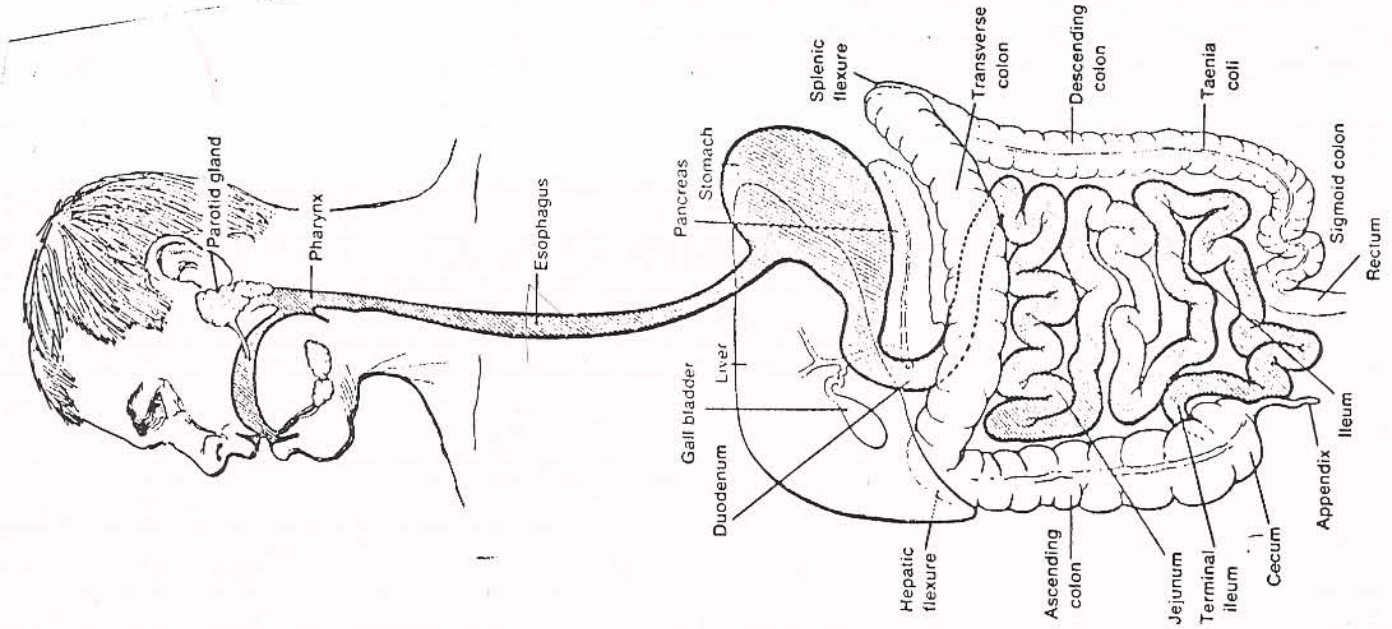
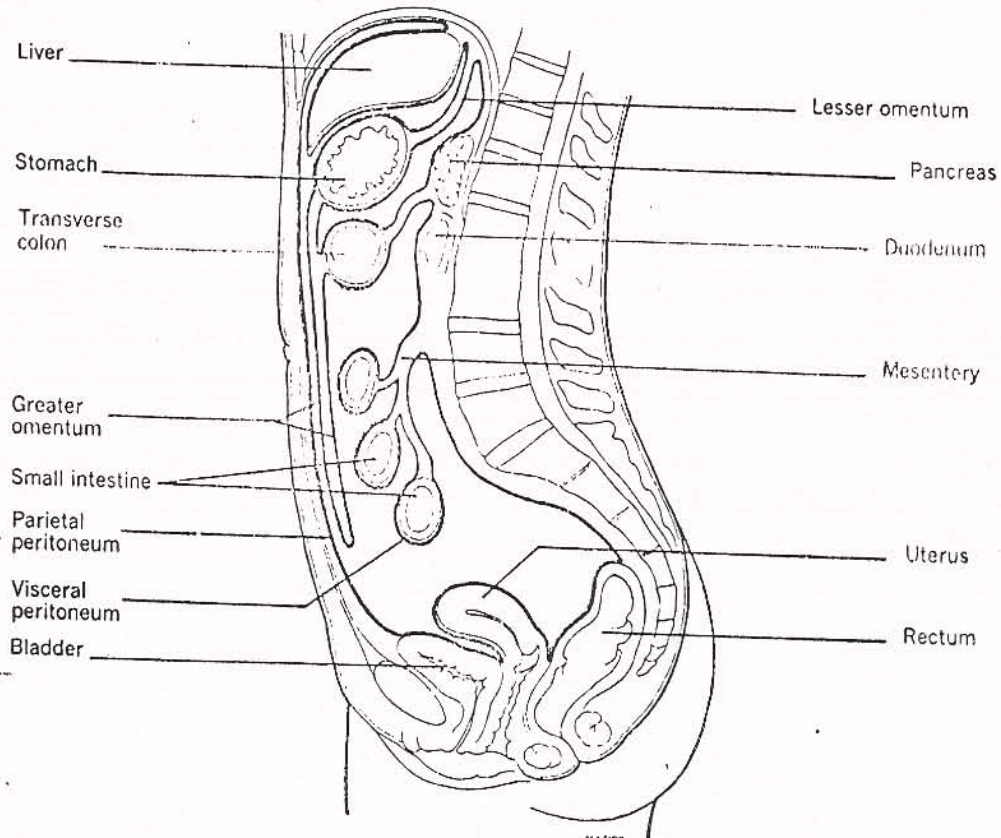
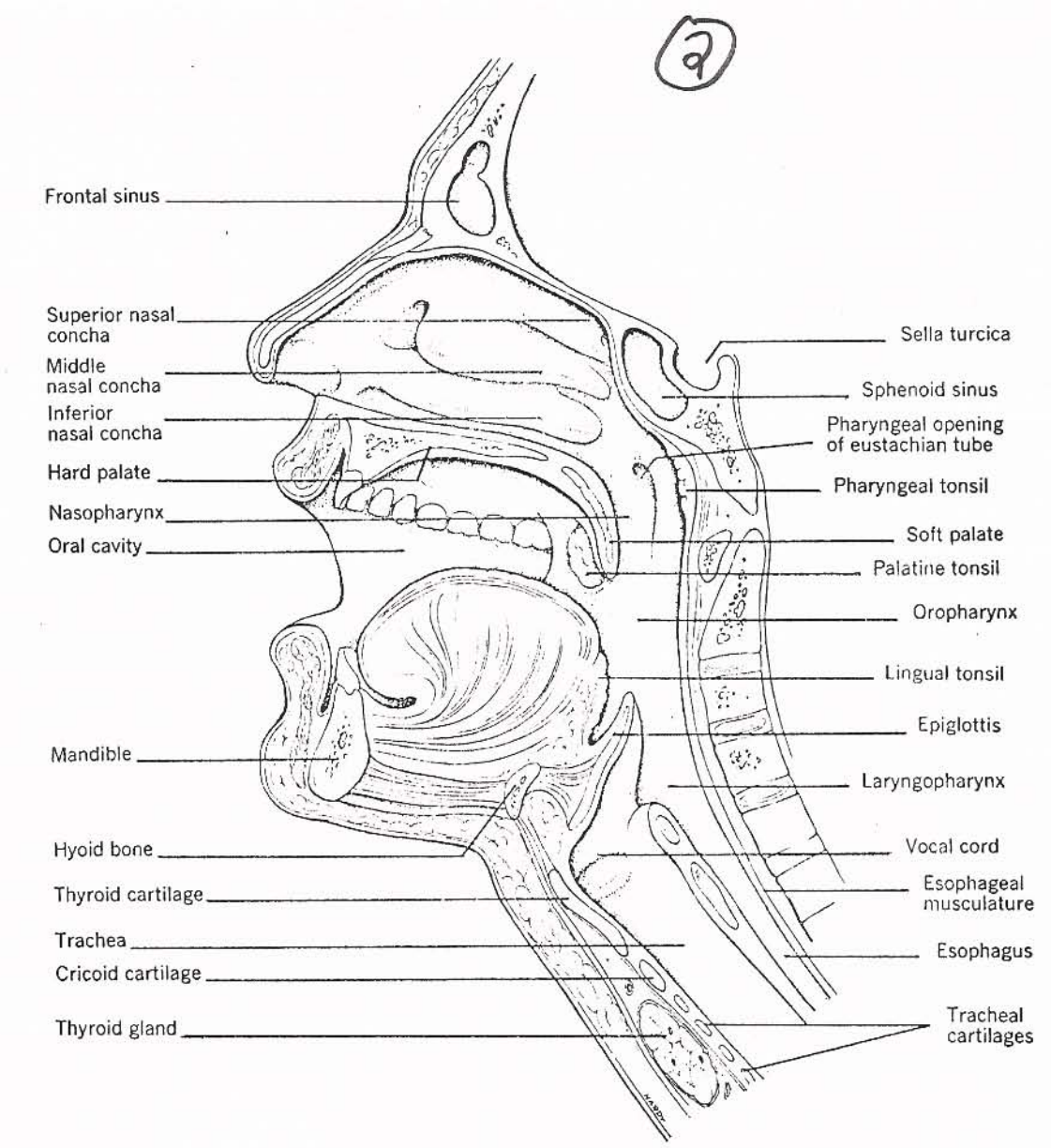
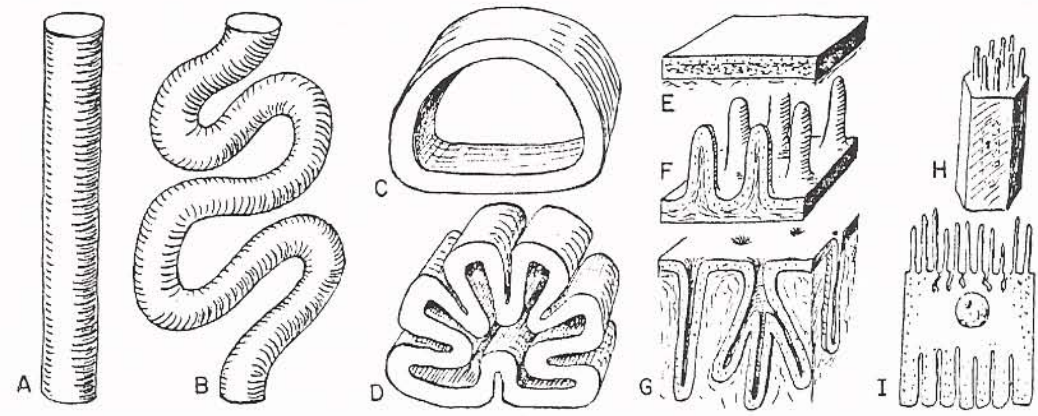
(1)

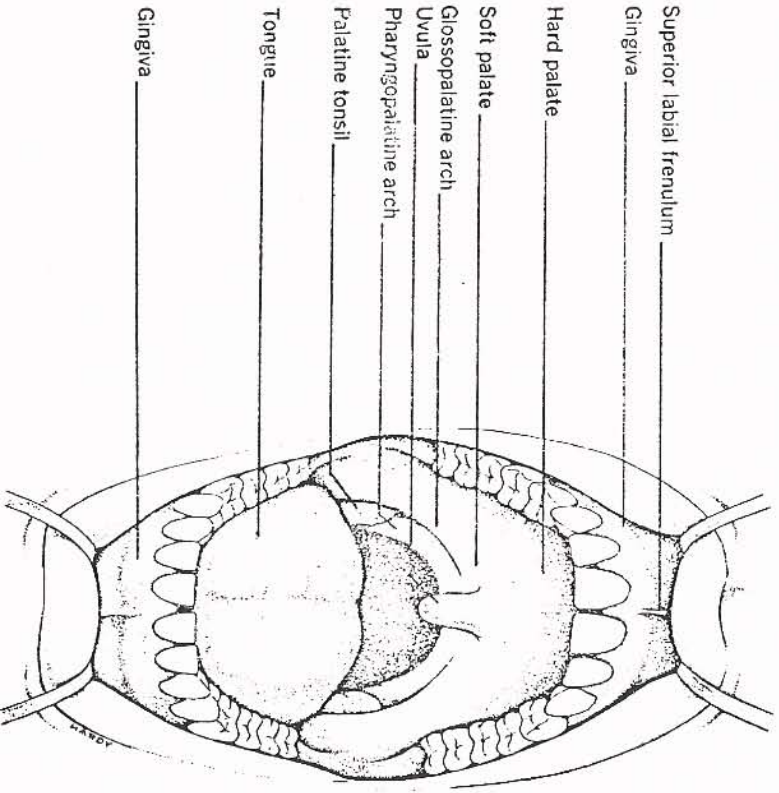

Parotid gland
Pharynx
Esophagus
Pancreas
Stomach
Splenic flexure
Transverse colon
Descending colon
Taenia coli
Sigmoid colon
Rectum
Gall bladder
Liver
Duodenum
Hepatic flexure
Ascending colon
Jejunum
Terminal ileum
Cecum
Appendix
Ileum

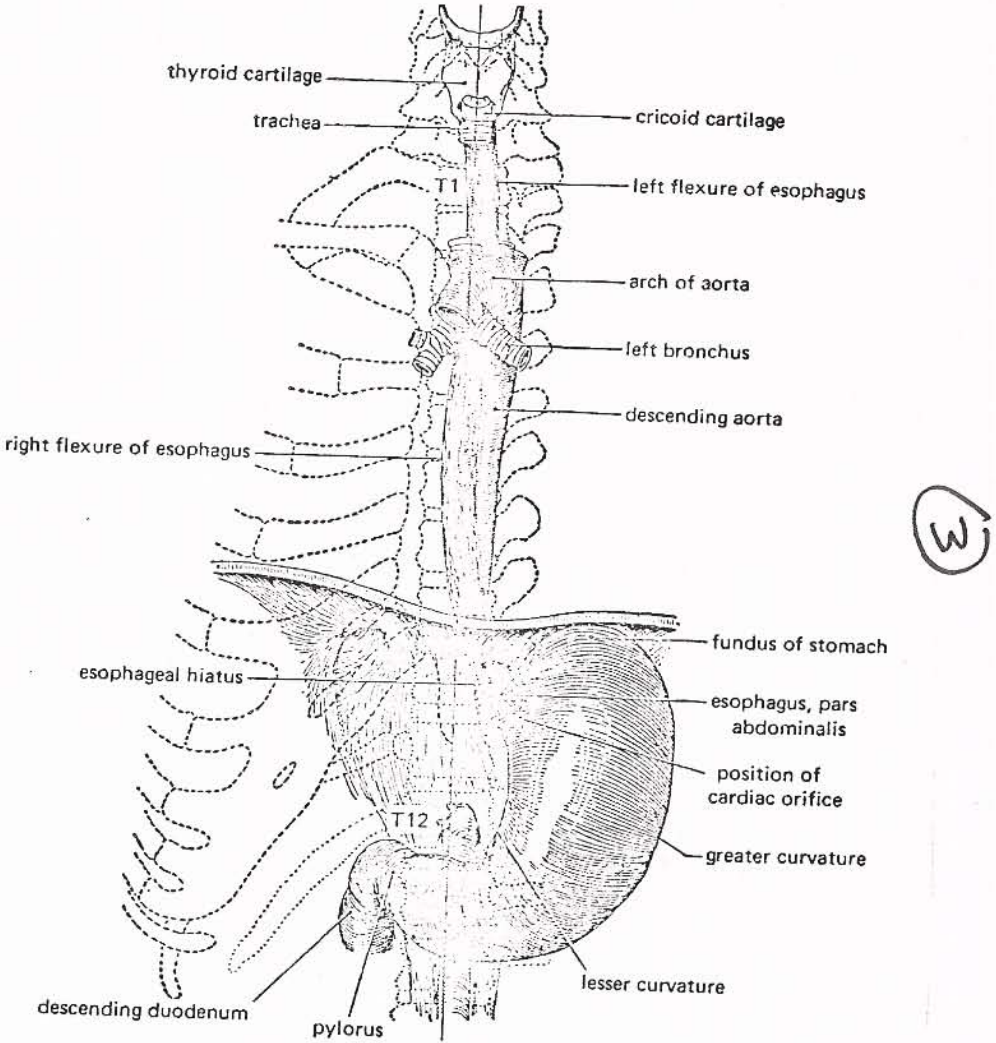

Liver
Lesser omentum
Stomach
Pancreas
Transverse colon
Duodenum
Mesentery
Greater omentum
Small intestine
Parietal peritoneum
Uterus
Visceral peritoneum
Rectum
Bladder



