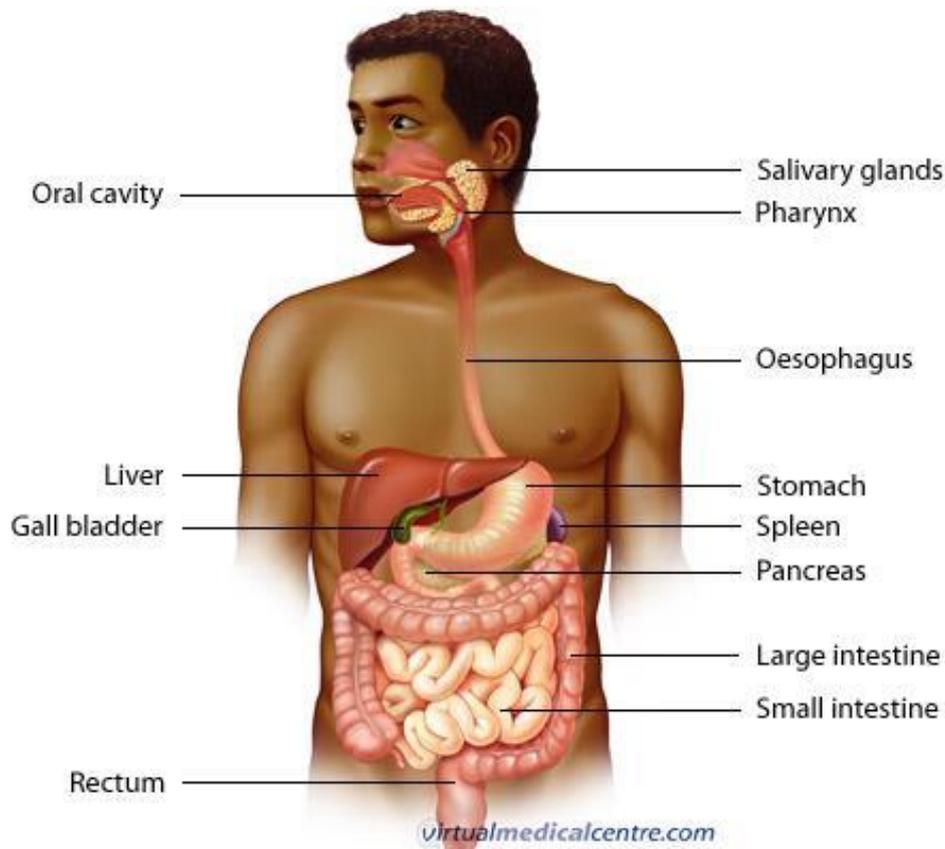


▪ **Gastrointestinal System:**

1. Gastrointestinal tract	2. Accessory digestive glands
<ul style="list-style-type: none"> It is a continues tube that extends from the mouth to the anus. 	<ul style="list-style-type: none"> Salivary glands. Liver. Gall bladder. Pancreas.



▪ **Functions of GIT:**

- 1) **Motility** : propels the ingested food and mixes it with the secretions.
- 2) **Secretions** of the digestive juices and mucus.
- 3) **Digestion** of the ingested foods into absorbable molecules.
- 4) **Absorption** of the nutrients, electrolytes and water from intestinal lumen into blood stream.

