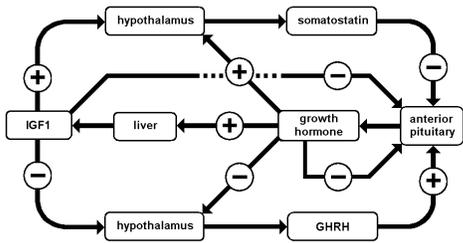


Hormone production & release: Feedback Mechanisms

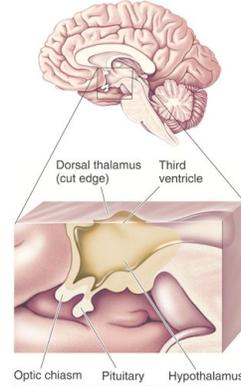
-Response to a stimulus has an effect on the original stimulus-

Negative feedback: produces decrease in original stimulus

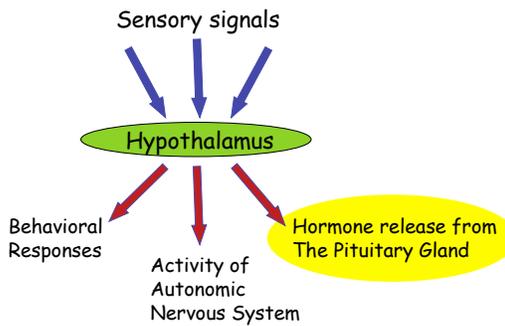
Positive feedback: produces increase in original stimulus



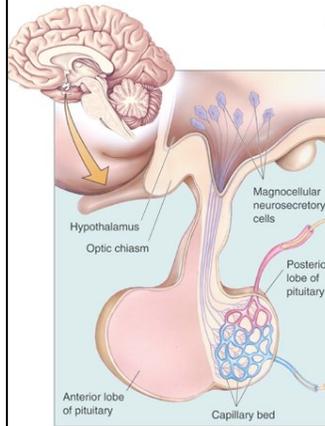
Hypothalamus and Pituitary



Hypothalamus: Functions

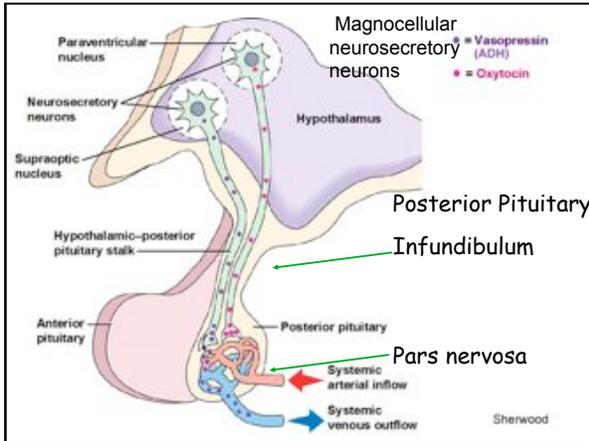


**Posterior Pituitary
NEURAL NOT ENDOCRINE**



Oxytocin targets:
uterus- contraction
mammary glands- milk ejection (let-down)

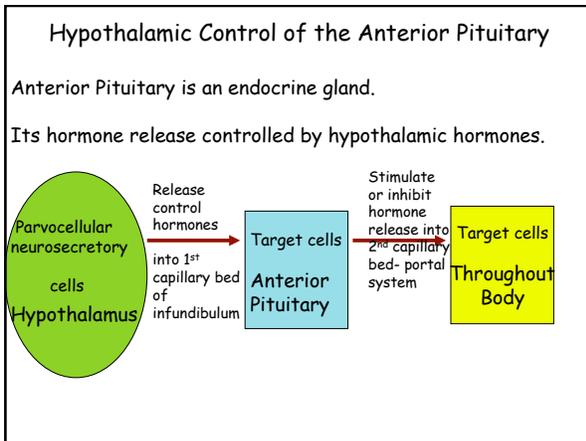
Vasopressin (ADH) targets:
Kidneys- water retention
increase blood volume
decrease [Na⁺]



Posterior Pituitary: Pars nervosa

Herring bodies: dilations of the axon filled with neurosecretory granules (blue arrows)
 Fenestrated capillaries
 Pituicytes: astrocyte-like cells, associated with capillaries (red arrow)

