PANCREAS

Emrbyology, anatomy, physiology

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OUTLINE

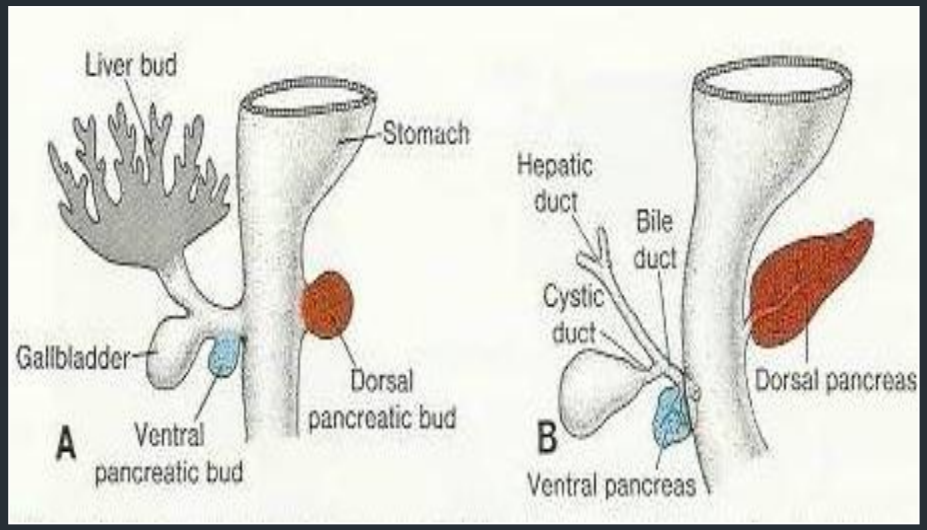
- Embryology
- Anatomy
- Physiology

DEFINITION

A glandular organ in the digestive system and endocrine system

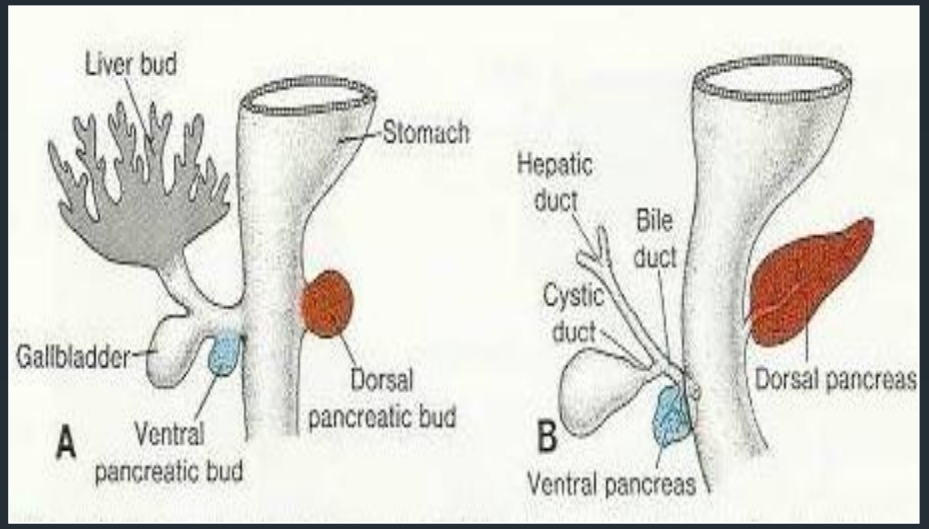
EMBRYOLOGY

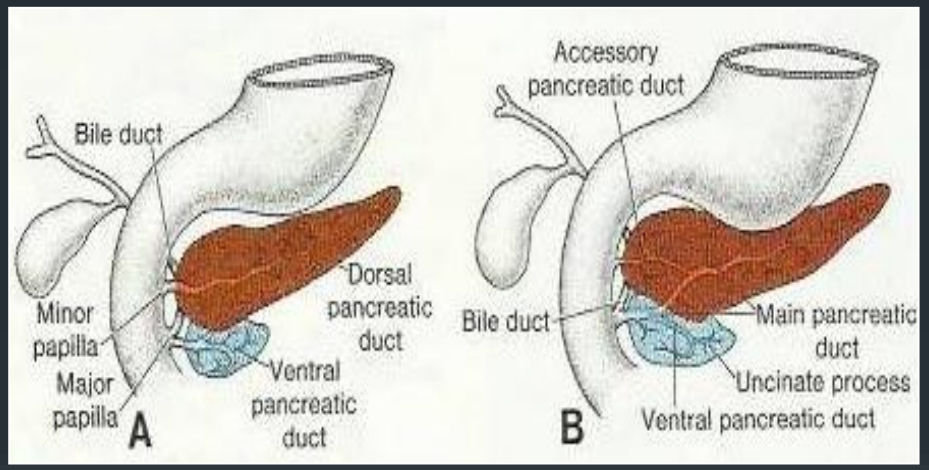
- Develops from 2 buds arising from endoderm of the caudal part of the foregut
- Ventral pancreatic bud develops from proximal end of hepatic diverticulum (forms liver & gall bladder)
- Dorsal pancreatic bud develops from dorsal wall of duodenum
- Most of pancreas derived from dorsal pancreatic bud



EMBRYOLOGY

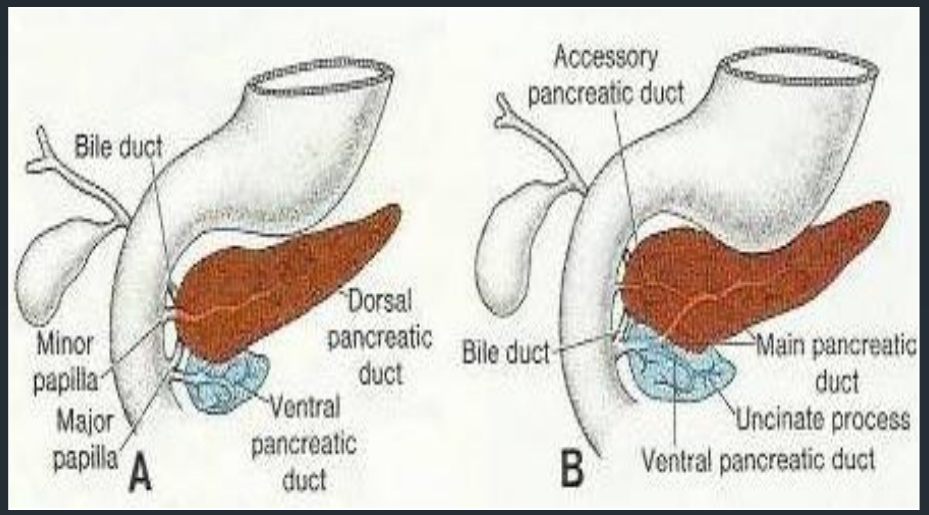
- Duodenum rotates to the right becoming C-shaped
- Ventral bud moves dorsally to lie below and behind dorsal bud
- 2 buds fuse together in the dorsal mesentery