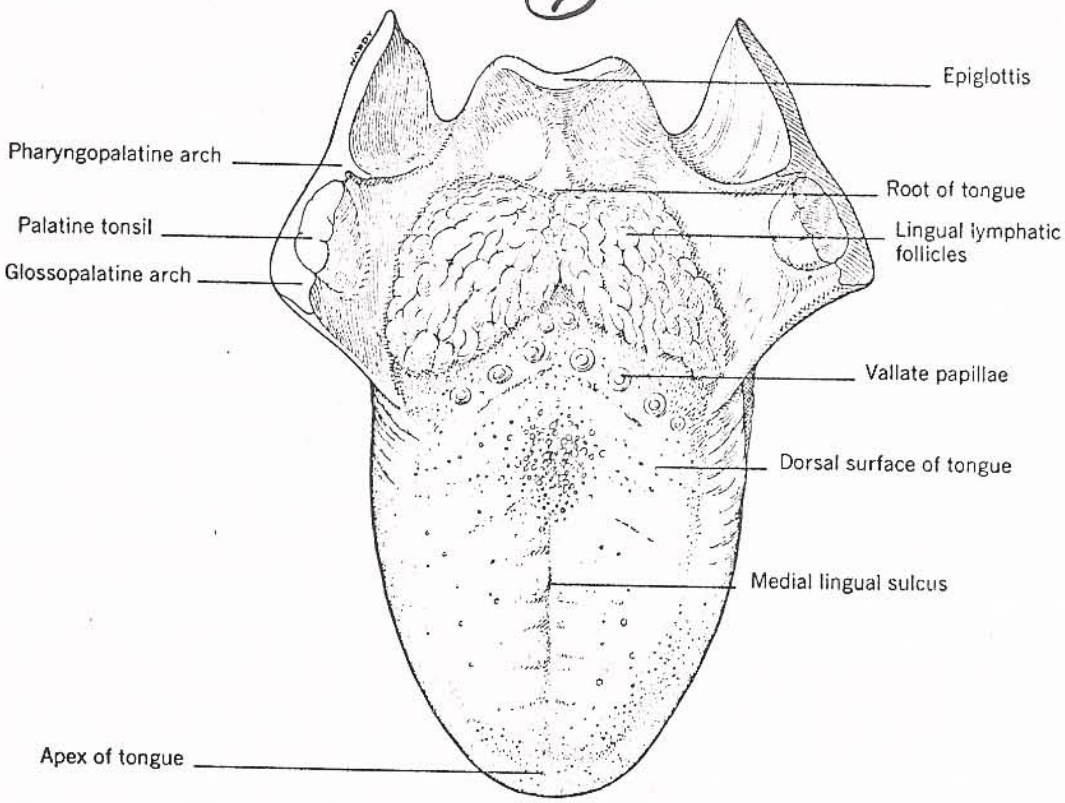


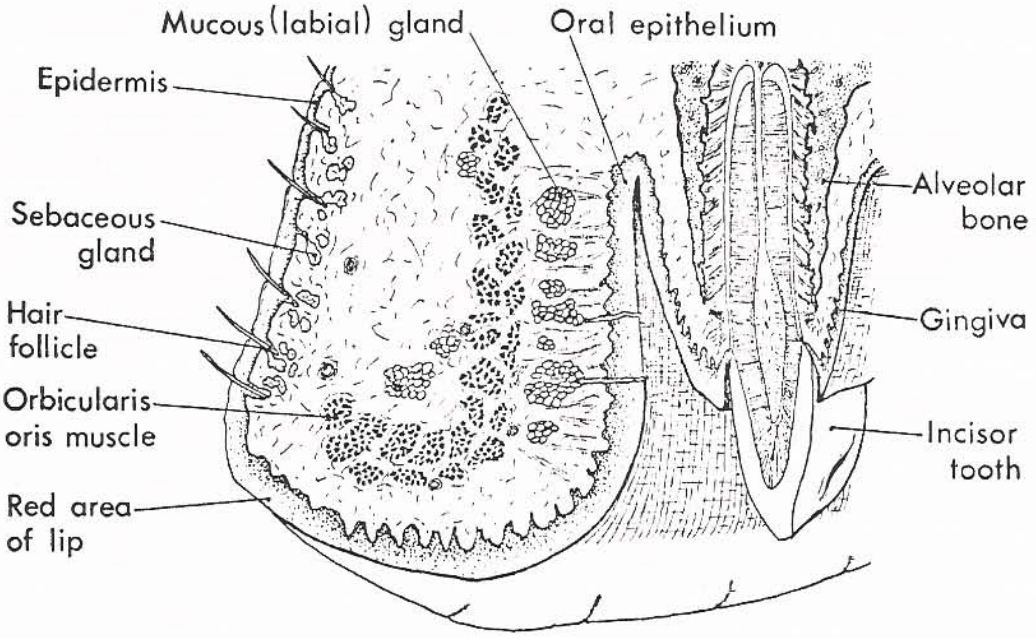
Methods of surface increase.


Superior labial frenulum
Gingiva
Hard palate
Soft palate
Glossopalatine arch
Uvula
Pharyngopalatine arch
Palatine tonsil
Tongue
Gingiva

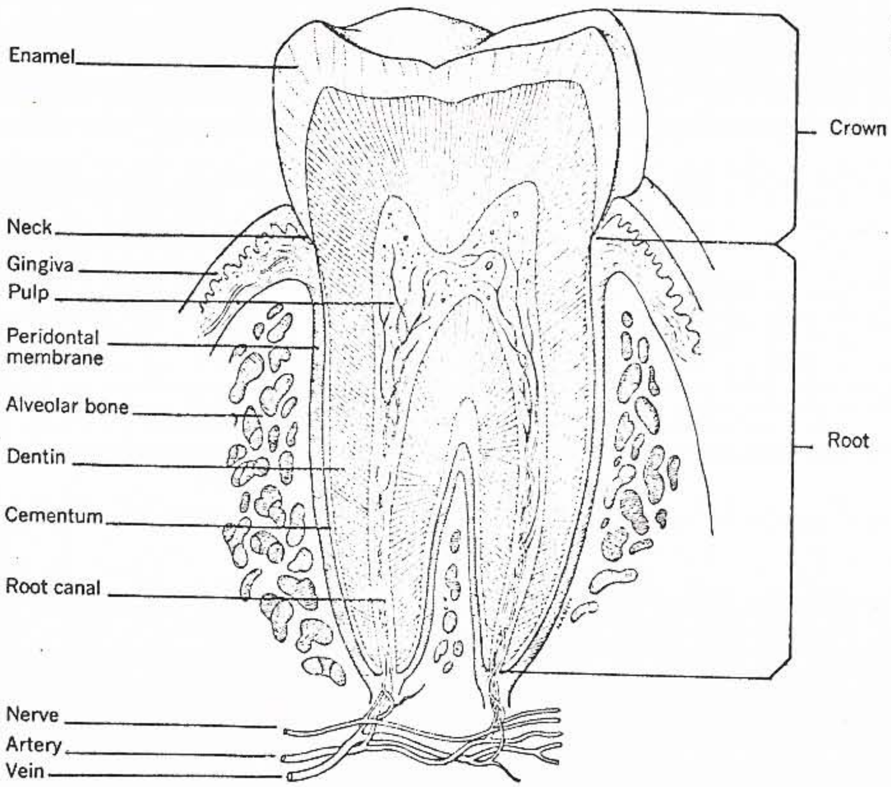

thyroid cartilage
trachea
cricoid cartilage
T1
left flexure of esophagus
arch of aorta
left bronchus
descending aorta
right flexure of esophagus
fundus of stomach
esophageal hiatus
esophagus, pars abdominalis
position of cardiac orifice
T12
greater curvature
lesser curvature
descending duodenum
pylorus

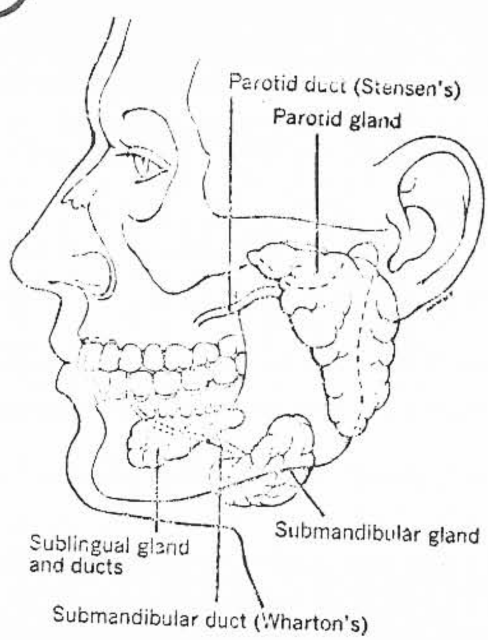
(4)

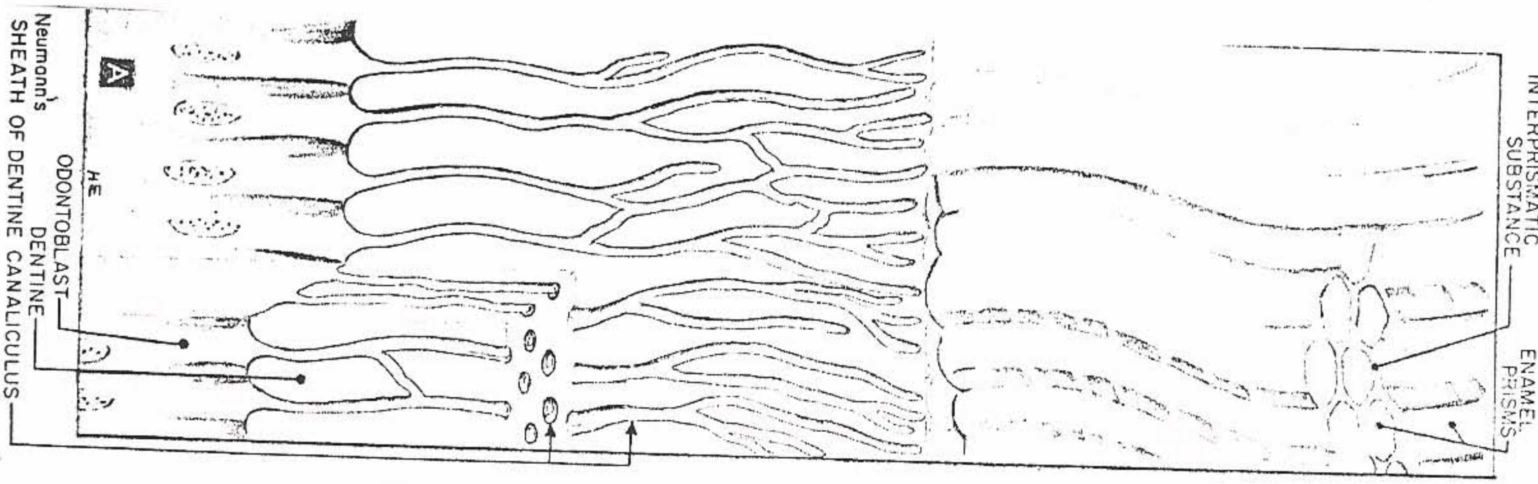

Epiglottis
Pharyngopalatine arch
Root of tongue
Palatine tonsil
Lingual lymphatic follicles
Glossopalatine arch
Vallate papillae
Dorsal surface of tongue
Medial lingual sulcus
Apex of tongue

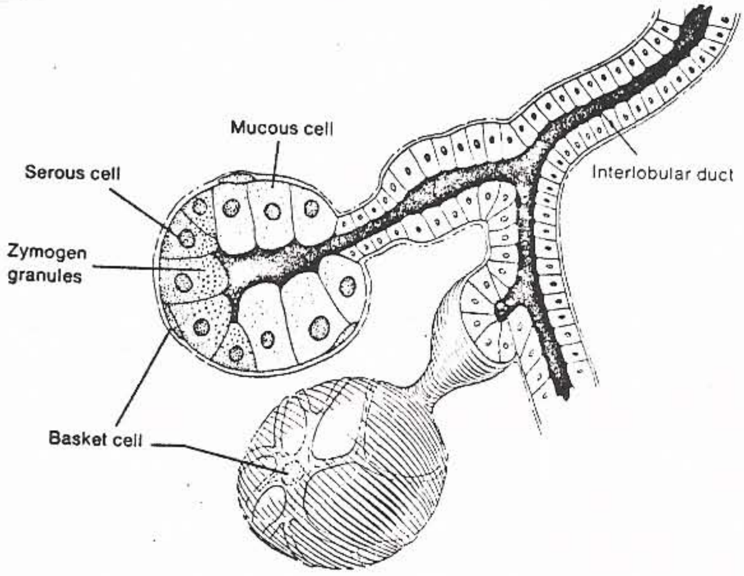

Mucous (labial) gland
Oral epithelium
Epidermis
Alveolar bone
Sebaceous gland
Gingiva
Hair follicle
Orbicularis oris muscle
Incisor tooth
Red area of lip

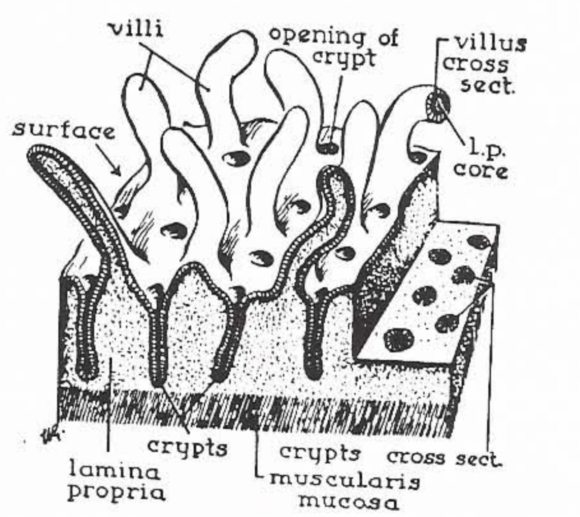
5


Enamel
Neck
Gingiva
Pulp
Peridontal membrane
Alveolar bone
Dentin
Cementum
Root canal
Nerve
Artery
Vein
Crown
Root