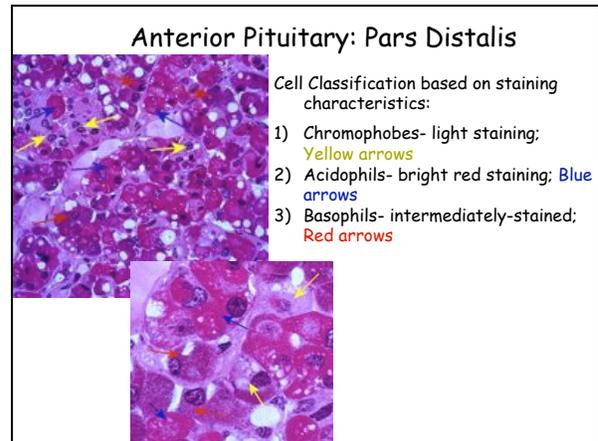
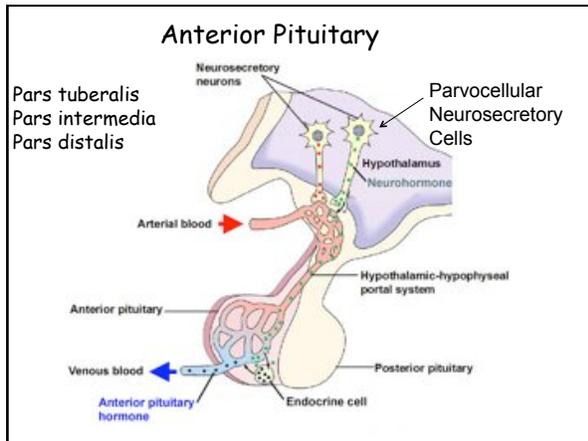
<http://som.umd.edu/physiology/lab22/lab22pituitary.html> <http://medpics.ucsd.edu>



Anterior Pituitary Hormones

- Follicle-stimulating hormone*
- Luteinizing hormone *
- Thyroid-stimulating hormone *
- Adrenocorticotropin *
- Growth Hormone
- Prolactin

**tropic hormones: regulate hormone release of target cells*



- Cell Classification based on functional characteristics:
- 1) Somatotropes: 50%, round nuclei, acidophilic, release growth hormone (somatotropin); +release GHRH and ghrelin, - release somatostatin
 - 2) Lactotropes: 15-20%, large polygonal, oval nuclei, acidophilic vesicles -when released-chromophobe; prolactin; +THR and VIP, -dopamine
 - 3) Corticotropes: 15-20%, medium polygonal, round eccentric nuclei, basophils, PAS+, produce Adrenocorticotropin (ACTH), MSH, enkephalin from precursor molecule POMC (proopiomelanocortin); +CRH
 - 4) Gonadotropes: 10%, small oval w/round eccentric nuclei, basophil and PAS+, release follicle-stimulating hormone (FSH) and luteinizing hormone (LH); +GnRH
 - 5) Tyrotropes: 5%, large, polygonal, basophilia, PAS+, thyroid-stimulating hormone (TSH), +TRH

Altered Hypothalamic/Pituitary Function

Excessive Growth hormone
↓
Giantism/Acromegaly

*Tom Thumb
(2 feet 1 inch)
& P. T. Barnum*

Insufficient Growth hormone
↓
Growth Hormone Deficiency
Dwarfism

www.pbs.org/.../special_dwarfism_ety.html

*Hussain Bisad
7feet 9 inches*

news.bbc.co.uk/.../south_east/0202086.stm?st=

Thyroid

Thyroid Follicles
 Epithelium: simple cuboidal or low columnar

Follicular Cells

- produce thyroid hormone T3 and T4
- spherical nuclei
- basophilic
- microvilli

Parafollicular (C) Cells

- produce calcitonin
- follicle periphery
- within basal lamina
- pale staining

Fenestrated capillaries

Copyright © 2007 Pearson Education, Inc., publishing as Benjamin Cummings. Fig. 23-

Follicular Cells

Arranged around lumen filled with acidophilic colloid (PAS positive)

Parafollicular (C) Cells

Calcitonin:

- Calcitonin secreted in response to increase in blood calcium
- Suppresses osteoclast function, increase osteoid calcification
- Decreases blood calcium levels
- Physiological antagonist to parathyroid hormone

A 100 μm B & C 50 μm

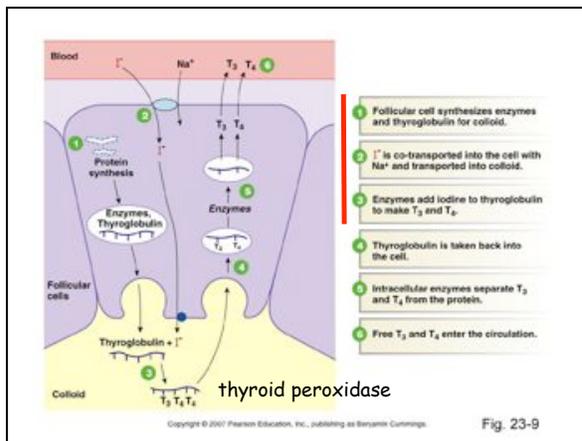
THYROID: Follicular and Parafollicular cells

Thyroid Hormone Synthesis

- 1) Follicular cells produce thyroglobulin and secrete it into lumen
- 2) Follicular cells actively take up iodide and it is oxidized to iodine and released into the colloid.
- 3) Tyrosine residues on thyroglobulin are iodinated to form MIT and DIT. Mediated by thyroid peroxidase on apical surface.