Regulation of Gastrointestinal Functions

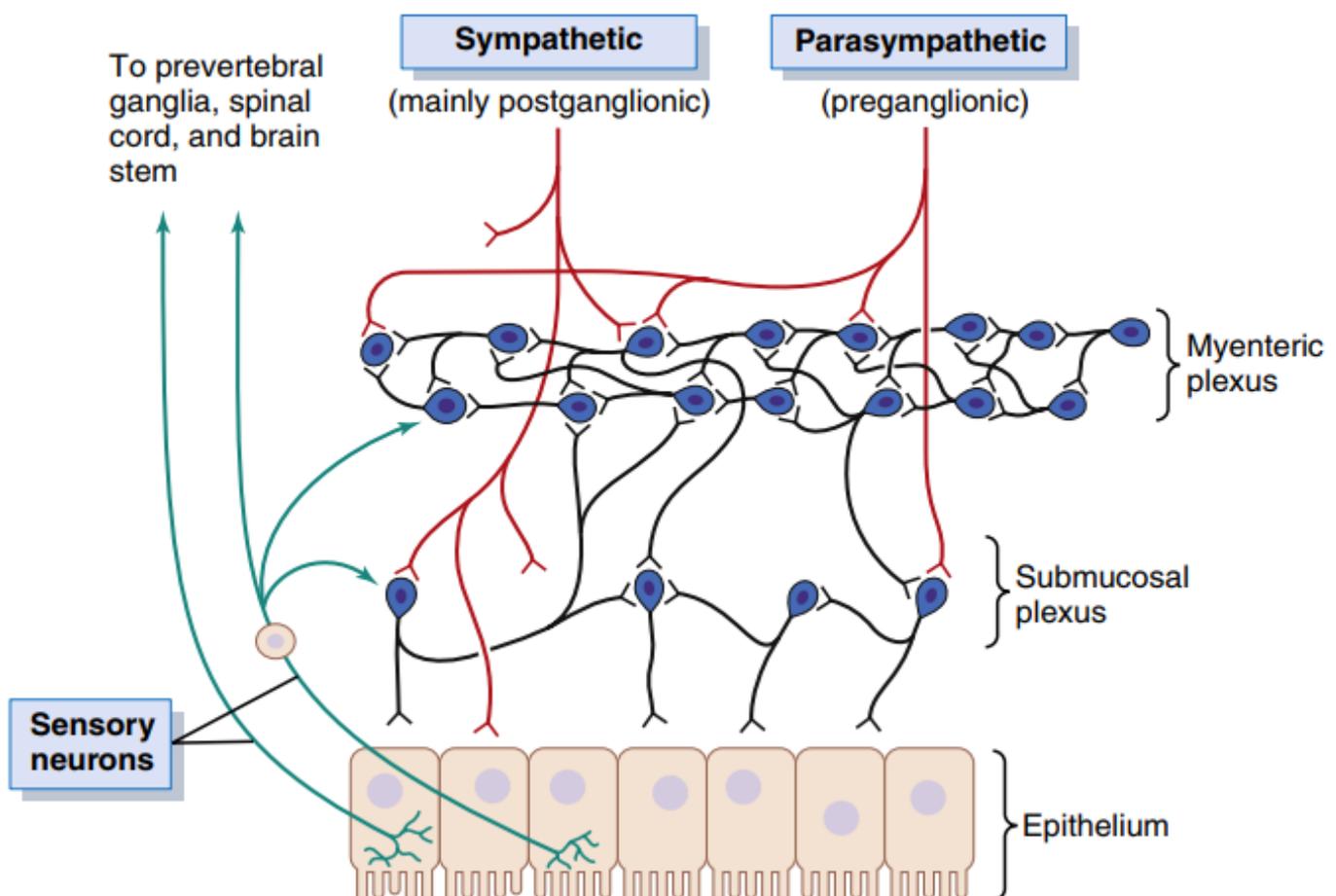
Nervous		Hormonal	
Extrinsic		Gastrin family	Secretin family
Parasympath	Sympathetic	- Gastrin - (CCK)	- Secretin - VIP - GIP
Intrinsic			
ENS			

I- Nervous Regulation

- It is done by the autonomic nervous system which has an extrinsic component and an intrinsic component :

a) The extrinsic component is the sympathetic and parasympathetic innervation of the GIT.

b) The intrinsic component is called the enteric nervous system (ENS).

