

إِنَّ فَعِي رَبِّي

سَيُفِدِينِي

Surely my Lord is with me.
He will guide me through.

26:62

ayyub

A close-up photograph of a person's hands holding a red stethoscope against their chest. The stethoscope's tubing is looped around the person's fingers, forming a heart shape. The word "Angels" is written in a white, elegant cursive font across the center of the image, partially overlapping the stethoscope and the person's chest. The background is a soft-focus view of the person's torso and arms.

NOT ALL

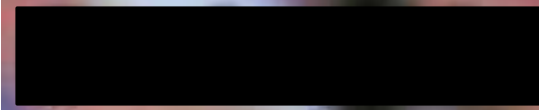
Angels

HAVE WINGS.

Some have

STETHOSCOPES.

HOW IT FEELS WHEN YOU



**ACTUALLY SHOWER, EAT BREAKFAST
AND GET TO WORK ON TIME**

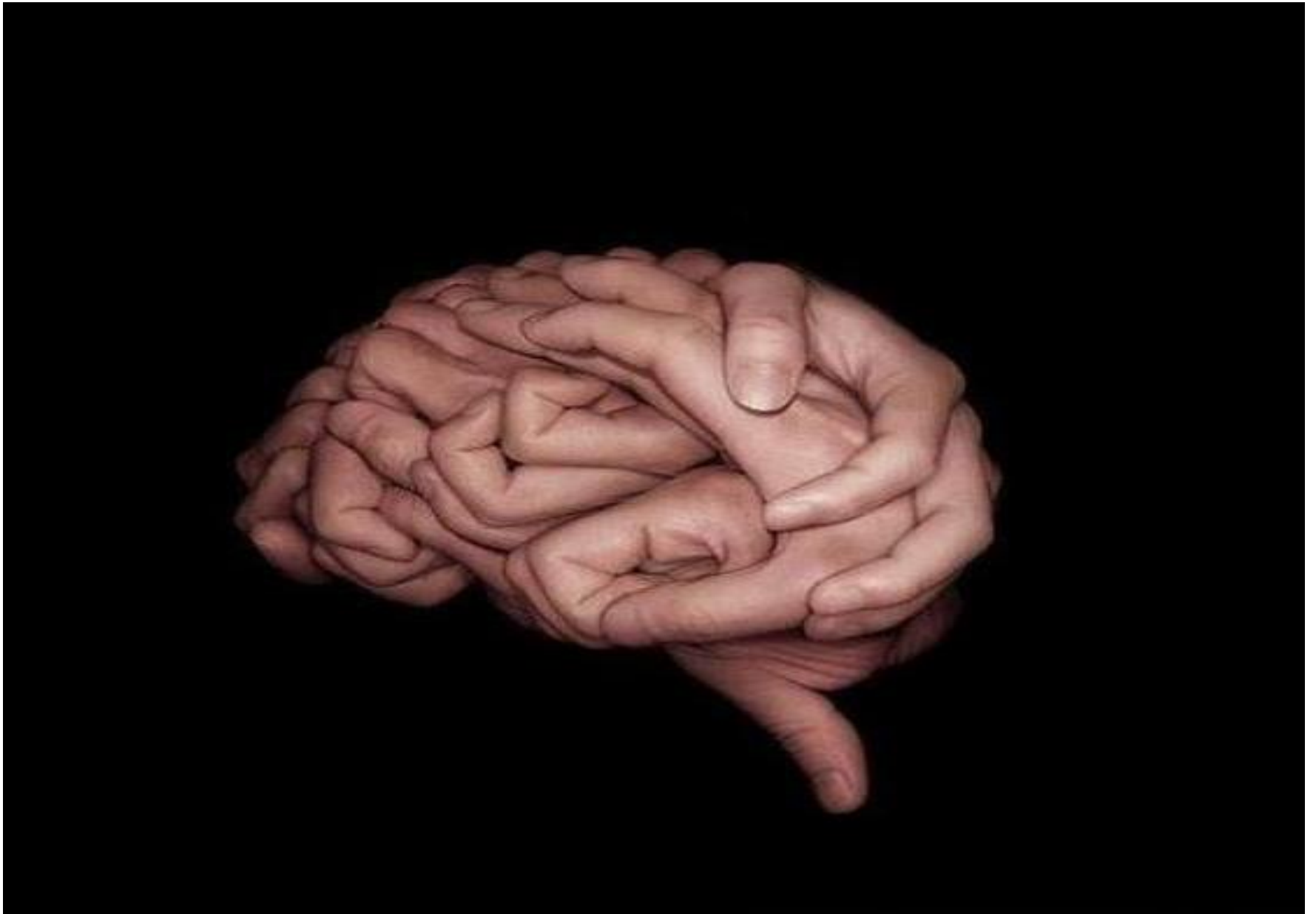
When yo alarm goes off and you just sit there questioning if your education is worth it anymore



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



The Enteric Nervous System: The second brain



Learning Objectives

By the end of this lecture, the student should be able to:

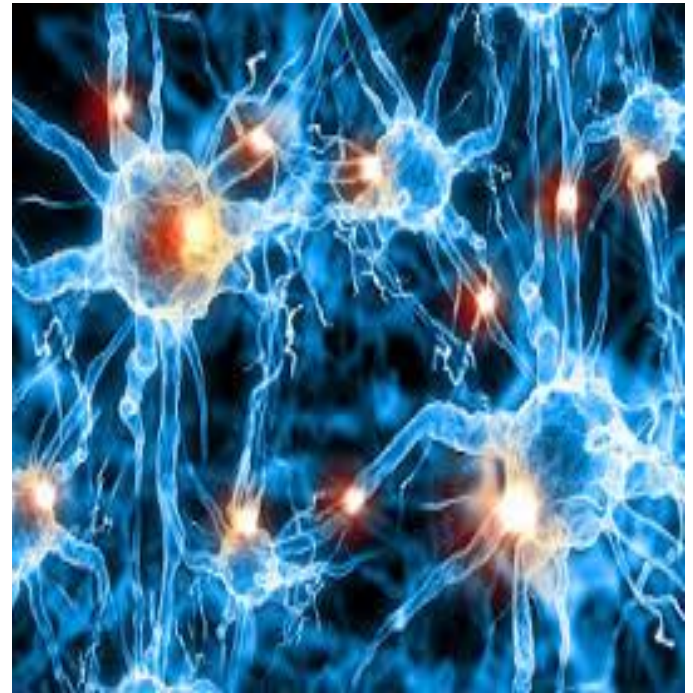
1. Differentiate between mesenteric and submucosal plexus.
2. Enumerate the enteric nervous system neurotransmitters
3. Describe the role of autonomic nervous system in regulation of GIT's function
4. Differentiate between sympathetic and parasympathetic modulation of the enteric nervous system and the effector organs of the GI tract

The Enteric Nervous System

Present in the entire wall of the gut.

