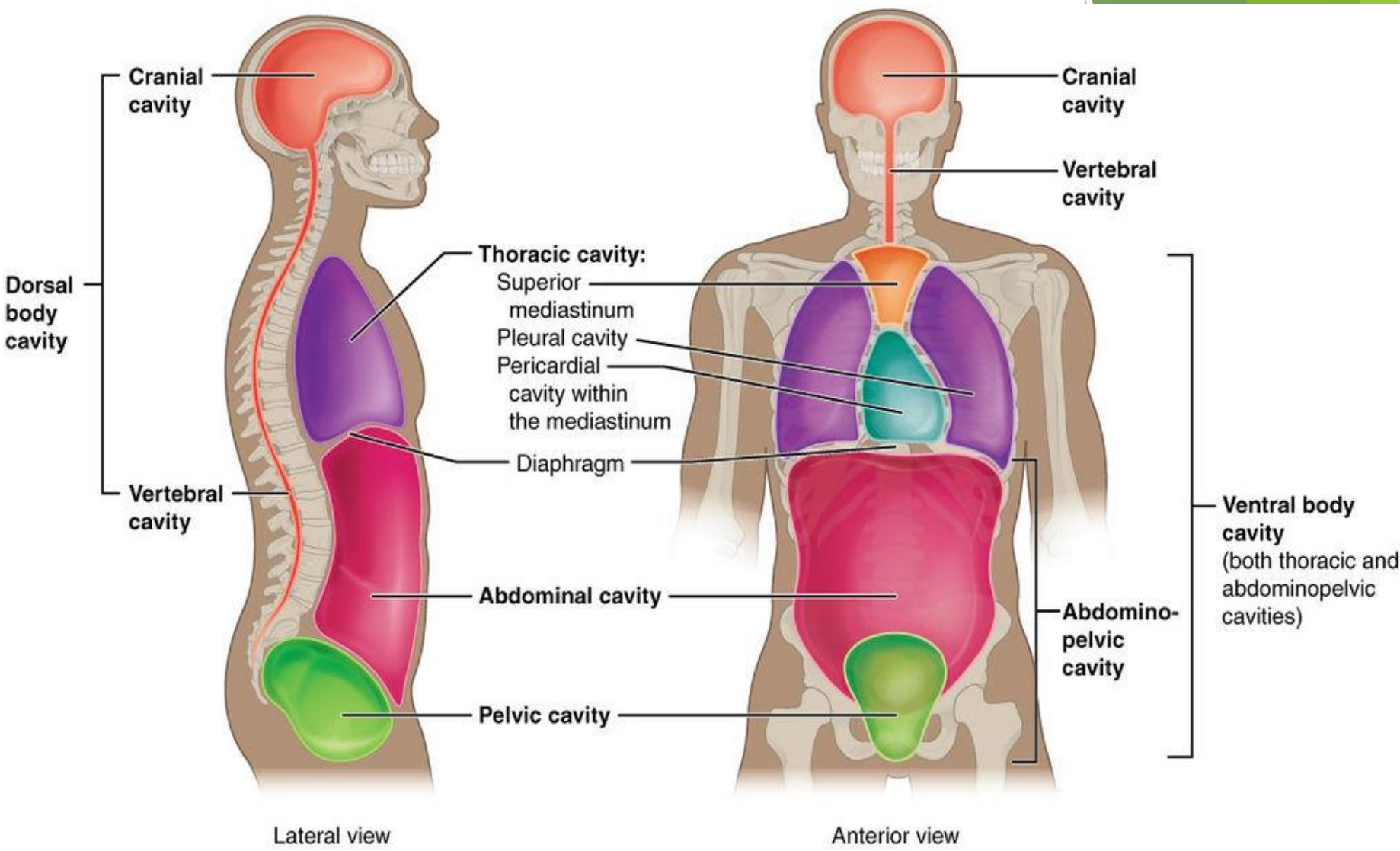
Anatomy and Physiology of Pancreas

INTRODUCTION

- Abdominal glandular organ with both digestive and hormonal functions.
- Pancreas is derived from the Greek word- "pan" – all and "kreas" – flesh.
- It is both an exocrine and endocrine gland
- SIZE- 15 to 20cm
- SHAPE: Oblong shape
- WEIGHT- 60-100 g
- LOCATION : posterior to the stomach with the head tucked into the curve of the duodenum. It is a retroperitoneal organ present in the epigastrium and left hypochondriac region.


Cranial cavity
Dorsal body cavity
Vertebral cavity
Thoracic cavity:
Superior mediastinum
Pleural cavity
Pericardial cavity within the mediastinum
Diaphragm
Abdominal cavity
Pelvic cavity
Lateral view
Cranial cavity
Vertebral cavity
Abdomino-pelvic cavity
Ventral body cavity (both thoracic and abdominopelvic cavities)
Anterior view

The thoracic cavity, or chest cavity, contains many organs and tissues, including:

