

# 7 The Large Intestine

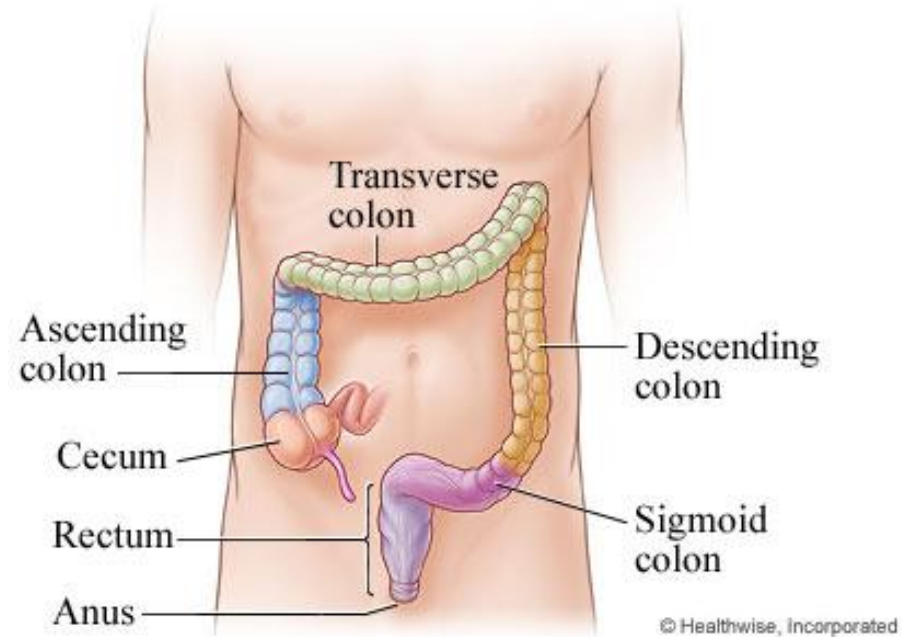


**GIT**

## The areas of colon are:

Ascending, Transverse, Descending, Sigmoid, Rectum then Anal canal.