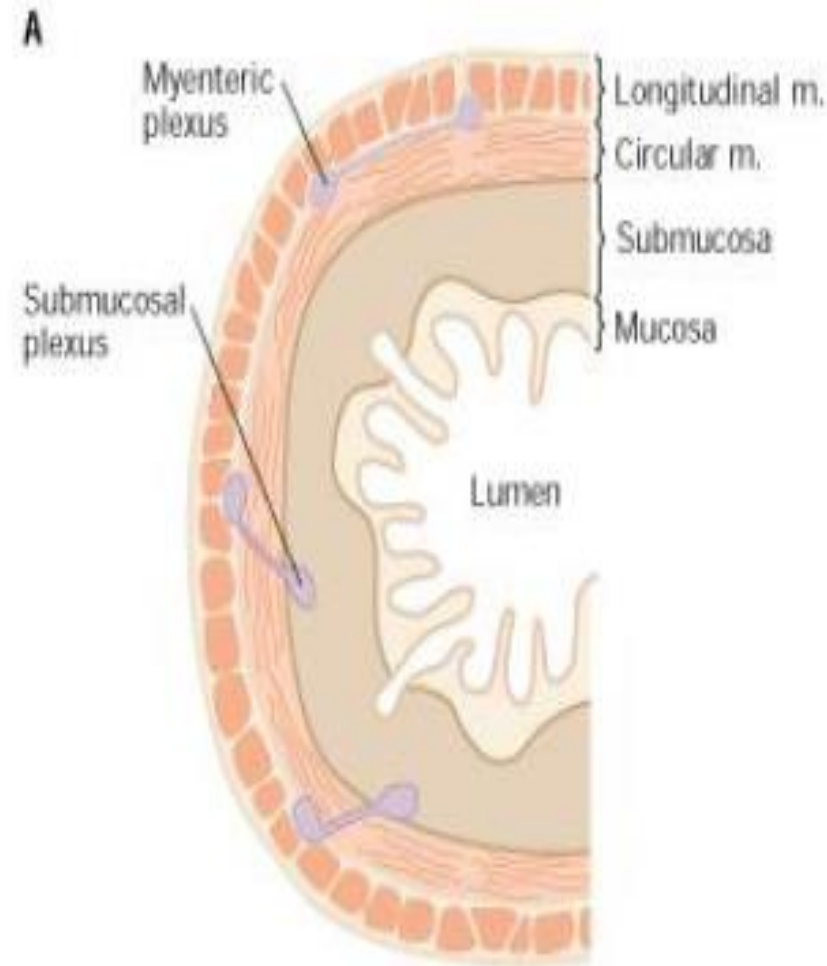
100 million neurons in the enteric nervous system.

Play important role in controlling GIT movement and secretion.



Enteric Nervous System

- Regulates digestive tract motility, secretion, and blood flow
- Composed of two ganglionated nerve networks
 - **Submucosal (Meissner) plexus**- in the submucosa
 - **Myenteric (Auerbach) plexus** between the two layers of the muscularis externa



The Enteric Nervous System

The enteric nervous system is composed mainly of two plexuses.

1) **Myenteric plexus (Auerbach's plexus)**

outer plexus lying between the longitudinal and circular muscle layers

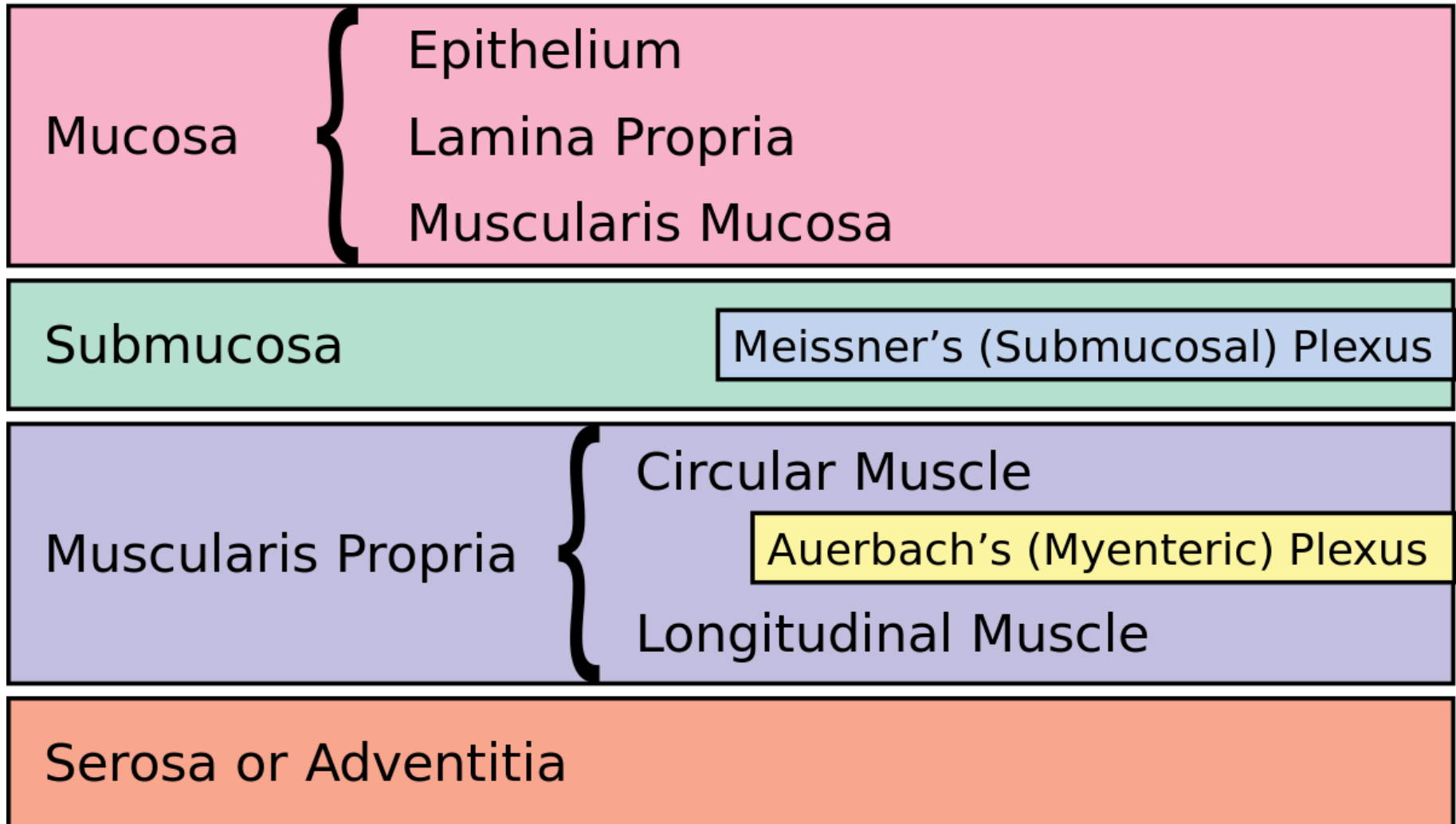
Controls mainly the gastrointestinal movements.