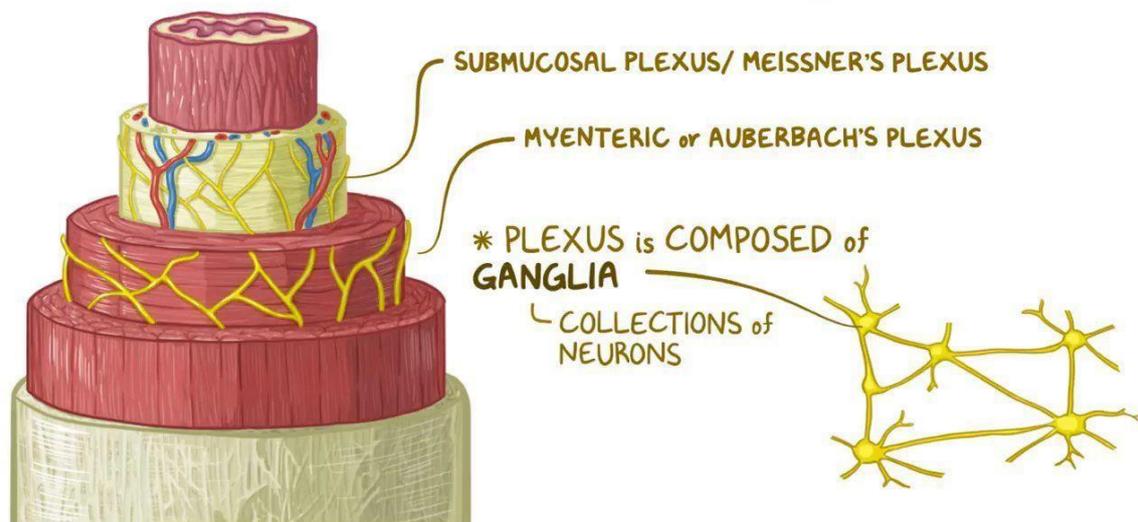


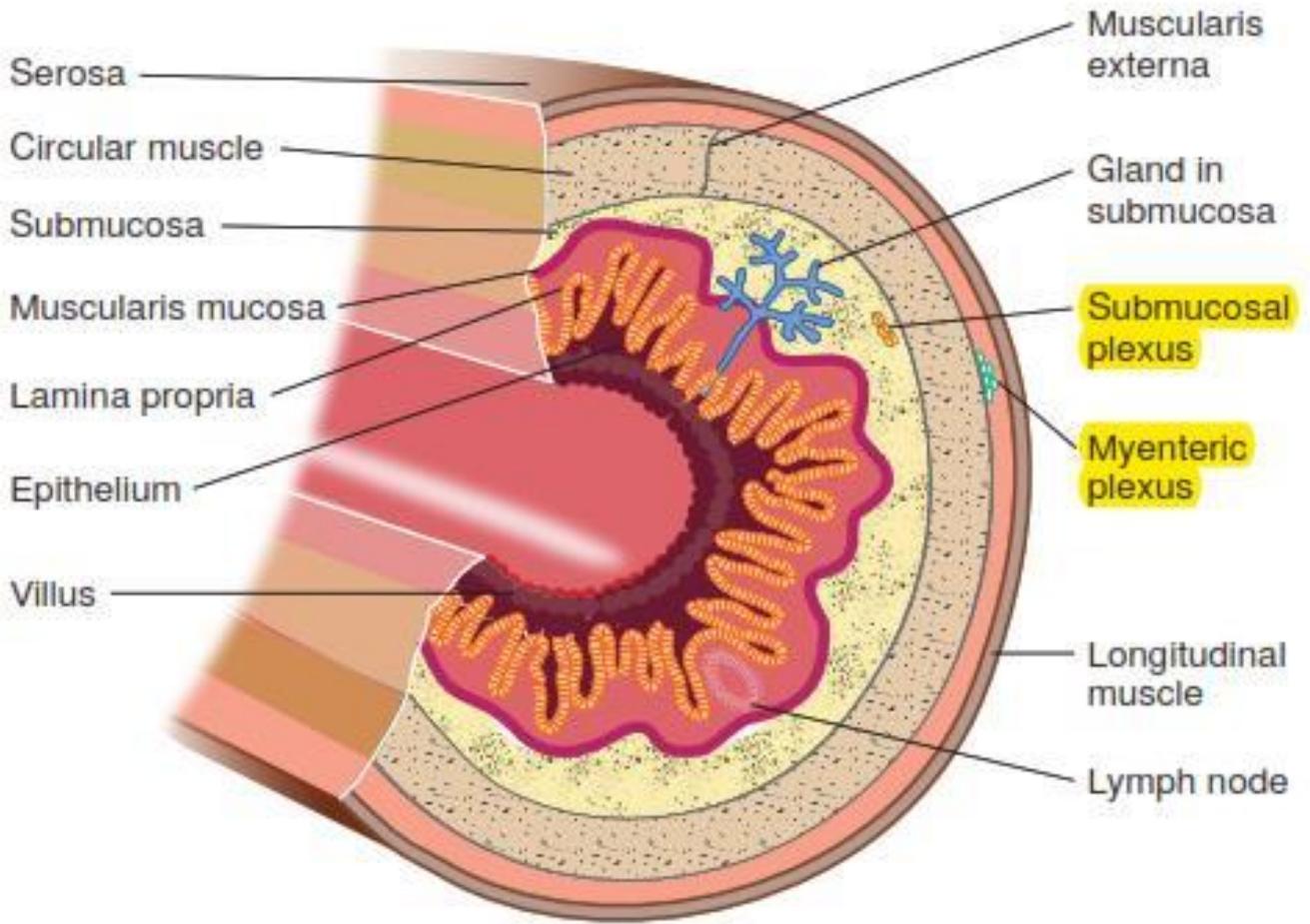
A) Intrinsic innervation = Enteric nervous system (ENS)