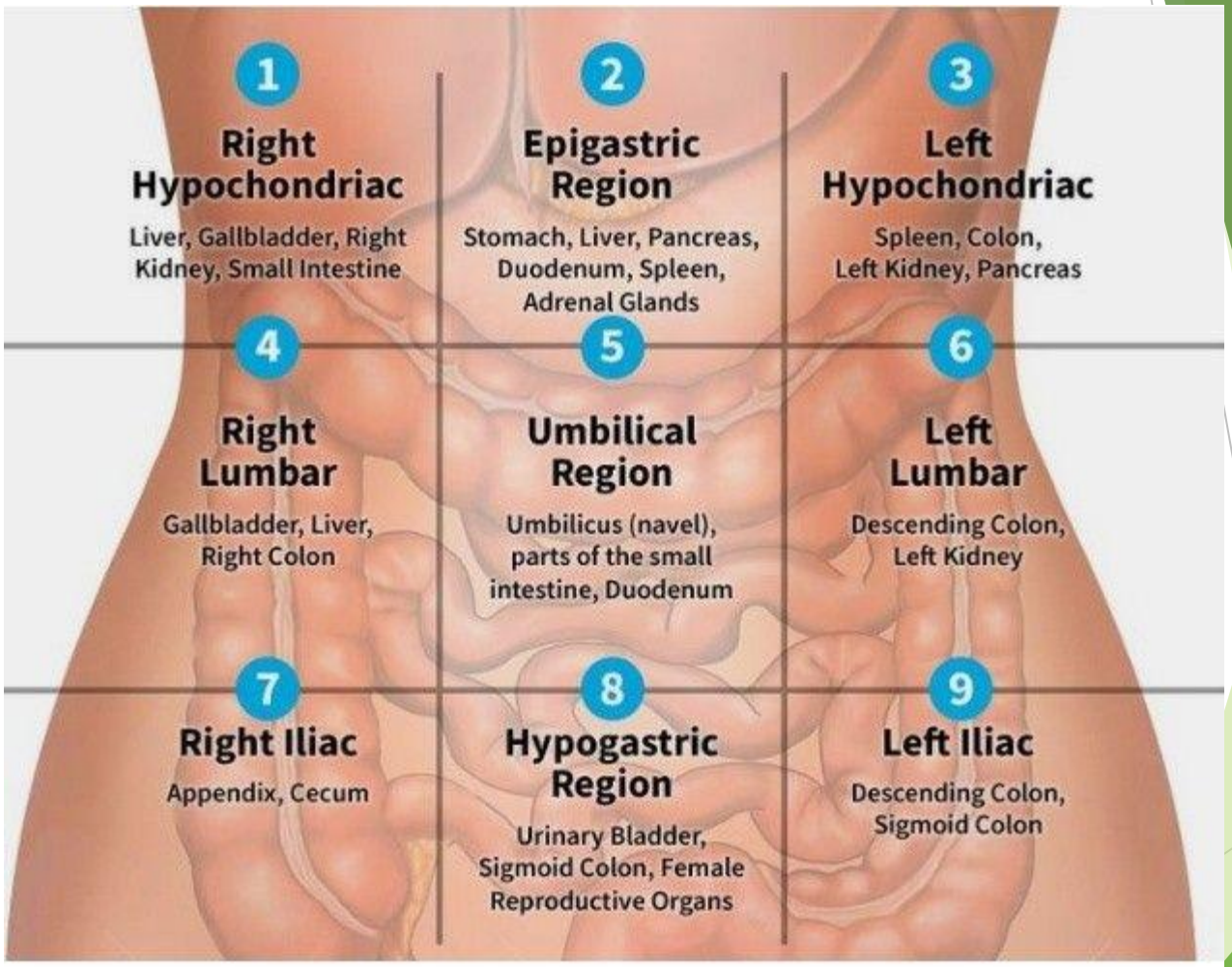
- Heart: Located in the mediastinum, the central part of the chest
- Lungs: Housed in the pleural cavities, which are located on either side of the mediastinum
- Esophagus: Located in the mediastinum
- Thymus: Located in the mediastinum
- Trachea: Located in the mediastinum
- Bronchi: Part of the respiratory system
- Pleura: Part of the respiratory system
- Pericardium: Part of the cardiovascular system

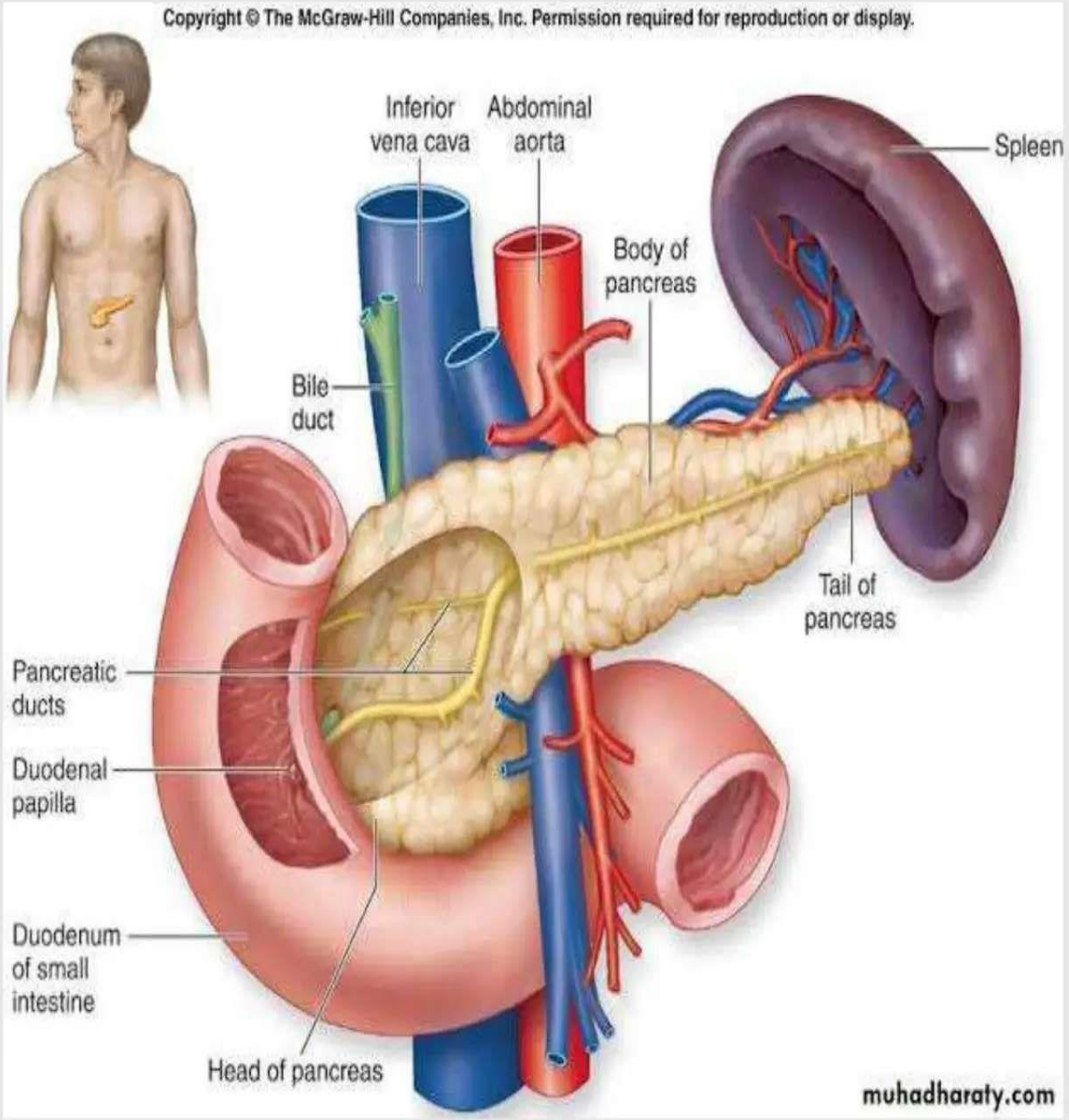
The abdominal cavity contains many organs, including:

