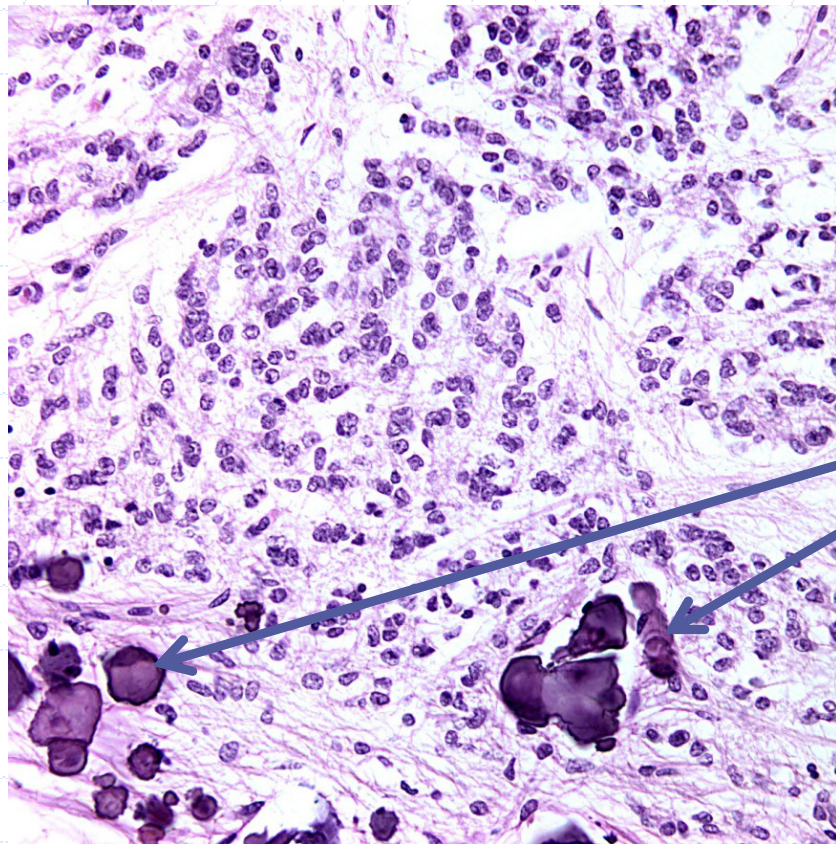




Pinealocyte

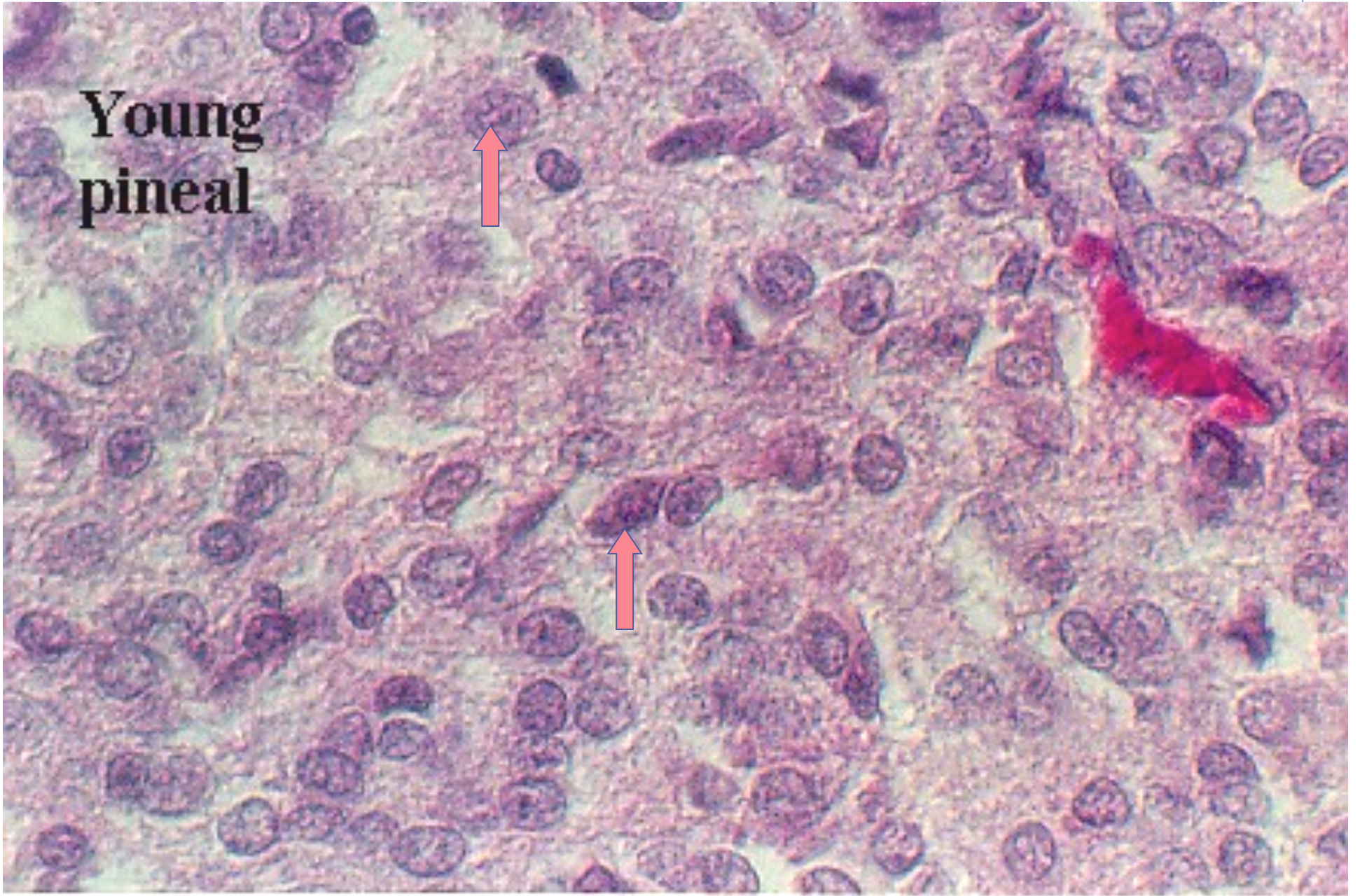


Pineal



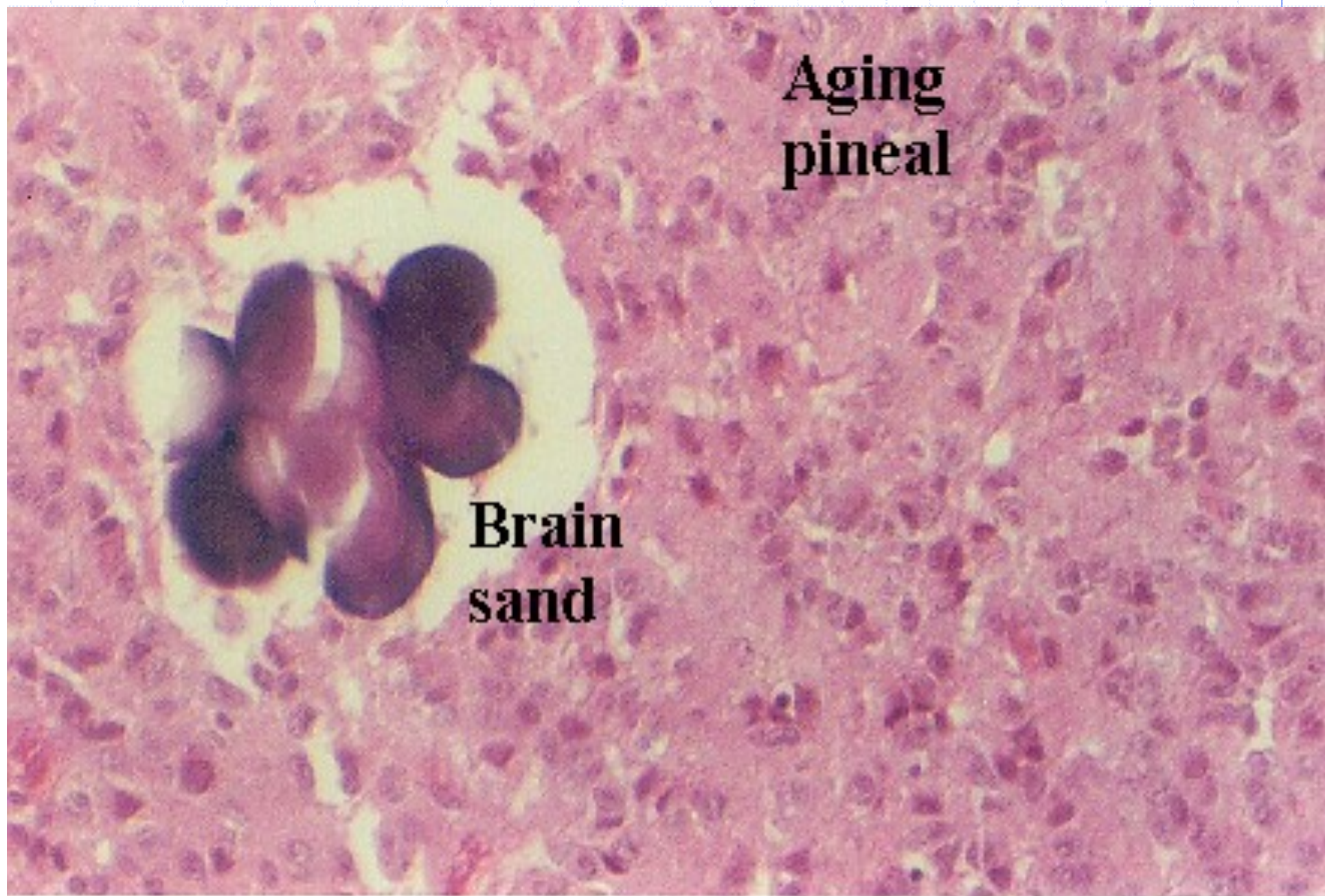
In older pineal, look for presence of "brain sand", which are landmarks for radiologists. Helps students identify the pineal

**Young
pineal**



**Aging
pineal**

**Brain
sand**



Functions of pineal

- ◆ **Produces melatonin, from serotonin**
- ◆ **Rise in melatonin at night makes us sleepy**
- ◆ **Melatonin helps establish rhythms**
- ◆ **Also, melatonin is inhibitory to gonadotropins (LH and FSH).**
 - **Rise in melatonin during short days/long nights causes regression of testes in seasonal breeders**
 - **Longer days lowers melatonin and allows for breeding**
- ◆ **Children with destroyed pineal gland may go through precocious puberty.**

What leads to increased melatonin?

- ◆ Dark, sunset...in fact drop in indigo blue light (460-480 nm) which is part of white light.
- ◆ Melatonin rise as long as you don't see this wavelength of light
- ◆ Makes us sleepy and we get a normal good night's sleep
- ◆ At sunrise the special photoreceptors receive the 460-480 nm light waves and they send signals through to suppress melatonin.
- ◆ Problems---presence of light during the night suppresses melatonin and may cause problems, including cancer.