

## Summary of Enzymatic Digestion and Absorption

<b>Secretion</b>	<b>Enzyme</b>	<b>Substrate</b>	<b>Action</b>	<b>Final Product</b>
Saliva	Ptyalin	Starch	Hydrolysis to form dextrins	
Gastric juice	Pepsin	Protein	Hydrolysis of peptide bonds	
	Gastric lipase	Fats	Hydrolysis into free fatty acids	

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Pancreatic exocrine secretion	Lipase	Fat	Hydrolysis to mono-glycerides	Fatty acids
	Cholesterol esterase	Cholesterol	Hydrolysis to esters of cholesterol and fatty acids	Cholesterol
	alpha-Amylase	Starch, dextrins	Hydrolysis	Dextrin, maltose

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Pancreatic exocrine secretion	Trypsin	Protein	Hydrolysis	Polypeptides
	Chymotrypsin	Protein	Hydrolysis	Polypeptides
	Carboxypeptidase	Polypeptides	Hydrolysis	Amino acids
	Ribonuclease	Ribonucleic acids	Hydrolysis	Mono-nucleotides
	Elastase	Fibrous protein	Hydrolysis	Amino acids

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Brush border enzymes	Carboxypeptidase; aminopeptidase; dipeptidase	Polypeptides	Hydrolysis	Amino acids
	Entero-kinase	Trypsino-gen	Activates to trypsin	Polypeptidases and peptides
	Sucrase	Sucrose	Hydrolysis	Glucose, fructose

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Brush border enzymes	Isomaltase	Dextrin	Hydrolysis	Glucose
	Maltase	Maltose	Hydrolysis	Glucose
	Lactase	Lactose	Hydrolysis	Glucose, galactose
	Nucleotidases	Nucleic acid	Hydrolysis	Nucleotides
	Nucleosidases and phosphorylase	Nucleosidases	Hydrolysis	Purine and pyrimidine bases

# Neurotransmitters

- **Alpha-aminobutyric acid**: relaxes LES (lower end of the esophagus)
- **Norepinephrine**: decreases motility, increases contractions of sphincters, inhibits secretions
- **Acetylcholine**: increases motility, relaxes sphincters, stimulates secretions
- **Neurotensin**: inhibits release of gastric emptying and acid secretion
- **Neuropeptide-Y**: stimulates feeding behavior

# Hormones and GI Function: Gastrin

- Released from gastric mucosa and duodenum in presence of peptides and amino acids;
- stimulates **secretion of hydrochloric acid** and pepsinogen;
- **increases gastric antral motility**, increases LES tone

# Hormones and GI Function: Gastrin

- **Secretin:** from duodenal mucosa in presence of acid in small intestine;
- **stimulates pancreas** to secrete water and bicarb; also insulin and pancreatic enzymes



# Hormones and GI function: Cholecystokinin (CCK)

- Released from proximal small bowel in presence of peptides, amino acids, fat, HCL, stimulates pancreas to release pancreatic enzymes

# Hormones and GI function: Gastric Inhibitory Polypeptide (GIP)

- Released from small intestine in presence of glucose and fat.
- inhibits gastrin-stimulated release of gastric acid

# Hormones and GI Function (Motilin)

- Released from stomach and small and large intestine in presence of biliary and pancreatic secretions;
- promotes gastric emptying and increases GI motility

# Hormones and GI function: Somatostatin

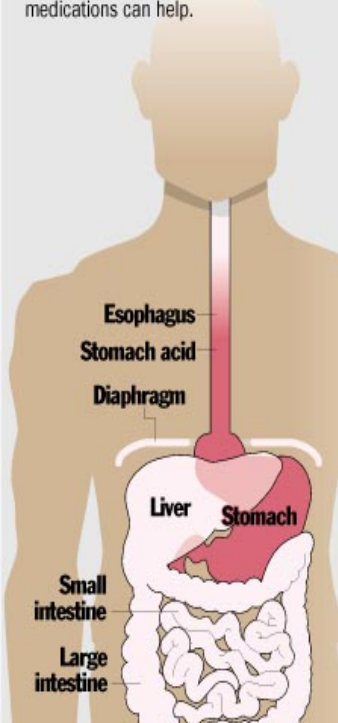
- **Released from stomach**, pancreas, and upper small intestine in presence of acidity and products of protein and fat digestion.
- Inhibits release of gastrin, motilin, and pancreatic secretions; decreases motility of GI tract

# Heartburn

- Acid Reflux
- **Symp**- burning sensation
- avoid chocolate and peppermint, coffee, citrus, fried or fatty foods, tomato products – stop smoking– take antacids – don't lay down 2-3 hours after eating.
- When small quantities of stomach acid are regurgitated into the esophagus

## Heartburn remedies

Some cases of heartburn are the result of a stomach disorder called gastroesophageal reflux disease, which forces stomach acid to travel backward and into the throat. Some cases are so bad they're correctable only by surgery, but medications can help.