- Digestive organs: Stomach, small intestine, colon, appendix, liver, gallbladder, and pancreas
- Urinary organs: Kidneys and ureters
- Reproductive organs: In women, the uterus, fallopian tubes, and ovaries
- Blood vessels: Aorta and inferior vena cava
- Spleen: Located in the upper peritoneal cavity

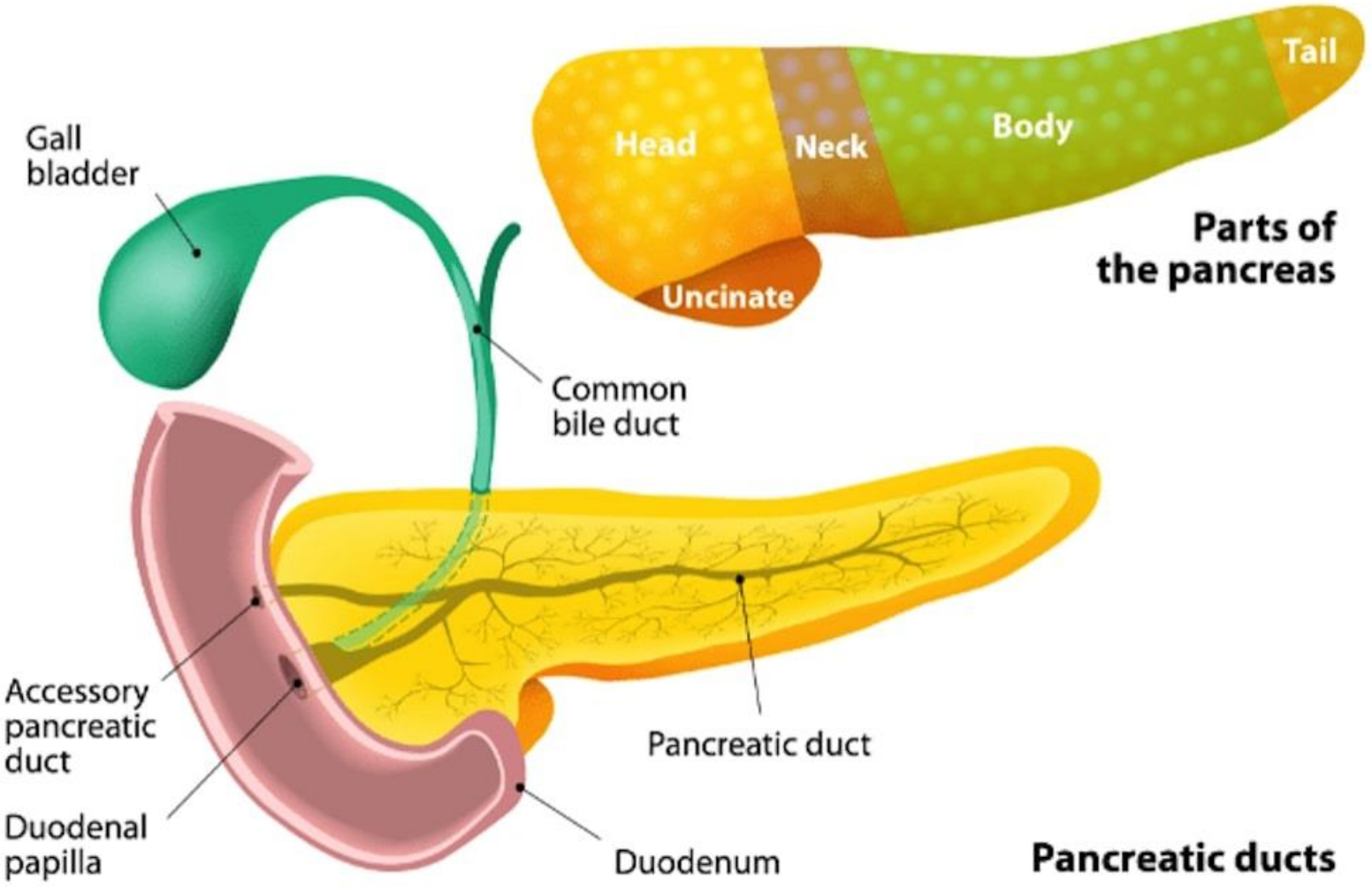
The pelvic cavity contains many organs, including:

- Urinary system: The majority of the urinary system is in the pelvic cavity, including the ureters, urinary bladder, and urethra. The ureters carry urine from the kidneys to the bladder.
- Reproductive organs: In females, the pelvic cavity contains the uterus, fallopian tubes, and ovaries. In males, the pelvic cavity contains the testes, epididymides, ductus deferens, seminal glands, ejaculatory ducts, prostate, and bulbourethral glands.
- Digestive system: The pelvic cavity contains the rectum and part of the descending colon.


1
Right Hypochondriac
Liver, Gallbladder, Right Kidney, Small Intestine
2
Epigastric Region
Stomach, Liver, Pancreas, Duodenum, Spleen, Adrenal Glands
3
Left Hypochondriac
Spleen, Colon, Left Kidney, Pancreas
4
Right Lumbar
Gallbladder, Liver, Right Colon
5
Umbilical Region
Umbilicus (navel), parts of the small intestine, Duodenum
6
Left Lumbar
Descending Colon, Left Kidney
7
Right Iliac
Appendix, Cecum
8
Hypogastric Region
Urinary Bladder, Sigmoid Colon, Female Reproductive Organs
9
Left Iliac
Descending Colon, Sigmoid Colon