Function:	<ul style="list-style-type: none"> It can direct all functions of the GIT, even in absence of extrinsic innervation. Controls the contractile, secretory and endocrine functions of GIT. 		
Site & types:	<ul style="list-style-type: none"> It is located in ganglia in the myenteric and submucosal plexuses between the wall of the whole length of the gut. 		
		Myenteric (Auerbach's plexus):	Submucosal (Meissner's plexus):
	Site	Lies between circular and longitudinal Muscle layers .	Lies in Submucosal layer .
	Function	control Motility of the GI smooth muscle.	control Secretory function & blood Flow of GIT.
Innervation:	<ul style="list-style-type: none"> The ganglia receive input from the parasympathetic and sympathetic nervous system which modulate their activity. 		

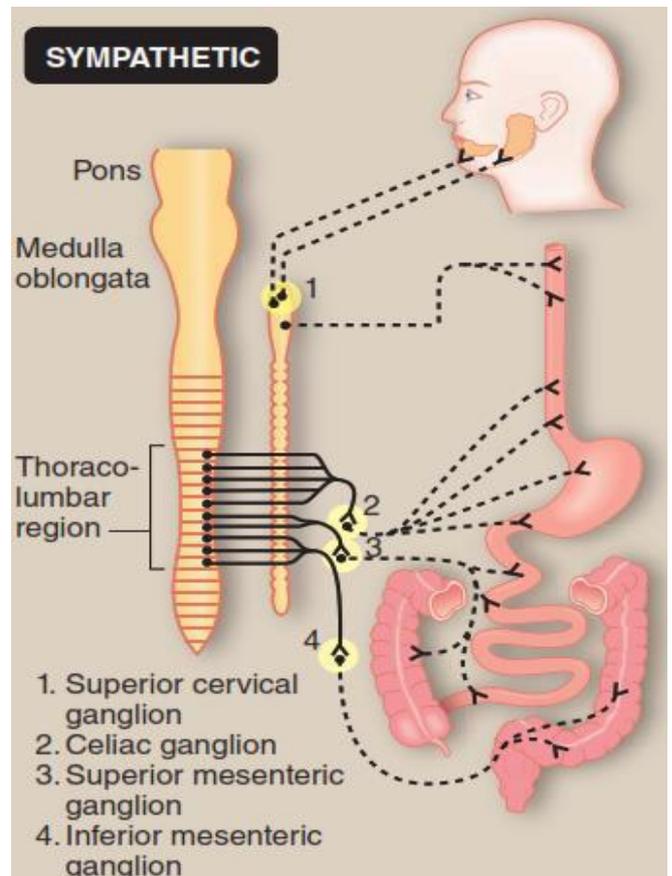
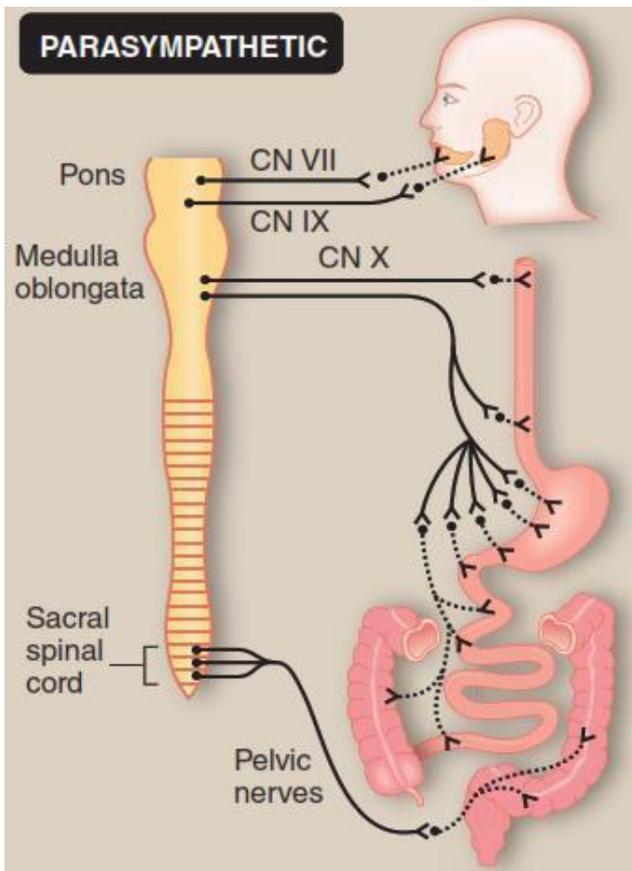
ENTERIC NERVOUS SYSTEM