### Types of relief

Remedies for heartburn and Gastroesophageal Reflux Disease (GERD) fall into five basic classes:

- Antacids:** (Tums, Alka-Seltzer, Milk of Magnesia, Maalox, etc.). These medications, which contain sodium bicarbonate, calcium, magnesium, aluminum or a combination, use basic chemical reactions to neutralize existing stomach acid.
- Sodium alginate or alginic acid with other antacid ingredients:** (Gaviscon). This type of medication produces a foam barrier between the stomach and the esophagus to prevent acid from back-flowing into the esophagus.
- Promotility or prokinetic agents:** (metoclopramide). This helps strengthen the valve that blocks acid from entering the esophagus by causing muscles in the upper intestinal tract to contract, resulting in a faster emptying of the stomach.
- H2 blockers or histamine receptor antagonists:** (Peppid AC, Tagamet HB, Axid AR, Zantac 75). These partially block the production of acid in stomach cells by inhibiting histamine, which stimulates the secretion of stomach acid.
- Proton pump inhibitors or acid pump inhibitors:** (Prilosec, Prevacid, rabeprazole, pantoprazole). The newest development, these inhibit stomach acid production by deactivating the acid pumps (the site where stomach acid is produced) in stomach cells.

Jennifer Novicko, Gannett News Service


# Gastroenteritis

- Inflammation of mucous membrane lining of stomach and intestine
- Common cause = Virus
- Symps – diarrhea and vomiting for 24-36 hours
- Complication = dehydration

**Información general**



**Definición**  
También denominada gripe estomacal, la gastroenteritis es una infección e inflamación del tracto intestinal que puede causar alteraciones más o menos serias. La infección puede contraerse por contacto con otra persona afectada o por ingerir alimentos o agua en mal estado.

**Zonas más afectadas**




Estómago, intestino delgado y colon.

**Individuos más afectados por edad y sexo**



**1 / 5**  
**60 / ...**

**Pérdida del apetito, fiebre, dolor de cabeza**




**Debilidad**


**Náuseas, vómitos**

**Diarrea, dolor y calambres abdominales**

**Síntomas entre 10 y 24 horas después de la ingestión**



**Recuperación entre 4 y 5 días**

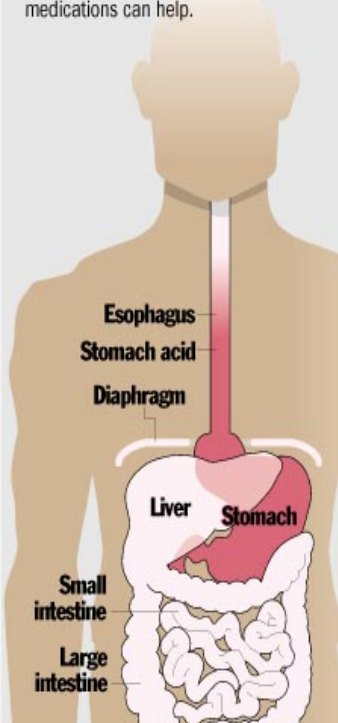


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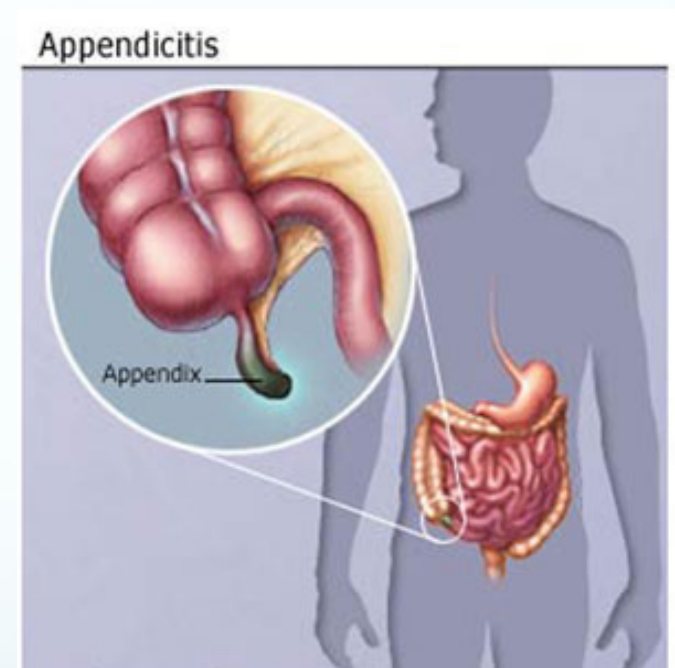
# Ulcer