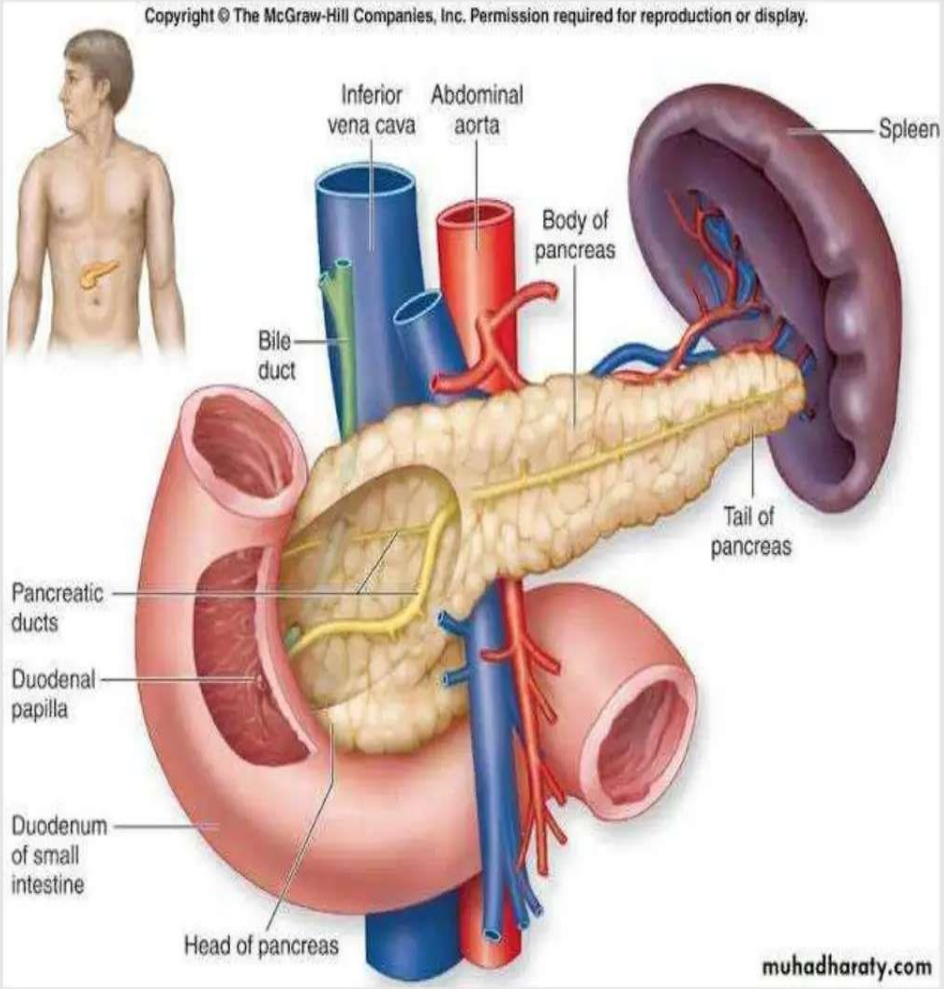


ANATOMY OF THE PANCREAS



HEAD

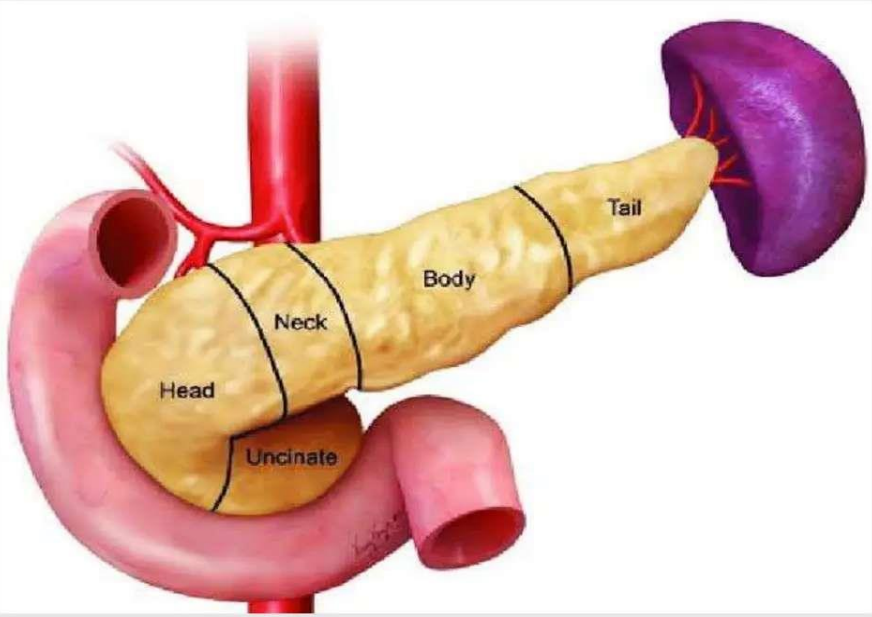
- Widest part of the pancreas.
- Lies within the C shaped curve created by the duodenum and is connected to it by connective tissue.



Uncinate PROCESS

- A projection arising from the lower part of the head and extending medially to lie beneath the body of the pancreas.
- Lies posterior to the superior mesenteric vessels.

Uncinate means “hook shaped”



Surrounds blood vessels

The uncinate process surrounds the superior mesenteric artery and vein, which supply blood to the liver, kidneys, and gut organs.

Neck part

The neck of the pancreas is **the thin section that connects the head to the body of the pancreas**. Here are some details about the neck of the pancreas:

Location

The neck of the pancreas is located in front of where the portal vein is formed, and mostly behind the pylorus of the stomach.

Length

The neck of the pancreas is about 2 cm wide.

Structure

The neck of the pancreas is somewhat flattened from above downward and backward.

Surface

The antero-superior surface of the neck of the pancreas supports the pylorus, and the postero-inferior surface is in relation with the commencement of the portal vein.