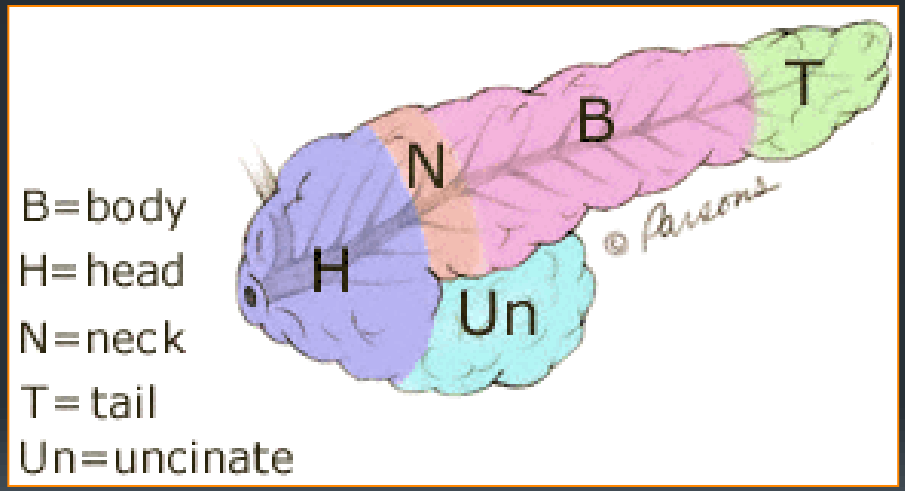




EMBRYOLOGY

- Ventral bud forms:
  - Uncinate process
  - Inferior part of head
- Dorsal bud forms:
  - Upper part of head
  - Neck
  - Body
  - Tail of pancreas

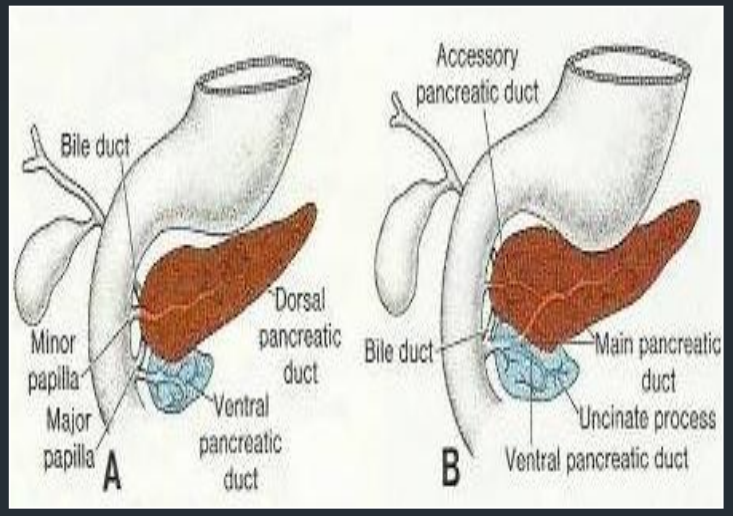


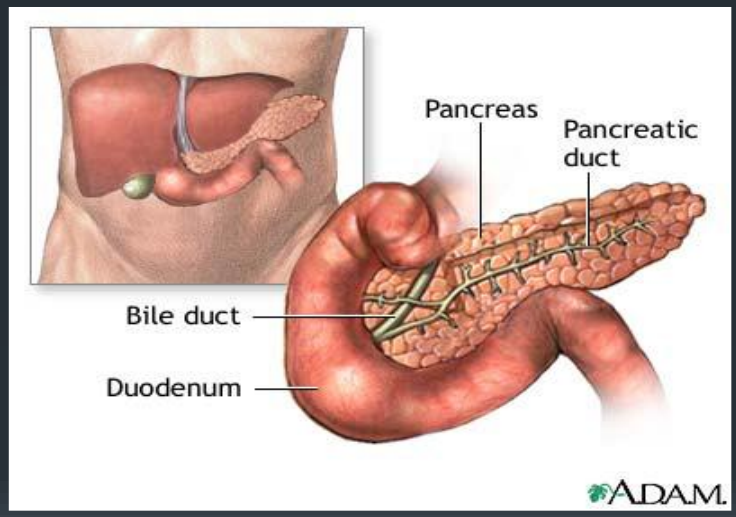


EMBRYOLOGY

- Main pancreatic duct formed from:
  - Duct of ventral bud
  - Distal part of dorsal bud duct

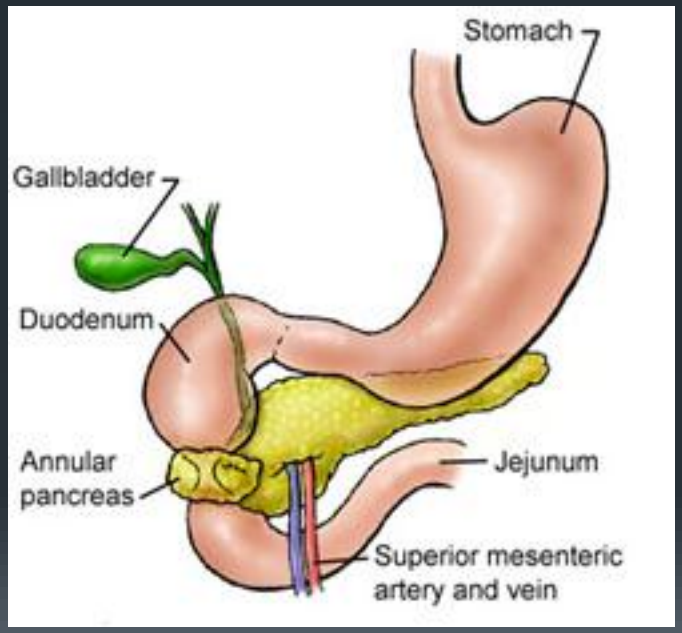
- Accessory pancreatic duct formed from:
  - Proximal part of dorsal bud duct