- **Sore or lesion that forms in the mucosal lining of the stomach**
- Gastric ulcers in the stomach and duodenal ulcer in the duodenum
- Cause – *H. pylori* (bacteria) is primary cause
- Lifestyle factors that contribute: cigarette smoking, alcohol, stress, certain drugs.
- Symp – burning pain in abdomen, between meals and early morning, may be relieved by eating or taking antacids.
- Diagnosis – x-ray, presence of bacteria
- Rx – H<sub>2</sub> blockers ( drugs) that block release of histamine



# Appendicitis

- A blind sac attached to the cecum and has no known function.
- When appendix becomes inflamed
- If it ruptures, bacteria from appendix can spread to peritoneal cavity.
- Symptoms- RLQ pain, rebound tenderness, fever, nausea, and vomiting
- RX - appendectomy



## Diarrhea

Loose, watery, frequent bowel movements when feces pass along colon to rapidly

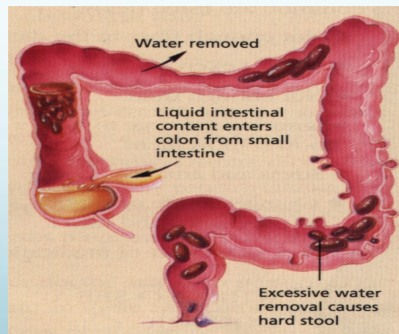
Caused by infection, poor diet, nervousness, toxic substances or irritants in food