2) **Submucosal plexus (Meissner's plexus)**

an inner plexus that lies in the submucosa

Controls mainly gastrointestinal secretion and local blood flow.

General Organization of the Gastrointestinal Tract



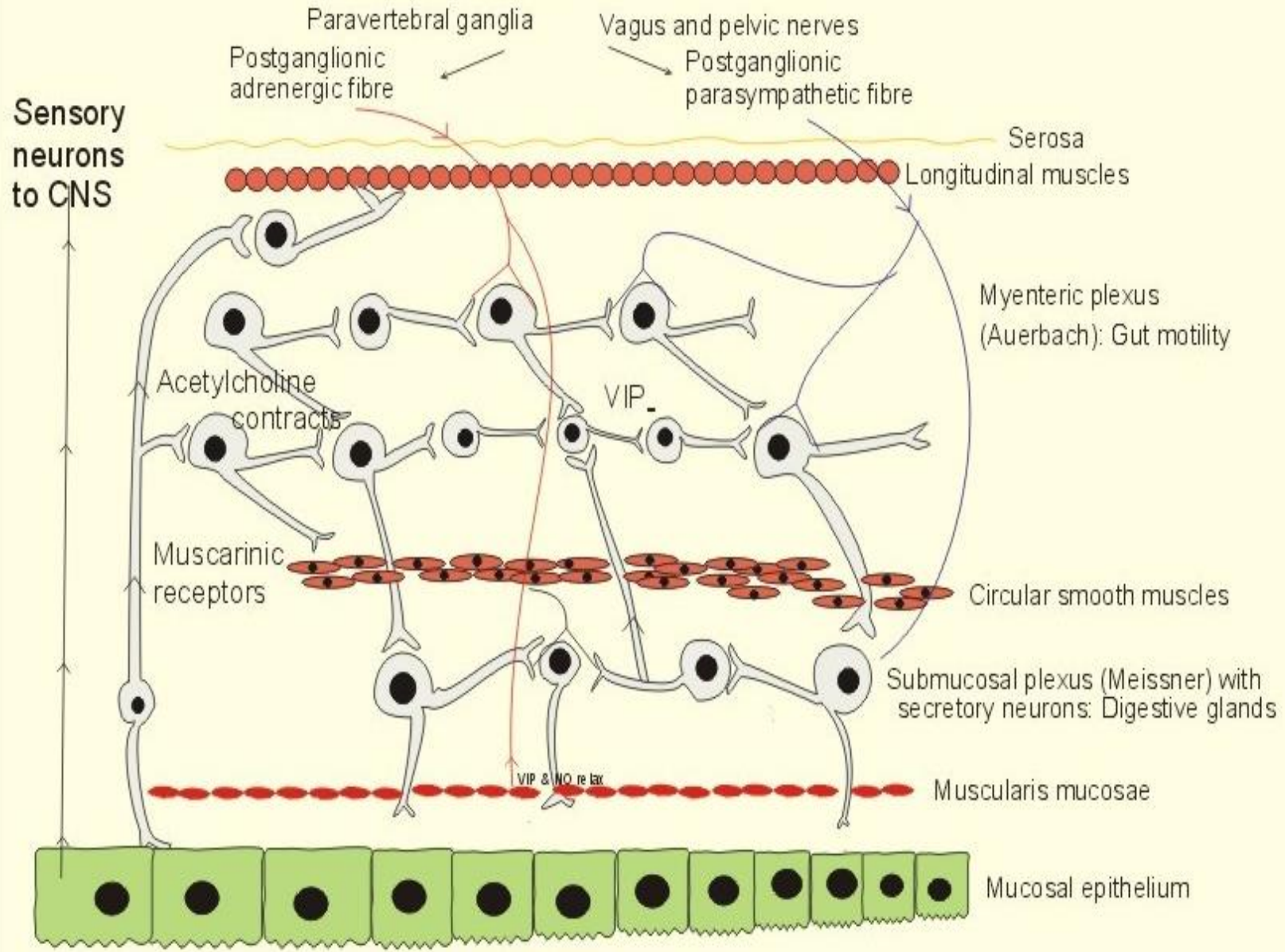


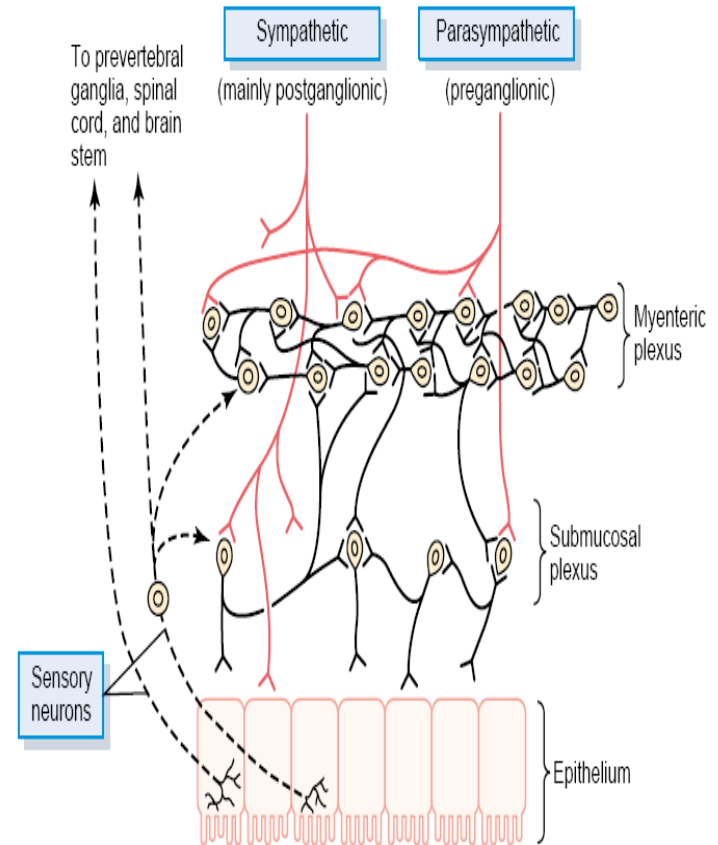
Fig. 22-1

KMc

Differences Between the Myenteric and Submucosal Plexuses

The *myenteric plexus* consists mostly of a linear chain of many interconnecting neurons that extends the entire length of the gastrointestinal tract.

concerned mainly with controlling muscular activity along the length of the gut.