Artery

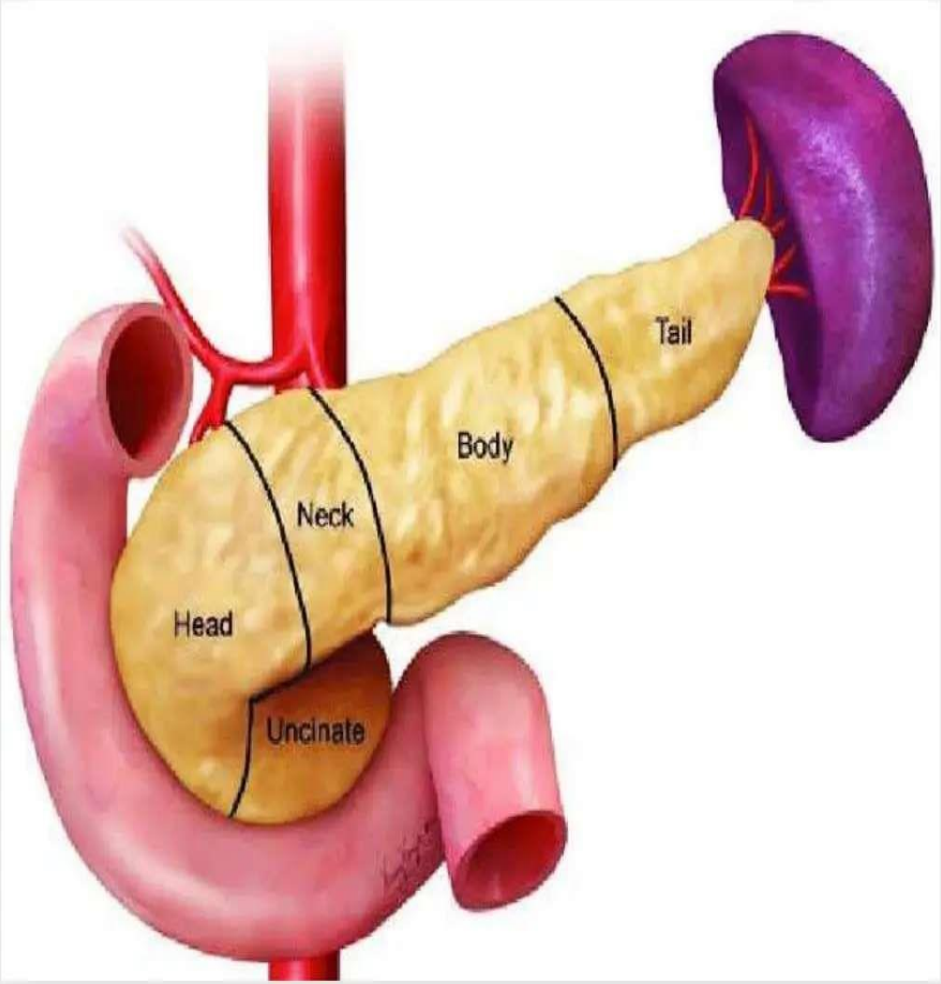
The anterior superior pancreaticoduodenal artery travels in front of the neck of the pancreas.

Blood vessels

The superior mesenteric artery and vein run behind the neck of the pancreas.

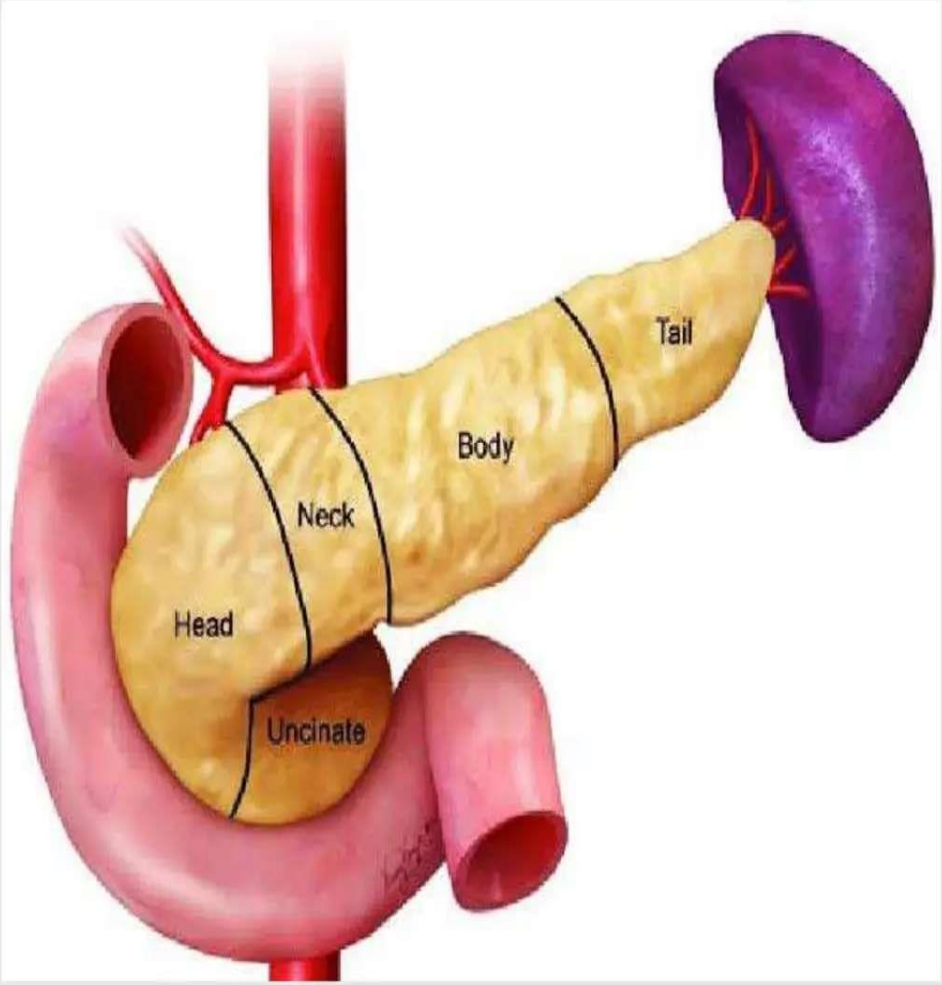
BODY

- Centrally located
- Lie behind the stomach and to the left of the superior mesenteric vessels