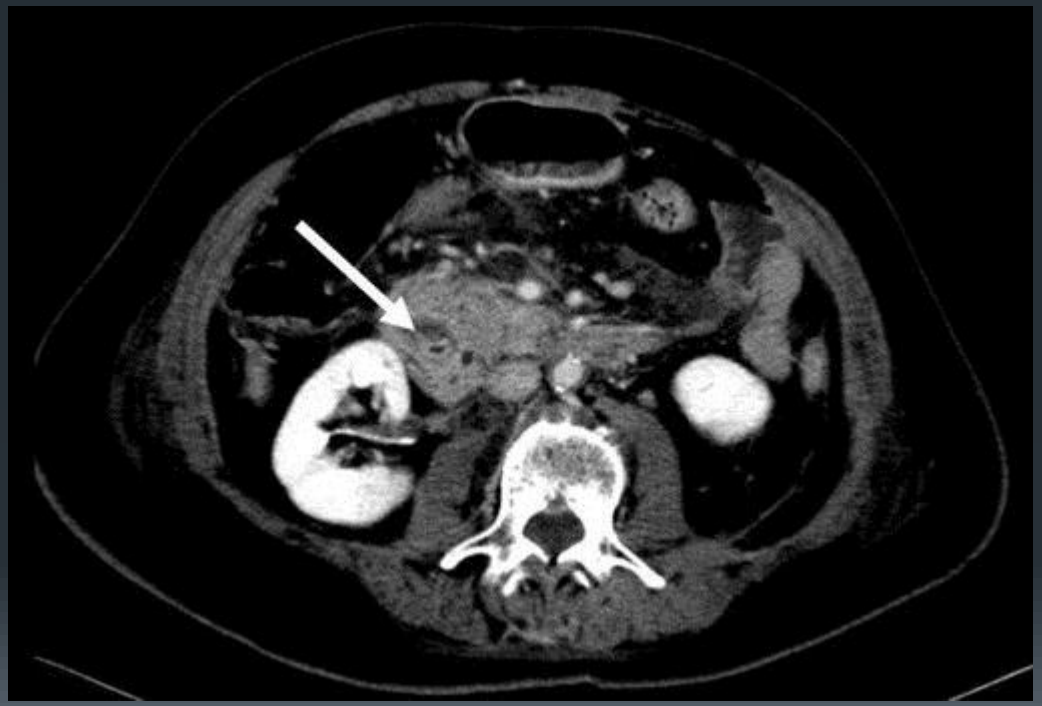




CONGENITAL ANOMALIES

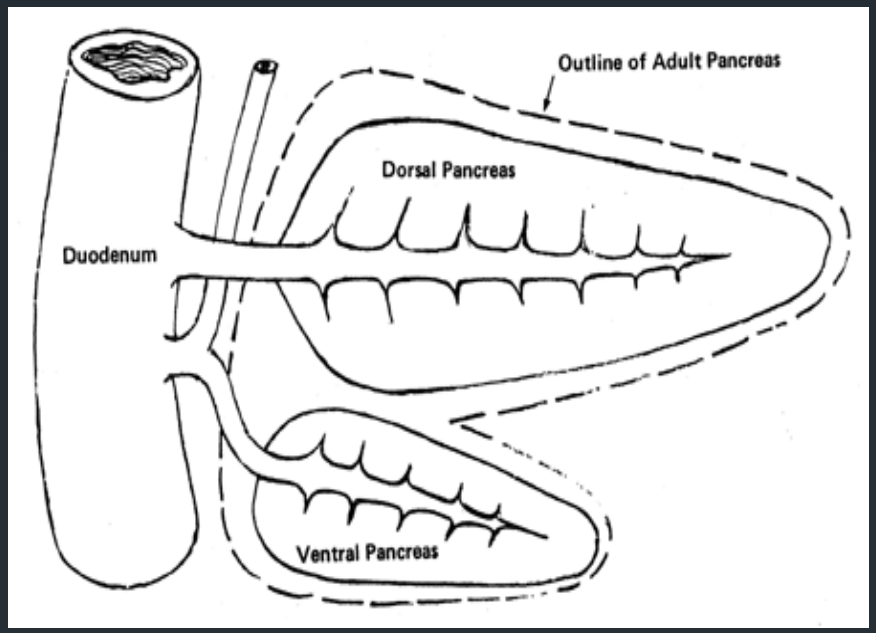
- *Accessory pancreatic tissue:* Located in wall of stomach or duodenum
- *Annular pancreas:* thin flat band of pancreatic tissue surrounding 2nd part of duodenum. Can cause duodenal obstruction

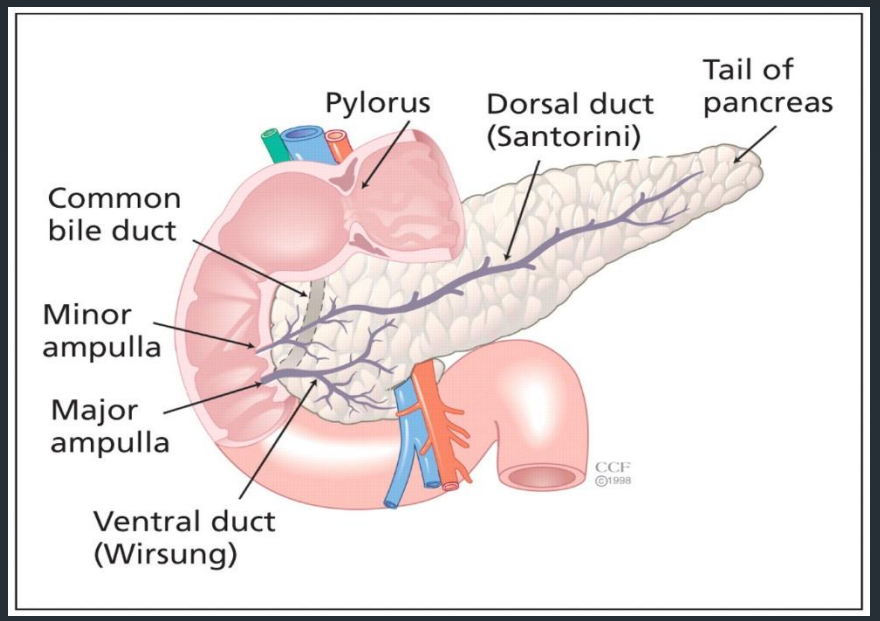




CONGENITAL ANOMALIES

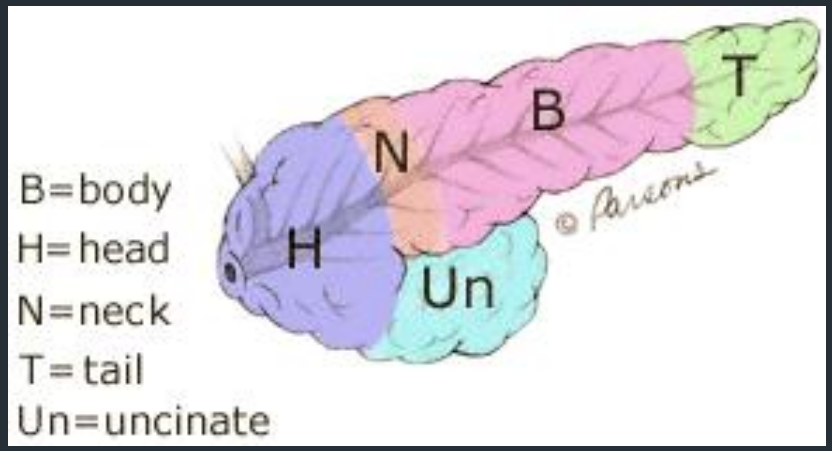
- *Pancreas divisum:* Pancreatic buds fail to fuse





ANATOMY

- Retro-peritoneal gland at 2nd lumbar level extending in oblique, transverse position
- Divided into:
  - Head
  - Neck
  - Body
  - Tail



- Both exocrine and endocrine functions

ANATOMY – Pancreas Head

- Surface marking: L2
- Relations:
  - Posterior: IVC, Aorta, Lt & Rt renal vns, CBD
  - Uncinate: Posterior = Aorta
    Anterior = SMV/SMA