The Law of the Intestine

"Local stimulation of the gut produces excitation above and inhibition below the excited spot. These effects are dependent on the activity of the local nervous mechanism."

Bayliss and Starling. The movements and innervation of the small intestine. *J Physiol* 24: 99-143, 1899.

Freely available at onlinelibrary.wiley.com/doi/10.1113/jphysiol.1899.sp000752/pdf

Stimulatory Function of the Myenteric Plexus

Stimulation of the myenteric nerves effects:

- 1) Increase tonic contraction, of the gut wall.
- 2) Increase intensity of the rhythmical contractions.
- 3) Increase rate of the rhythm of contraction.
- 4) Increased velocity of conduction of excitatory waves along the gut wall, causing more rapid movement of the gut peristaltic waves.

Inhibitory Function of the Myenteric Plexus

The fiber endings secrete an inhibitory transmitter, possibly *vasoactive intestinal polypeptide* or some other inhibitory peptide.

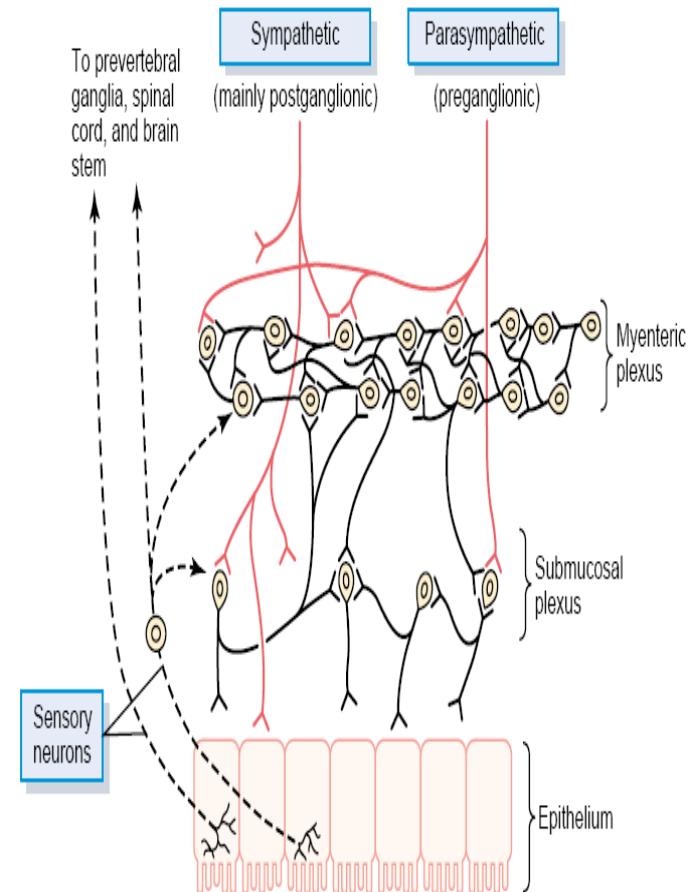
The inhibitory signals are especially useful for inhibiting some of the intestinal sphincter muscles such as the *pyloric sphincter*, which controls emptying of the stomach into the duodenum,

and the *sphincter of the ileocecal valve*, which controls emptying from the small intestine into the cecum.

Function of the Submucosal Plexus

The sensory nerves arising from GI epithelium together with submucosal plexus control

- 1) *Intestinal secretion.*
- 2) *Intestinal absorption.*
- 3) *Contraction of the submucosal muscle that causes various degrees of infolding of the gastrointestinal mucosa.*



Types of Neurotransmitters Secreted by Enteric Neurons

Different neurotransmitter substances that are released by the nerve endings of different types of enteric neurons.

- | | |
|----------------------------|---------------------------------------|
| (1) Acetylcholine | (2) Norepinephrine |
| (3) Adenosine Triphosphate | (4) Serotonin |
| (5) Dopamine | (6) Cholecystokinin |
| (7) Substance P | (8) Vasoactive Intestinal Polypeptide |
| (9) Somatostatin | (10) Leu-enkephalin |
| (11) Metenkephalin | (12) Bombesin |

Table 1. Putative Neurotransmitters Found
in the Enteric Nervous System.

Amines

Acetylcholine

Norepinephrine

Serotonin (5-hydroxytryptamine)

Amino acids

γ -Aminobutyric acid

Purines

ATP

Gases

Nitric oxide

Carbon monoxide

Peptides

Calcitonin gene-related peptide

Cholecystokinin

Galanin

Gastrin-releasing peptide

Neuromedin U

Neuropeptide Y

Neurotensin

Opioids

Dynorphin

Enkephalins

Endorphins

Peptide YY

Pituitary adenylyl cyclase-activating peptide

Somatostatin

Substance P

Thyrotropin-releasing hormone

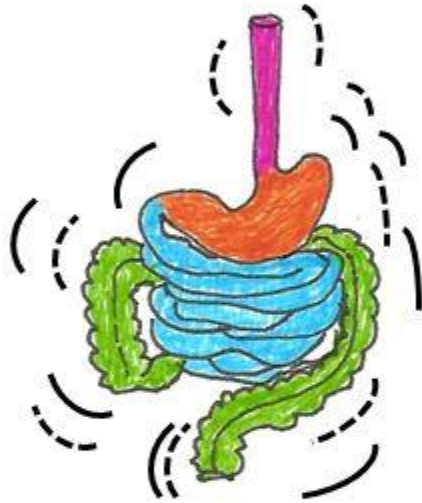
Vasoactive intestinal contractor (an endothelin)

Vasoactive intestinal polypeptide

Autonomic control of the gastrointestinal tract

PARA

Rest and DIGEST



↑ In G. I. Tract Motility

↑ In G. I. Tract Secretions

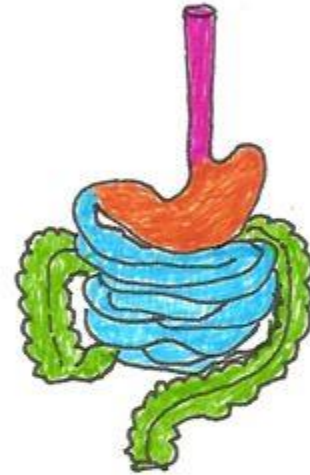
G.I. Tract

or

Alimentary Canal

SYM

Emergency - no time to digest!