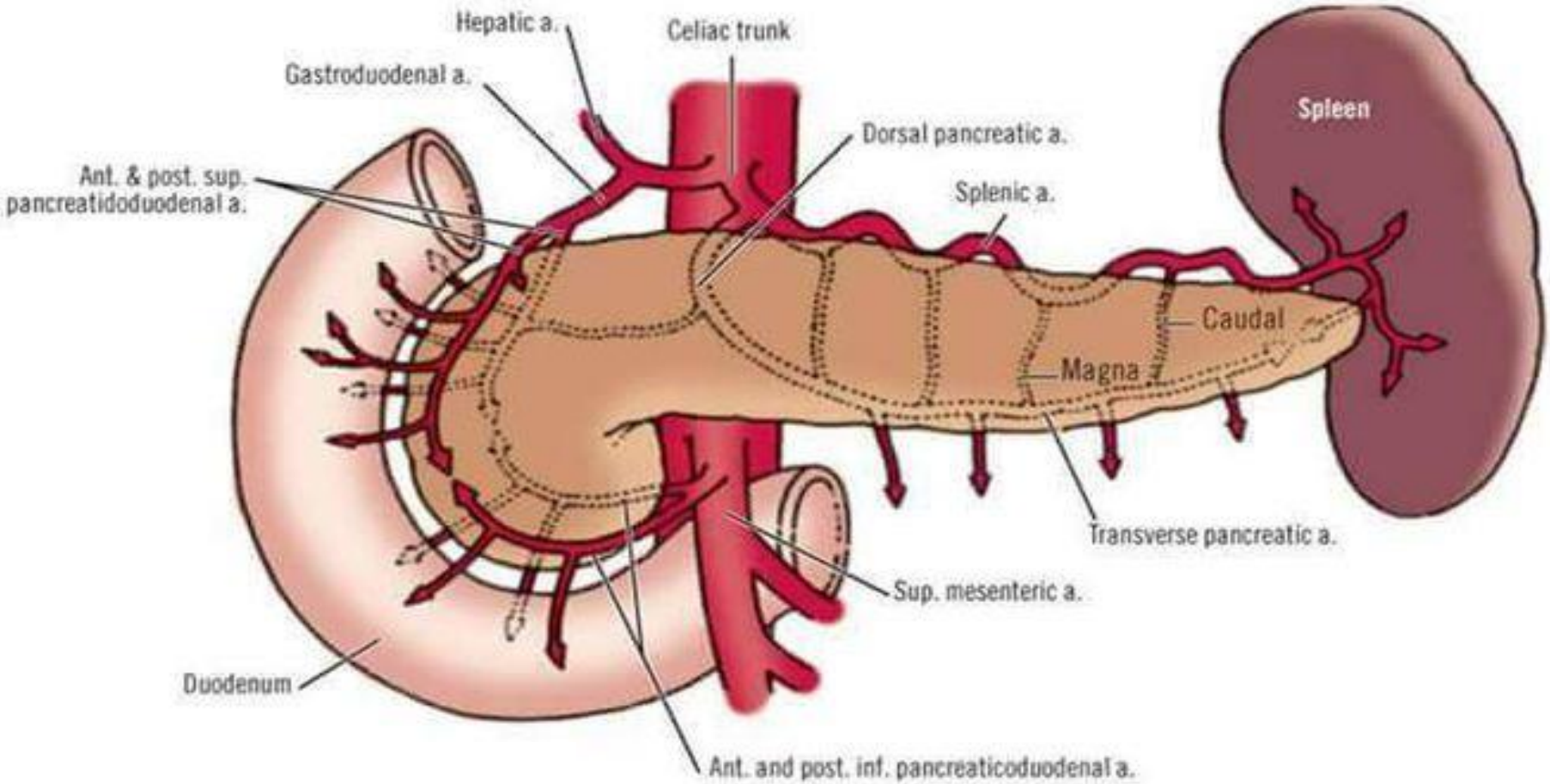


TAIL

- Left end of the pancreas that lies within close proximity to the hilum of the spleen.
- Lies inside the peritoneum



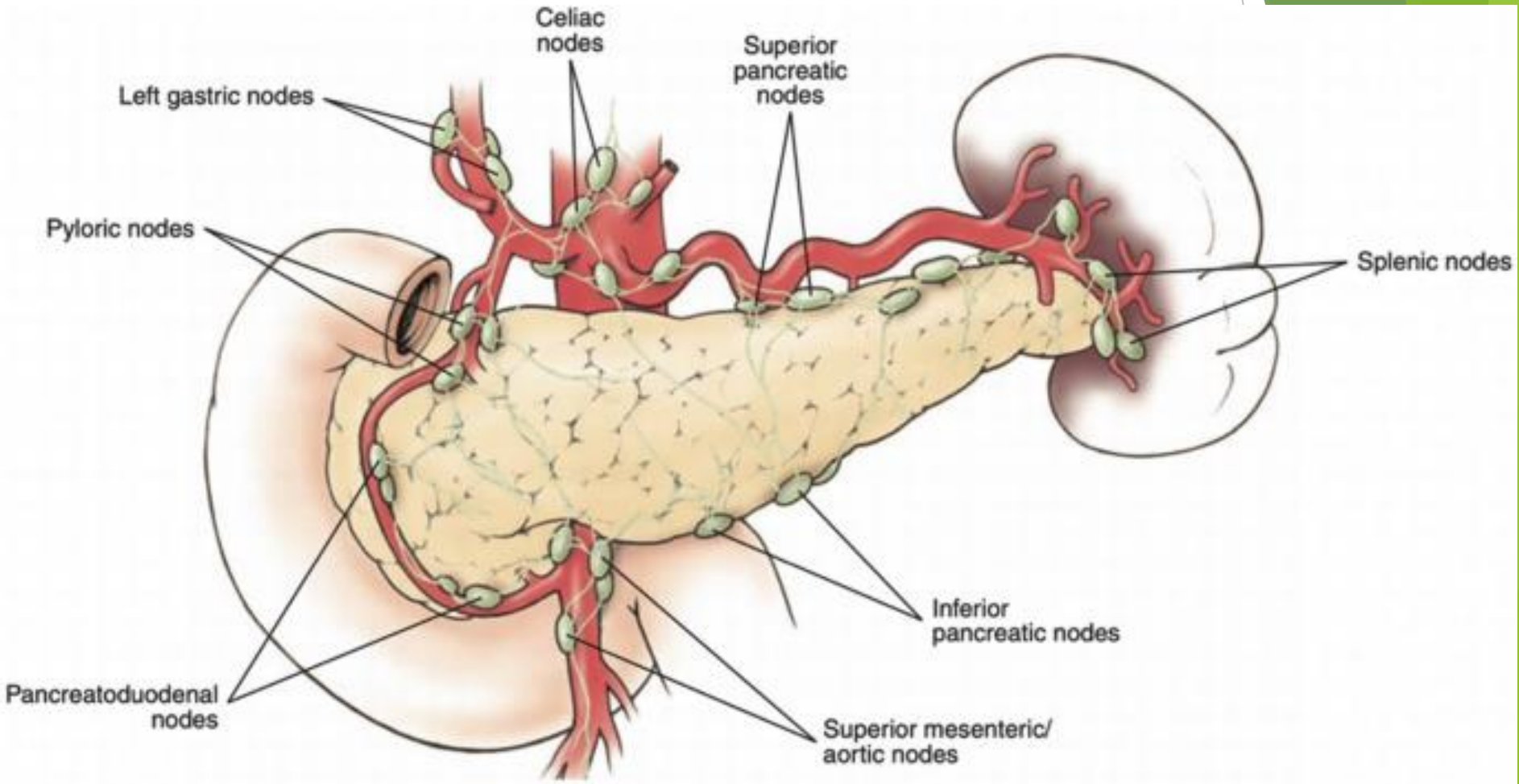
Blood supply of the Pancreas



The pancreas receives blood from two major arteries: the celiac trunk and the superior mesenteric artery.

- The celiac trunk, also known as the celiac artery, is a short vessel that branches off from the aorta and supplies blood to the abdominal organs.
- The superior mesenteric arteries branch off from the abdominal aorta to supply blood to the intestines and other parts of the gastrointestinal tract including pancreas.