ANATOMY – Pancreas Neck

- Surface marking: L1
- Relations:
  - Posterior: SMV/SMA (emerge inferiorly),
    Portal vein (confluence SMV, Splenic vn)
  - Superior: D1
  - Right: Gastroduodenal artery

ANATOMY – Pancreas Body

- Surface marking: L1
- Relations:
  - Anterior: Lesser sac, Stomach
  - Posterior: Lt renal vn, Lt crus, aorta, Lt psoas, Lt adrenal, Lt renal hilum, Splenic vn
  - Superior: Splenic artery
  - Inferior: Transverse mesocolon

ANATOMY – Pancreas Tail

- Surface marking: T12
- Within lienorenal ligament
- Up to splenic hilum
- Relations:
  - Posterior: Kidney
  - Inferior: Colon

ANATOMY – Pancreas Ducts

- Main duct (of Wirsung):

  Joins CBD at Ampulla of Vater

- Normal diameter of main duct (of Wirsung):

  Head: 4 mm

  Neck: 3 mm

  Tail: 2 mm

  > 70yrs: 5-6 mm

ANATOMY – Pancreas Ducts

- Ampulla:
  - Major:

    Duct of Wirsung

    Surface marking: L2

    Opens in D2, 7.5-10cm distal from pylorus
  - Minor:

    2cm proximal to major papilla

ANATOMY – Pancreas Ducts

- Main duct/CBD at Ampulla
  - Common with CBD: 90%
    - Y 70%
    - V 20%
  - Separate duodenal entry: 10%
    - U 10%

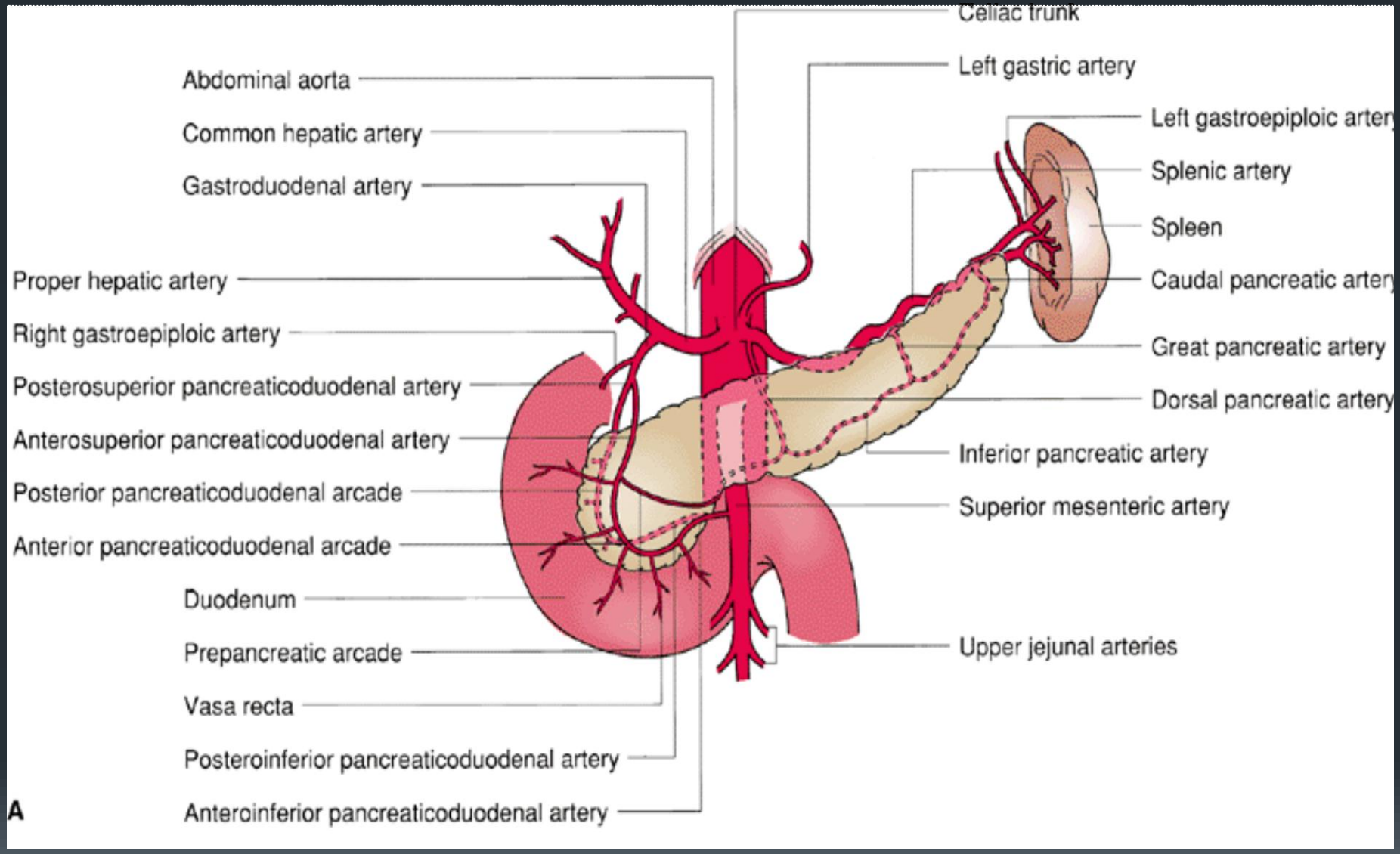
ANATOMY – Arterial Supply

- Splenic artery:
  - 3 biggest branches are:
    Dorsal pancreatic artery
    Pancreatica Magna (midportion of body)
    Caudal pancreatic artery (tail)

- Superior pancreaticoduodenal:
  - Coeliac > Common hepatic > Gastroduodenal
  - Divides into anterior and posterior branches

- Inferior pancreaticoduodenal:
  - Direct branch off SMA
  - Divides into anterior and posterior branches
  - Anastomosis with superior pancreaticoduodenal