## Constipation

When defecation delayed, feces becomes dry and hard

**RX –diet with cereals, fruits, vegetables, (roughage) drinking plenty of fluids, exercise, and avoiding tension**



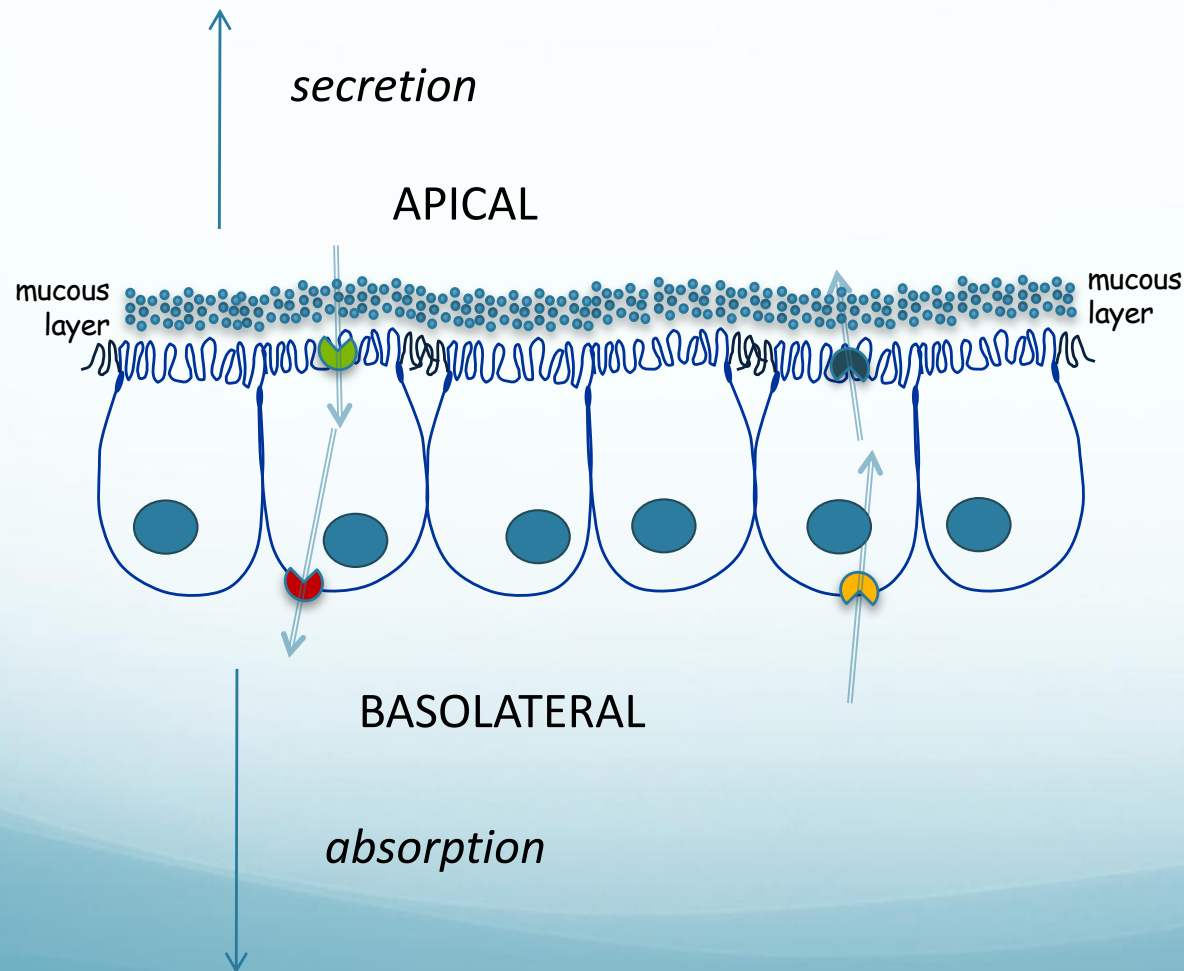
## Jaundice

**Yellow color of the skin**

# GI Fluid and Electrolyte Balance

- Regulation of fluid transport in the gut is critical for normal intestinal function
- Large amounts of fluid are secreted into and absorbed from the gut daily
- Because water follows an osmotic gradient, the understanding of electrolyte transit is key to understanding intestinal fluid balance in health and disease