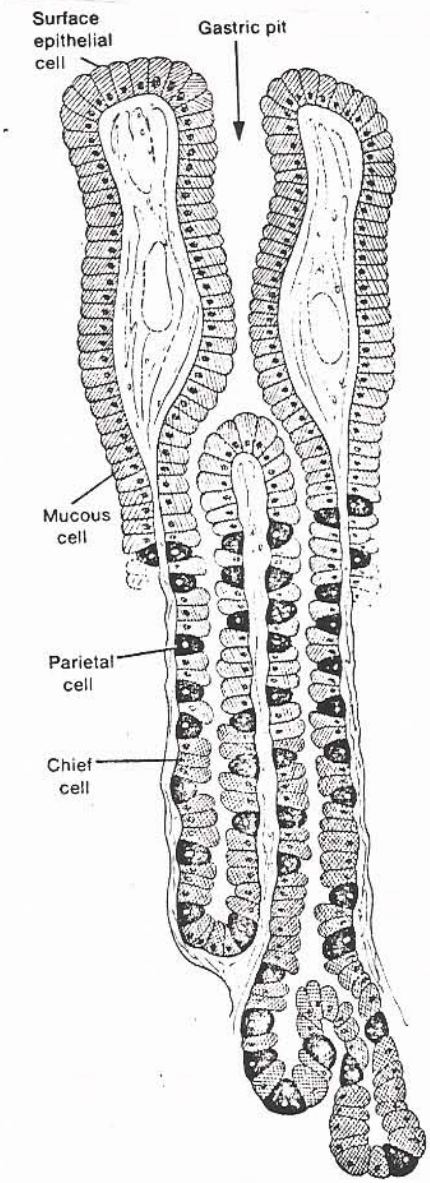

Parotid duct (Stensen's)
Parotid gland
Sublingual gland and ducts
Submandibular gland
Submandibular duct (Wharton's)

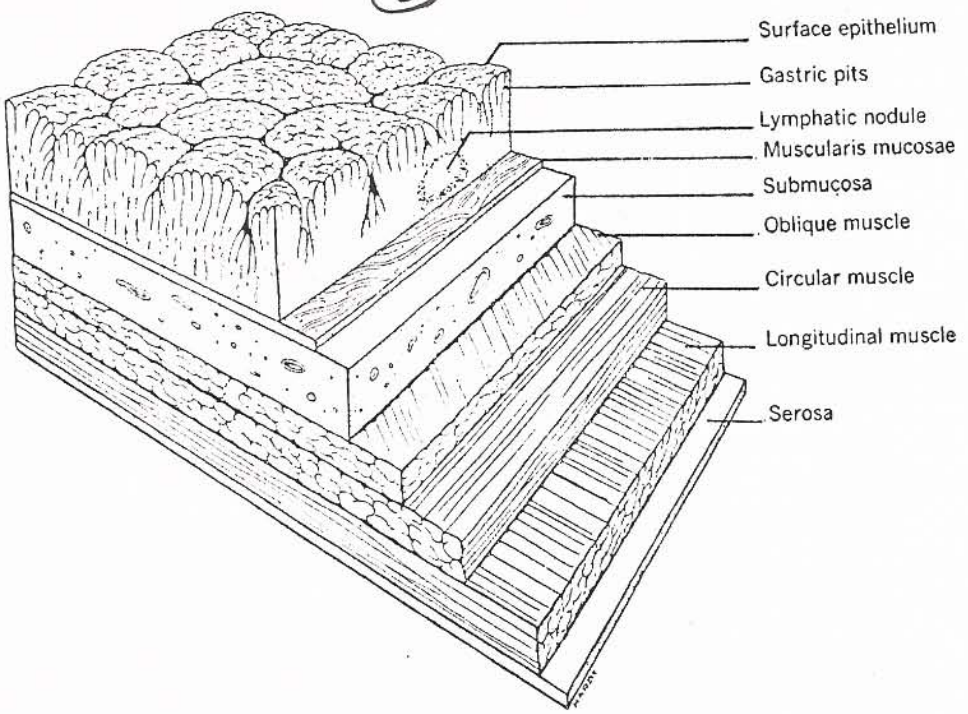

A
HE
Neumann's SHEATH OF DENTINE CANALICULUS
ODONTOBLAST
DENTINE
INTERPRISMATIC SUBSTANCE
ENAMEL PRISMS

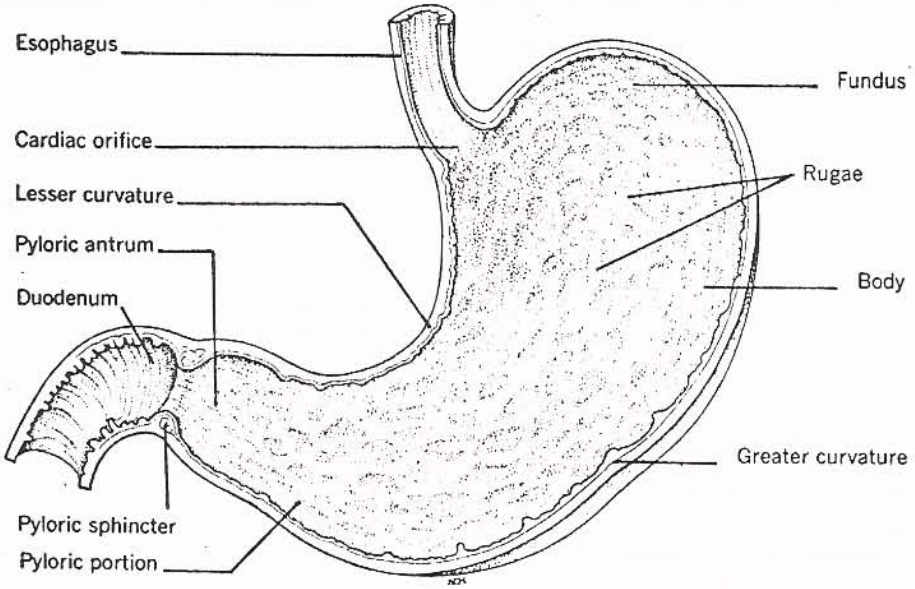

Mucous cell
Serous cell
Zymogen granules
Basket cell
Interlobular duct

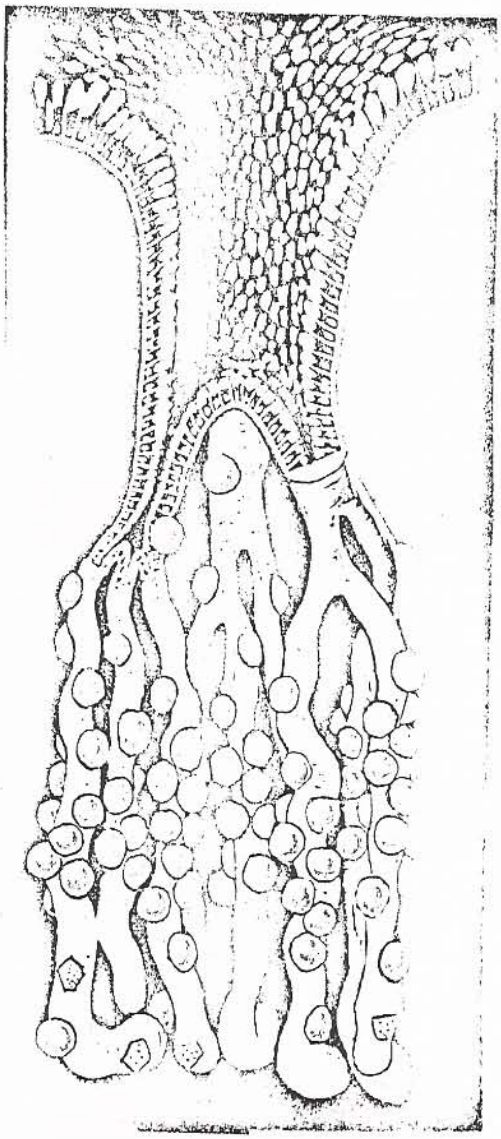

villi
opening of crypt
villus cross sect.
surface
l.p. core
lamina propria
crypts
crypts
muscularis mucosa
cross sect.

(6)

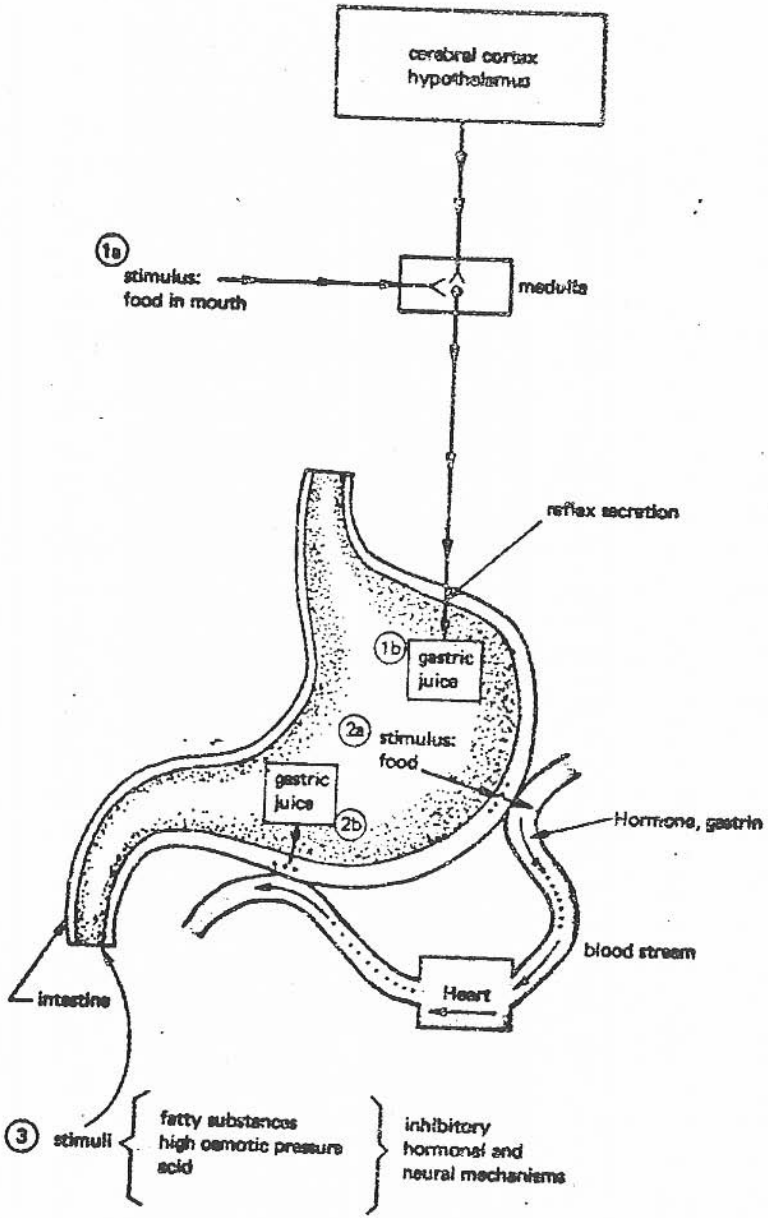


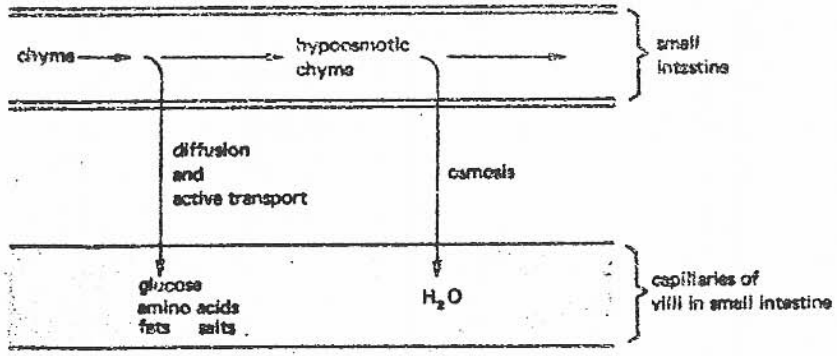


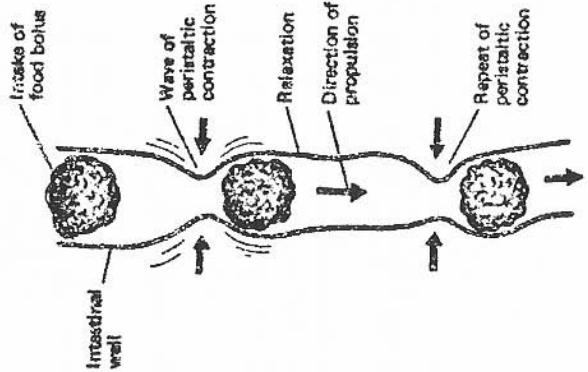


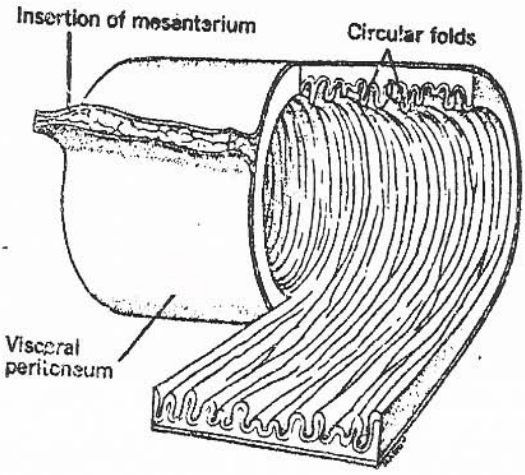


gastric pit

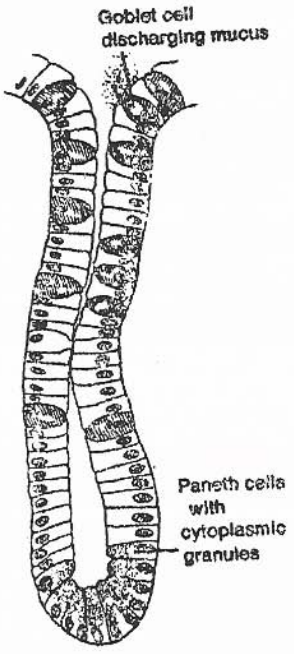

cerebral cortex
hypothalamus
1a
stimulus:
food in mouth
medulla
reflex secretion
1b
gastric
juice
2a
stimulus:
food
gastric
juice
2b
Hormone, gastrin
blood stream
Heart
intestine
3
stimuli
fatty substances
high osmotic pressure
acid
inhibitory
hormonal and
neural mechanisms

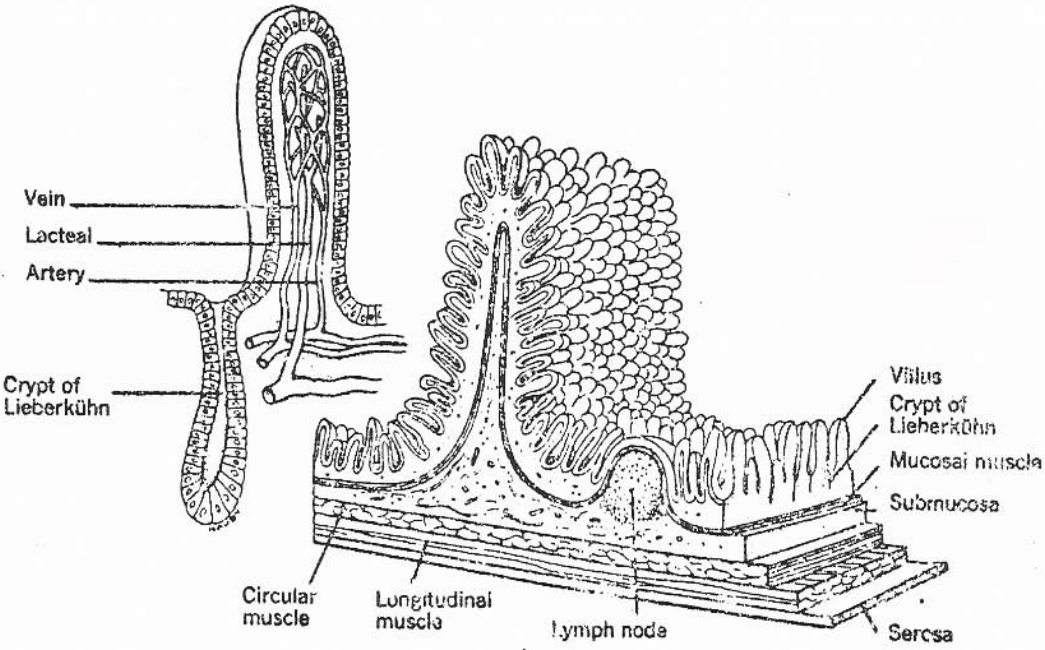

chyme
hypoosmotic
chyme
small
intestine
diffusion
and
active transport
osmosis
glucose
amino acids
fats
salts
H_2O
capillaries of
villi in small intestine