↓ In G. I. Tract Motility

↓ In G. I. Tract Secretions

Autonomic Control of the Gastrointestinal Tract

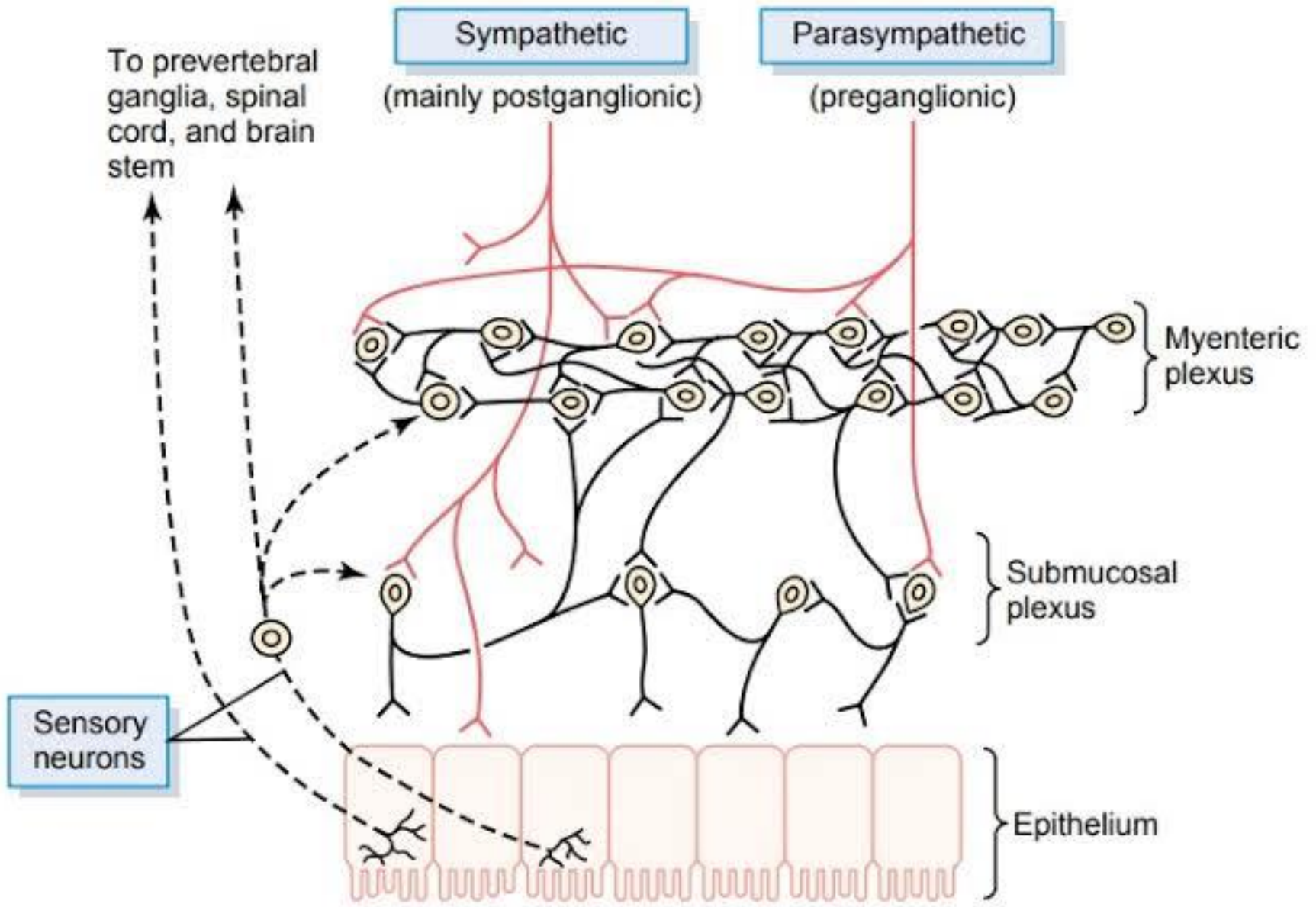
Parasympathetic Innervation.