* FOUND WITHIN WALLS of ENTIRE GI TRACT





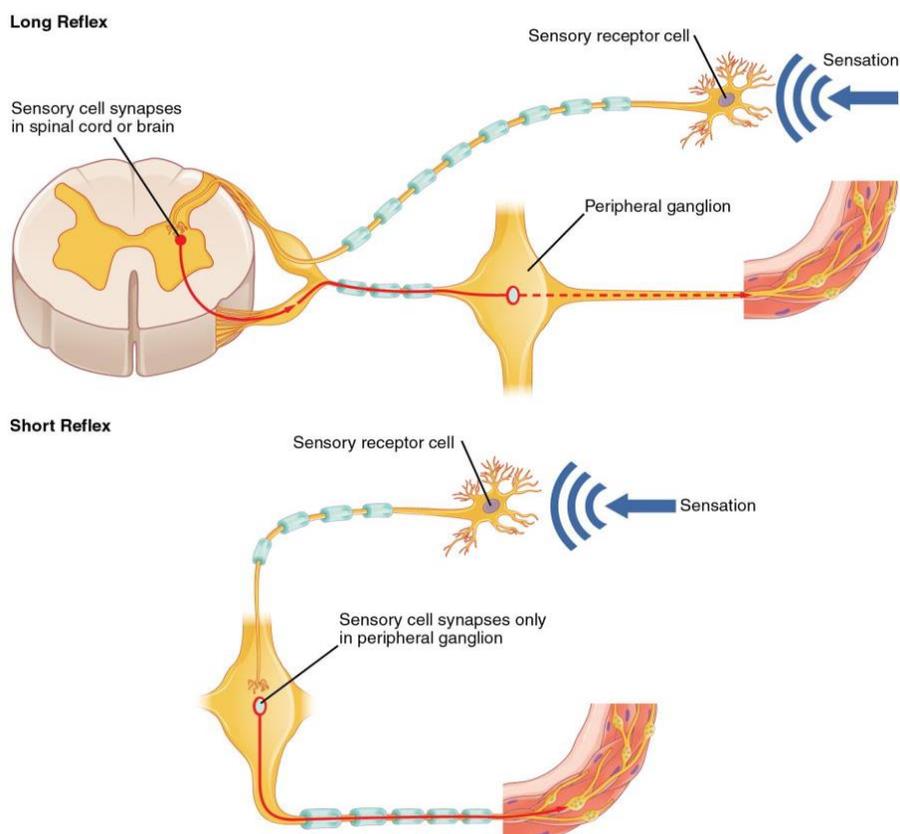
B) Extrinsic innervation:



	<i>Parasympathetic innervation</i>		<i>Sympathetic innervation</i>
	<i>Cranial Division</i>	<i>Sacral Division</i>	
Origin	1) Pons: CN 7 2) Medulla oblongata: CN 9, 10.	<ul style="list-style-type: none"> • Arises from 2nd, 3rd, 4th sacral segments of the spinal cord. 	<ul style="list-style-type: none"> • Arises from T5-L2 segments of the spinal cord.
	<ul style="list-style-type: none"> • Most conveyed by Vagus. 	<ul style="list-style-type: none"> • Passes through the pelvic nerve. 	
Supply	<ul style="list-style-type: none"> • Esophagus, stomach, duodenum, small intestine and the proximal half of the large intestine. 	<ul style="list-style-type: none"> • The distal half of the colon, rectum and anus. 	
Function	<i>Stimulates all functions of the GIT.</i>		<ul style="list-style-type: none"> • Inhibition of all functions of the GIT. • Vasoconstriction of blood vessels