ANATOMY – Arterial Supply

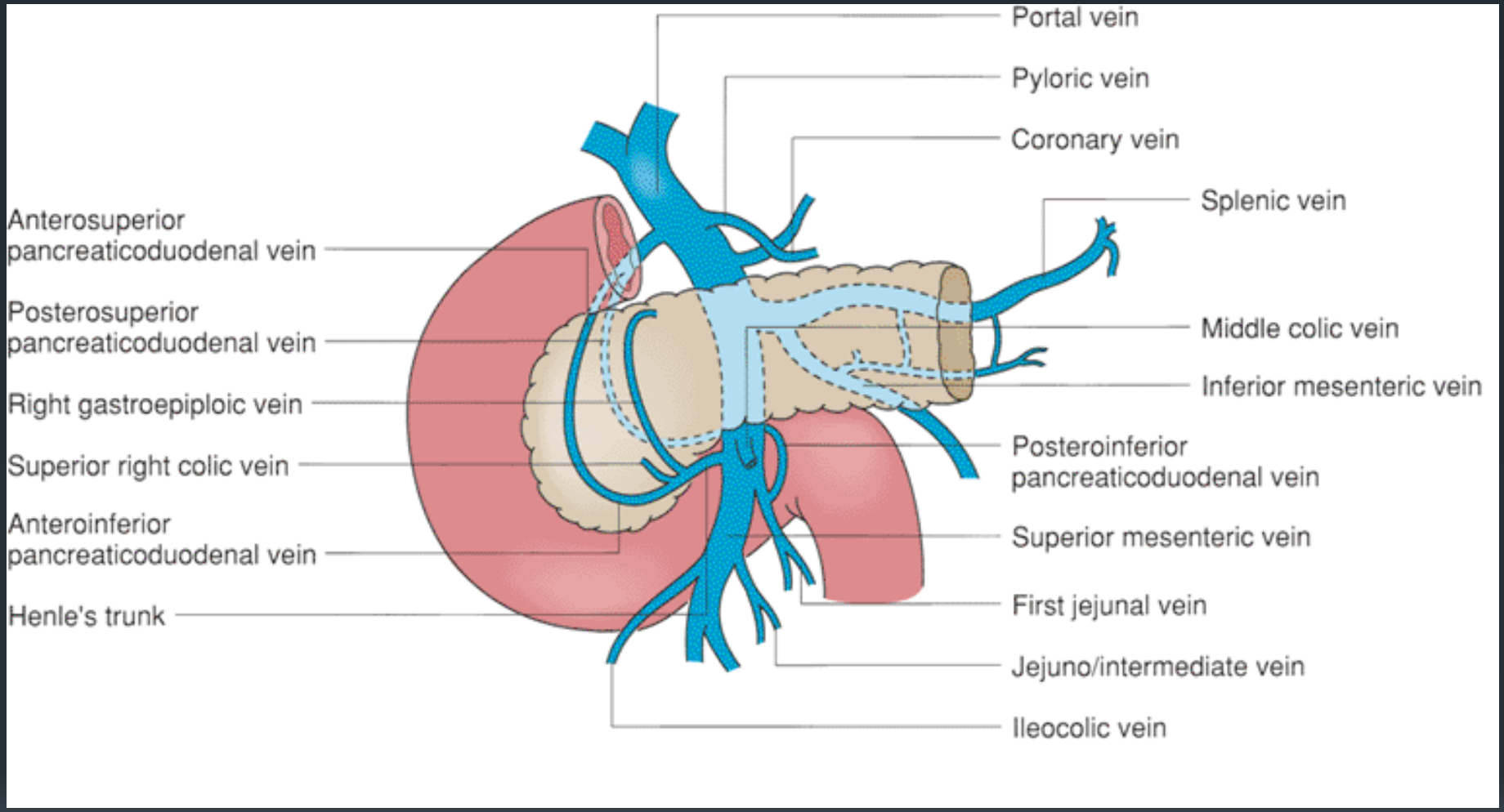


ANATOMY – Venous drainage

- Head:
  - Superior pancreaticoduodenal vn:
    - Rt gastroepiploic vn & middle colic → SMV
  - Inferior pancreaticoduodenal vn:
    - SMV

- Neck, Body, Tail:
  - Small tributaries to splenic vein

ANATOMY – Venous drainage



ANATOMY – Lymph drainage

- Head:
  - Upper → Coeliac
  - Lower & uncinated → SM group
- Neck, Body, Tail:
  - → Retropancreatic & Splenic

ANATOMY – Nerve supply

- Parasympathetic:
  - Posterior vagus & Coeliac ganglia
  - Stimulate both endocrine and exocrine secretion

- Sympathetic:
  - Splanchnics T6-10 & Coeliac plexus
  - Predominantly inhibitory effect

ANATOMY - Structure

- Lobules separated by septa:
  - Acini: Exocrine
  - Islets of Langerhans: Endocrine
- Ducts: - Intercalated ducts at acini
  > Intralobular ducts
  > Interlobular ducts
  > Main duct

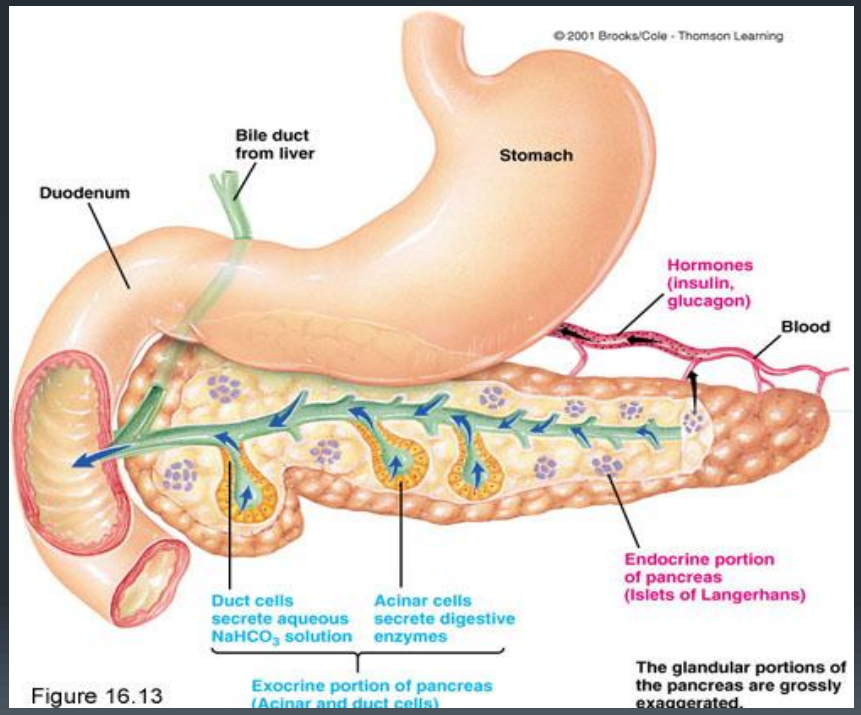
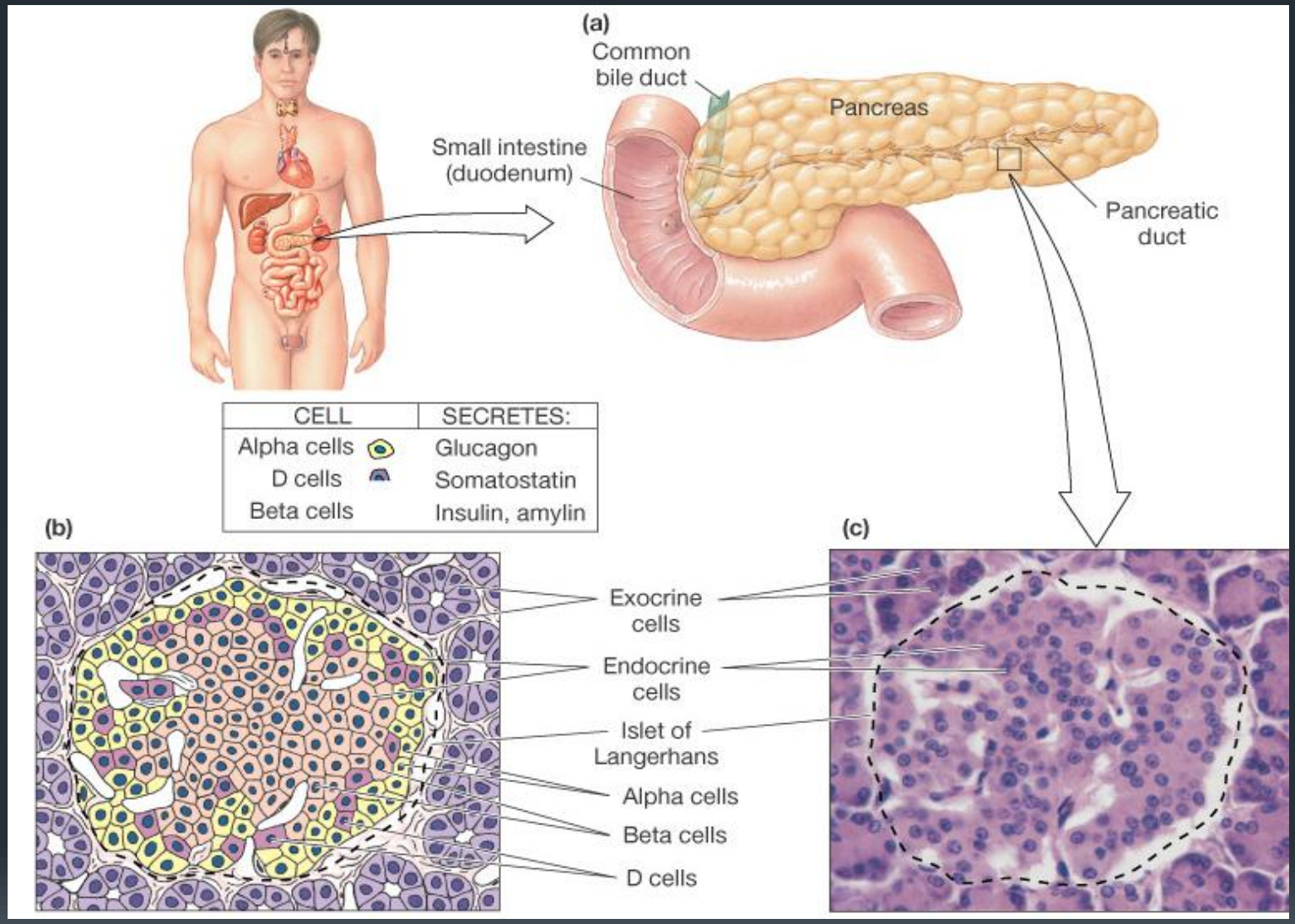