Cranial parasympathetic nerve fibers

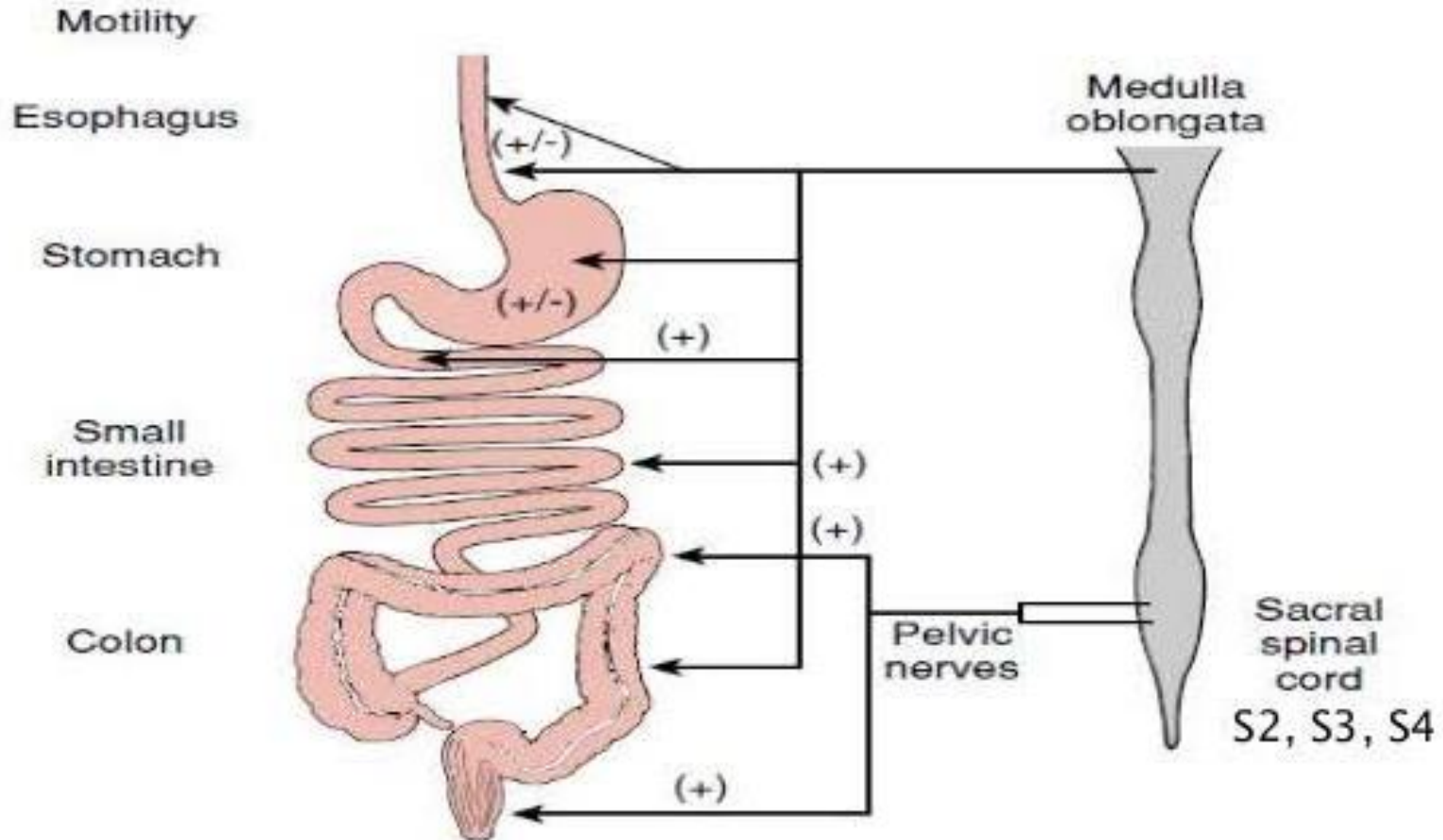
Provide innervation to the esophagus, stomach, pancreas and to the intestines.

Sacral parasympathetic nerve fibers

The sigmoidal, rectal, and anal regions. These fibers function in the defecation reflexes.



PARASYMPATHETIC INNERVATION



Autonomic Control of the Gastrointestinal Tract

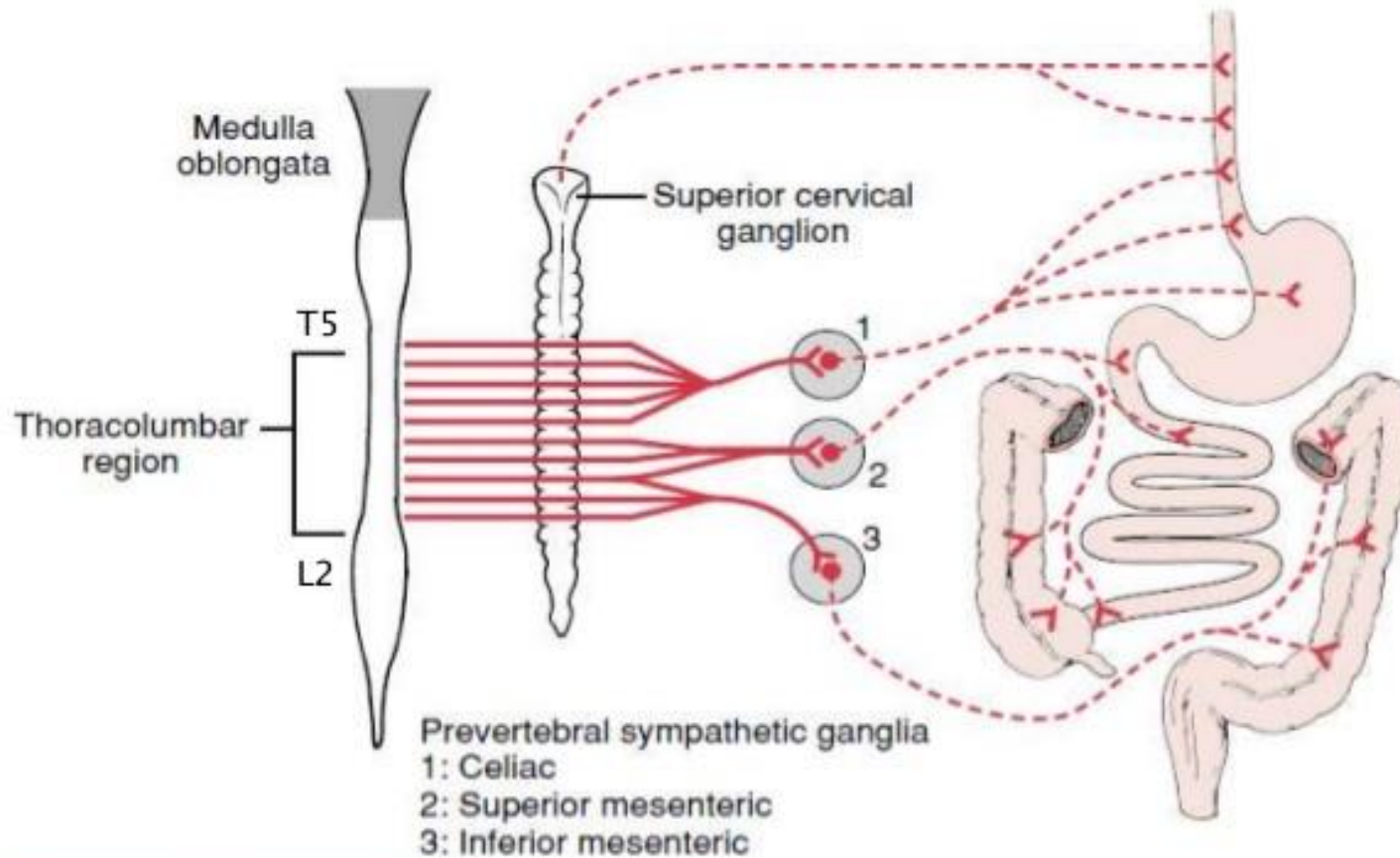
Sympathetic Innervation.

The sympathetic nerves innervate all of the gastrointestinal tract.

Stimulation of the sympathetic nervous system *inhibits activity of the gastrointestinal tract.*

- (1) Secrete norepinephrine to inhibit intestinal tract smooth muscle neurons of the entire enteric nervous system

SYMPATHETIC INNERVATION



Afferent Sensory Nerve Fibers from the Gut

Many afferent sensory nerve fibers innervate the gut.