### Functions of the Large Intestine

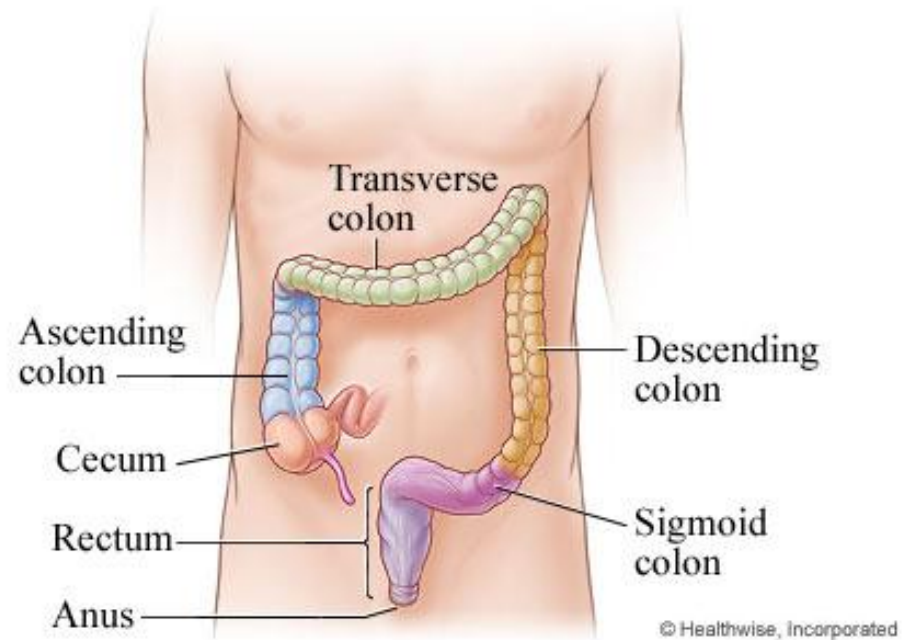


Reabsorb water  
and compact  
material into feces

Absorb vitamins  
produced by  
bacteria

Store fecal matter  
prior to defecation

**Secretion of colon :  
Stimulation of the pelvic  
nerves cause:**



**Marked increase in mucus  
secretion.**

**Increase in peristaltic  
motility of the colon.**

**During extreme parasympathetic  
stimulation, so much mucus can be  
secreted into the large intestine that the  
person has a bowel movement of ropy  
mucus as often as every 30 minutes; this  
mucus often contains little or no fecal  
material.**

**The explanation will be in the next  
slide**

## The Colon:

- The outer longitudinal muscle layer is modified to form three longitudinal bands called tenia coli visible on the outer surface.
- Since the muscle bands are shorter than the length of the colon, the colonic wall is sacculated and forms haustra.
- The colon has a length of 150 cm.
- The transit of small labeled markers through the large intestine occurs in 36-48 hrs.

## Secretion in Large Intestines :

### Mucus Secretion:

- The mucosa of the large intestine has many crypts of Lieberkühn.
- Absence of villi, and epithelial cells contain almost no enzymes.
- Presence of abundant goblet cells that secrete mucus (**provides an adherent medium for holding fecal matter together**).
- Stimulation of the parasympathetic (through *pelvic nerves*) can cause marked increase in mucus secretion & peristaltic motility of the colon.

**It is mainly mucus, no digestive enzymes.**

**The mucus has the following functions:**

- 1- It neutralizes against any acids present.
- 2- It protects against irritation.
- 3- It helps to lubricate feces.
- 4- It provides a binding medium for fecal matter.
- 5- Whenever a segment of large intestine becomes irritated as occurs in bacterial infection, the mucosa secretes large amount of water & electrolytes in addition to the alkaline mucus.
- 6- This dilute the irritating factors and causes rapid movement of the feces toward the anus.

# Absorption in the Large Intestine (Formation of Feces) :

- Proximal one half of the colon (**absorbing colon**), where most of the absorption in the large intestine occur.
- Distal colon (**storage colon**), where feces storage occur until a propitious time for feces excretion.

## Cont..

- The large intestine can absorb a maximum of 5 to 8 liters of fluid and electrolytes each day !
- The mucosa, like that of the small intestine, has a high capability for active absorption of sodium\* (in the presence of Na<sup>+</sup>-K<sup>+</sup> ATPase) at the basolateral membrane , Cl and water.
- \* K<sup>+</sup> is secreted into the lumen of colon.
- It secretes bicarbonate ions\* (by exchange with cl<sup>-</sup>).
- **Reabsorption in the large intestine includes:**
- **Water\*** (about 0.5- 1.5L/day is absorbed. The net water loss is 150-200 ml/day. )
- 1. **Vitamins – K, biotin, and B<sub>5</sub>** \* (folic acid and some AA and short chain FA resulting from bacterial fermentation of CHO are absorbed. )
- 2. Certain drugs as steroids and aspirin may be absorbed.
- 3. **Organic wastes – Urobilinogens and Sterobilinogens**
- 4. **Bile salts**
- 5. **Toxins.**
- **N.B.** Ascending colon for absorption of nutrients, while first half of transverse colon mainly for absorption of water.

## Role of Bacteria in the Colon :

- This bacterial flora is living in symbiosis with human and its effects are beneficial to the body as follows:

Colon bacteria are capable of digesting small amounts of cellulose **\*which is not digested by human enzymes\***.

Vitamin K, vitamin B12, thiamine, and various gases can be formed by bacteria.