Lymphatic System and Lymph Nodes of the Pancreas



The lymphatic system of the pancreas is **a complex network of vessels and lymph nodes that drains the pancreas and is important for its homeostasis**:

	Function
Collection	Collects interstitial fluid containing pathogens, immune cells, cell products, and cell debris
Filtration	Filters the fluid through lymph nodes
Return	Returns the filtered fluid to the venous circulation
Importance	Critical for understanding pancreatic cancer and pancreatitis

The lymphatic system of the pancreas is complex due to the gland's high vascularity and variable drainage patterns. Here are some other things to know about the lymphatic system of the pancreas:

Lymph nodes

The pancreas shares lymph nodes with the duodenum, gut, and liver.

Drainage

The head of the pancreas drains into pancreaticoduodenal lymph nodes, while the body and tail drain into mesocolic lymph nodes.

Location

In a normal pancreas, lymphatic vessels are usually found in the interlobular spaces and near blood vessels.

Inflammation

When the lymphatic system is overwhelmed, as in inflammation, proteolytic enzymes can damage tissue. This can lead to chronic and recurrent pancreatitis.

Pancreatic cancer

Pancreatic cancer spreads quickly to the lymph nodes, even in early stages.

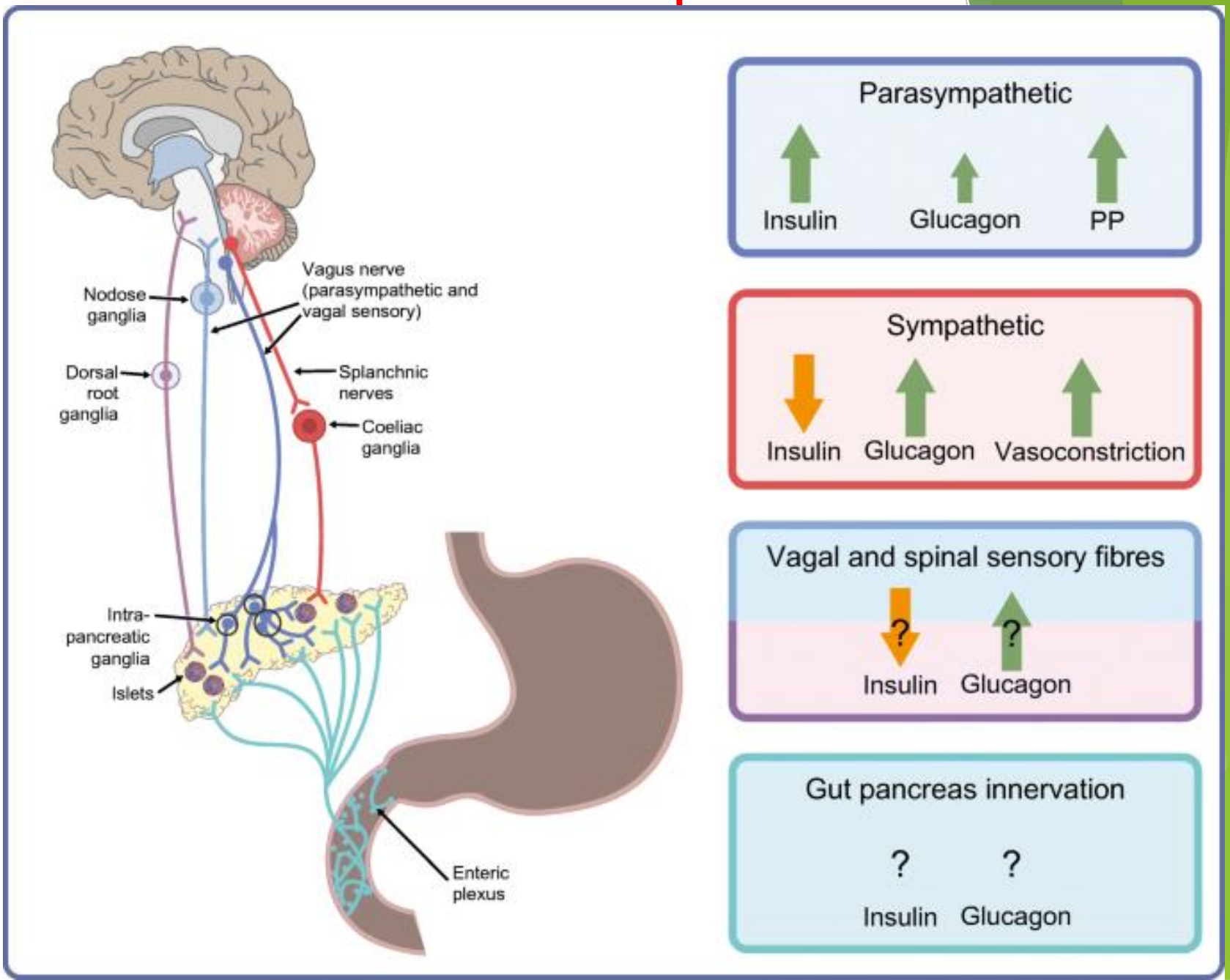
Nerve connections to pancreas

The pancreas is innervated by the autonomic nervous system, which is made up of the parasympathetic and sympathetic nervous systems. The pancreas also has an intrinsic nerve plexus.