These sensory nerves can be stimulated by

- (1) Irritation of the gut mucosa.
- (2) Excessive distention of the gut.
- (3) Presence of specific chemical substances in the gut.

Signals transmitted through the fibers can then cause *excitation or inhibition of intestinal movements*, intestinal secretion.

Gastrointestinal Reflexes

Three types of gastrointestinal reflexes that are essential to gastrointestinal control.

Reflexes within the gut wall

Reflexes from the gut to other part within GIT

Reflexes from the gut to the spinal cord or brain

Gastrointestinal Reflexes

Reflexes within the gut wall

Local reflexes present entirely within the gut wall.

Control GI secretion such as peristalsis, mixing contractions, local inhibitory effects etc.

Gastrointestinal Reflexes

Reflexes from the gut to other part within GIT

Transmit signals long distances to other areas of the gastrointestinal tract.

3 types

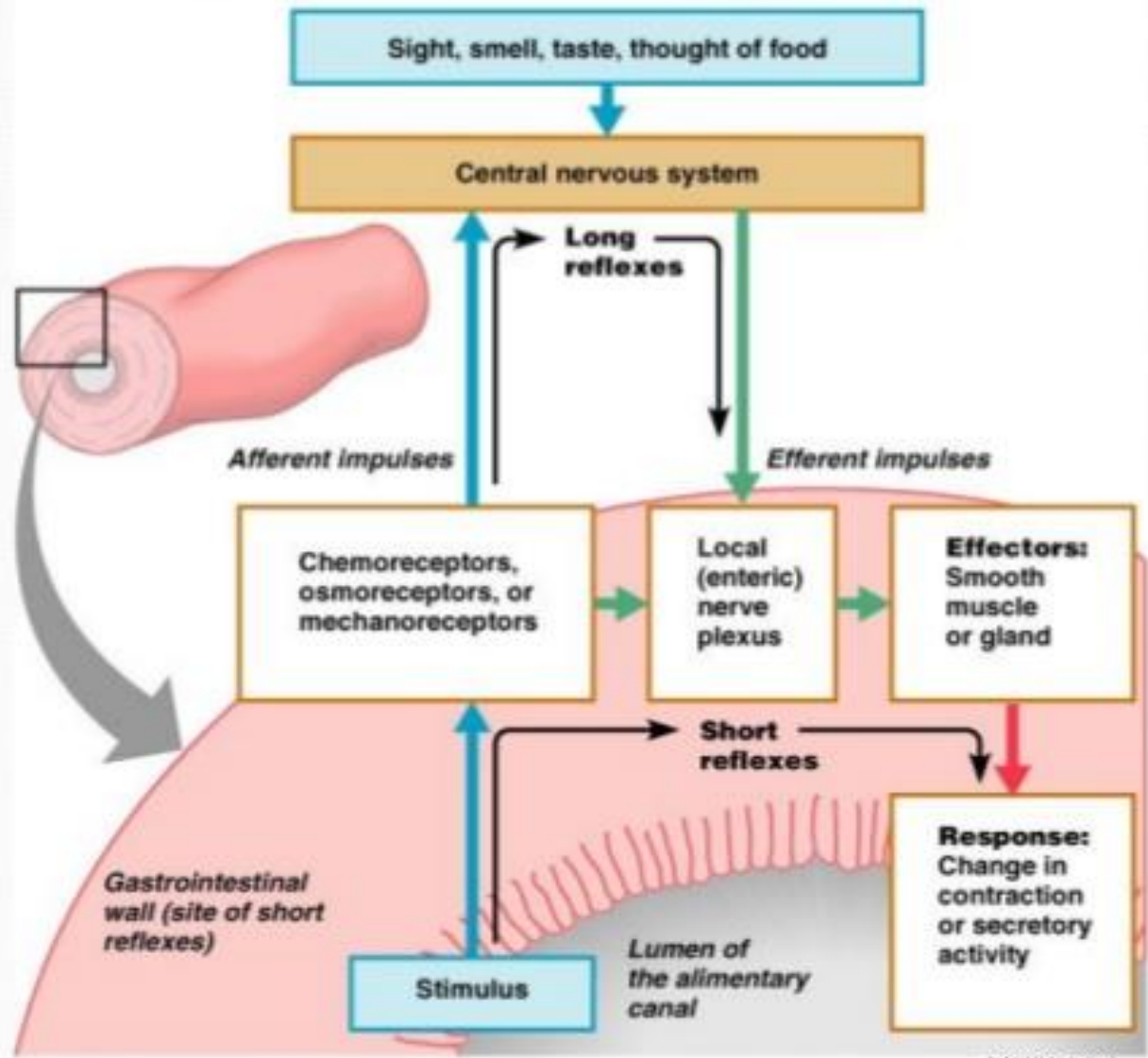
- i) **Gastrocolic reflexes** signals from the stomach to cause evacuation of the colon
- ii) **Enterogastric reflexes** signals from the colon and small intestine to inhibit stomach motility and stomach secretion
- iii) **Coloileal reflexes** reflexes from the colon to inhibit emptying of ileal contents into the colon