Reflexes controlling GIT function

	Short (local) reflexes	Long reflexes
Center	<ul style="list-style-type: none"> All the components of these reflexes are located in the gut's wall. 	<ul style="list-style-type: none"> In CNS
Mediated by	<ul style="list-style-type: none"> Enteric nervous system 	<ul style="list-style-type: none"> Extrinsic autonomic nerves (sympathetic & para-sympathetic)
Function	<ul style="list-style-type: none"> Responsible for self-regulation of GI functions. 	<ul style="list-style-type: none"> Afferent fibers: carry sensory information from chemoreceptors and mechanoreceptors in GI tract to the brain stem and spinal cord. Efferent fibers: carry information from brain stem and spinal cord to the wall of the GIT.



II- Hormonal Regulation of GIT functions

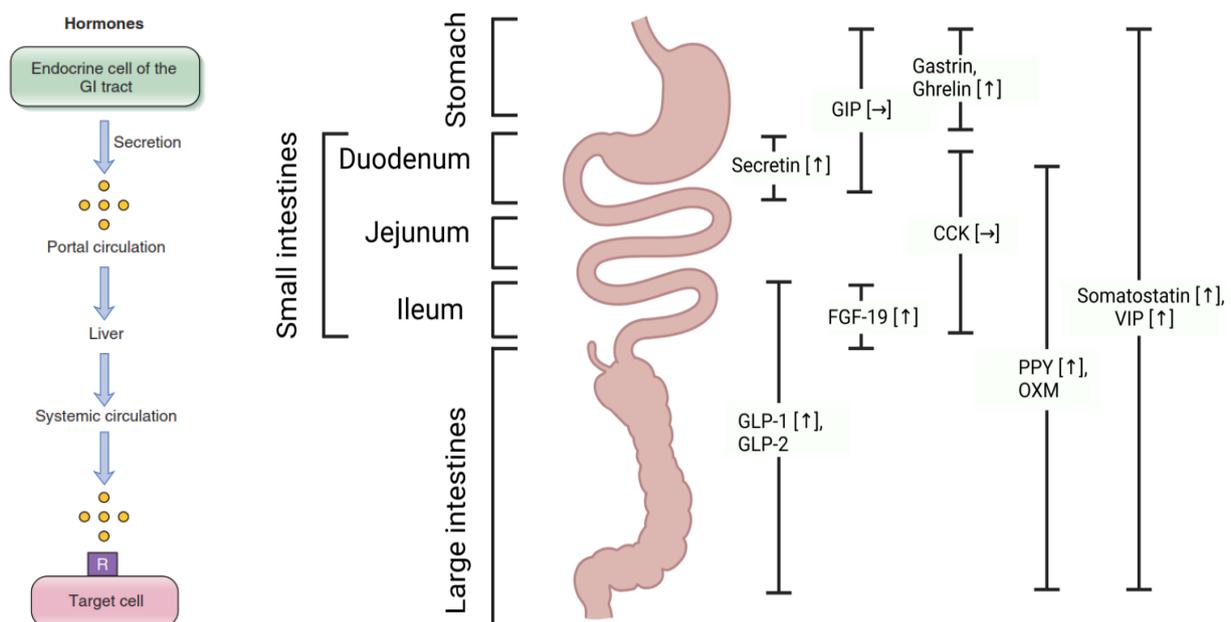
- The digestive system has its own **endocrine system**.
- It consists of group of **special cells** present in the mucosa of the gut.
- They are called **APUD cells** (Amine Precursor Uptake and De-carboxylation).
- **Course:**
 - APUD cells secrete **polypeptide hormones** called gastrointestinal hormones.
 - After secretion, these hormones enter the **portal circulation** then through the **inferior vena cava** to the heart and then through the **systemic circulation** back again to the digestive system to exert their actions.
- **Gastrointestinal hormones are divided into 2 main groups or families:**

1- Gastrin family	2- Secretin family
Gastrin hormone Cholecystikin (CCK)	Secretin hormone. Vasoactive intestinal polypeptide (VIP). Glucose – dependent insulin-tropic peptide (GIP).