**The bacteria-formed vitamin K is especially important because the amount of this vitamin in the daily ingested foods is normally insufficient to maintain adequate blood coagulation.**

- Deconjugation and decarboxylation of Bile salts.
- Break down of bile pigments to produce stercobilinogen.
- Decarboxylation of some AA to produce amine and histamine. The amines are excreted in feces and are responsible for its smell.
- Break down of urea by bacterial urease to ammonia. Most ammonia is absorbed and reconverted into urea by liver. In hepatic failure, accumulation of ammonia can cause hepatic encephalopathy.
- Fermentation of undigested CHO.

## The ileocaecal:

- It prevents backflow of contents from colon into small intestine.
- It remains closed and open only when an intestinal peristaltic wave reaches it.
- Distension of the cecum, Secretin, Ach, alpha adrenergic stimulation contract ileocaecal valve.
- Gastrin, Cck, B adrenergic stimulation relax ileocaecal valve.

# The physiology of different colon regions

## Ascending Colon

- **Specialized for processing chyme delivered from the terminal ileum and absorption of nutrients.**
- Chyme travels along ascending colon in 87 min, which even considered short time comparing to transverse colon
- Not site of storage, mixing and removal of water.

## Transverse Colon

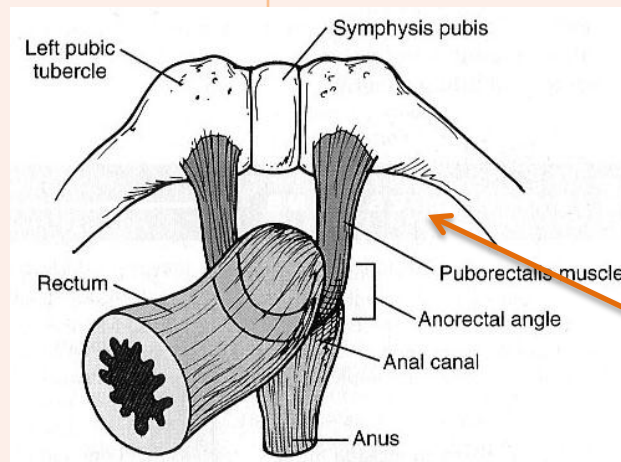
- **Specialized for the storage and dehydration of feces.**
- feces could stay here for about 24 hrs.
- The transverse colon is the **primary site** for the removal of water and electrolytes and the storage of feces.

## Descending Colon

- Feces begin to accumulate in the sigmoid colon about 24 hours after entering the cecum.
- This region has the neural program for power propulsion that is involved in defecation reflex.

## Sigmoid Colon & Rectum

- **The physiology of the rectosigmoid region, anal canal, and pelvic floor musculature maintains fecal continence (stop defecation).**
- The sigmoid and rectum are reservoirs with a capacity of up to 500mL .
- The puborectalis muscle and external anal sphincter comprise a functional unit that maintain continence.
- Fibers of puborectalis join behind the anorectum and pass around it to form a U-shaped sling (physiological valve).



## Sensory innervation and continence for rectum :

- **ENS** supply mechanoreceptors in the rectum detect distention.
- The anal canal in the region of the skin is innervated by **somatosensory** nerves that transmit signals to CNS.
- This region has sensory receptors of pain, temperature and touch
- Contraction of internal anal sphincter and puborectalis muscle blocks the passage of feces and maintains continence.



# Motility in the Large Intestine

The proximal half of the colon is concerned with absorption and the distal half with storage

## 1. Mixing movements (Haustrations)

- The motor events in the cecum and ascending colon .
  - These combined contractions cause the unstimulated portion of large intestine to bulge outward into baglike sacs (haustrations).
  - They also at times move slowly analward during their period of contraction.
  - After another few minute new haustral contractions occur in other areas nearby.
  - In this way all fecal material is gradually exposed to the surface of the large intestine & fluid is progressively absorbed.
  - Ring-like contractions of the circular muscle **(about 2.5 cm)** divide the colon into pockets called haustra, uniform repetition of the haustra along the colon.
  - The contracting segment and receiving segment on either side remain in their respective state for longer periods.
  - Net forward propulsion occurs when sequential migration of haustra occurs along the length of the bowel.
  - **N.B.** Haustrations occur mainly in ascending colon which cause also the movement of faces through it.
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## 2. Propulsive movements (Mass Movements)