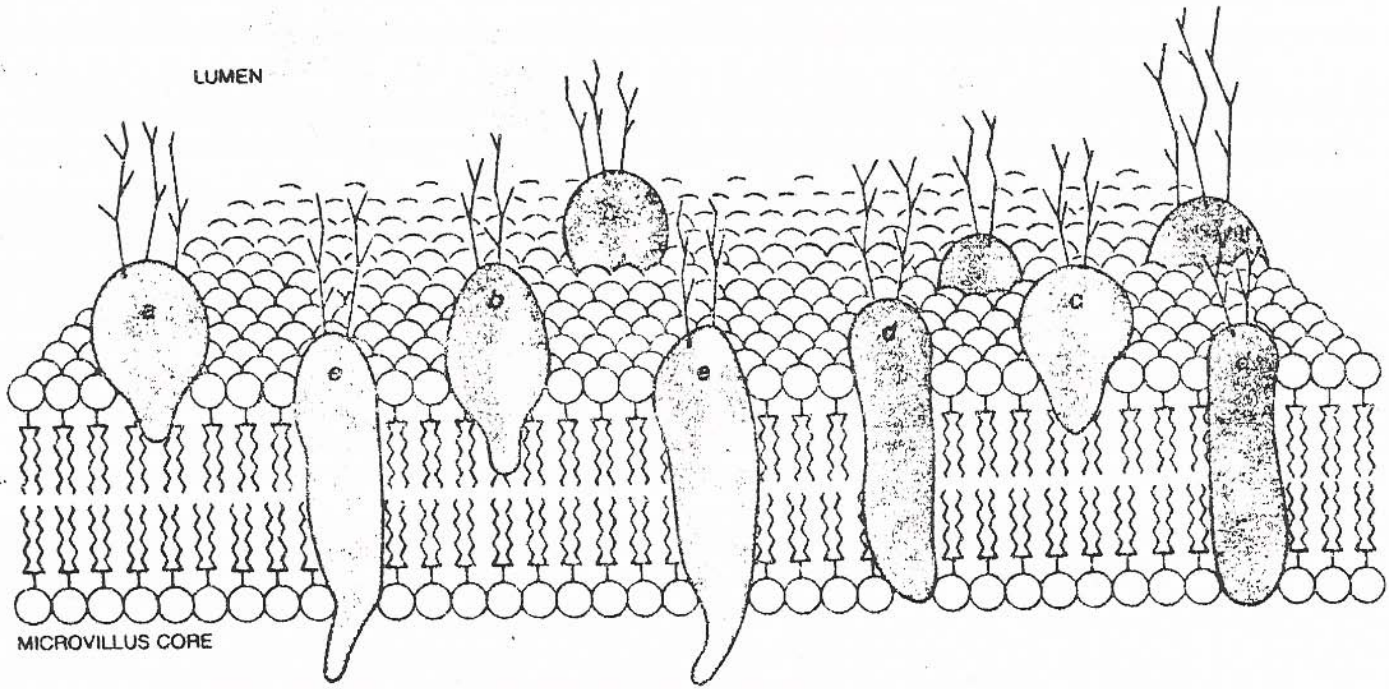

Intake of
food bolus
Wave of
peristaltic
contraction
Relaxation
Direction of
propulsion
Repeat of
peristaltic
contraction
Intestinal
wall


Insertion of mesenterium
Circular folds
Visceral peritoneum

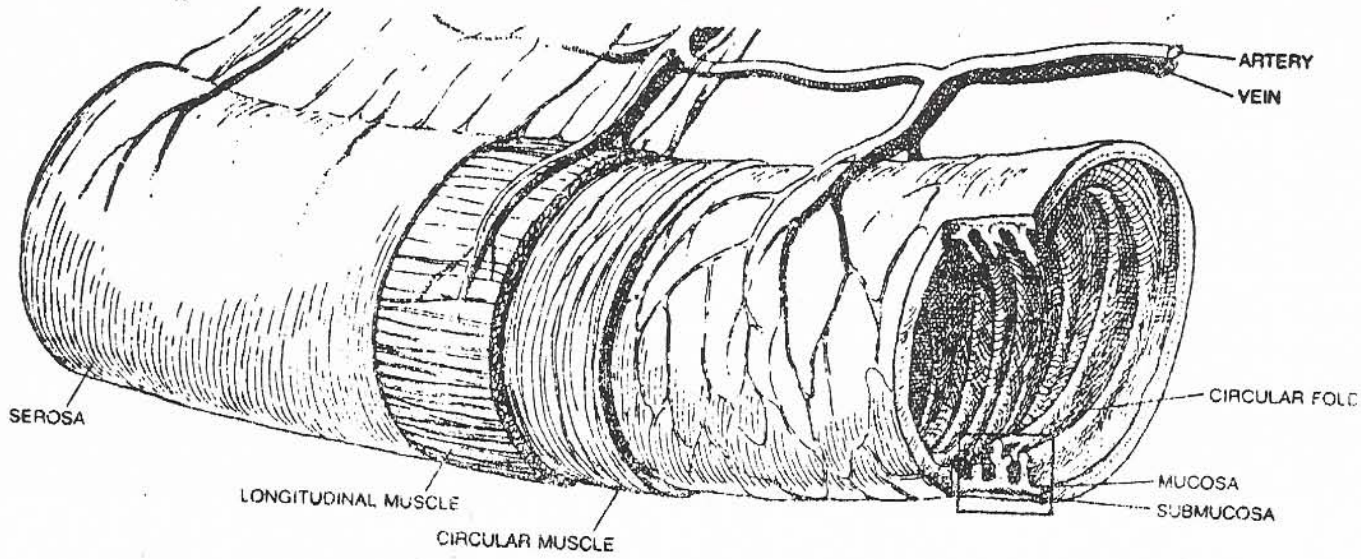
Jejunum.

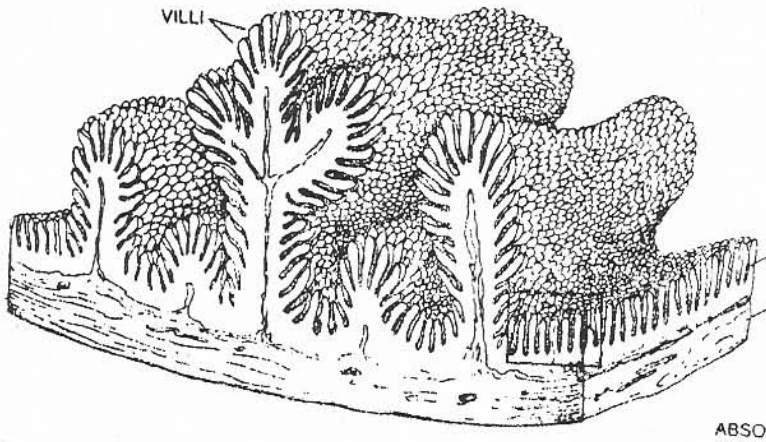

Goblet cell discharging mucus
Paneth cells with cytoplasmic granules

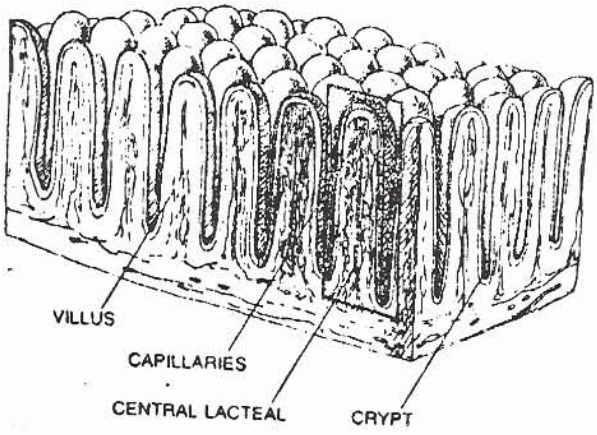

Vein
Lacteal
Artery
Crypt of Lieberkühn
Villus
Crypt of Lieberkühn
Mucosal muscle
Submucosa
Circular muscle
Longitudinal muscle
Lymph node
Serosa

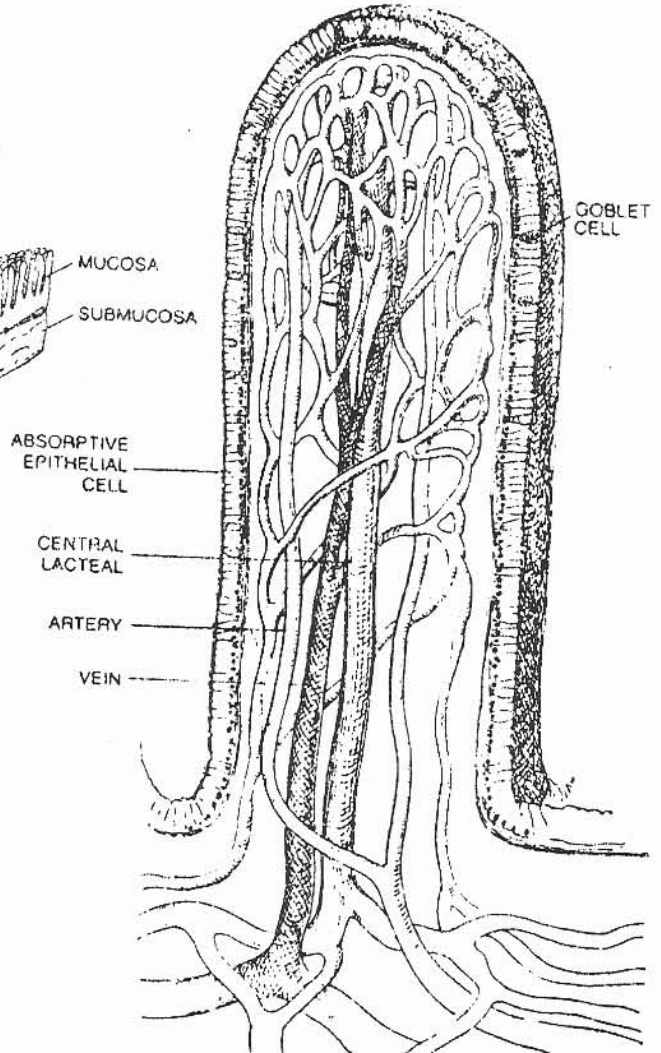


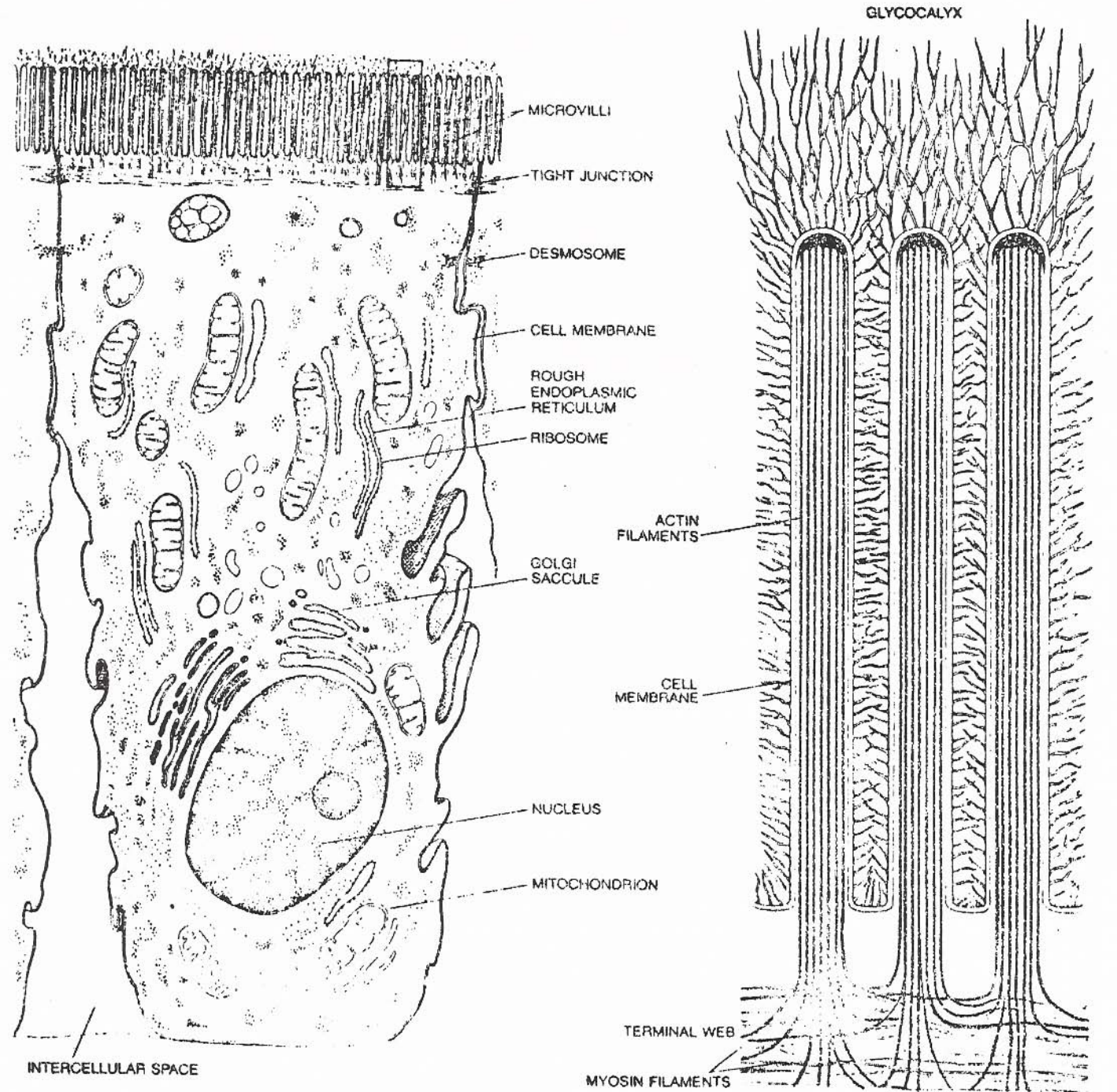
GLYCOPROTEIN DIGESTIVE ENZYMES extend to varying depths into the membrane of the microvillus. The protein component of the enzyme is inserted into the matrix of lipid molecules making up the membrane; the carbohydrate chains protrude into the lumen. The lipids of the membrane are arranged in two apposed layers, with their hydrophilic "heads" facing outward and their hydrophobic "tails," composed of fatty acid chains, facing in. The enzymes attached to the membrane are of several kinds, distinguished by the substances they digest. Each disaccharidase (*a*, *b*, *c*) splits one kind of 12-carbon sugar into its six-carbon subunits. These enzymes protrude from the membrane, which they penetrate only to a limited depth. Alkaline phosphatase (*d*) hydrolyzes, or splits, many of the phosphate compounds in food; the protein segment of the enzyme extends the depth of the membrane. Aminopeptidases (*e*) remove an amino acid from one end of a short peptide chain; they pass all the way through the membrane and into the interior of the microvillus.