▪ **Secretion of GIHs is regulated by:**

1- **Nervous factors:** ENS & A.N.S.

2- **Chemical factors:** Blood-born materials & Luminal factors

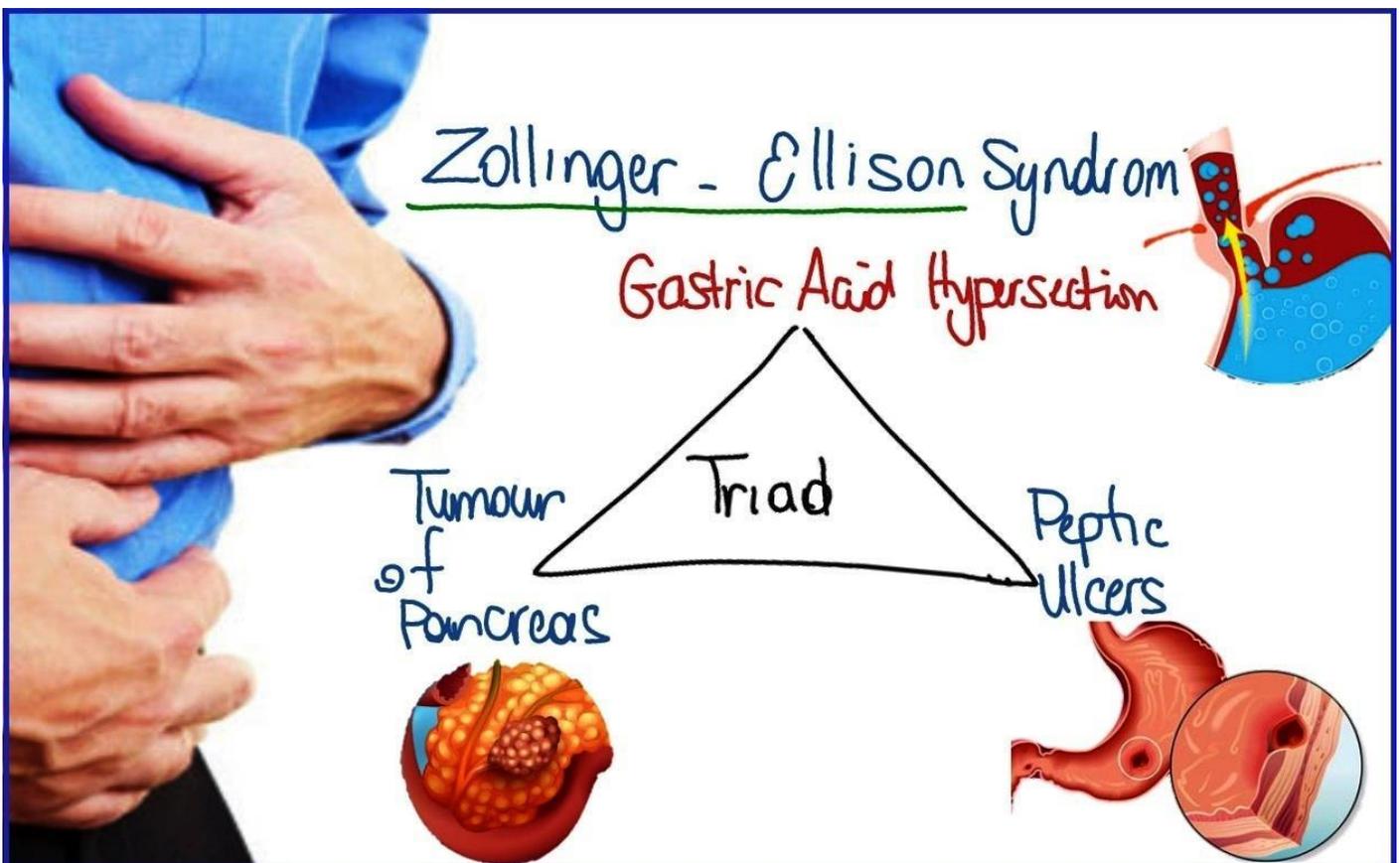


	Gastrin	Secretin	Cholecystokinin (CCK)
Source	<ul style="list-style-type: none"> • G cells: present in the mucosa of the gastric antrum • Other source: TG-cells in stomach and small intestine. 	<ul style="list-style-type: none"> • S cells: present in the mucosa of the duodenum. 	<ul style="list-style-type: none"> • I cells: present in the mucosa of the duodenum and jejunum.
Action	<ol style="list-style-type: none"> 1) Stimulates secretion of HCl and pepsin from the stomach's glands. 2) Stimulates mucosal growth (trophic) of the stomach, small and large intestine. 3) Stimulates gastric motility. <ul style="list-style-type: none"> • NB: When acidity becomes excess, it will inhibit gastrin secretion. 	<ol style="list-style-type: none"> 1) It stimulates pancreatic bicarbonate secretion : <ul style="list-style-type: none"> ➤ Bicarbonate causes neutralization of acidity & provides alkaline medium needed for the action of pancreatic enzymes. 2) Stimulates HCO₃⁻ and H₂O secretion by the liver. 3) Stimulates bile production. 4) Inhibits H⁺ secretion by gastric parietal cells. 	<ol style="list-style-type: none"> 1) Stimulates pancreatic Enzymatic secretion. 2) Stimulates bile secretion by : <ul style="list-style-type: none"> ➤ Contraction of gallbladder. ➤ Relaxation of sphincter of Oddi. 3) Stimulates growth of exocrine pancreas. 4) Potentiates secretin-induced stimulation of pancreatic bicarbonate secretion 5) Inhibits gastric motility: Important for the processes of fat digestion and absorption.

<p>Stimulated by:</p>	<ol style="list-style-type: none"> 1) Distension of the stomach by food. 2) Increased Amino acids and small peptides in gastric contents. 3) Decreased acidity & increase (PH) of gastric contents. 4) Vagal stimulation: <ul style="list-style-type: none"> ➤ Chemical transmitter in this condition is gastrin releasing polypeptide (GRP) not A.ch (not be blocked by Atropine) 	<ol style="list-style-type: none"> 1) Products of Protein digestion. 2) Increased Acidity & fatty acids of the fluid passing from the stomach to the duodenum. 	<ol style="list-style-type: none"> 1) Products of protein digestion in the duodenum. 2) Fatty acids 3) mono-glycerides