- **The motor events in the transverse and descending colon.**
- **These movements occur few times each day, most abundantly for 15 min during the first hour after eating breakfast.**
- **A mass movement is a modified type of peristalsis.**
- **A constrictive ring occurs at a distended or irritated point in the colon. Then rapidly the 20 or more cm of the colon distal to the constriction contract almost as a unit forcing the fecal material en mass down the colon.**
- **The initiation of contraction is complete in about 30 seconds.**
- **During the next 2 to 3 min another mass movement occurs.**
- **the whole series of mass movement will usually persist for only 10 min to half an hour. They will then return after a half day or even a day later.**
- **When they have forced a mass of feces into the rectum the desire for defecation is felt.**

### Initiation of mass movement :

- **Gastrocolic & duodenocolic reflexes after meals. They result from distension of the stomach & duodenum.**
- **Irritation of the colon e.g., castor oil.**
- **Intense stimulation of parasympathetic NS.**
- **Over distension of a segment of the colon.**
- **threatening agents such as parasites and enterotoxins**
- **May be triggered by the increased delivery of ileal chyme into ascending colon following a meal (gastrocolic reflex).**
- **Start at the middle of transverse colon and is preceded by relaxation of the circular muscle and the downstream disappearance of haustral contractions.**

### 3. Antiperistalsis movement :

- It starts at the junction of ascending and transverse colon and traveling towards the cecum.
- It mixes contents and help water absorption.

### Control of colonic motility :

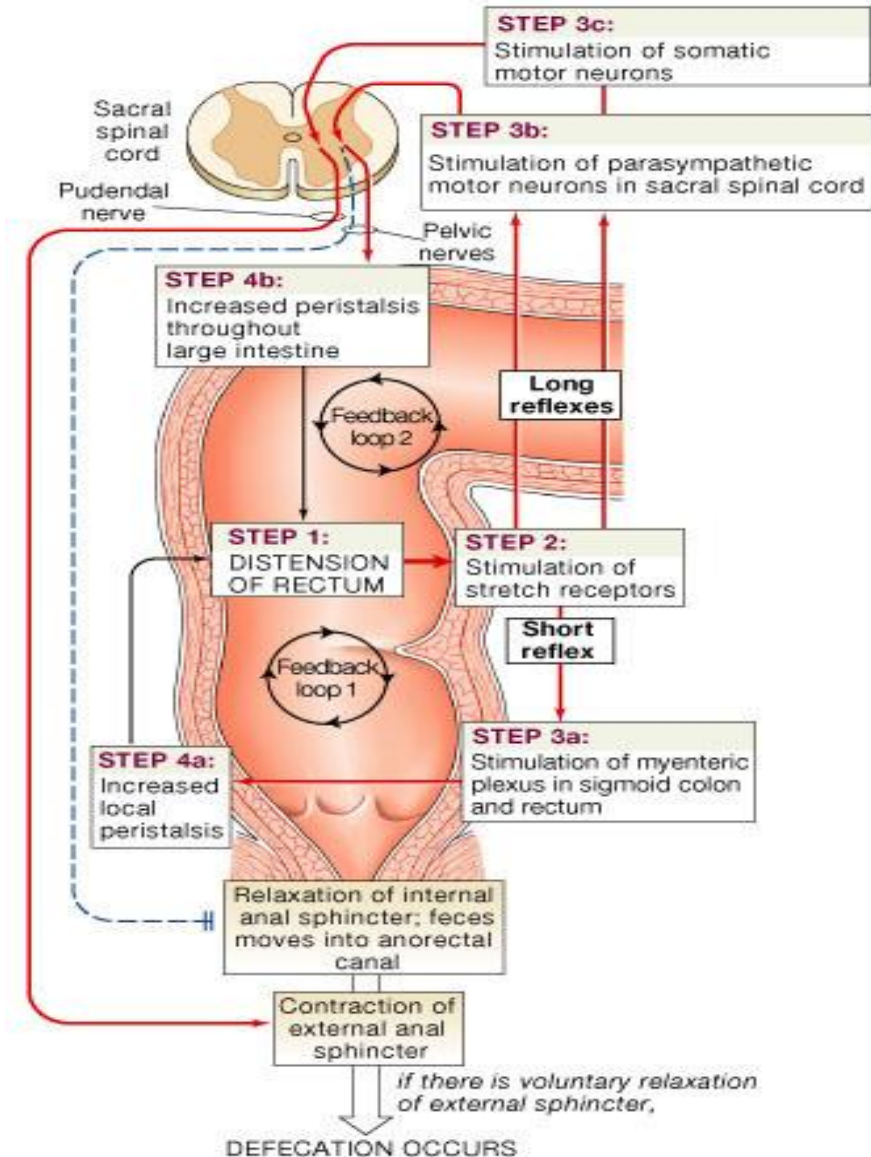
1. The intramural plexuses directly control the contractile behavior of the colon.
2. Stimulatory enteric motor neurons use acetylcholine & substance P as neurotransmitters.
3. Inhibitory enteric motor neurons release VIP & NO onto colonic smooth muscle cells.
4. The extrinsic autonomic nerves to the colon modulate the control of the colonic motility by the enteric nervous system.