Figure 16.13

HISTOLOGY

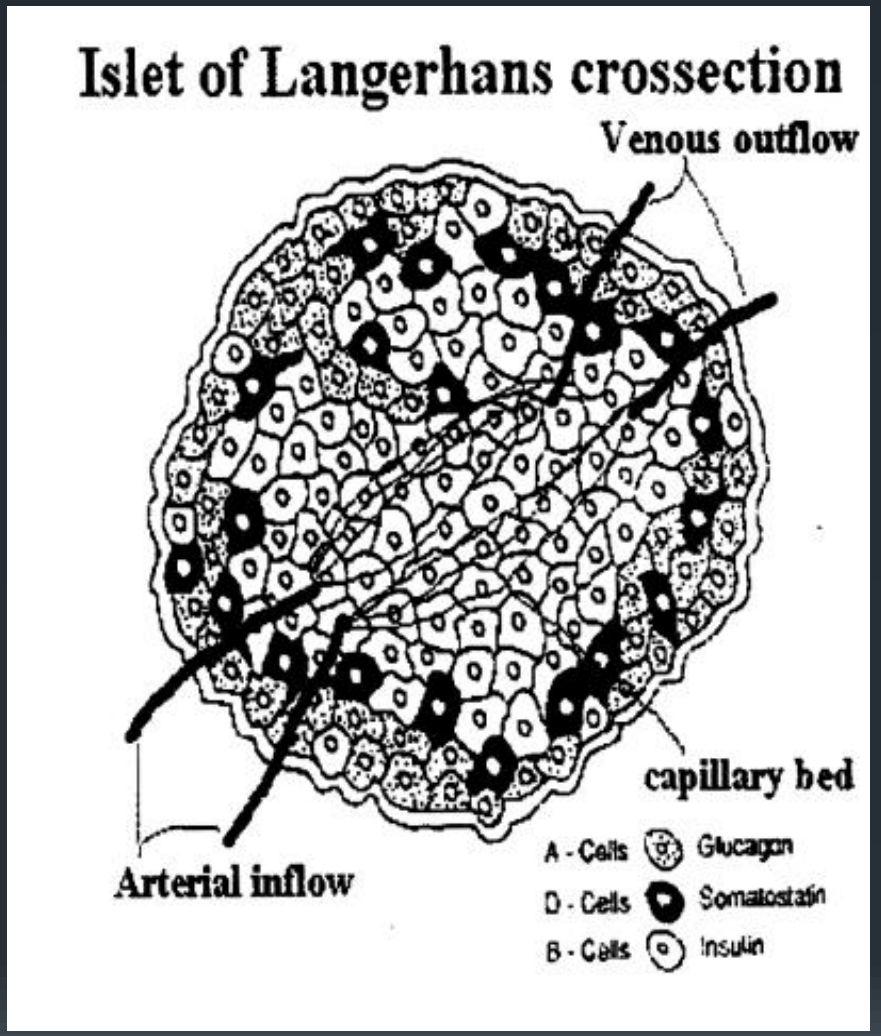

(a)
Common bile duct
Pancreas
Small intestine (duodenum)
Pancreatic duct
CELL
SECRETES:
Alpha cells
Glucagon
D cells
Somatostatin
Beta cells
Insulin, amylin
(b)
(c)
Exocrine cells
Endocrine cells
Islet of Langerhans
Alpha cells
Beta cells
D cells

PHYSIOLOGY

- Production of pancreatic hormones by 3 cell types:
  - 1) Alpha cells → glucagon
  - 2) Beta cells → insulin
  - 3) Delta cells → somatostatin