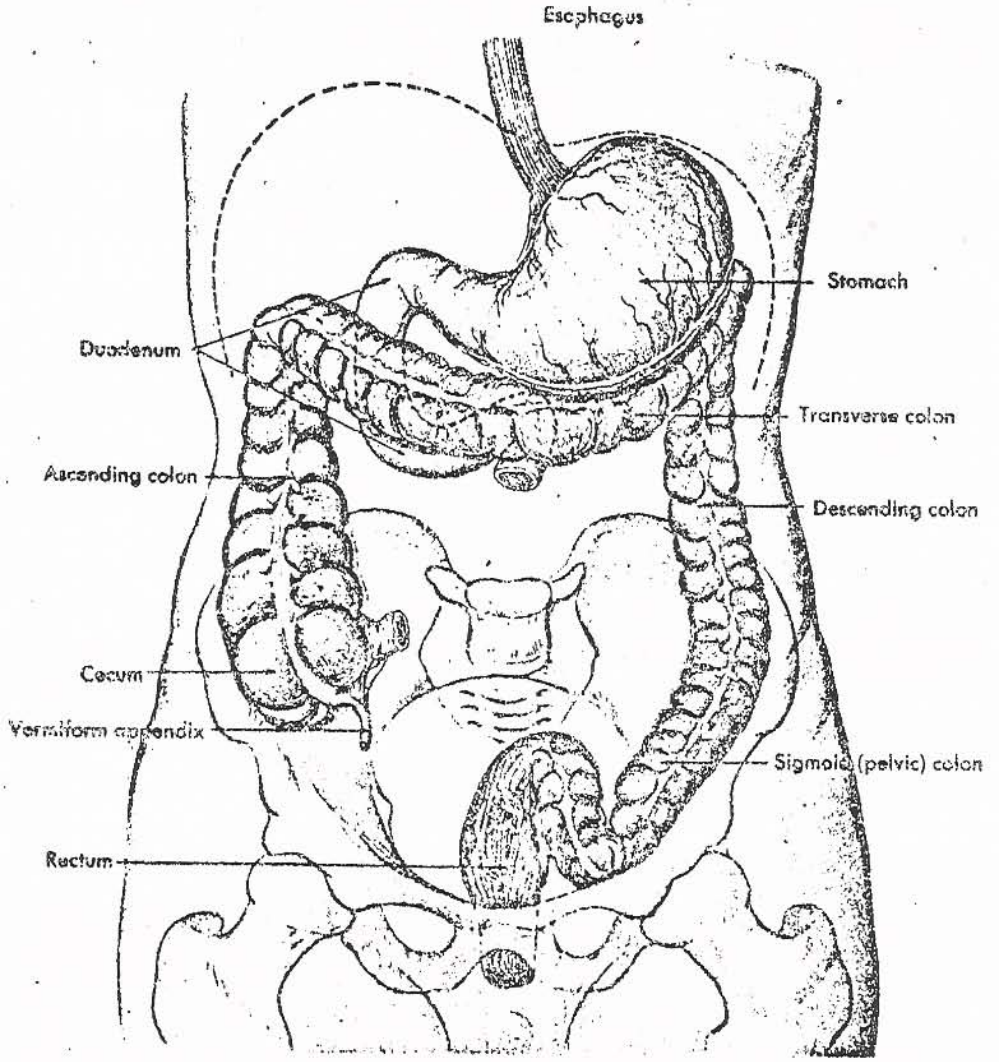

ARTERY
VEIN
SEROSA
CIRCULAR FOLD
MUCOSA
SUBMUCOSA
LONGITUDINAL MUSCLE
CIRCULAR MUSCLE

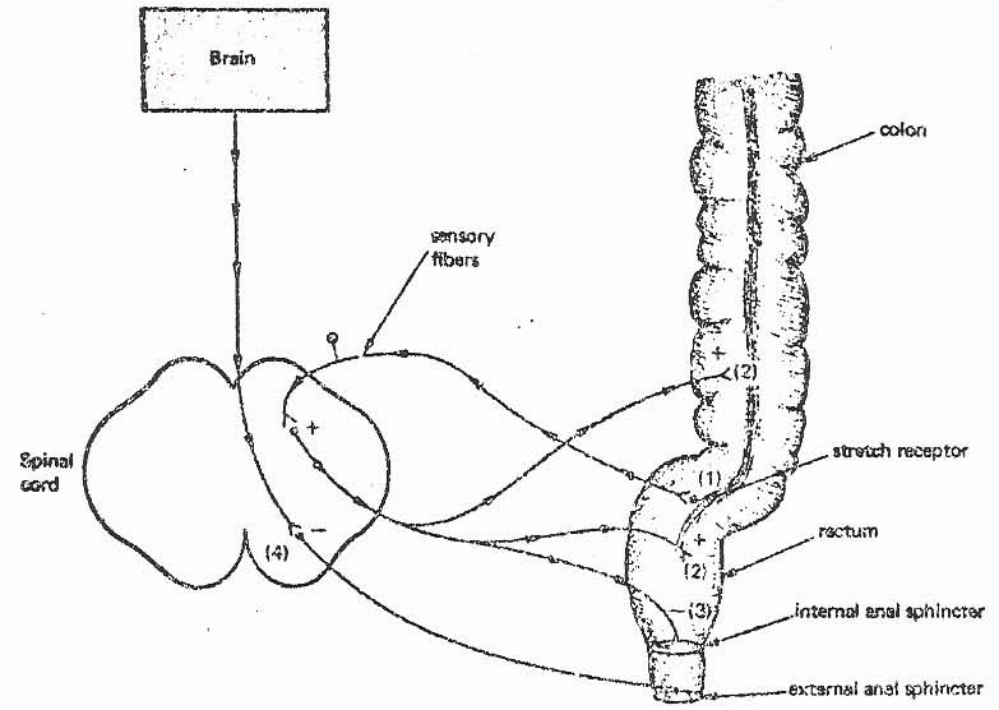

VILLI
MUCOSA
SUBMUCOSA

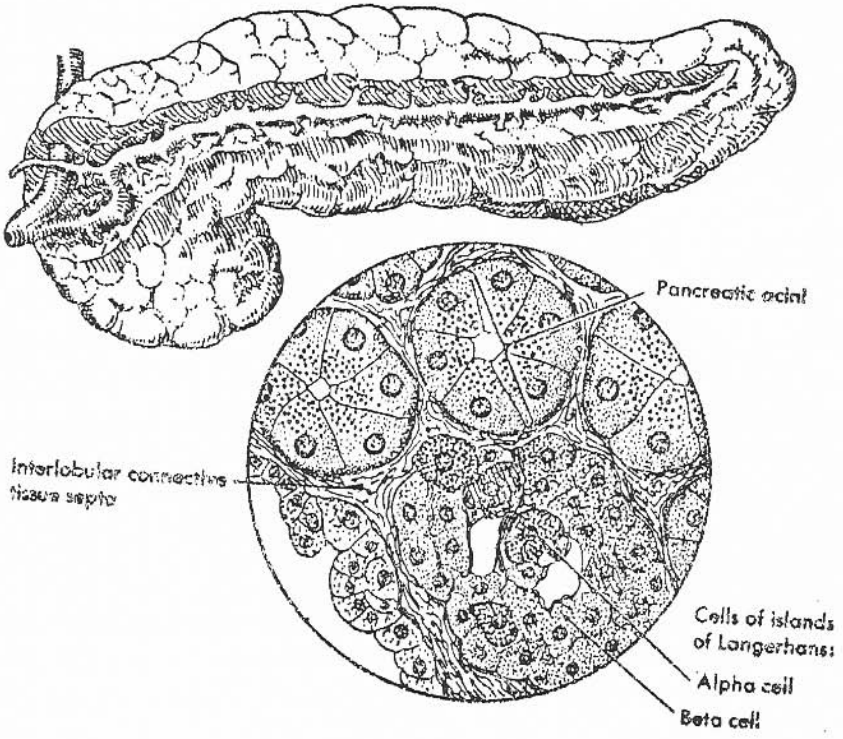

VILLUS
CAPILLARIES
CENTRAL LACTEAL
CRYPT

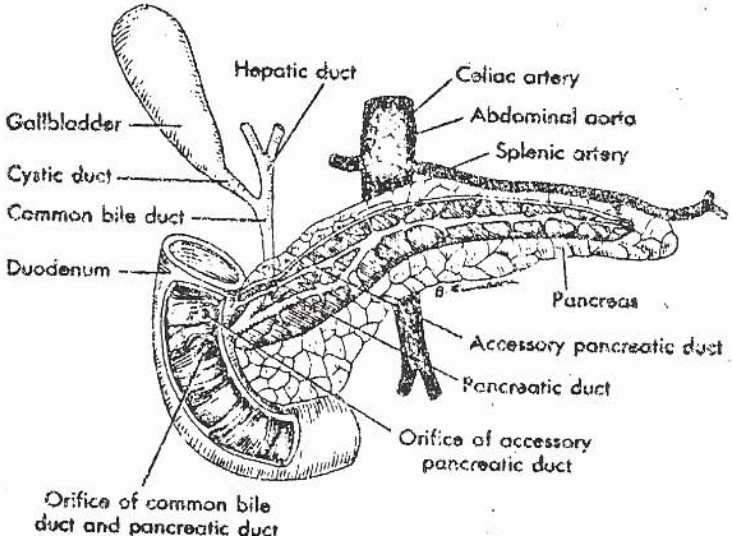

GOBLET CELL
ABSORPTIVE EPITHELIAL CELL
CENTRAL LACTEAL
ARTERY
VEIN

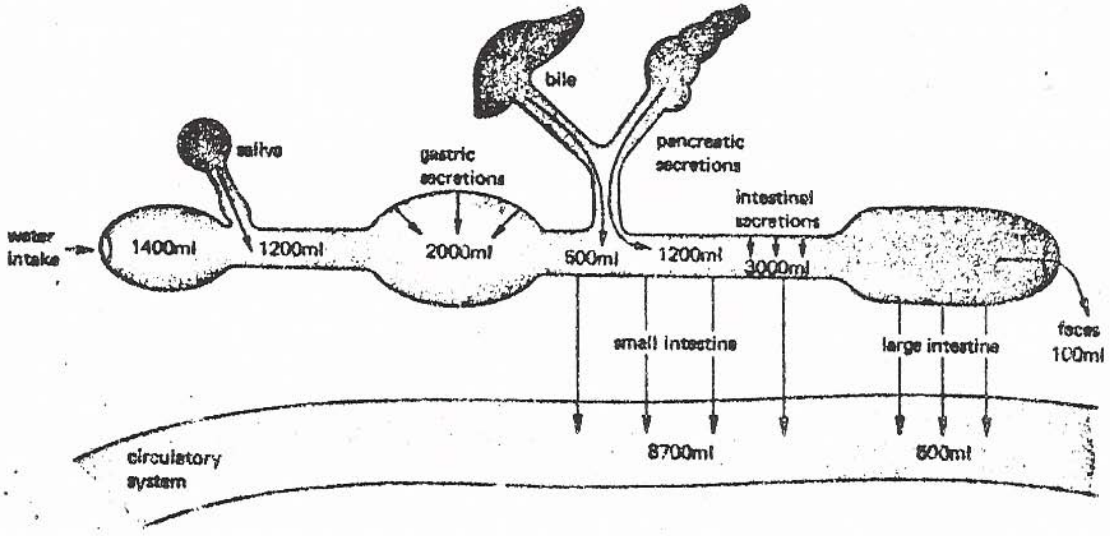

GLYCOCALYX
MICROVILLI
TIGHT JUNCTION
DESMOSOME
CELL MEMBRANE
ROUGH ENDOPLASMIC RETICULUM
RIBOSOME
ACTIN FILAMENTS
GOLGI SACCULE
CELL MEMBRANE
NUCLEUS
MITOCHONDRION
TERMINAL WEB
INTERCELLULAR SPACE
MYOSIN FILAMENTS

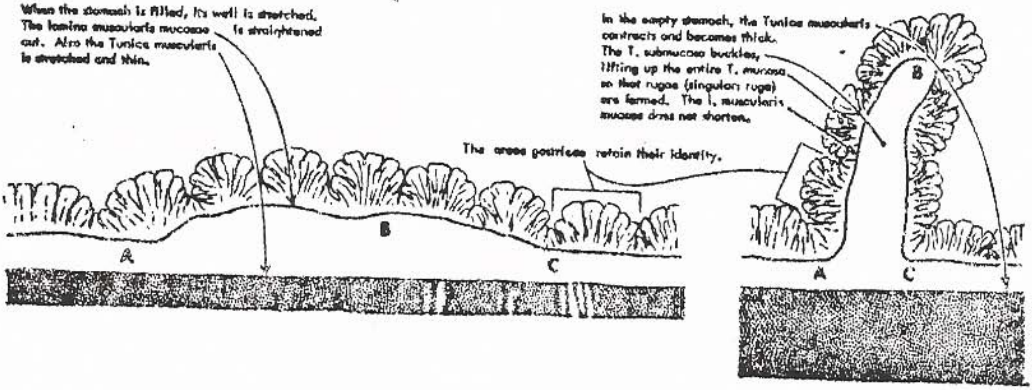

Esophagus
Stomach
Duodenum
Transverse colon
Ascending colon
Descending colon
Cecum
Vermiform appendix
Sigmoid (pelvic) colon
Rectum