<p>Inhibited by:</p>	<ol style="list-style-type: none"> 1) Increased acidity & decrease (PH) of gastric contents. 2) GIT hormones: Secretin hormone & GIP & Somatostatin. 		

NB:

- High acidity of the stomach inhibits gastrin release by **negative feedback** control to protect the gastric mucosa from high acidity.
- **Zollinger–Ellison syndrome (Gastrinoma):**
 - Occurs when gastrin is secreted by **non-β- cell tumors of the pancreas**.
 - Patient with gastrin secreting tumor commonly develop **peptic ulcer**.



	Glucose-Dependent Insulinotropic Peptide (GIP)	Vasoactive intestinal polypeptide (VIP)	Motilin	Somatostatin
Sources:	<ul style="list-style-type: none"> Mucosa of the duodenum & jejunum. 	<ul style="list-style-type: none"> Nerves in GIT. Brain. 	<ul style="list-style-type: none"> Mucosa of the duodenum. 	<ul style="list-style-type: none"> D cells in the pancreas and GI mucosa.
Stimulated by:	<ul style="list-style-type: none"> Glucose. Fatty acids. Amino acids. 	<ul style="list-style-type: none"> Fats in the jejunum 	<ul style="list-style-type: none"> Fasting 	<ul style="list-style-type: none"> Acidity in the lumen of the upper intestine.
Actions:	<ol style="list-style-type: none"> Stimulates insulin secretion. Decreases HCl secretion 	<ol style="list-style-type: none"> Stimulates: <ul style="list-style-type: none"> Pancreatic HCO₃ secretion Secretion of water & electrolytes from the intestine. Decreases HCl secretion. 	<ul style="list-style-type: none"> Regulator of the inter-digestive Motility that preparing the intestine for the next Meal. 	<ol style="list-style-type: none"> Inhibits secretion of gastrin, VIP, GIP, secretin and motilin. Inhibits pancreatic exocrine secretion. Decrease HCl secretion Decrease gastric motility