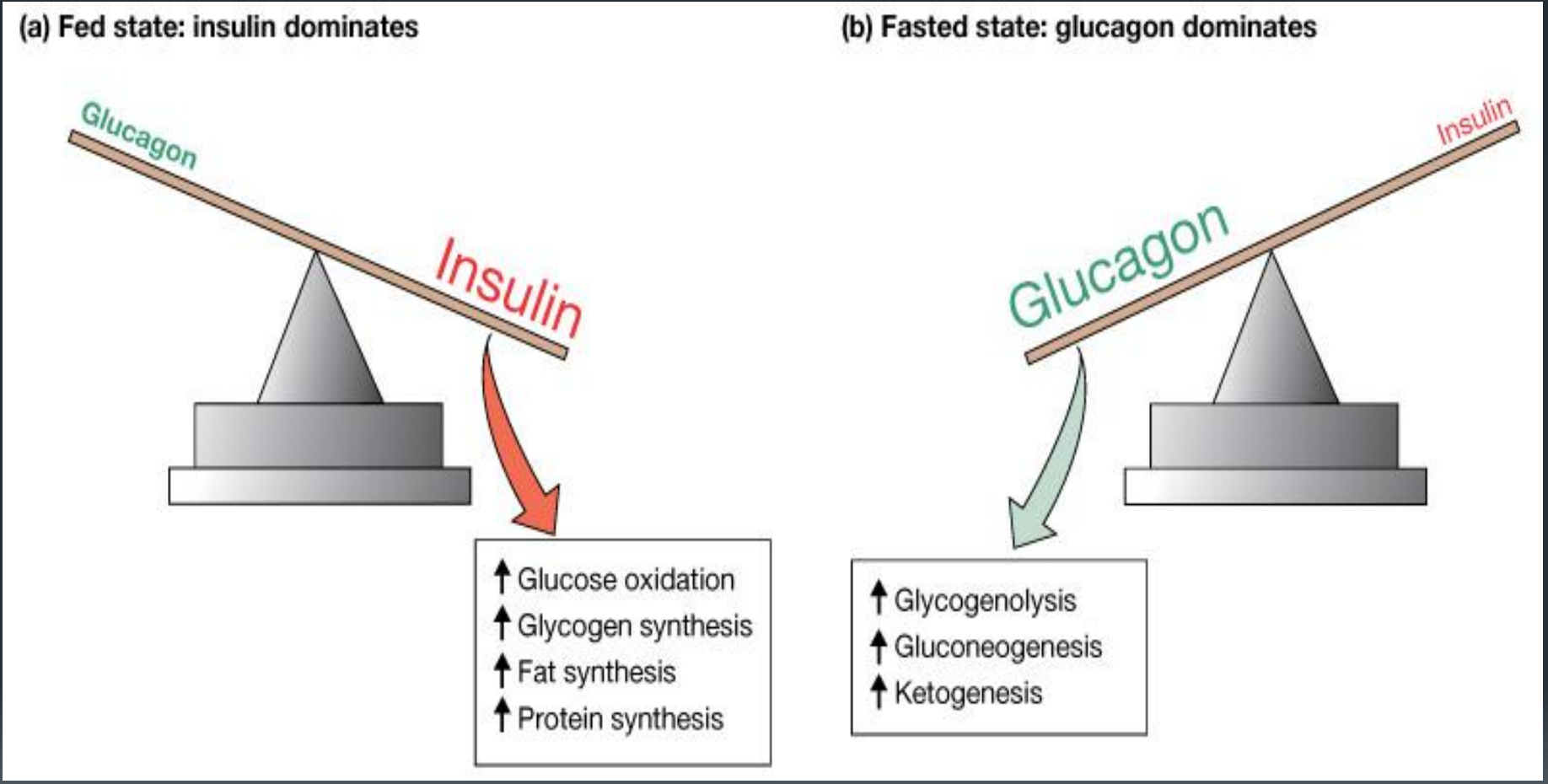
PHYSIOLOGY & HISTOLOGY

- Three cell types are present, A (glucagon secretion), B (Insulin secretion) and D (Somatostatin secretion)
- A and D cells are located around the perimeter while B cells are located in the interior



PHYSIOLOGY - Metabolism

Pancreatic Hormones, Insulin & Glucagon, Regulate Metabolism



PHYSIOLOGY – Role of Insulin

- Acts on tissues (especially liver, skeletal muscle, adipose) to increase uptake of glucose and amino acids.
  - Without insulin, most tissues do not take in glucose and amino acids well (except brain).
- Increases glycogen production (glucose storage) in the liver and muscle.
- Stimulates lipid synthesis from free fatty acids and triglycerides in adipose tissue.
- Also stimulates potassium uptake by cells (role in potassium homeostasis).

PHYSIOLOGY – Insulin regulation

- Major stimulus is increased blood glucose levels
  - After meal, blood glucose increases
  - Insulin released
  - Insulin causes uptake of glucose into tissues
  - Blood glucose levels decrease.
- Insulin levels decline as blood glucose declines
- Glucagon stimulates insulin secretion (glucagon has opposite actions).

PHYSIOLOGY – Role of Glucagon

- Acts on liver to cause breakdown of glycogen (glycogenolysis), releasing glucose into the bloodstream.
- Inhibits glycolysis
- Increases production of glucose from amino acids (gluconeogenesis).
- Increases lipolysis, to free fatty acids for metabolism.

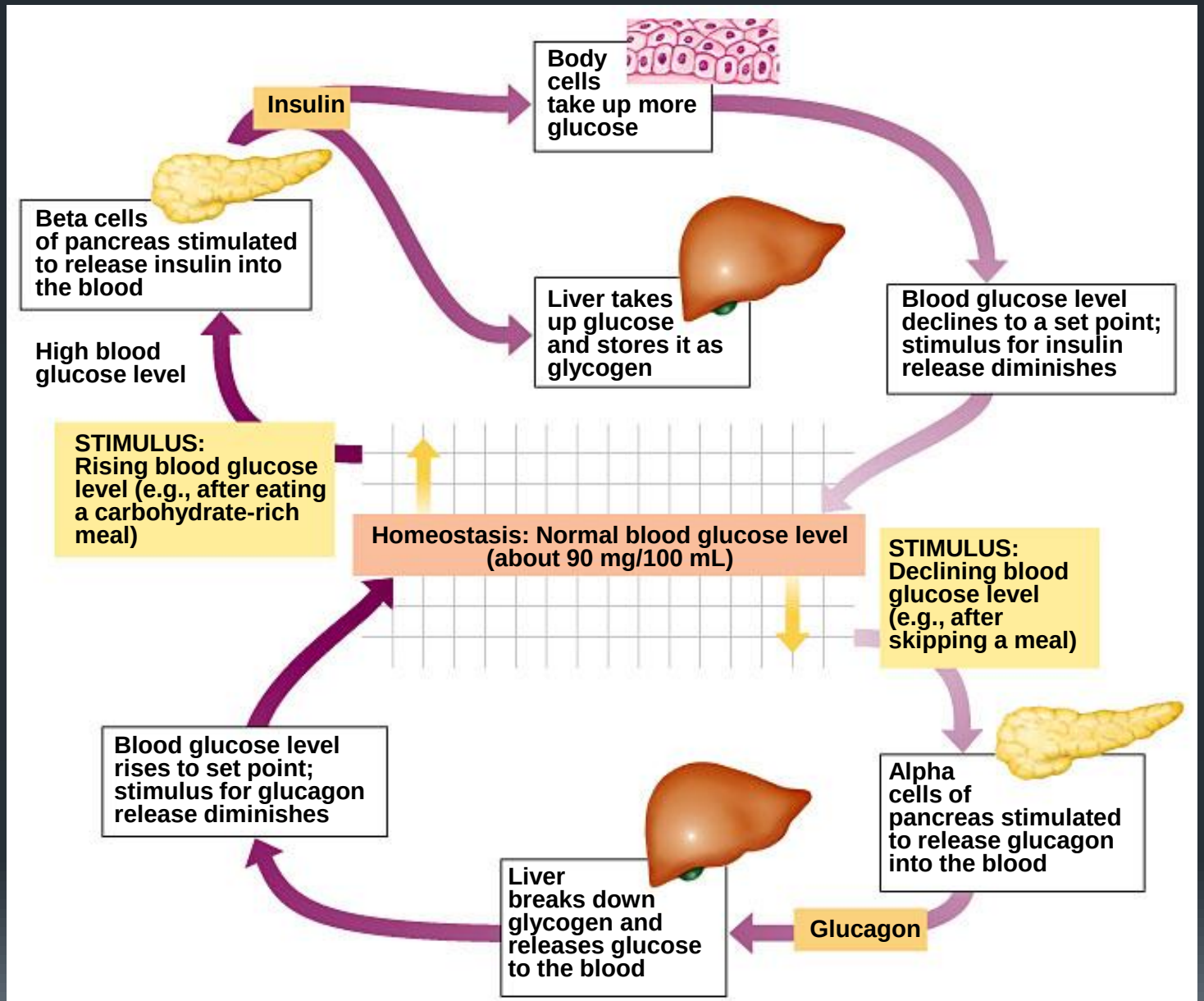
Result: maintenance of blood glucose levels during fasting.