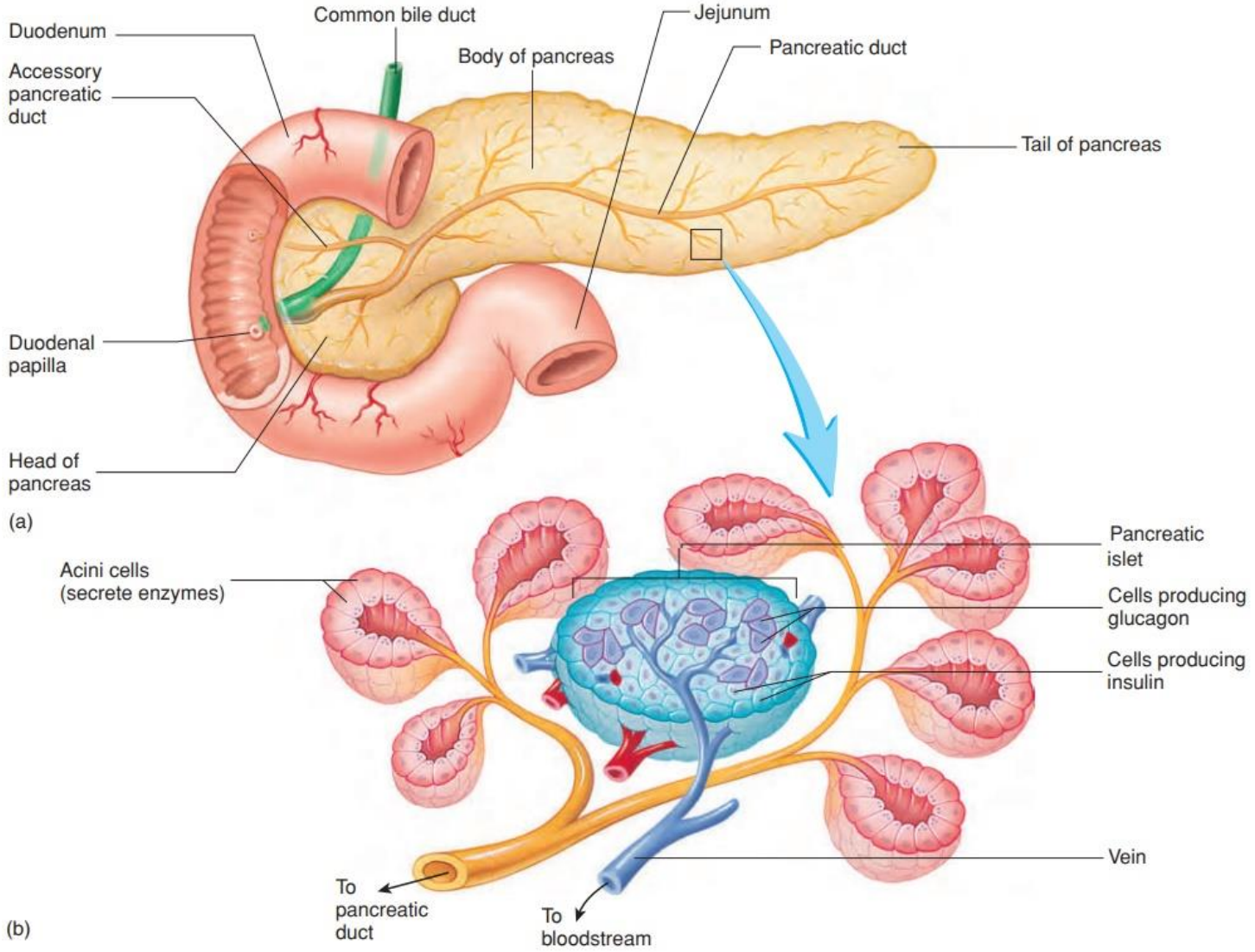
Nerve supply	Description
Parasympathetic	Originates in the brain's dorsal vagal complex, and is secretomotor.
Sympathetic	Comes from the T6-T10 thoracic splanchnic nerves and the celiac plexus.
Sensory	Spinal afferent nerves detect pancreatic sensory signals.
Enteropancreatic	Fibers project from the gastrointestinal tract to the pancreas.

Neural signals are important for regulating pancreatic hormone release and metabolism.

Nerve connections to pancreas



Physiology of pancreas



gure 16.19 AP|R **Anatomy and Histology of the Duodenum and Pancreas**

The head of the pancreas lies within the duodenal curvature, with the pancreatic duct emptying into the duodenum. (*b*) Histology of the pancreas, owing both the acini and the pancreatic duct system.

Digestive Enzymes secreted by pancreas

Enzyme	Target
Amylolytic enzymes	
Amylase	alpha-1,4-glycosidic bonds in starch
Lipolytic enzymes	
Lipase	Triglyceride, producing fatty acids and 2-monoglycerides
Phospholipase A2	Phosphotidylcholine, producing a free fatty acid and lysophosphotidylcholine
Carboxylesterase	Cholesterol esters, lipid-soluble vitamin esters, and glycerides (tri-, di-, or monoglycerides)
Proteolytic enzymes	
Trypsin	Interior peptide bonds involving basic amino acids
Chymotrypsin	Interior peptide bonds involving aromatic amino acids
Carboxypeptidase A and B	External peptide bonds involving aromatic and neutral aliphatic amino acids (A) and basic amino acids (B) at the carboxy-terminal end
Elastase	Interior peptide bonds involving neutral aliphatic amino acids
Nucleases	
Deoxyribonuclease (DNAse)	Endonuclease that splits phosphodiester linkages adjacent to pyrimidine nucleotide
Ribonuclease (RNAse)	Catalyzes the breakdown of RNA

Adapted from Henderson.[1]

Hormones secreted by pancreas

Hormone	Secreted by	Function
Insulin	β-cells	1) Decreases blood glucose by increasing glucose uptake primarily in skeletal muscle and adipose tissue. 3) Anabolic effects: increases lipogenesis, and synthesis of glycogen and proteins. 4) Promotes storage of macromolecules in muscle, fat and liver tissue 5) Inhibits catabolic processes
Glucagon	α-cells	1) Increases blood glucose by: - Increases hepatic glycogenolysis - Promotes glyconeogenesis - Increases catabolic activity
GLP-1	L-cells	Increases insulin secretion
GIP	K-cells	Increases insulin secretion
Somatostatin	δ-cells	Inhibits insulin and glucagon secretion

Cell Types[1]	Approximate Percent of Islet Mass	Secretory Products
Alpha (A) cell	20	Glucagon, proglucagon
Beta (B) cell	75	Insulin, C-peptide, proinsulin, amylin
Delta (D) cell	3–5	Somatostatin

Summary

The pancreas is a gland in the upper abdomen that has both exocrine and endocrine functions:

- Anatomy
- The pancreas is a retroperitoneal organ that's located behind the stomach and crosses the bodies of the L1 and L2 vertebrae. It's shaped like a flat pear or fish, and is made up of four parts: the head, neck, body, and tail. The pancreas is surrounded by the small intestine, liver, and spleen.
- Physiology
- Exocrine function
- The pancreas produces digestive enzymes that are secreted into the duodenum through the main and accessory pancreatic ducts. The pancreas produces about 1 to 4 liters of juice each day, depending on how much food you eat.
- Endocrine function
- The pancreas produces hormones that regulate blood sugar and pancreatic secretions. The endocrine portion of the pancreas is made up of the islets of Langerhans, which are clusters of cells that produce hormones like insulin and glucagon. Insulin helps regulate blood glucose levels, and glucagon helps stimulate the body to release glucose into the blood