## # The Rectum :

- Last portion of the digestive tract.
- Terminates at the anal canal.
- Has the internal and external anal sphincters.

## #Defecation :

1. It is a spinal reflex which is influenced by higher center.
2. Most of the time the rectum is empty and both internal and external sphincters are reflexly maintained in a state of tonic contraction.
3. Gastric or intestinal filling initiate a mass movement in the colon that pushes feces into rectum (gastrocolic & duodenocolic reflexes).
4. The rectum is distended and sends signals to cerebral cortex producing the desire to defecate.



## # Defecation Reflex :

1. Distension of the rectum.
2. Stimulation of the stretch receptors in the rectum.
3. **A. Short reflex:** Stimulation of myenteric plexus in sigmoid colon and rectum.  
**B. long reflex:** stimulation of parasympathetic motor neurons in sacral spinal cord.  
**C. stimulation of somatic motor neurons.**
4. Increased local peristalsis. Relaxation of internal anal sphincter and contraction of external anal sphincter.

**N.B.** But when the time is appropriate for defecation, voluntarily relaxation of external anal sphincter and passing stool.

**\* If the surrounding circumstances are suitable:**

1. **\* Defecation reflex will be allowed.**  
Stretch of the rectal wall is signaled to SC by pelvic nerve. Efferent pelvic impulses cause reflex contraction of the rectum and relaxation of IAS.
2. **\* This is followed by reduction in tonic impulses to EAS, so it relaxes and feces leave the rectum assisted by voluntary straining and contraction of pelvic floor muscle.**

**\* If the situation is not suitable for defecation:**

1. **\* The reflex is inhibited by the cerebral cortex.**
2. **\* Tonic contraction of EAS is voluntary maintained which leads to accommodation of the rectum to distension and return of tonic contraction of the IAS.**

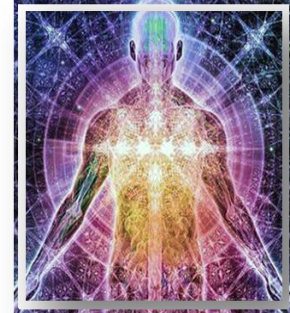
## **Fecal incontinence :**

The spinal reflex of defecation operates without interference from higher centers.*Causes:*

- 1. In infants (physiological)**
- 2. Spinal cord lesion**
- 3. Weakness of IAS and EAS**
- 4. Weakness of pulborectalis**
- 5. Altered rectal or anal sensation**
- 6. Diarrheal conditions**
- 7. Diminished rectal capacity**

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