Gastrointestinal Reflexes

Reflexes from the gut to the spinal cord or brain

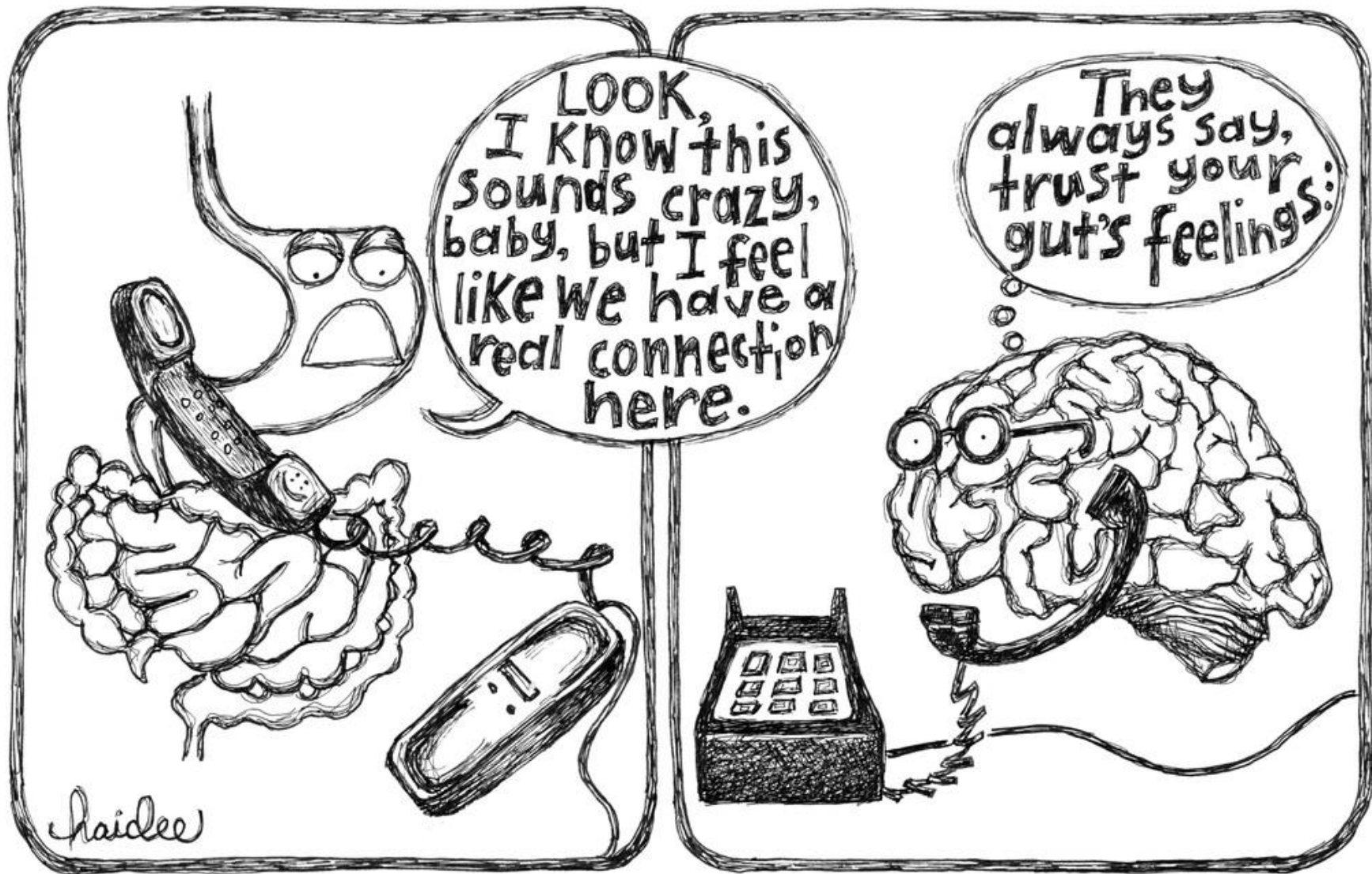
- (1) reflexes from the stomach and duodenum to the brain stem (control gastric motor and secretory activity)
- 2) pain reflexes that cause general inhibition of the entire gastrointestinal tract
- 3) defecation reflexes that travel from the colon and rectum to the spinal cord and back again to produce the powerful colonic, rectal, and abdominal contractions required for defecation reflexes.

Nervous Control of the GI Tract



The 4 stages of an 8 am lecture





Take home points

GI smooth muscle is involuntary.

GI motility and secretions are controlled by the enteric nervous system

Regulation of GIT is complex and synergistic

Parasympathetic System activates the GI functions and Sympathetic slows it down.

Most awaited slide of any lecture :
#BeingMedico



Fun Facts



Meet Your Happy Chemicals

Dopamine



Serotonin



Oxytocin



Endorphin

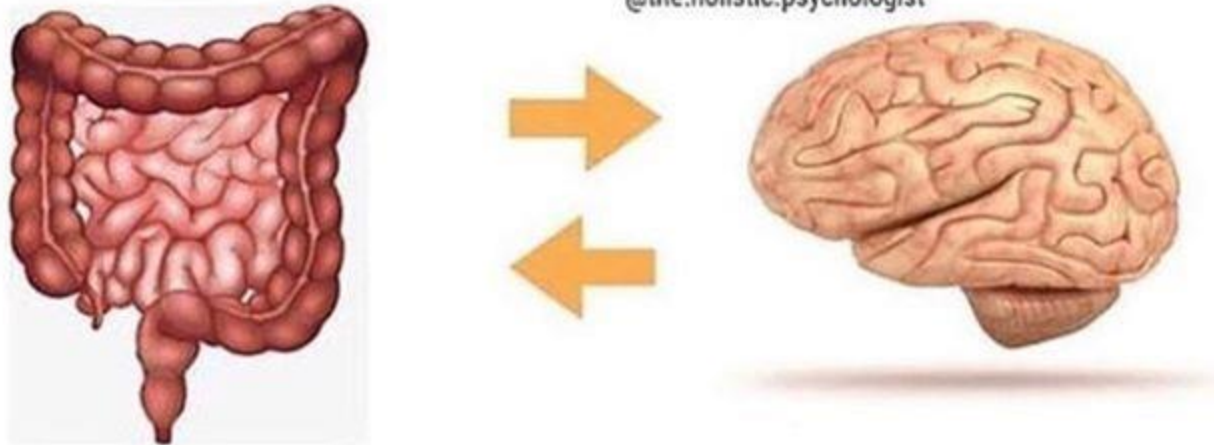


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Mood is Made in the Gut

@the.holistic.psychologist



There is constant **bi-directional** communication between the brain and the GI tract. The microbes in the gut communicate with the **cognitive** and **emotional** centers of the brain. 70% of Neurotransmitters like serotonin are made in the gut then sent to the brain via the vagus nerve.

Nutrition creates mood.

12x happy

Dave Sommers

Increase Serotonin



Banana
boosts serotonin



Spend time
in nature



Leafy Greens
boost Energy



Walnuts - Omega 3
brain nutrients



Smiling releases
happy hormones



Epsom Salt
Calming



Oats
Eases Depression



Cayenne Peppers
Relieves Depression



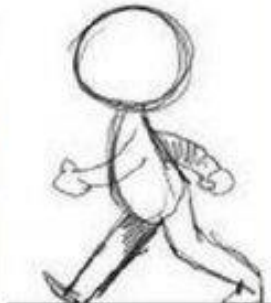
Water Hydration
More Energy less stress



Green Smoothie
Energy boost, zap!



Almonds
Brain Food-Magnesium



Walking- clears mind
boosts serotonin

More pics on www.imfunny.net

Recommended Books

Principles of Human Physiology

-Lauralee Sherwood

Guyton & Hall

Ganong's review of Medical Physiology





**Ordinary
Student**

**Medical
Student**



That's all Folks!

“Because
answers
exist only
to *questions...*”

Mungara Tarou Krishnamurti

26 Jan 2013 2:17 am

Questions,
comments,
feedback?