PHYSIOLOGY – Glucagon regulation

- Increased blood glucose inhibits glucagon release
- Insulin inhibits glucagon secretion

- Amino acids stimulate (high protein, low carbohydrate meal)
- Stress: Epinephrine acts on beta-adrenergic receptors on alpha cells, increasing gluagon release (increases availability of glucose for energy)

Glucose Homeostasis



PHYSIOLOGY - Somatostatin

- Secreted by Delta cells
- Suppresses release of GIT hormones:
  - Gastrin, Cholecystokinin, Secretin, Motilin, VIP, GIP
- Decreases rate of gastric emptying
- Decreases smooth muscle contractions and blood flow within intestine

PHYSIOLOGY - Somatostatin

- Supresses release of pancreatic hormones:
  - Inhibits insulin & glucagon

- Suppresses exocrine secretory action of pancreas.

PHYSIOLOGY – Exocrine function

- Control via hormones secreted by stomach & duodenum in response to distension:
  - Gastrin, CCK, Secretin

- 2 Main classes of exocrine pancreatic secretions:

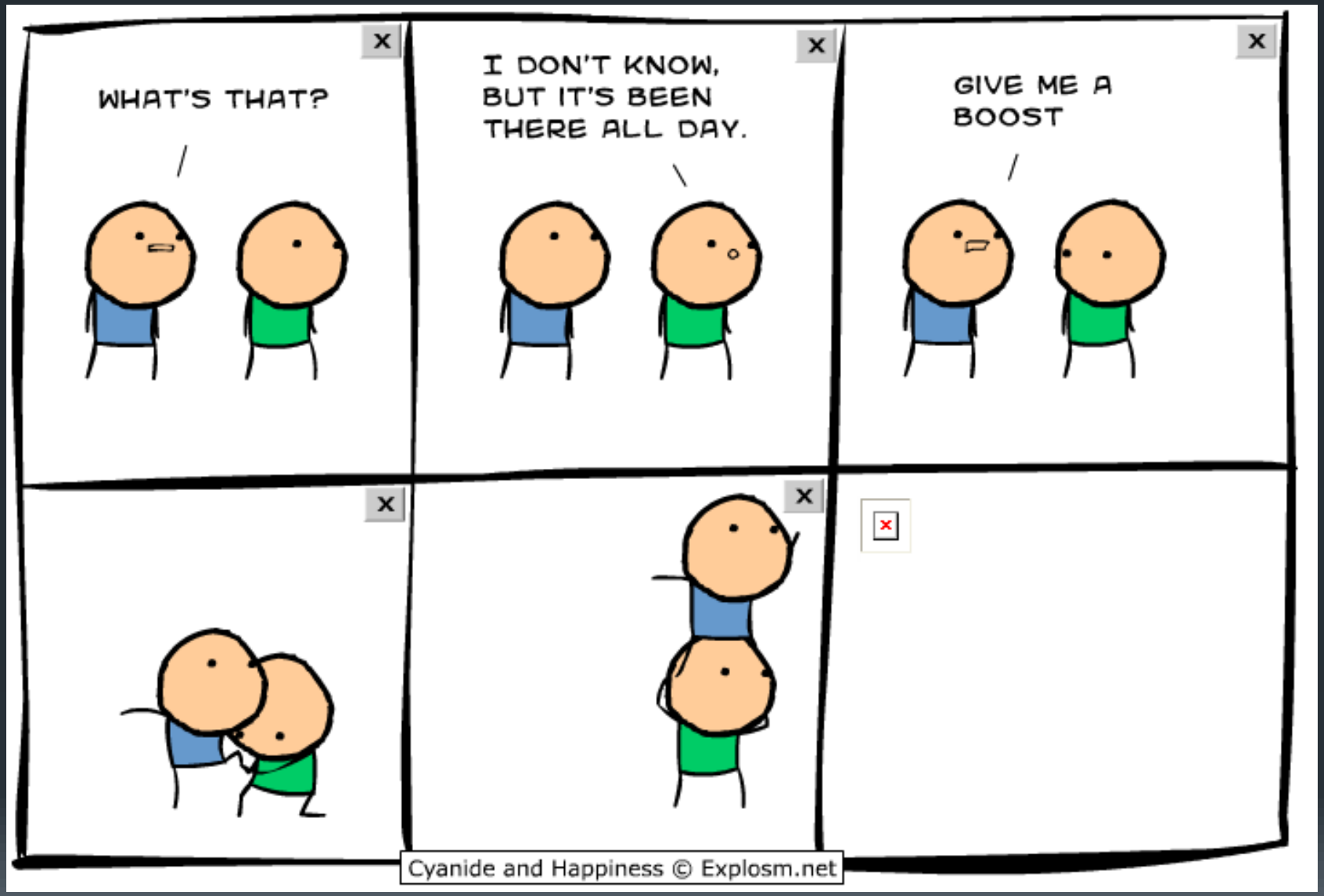
  Secretin → Bicarbonate ions

  CCK → Digestive enzymes

PHYSIOLOGY – Exocrine function

- Bicarbonate ions neutralize acidic chyme
- Pancreas main source of enzymes for fat/lipid and protein digestion. Major proteases:
  - Trypsinogen, Chymotrypsinogen
  - Lipase, amylase
  - Phospholipase, Cholesterol esterase
- Precursors activated by enteropeptidases

QUESTIONS?


WHAT'S THAT?
I DON'T KNOW, BUT IT'S BEEN THERE ALL DAY.
GIVE ME A BOOST
Cyanide and Happiness © Explosm.net