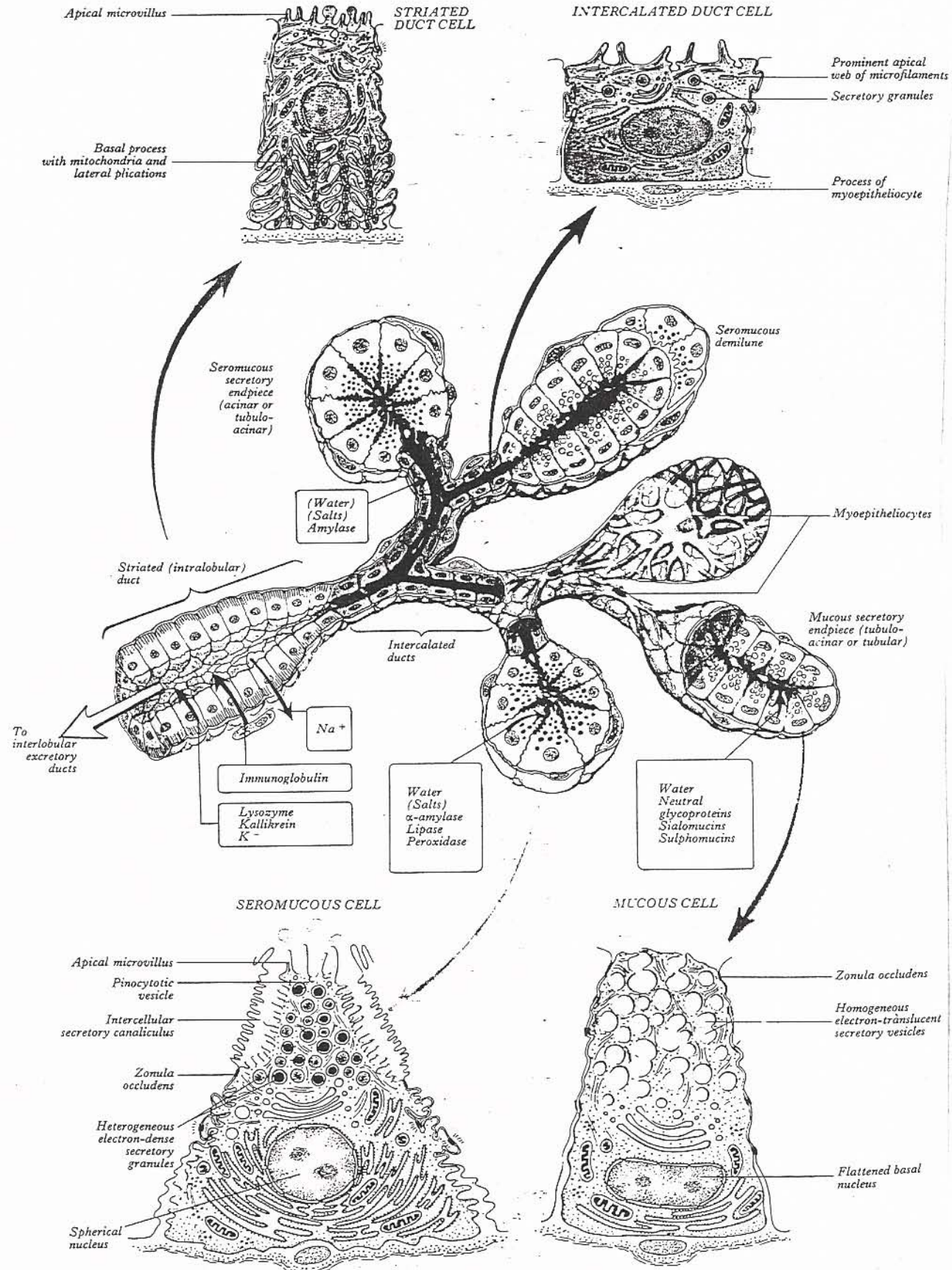

Brain
colon
sensory fibers
(2)
stretch receptor
Spinal cord
(1)
rectum
(2)
(3)
internal anal sphincter
(4)
external anal sphincter

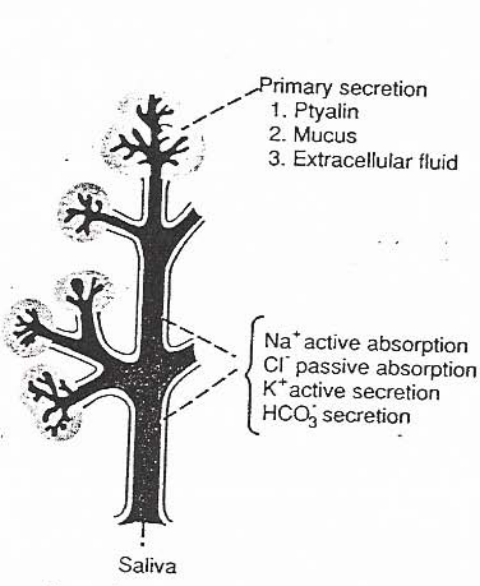

Pancreatic acini
Interlobular connective tissue septa
Cells of islands of Langerhans:
Alpha cell
Beta cell


Hepatic duct
Celiac artery
Gallbladder
Abdominal aorta
Splenic artery
Cystic duct
Common bile duct
Duodenum
Pancreas
Accessory pancreatic duct
Pancreatic duct
Orifice of accessory pancreatic duct
Orifice of common bile duct and pancreatic duct

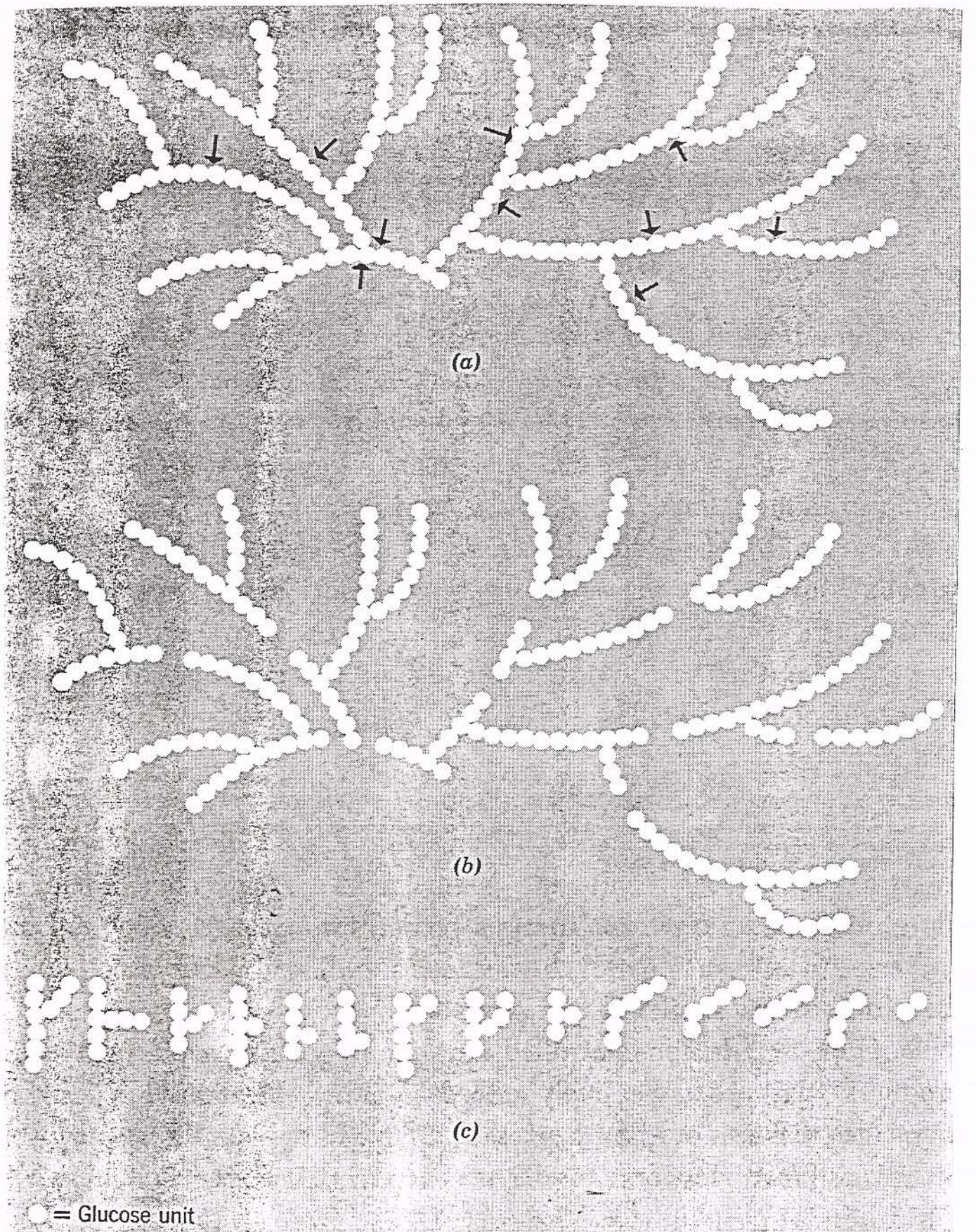

bile
saliva
gastric secretions
pancreatic secretions
intestinal secretions
water intake
1400ml
1200ml
2000ml
500ml
1200ml
3000ml
small intestine
large intestine
faces 100ml
circulatory system
8700ml
800ml

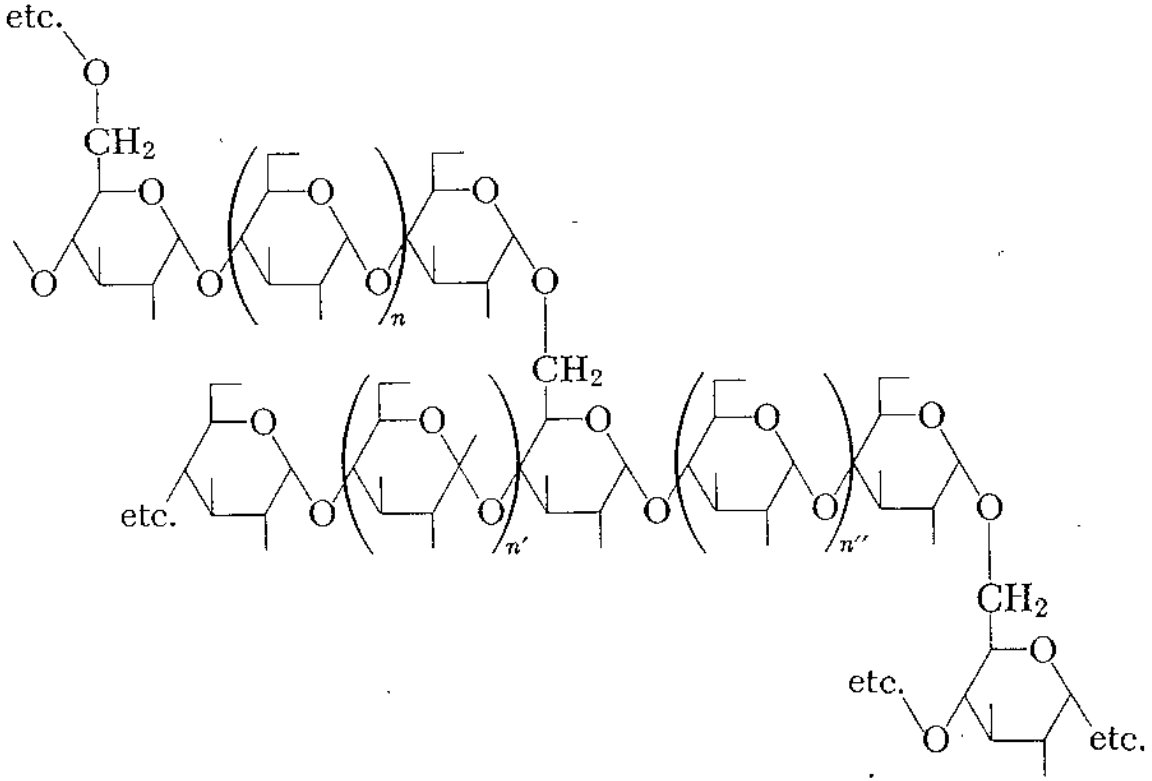

When the stomach is filled, its wall is stretched. The lamina muscularis mucosae is straightened out. Also the Tunica muscularis is stretched and thin.
In the empty stomach, the Tunica muscularis contracts and becomes thick. The T. submucosa buckles, lifting up the entire T. mucosa so that rugae (singular: ruga) are formed. The L. muscularis mucosae does not shorten.
The areae gastricae retain their identity.
A
B
C
A
B
C


Apical microvillus
STRIATED DUCT CELL
Basal process with mitochondria and lateral plications
INTERCALATED DUCT CELL
Prominent apical web of microfilaments
Secretory granules
Process of myoepitheliocyte
Seromucous demilune
Seromucous secretory endpiece (acinar or tubulo-acinar)
(Water) (Salts) Amylase
Myoepitheliocytes
Striated (intralobular) duct
Intercalated ducts
Mucous secretory endpiece (tubulo-acinar or tubular)
To interlobular excretory ducts
Na+
Immunoglobulin
Lysozyme Kallikrein K−
Water (Salts) α-amylase Lipase Peroxidase
Water Neutral glycoproteins Sialomucins Sulphomucins
SEROMUCOUS CELL
MUCOUS CELL
Apical microvillus
Pinocytotic vesicle
Intercellular secretory canaliculus
Zonula occludens
Heterogeneous electron-dense secretory granules
Spherical nucleus
Zonula occludens
Homogeneous electron-translucent secretory vesicles
Flattened basal nucleus

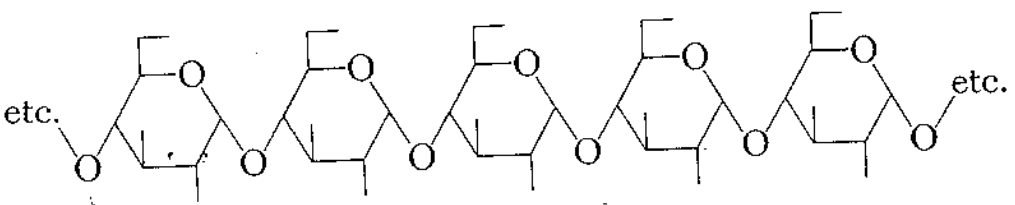


Formation and secretion of saliva by a salivary gland.