# Intestinal Epithelial Cells as Gatekeepers for Ion and Fluid Movement

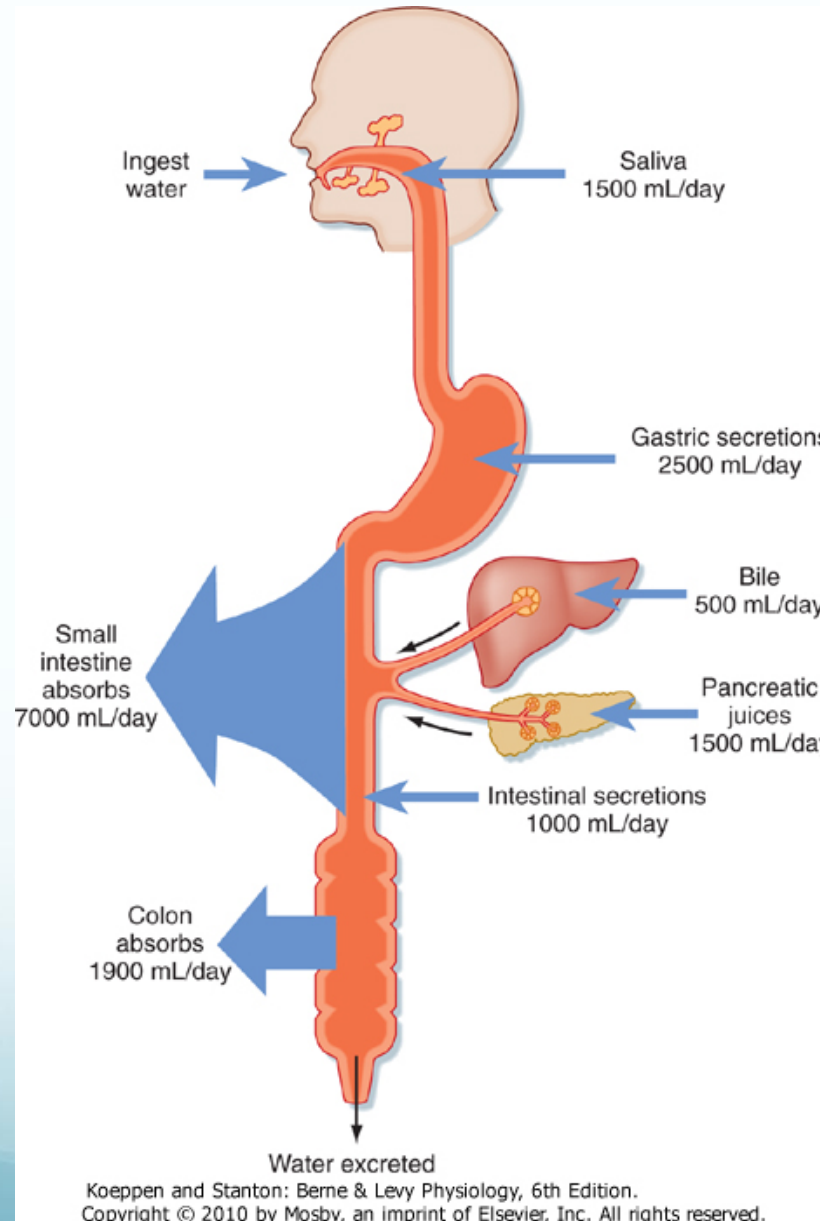


# Mechanisms of Transcellular Transport

	Mechanism	Example
Primary Active Transport	Utilizes energy (ATP) to drive ion against electrochemical gradient	Na-ATPase
Secondary Active Transport	Co-Transport of molecules with (ATP-driven) ion transport	Na-GLUC cotransporter
Facilitated Diffusion	Specific transporters facilitate passive transport across epithelial layer	Glut-5 (fructose)

# Overview of fluid movement in the GI tract

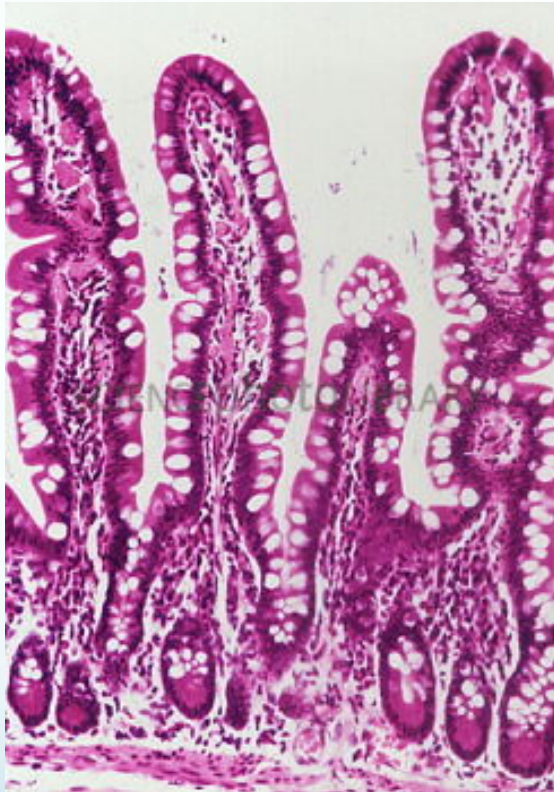
NET Fluid entering bowel: 8.5 L / day



NET Fluid reabsorbed by bowel: 8.4 L / day

NET Fluid loss via stool: 100 mL / day

# Simultaneous secretion and absorption occur in any segment of the intestine



## **Villi = Absorption**

- Fluid absorption primarily depends on sodium transport
- Na may be Coupled with chloride, nutrients, bile acids, and other solutes

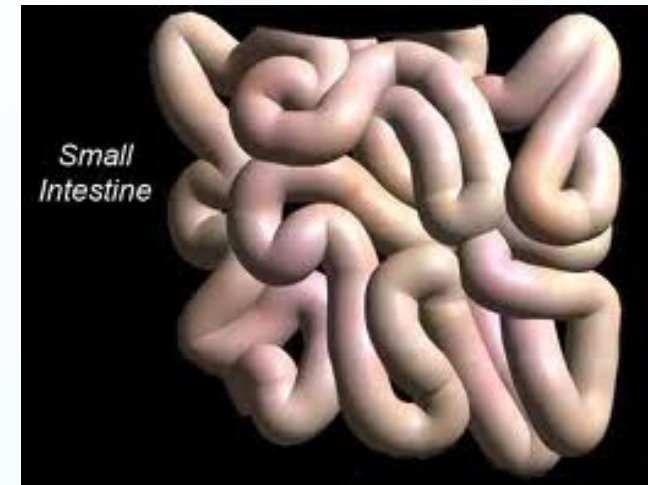
## **Crypt = Secretion**

- Primarily follows Chloride and bicarbonate



# Small Intestinal Ion Transport Mechanisms

- Ion transport:
  - Bicarbonate secretion
  - Electroneutral NaCl absorption
  - Chloride Secretion
- Nutrient, mineral, other:
  - Sodium-coupled nutrient absorption
  - Proton-coupled nutrient absorption
  - Sodium-coupled bile acid absorption
  - Calcium absorption
  - Iron absorption





# Colonic ion transport mechanisms

- Sodium Absorption:
  - Electrogenic sodium absorption
  - Electroneutral NaCl Absorption
- Potassium secretion and absorption
- Chloride secretion
- Short Chain fatty acid (SCFA) absorption