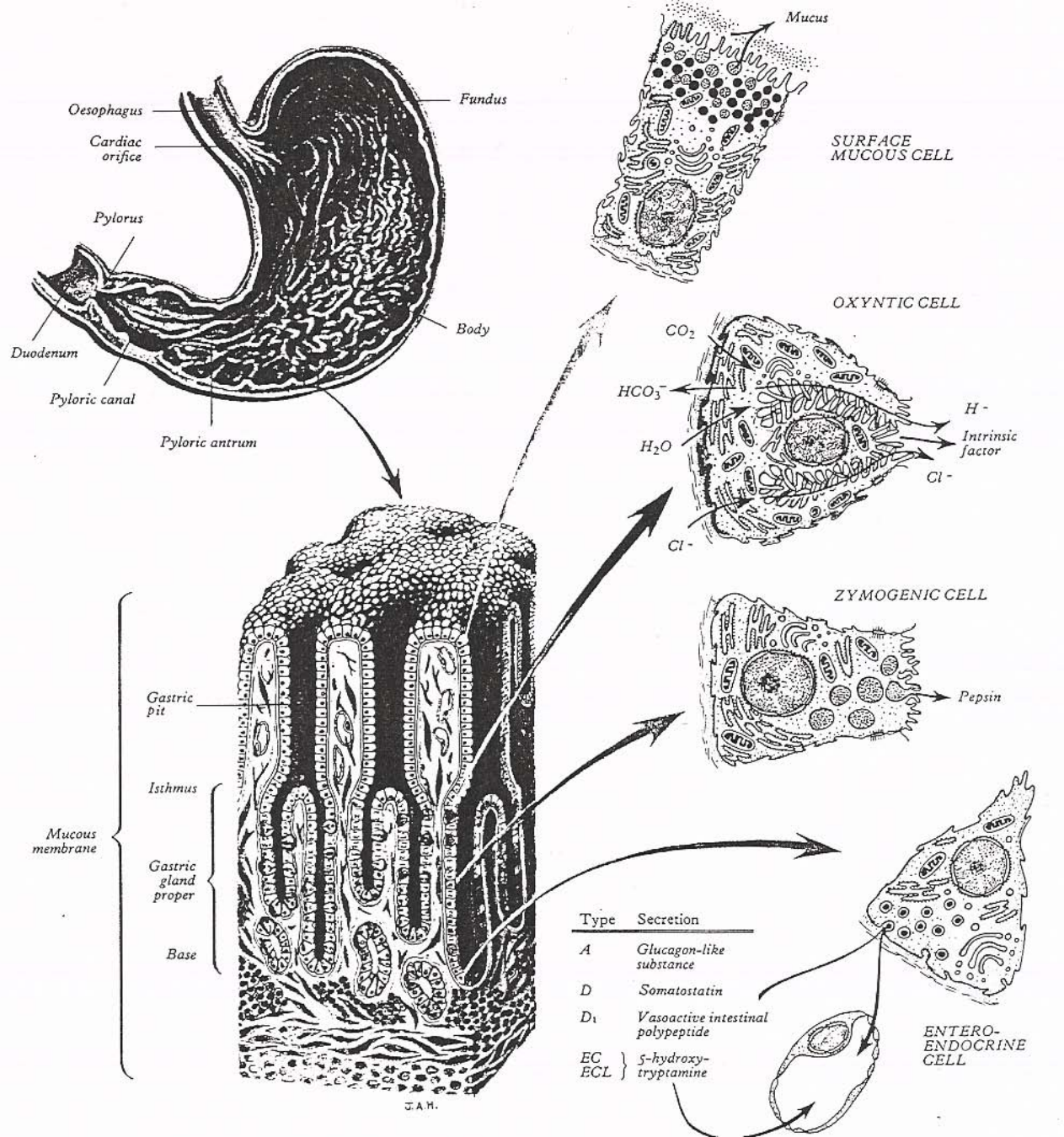

(a)
(b)
(c)
= Glucose unit

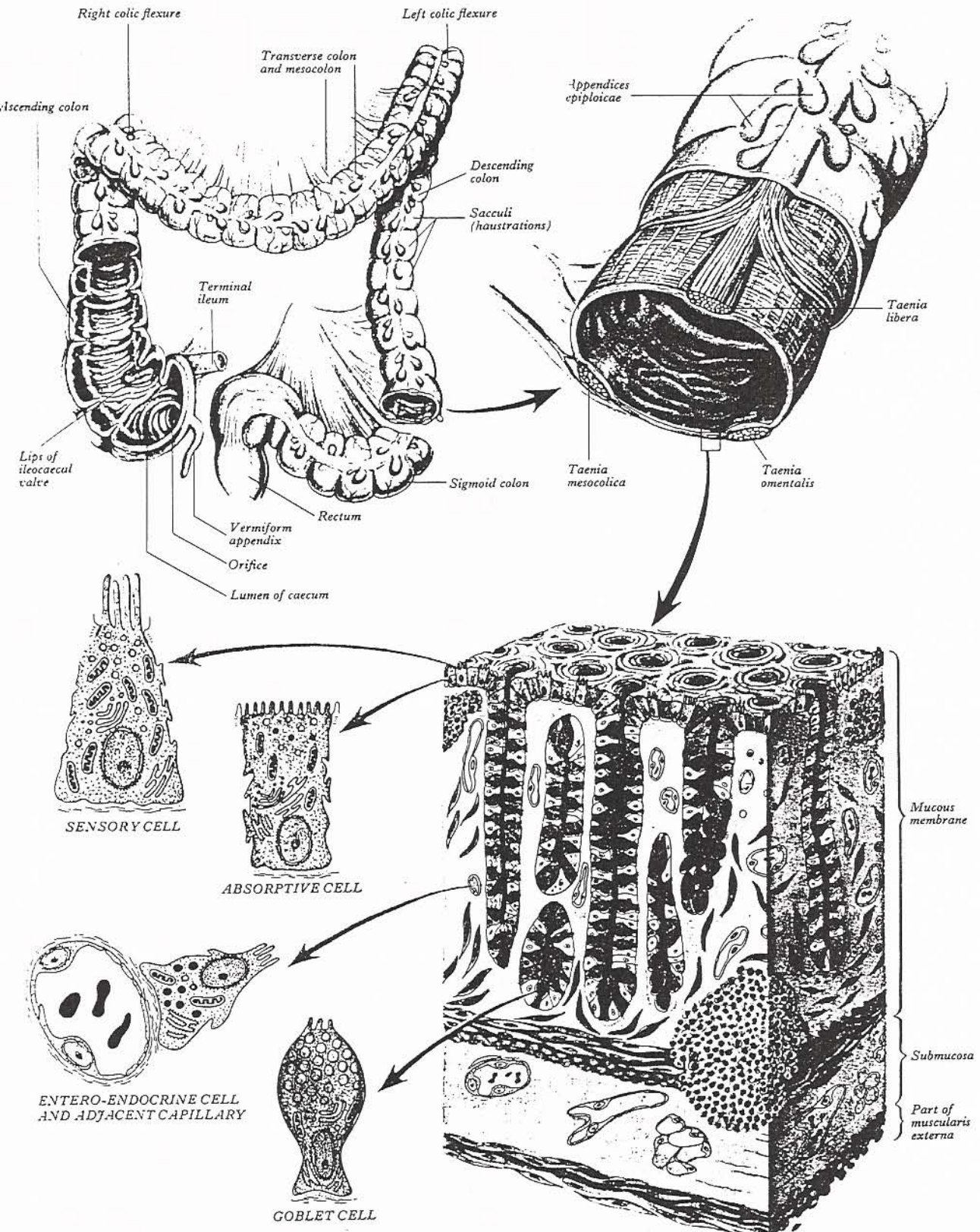


Amylopectin (n, n', n'' = large numbers)



Amylose


Oesophagus
Cardiac orifice
Fundus
Pylorus
Body
Duodenum
Pyloric canal
Pyloric antrum
Mucus
SURFACE MUCOUS CELL
OXYNTIC CELL
CO_2
HCO_3^-
H_2O
H^+
Intrinsic factor
Cl^-
Cl^-
ZYMOGENIC CELL
Pepsin
Gastric pit
Isthmus
Gastric gland proper
Base
Mucous membrane
Type Secretion
A Glucagon-like substance
D Somatostatin
D_1 Vasoactive intestinal polypeptide
EC, ECL } 5-hydroxy-tryptamine
ENTERO-ENDOCRINE CELL
J.A.H.


Right colic flexure
Left colic flexure
Transverse colon and mesocolon
Ascending colon
Descending colon
Sacculi (haustrations)
Terminal ileum
Lips of ileocaecal valve
Sigmoid colon
Rectum
Vermiform appendix
Orifice
Lumen of caecum
Appendices epiploicae
Taenia libera
Taenia mesocolica
Taenia omentalis
SENSORY CELL
ABSORPTIVE CELL
ENTERO-ENDOCRINE CELL AND ADJACENT CAPILLARY
GOBLET CELL
Mucous membrane
Submucosa
Part of muscularis externa

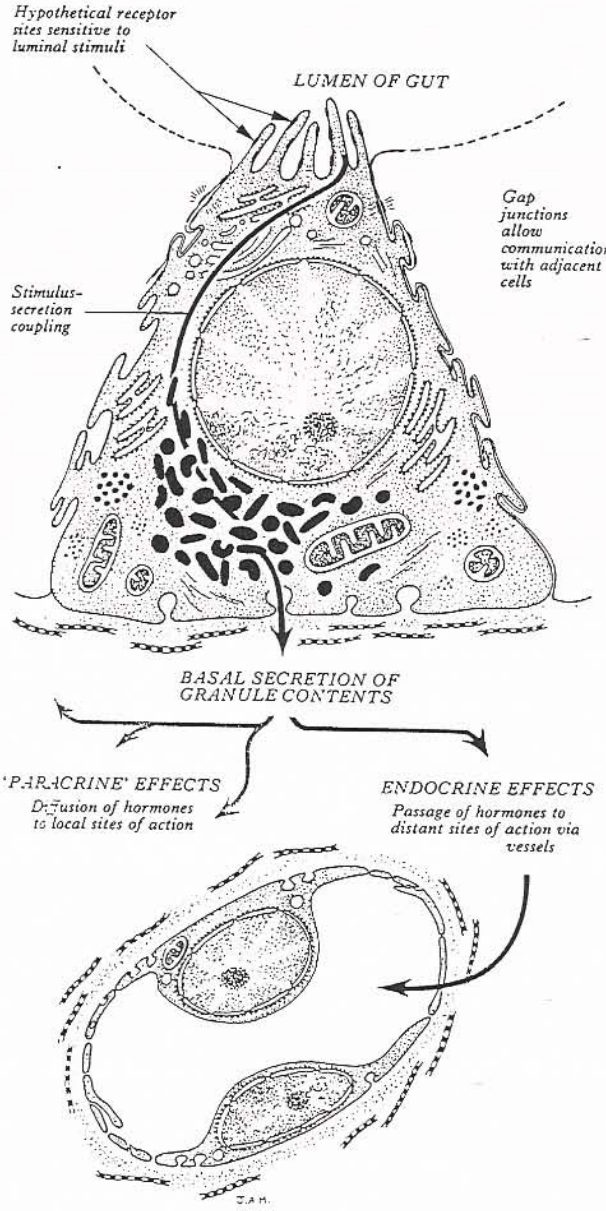
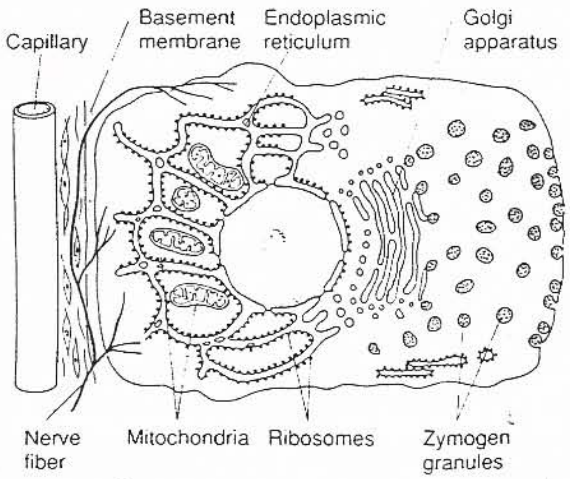
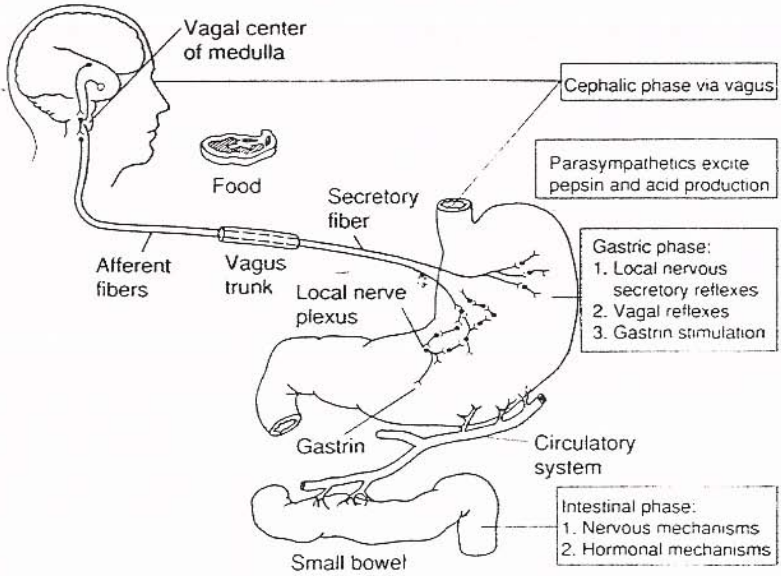
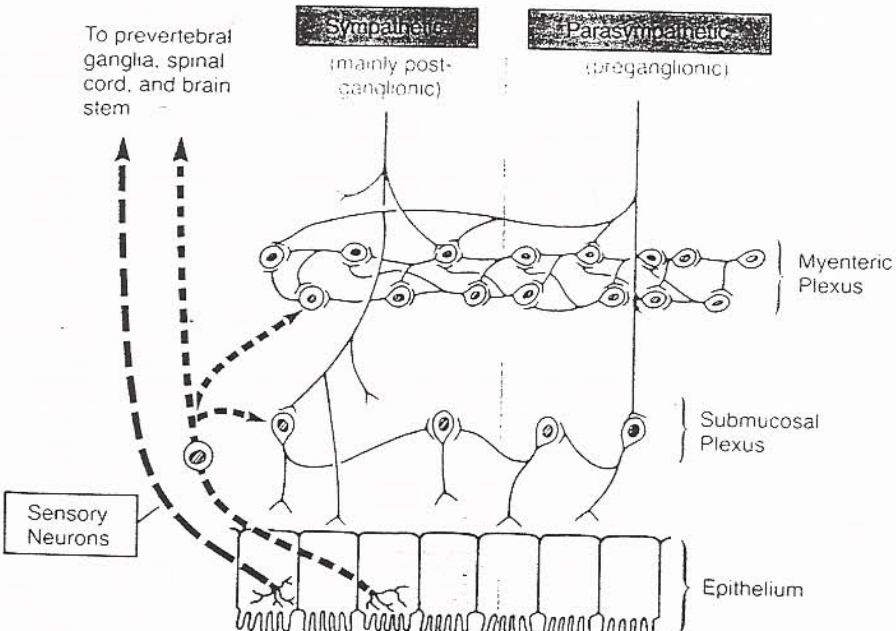


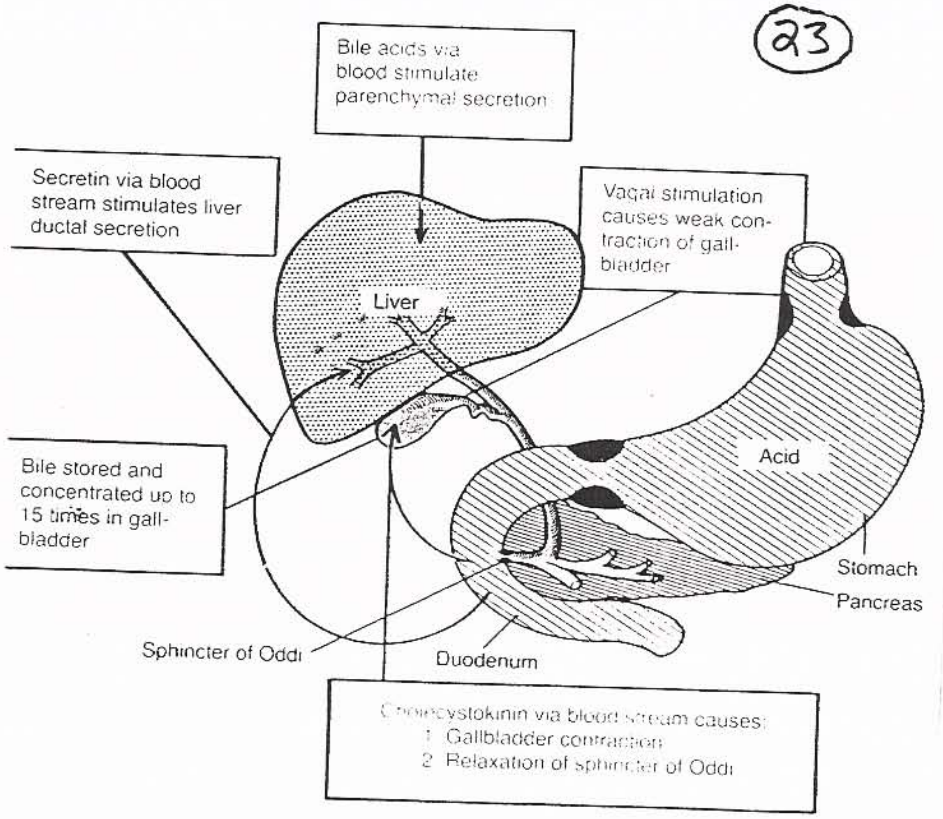
Diagram showing the ultrastructure and possible modes of action of an entero-endocrine cell.

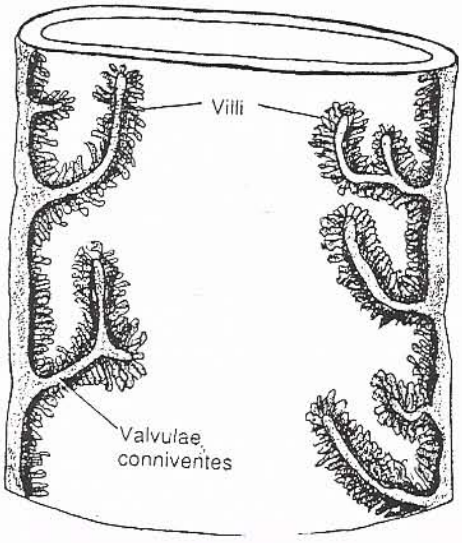


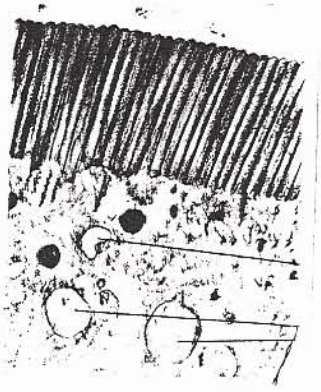
Typical function of a glandular cell in formation and secre- enzymes or other secretory substances.

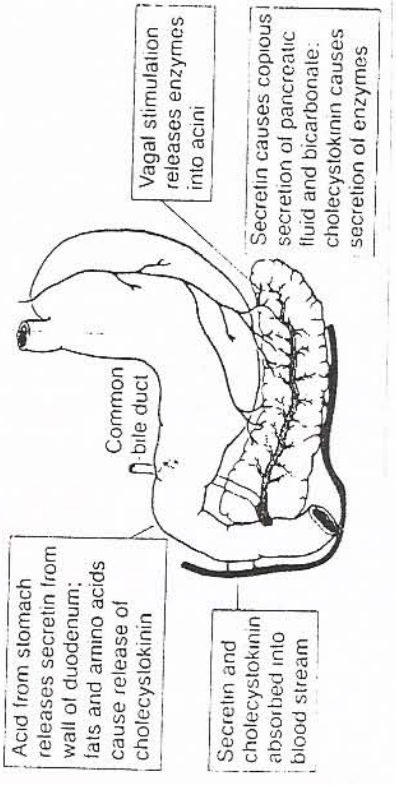

Vagal center of medulla
Cephalic phase via vagus
Food
Parasympathetics excite pepsin and acid production
Secretory fiber
Afferent fibers
Vagus trunk
Local nerve plexus
Gastric phase:
1. Local nervous secretory reflexes
2. Vagal reflexes
3. Gastrin stimulation
Gastrin
Circulatory system
Intestinal phase:
1. Nervous mechanisms
2. Hormonal mechanisms
Small bowel

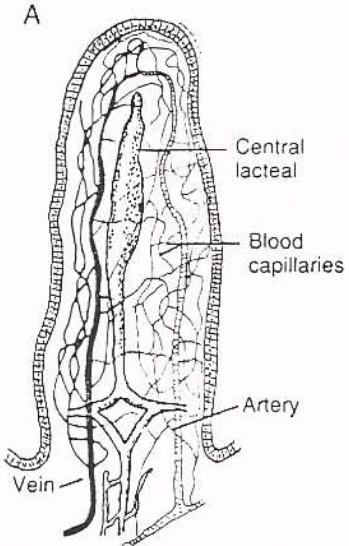

To prevertebral ganglia, spinal cord, and brain stem
Sympathetic
(mainly post-ganglionic)
Parasympathetic
(preganglionic)
Myenteric Plexus
Submucosal Plexus
Sensory Neurons
Epithelium

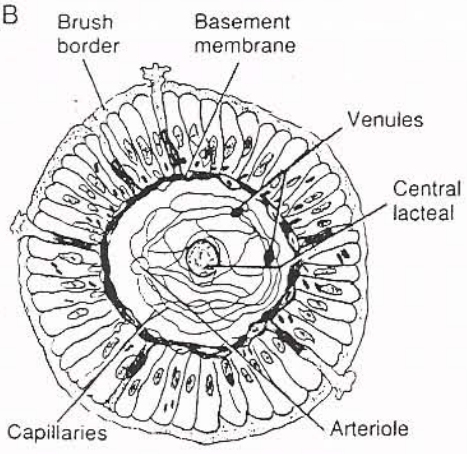

Bile acids via blood stimulate parenchymal secretion
Secretin via blood stream stimulates liver ductal secretion
Vagal stimulation causes weak contraction of gall-bladder
Liver
Bile stored and concentrated up to 15 times in gall-bladder
Acid
Stomach
Pancreas
Sphincter of Oddi
Duodenum
Cholecystokinin via blood stream causes:
1 Gallbladder contraction
2 Relaxation of sphincter of Oddi

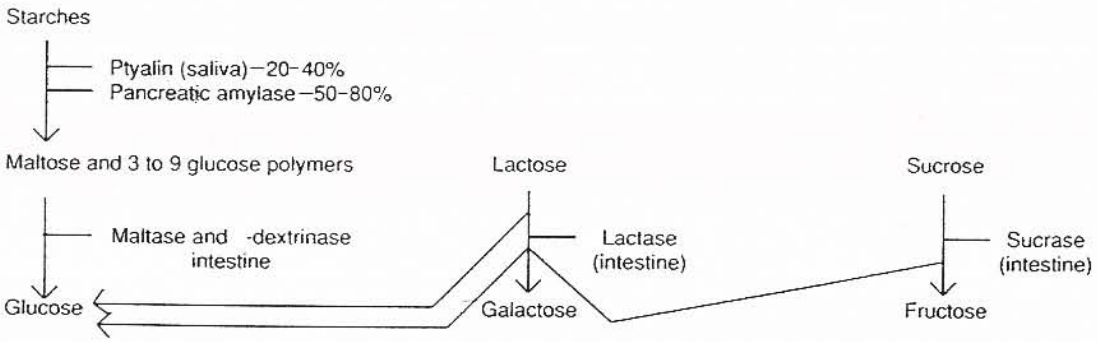

Villi
Valvulae conniventes

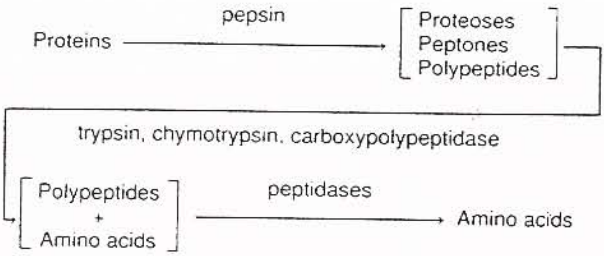


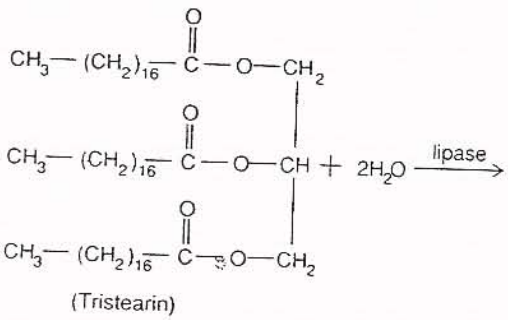

Vagal stimulation releases enzymes into acini
Secretin causes copious secretion of pancreatic fluid and bicarbonate; cholecystokinin causes secretion of enzymes
Common bile duct
Acid from stomach releases secretin from wall of duodenum; fats and amino acids cause release of cholecystokinin
Secretin and cholecystokinin absorbed into blood stream

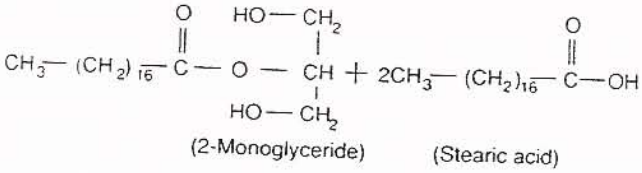

A
Central lacteal
Blood capillaries
Artery
Vein

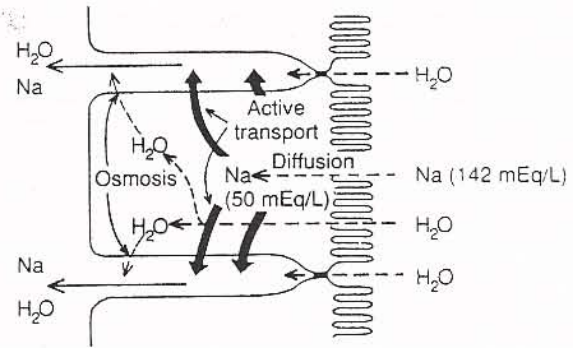

B
Brush border
Basement membrane
Venules
Central lacteal
Capillaries
Arteriole

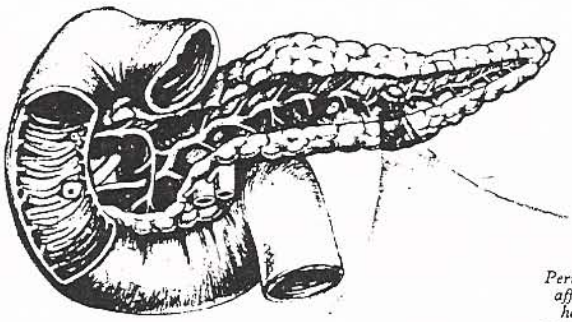

Starches
Ptyalin (saliva)—20–40%
Pancreatic amylase—50–80%
Maltose and 3 to 9 glucose polymers
Lactose
Sucrose
Maltase and -dextrinase
intestine
Lactase
(intestine)
Sucrase
(intestine)
Glucose
Galactose
Fructose


Proteins
pepsin
Proteoses
Peptones
Polypeptides
trypsin, chymotrypsin, carboxypolypeptidase
Polypeptides
+
Amino acids
peptidases
Amino acids


lipase
(Tristearin)


(2-Monoglyceride)
(Stearic acid)


Active
transport
Diffusion
Osmosis
Na (142 mEq/L)
(50 mEq/L)



SPHINCTERIC TONE

Neural control

1. *Parasympathetic fibres* –
2. *Sympathetic fibres* +

Peri-insular tissue affected by islet hormones and neurotransmitters

Pancreatic islet

Telo-insular tissue affected by gastro-intestinal hormones and neurotransmitters

BICARBONATE IONS & WATER
(Ductual and centro-acinar cells)

A: Neural control

1. *Vagi: Cholinergic fibres* +
2. *Splanchnic nerves*
   - (a) *Adrenergic fibres* –
   - (b) *Vagal cholinergic fibres* +

B: Hormonal control

1. *Gastrin* +
2. *CCK-PZ* +
3. *Secretin* + + + +
4. *VIP* – –
5. *Somatostatin* –
6. *Pancreatic polypeptide* + –
7. *Glucagon* –

Acinar cell

Centro-acinar cell

Ductal cell

Adrenergic vaso-constrictor terminals

Postganglionic parasympathetic neuron

Preganglionic cholinergic fibres

Secretion of granule contents

Secretion of amylase and lipase

Stimulation of secretion

Zymogen granule (enzyme storage)

Interaction of c-AMP and c-GMP

Synthesis of c-AMP and c-GMP

Activation of
A, B } *Adenyl cyclase*
C *Guanyl cyclase*

Binding sites for
A *Acetylcholine*
B *CCK-PZ and/or gastrin*

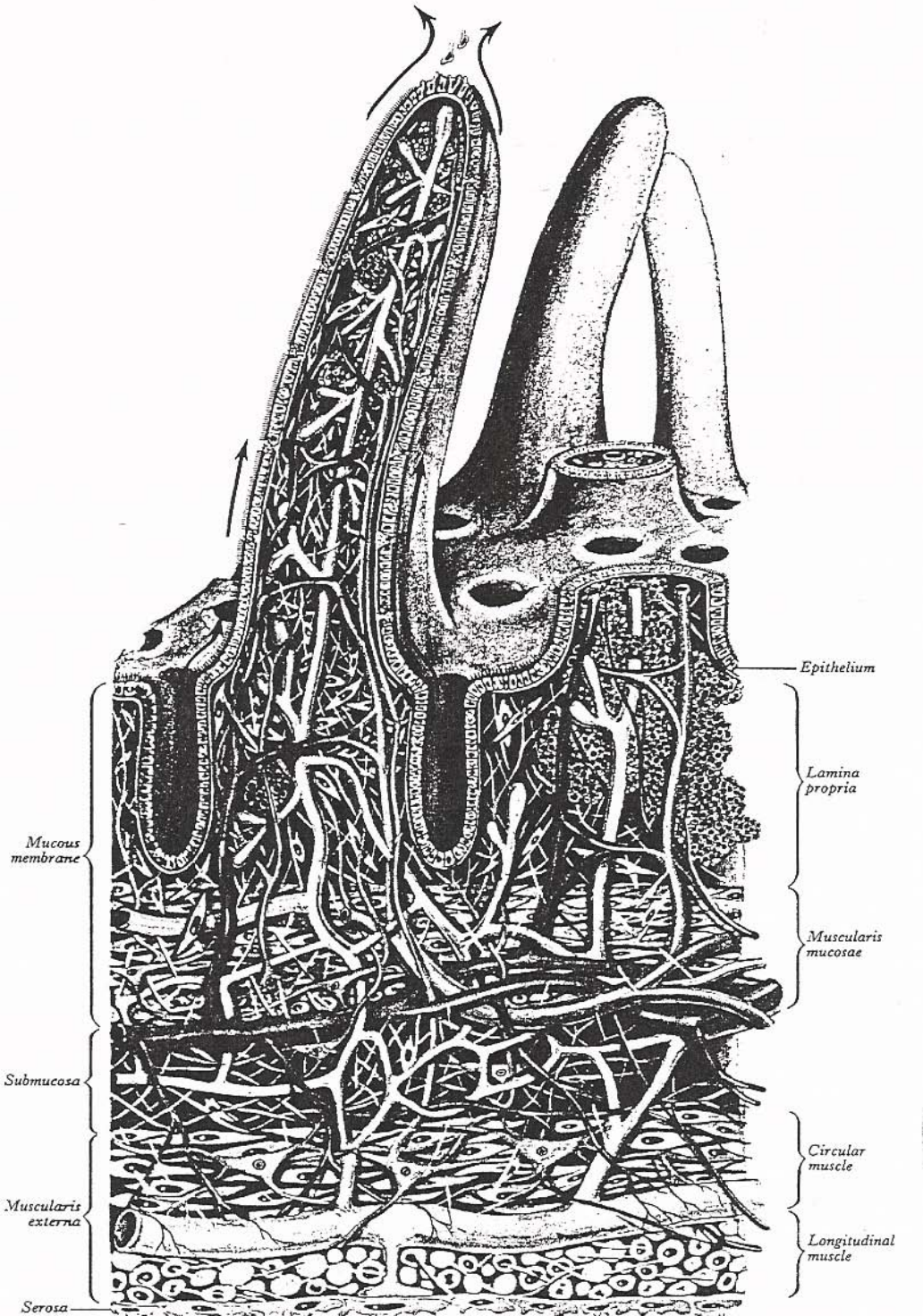
ENZYMES (Acinar cells)

A: Neural control

1. *Vagi: Cholinergic fibres* + + + –
2. *Splanchnic nerves*
   - (a) *Adrenergic fibres* –
   - (b) *Vagal cholinergic fibres* +

B: Hormonal control

1. *Gastrin* +
2. *CCK-PZ* + + + –
3. *Secretin* +
4. *VIP* + –
5. *Glucagon* –


Epithelium
Lamina propria
Muscularis mucosae
Mucous membrane
Submucosa
Circular muscle
Muscularis externa
Longitudinal muscle
Serosa