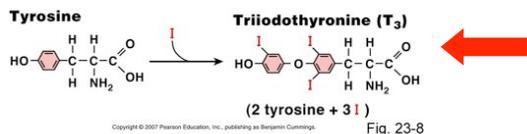
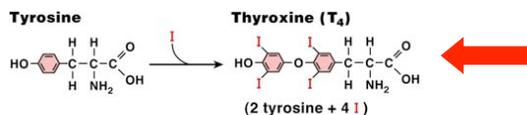
MIT= moniodotyrosine

DIT= diiodotyrosine



Thyroid Hormone Synthesis

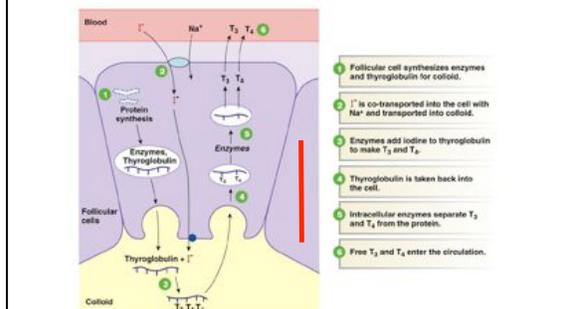
- 4) MIT + DIT form T₃ > Still part of thyroglobulin in colloid
DIT + DIT form T₄



Copyright © 2007 Pearson Education, Inc., publishing as Benjamin Cummings. Fig. 23-8

Thyroid Hormone Synthesis

- 5) Upon stimulation with TSH (Thyroid Stimulating Hormone), thyroglobulin is reabsorbed by receptor mediated endocytosis and combine with lysosomes, releasing T₃ and T₄.



Thyroid Hormone Synthesis

Metabolic Activity: T3 >>> T4

Amount released from Thyroid: T4 >>> T3 20:1

Transport in blood: Bound to transport (carrier) protein --> Thyroxine-binding protein

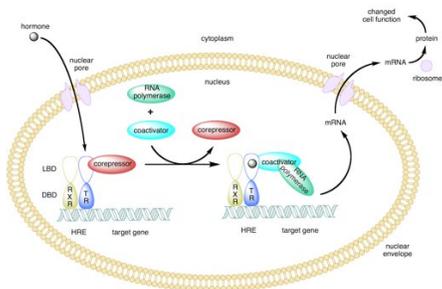
T4 is converted to T3 in kidneys and liver

Thyroid Hormone Targets and Function

- Increases basal metabolic rate (BMR) (heat production)
- Accelerates protein synthesis in children
body growth and development
brain development
- Enhances sympathetic tone

Thyroid Hormone Targets and Function

Thyroid Hormone Receptor: intracellular, bound to DNA as repressor without T3; with T3 present, acts as an activator of gene transcription

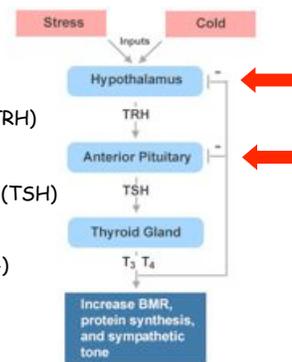


Thyroid Hormone Release: Negative Feedback

Thyroid Releasing Hormone (TRH)

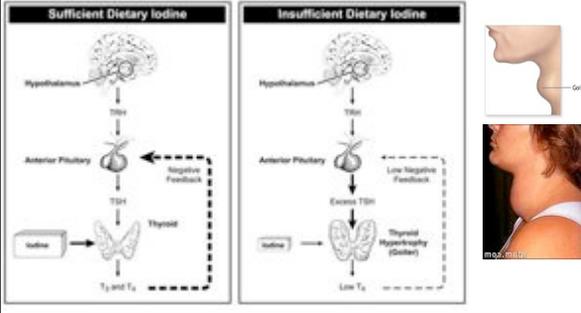
Thyroid Stimulating Hormone (TSH)

Thyroid Hormones (T3 and T4)



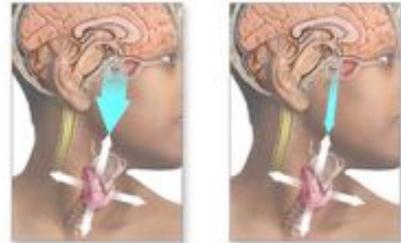
Diseases of the Thyroid

Iodine Deficiency: low T3 + T4, elevated TSH, goiter
Hypothyroidism



Diseases of the Thyroid

Hypothyroidism



Primary hypothyroidism: thyroid can't produce amount of hormones pituitary calls for

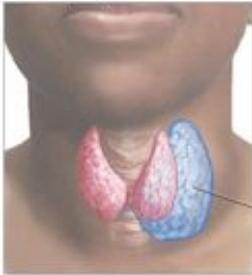
Secondary hypothyroidism: thyroid isn't being stimulated by pituitary to produce hormones

#ADAM

Diseases of the Thyroid

Hyperthyroidism

Hyperthyroidism caused by thyroid adenoma



Hyperfunctioning thyroid (goiter)

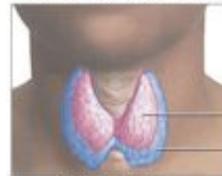
#ADAM

Diseases of the Thyroid

Graves Disease



Exophthalmos (bulging eyes)



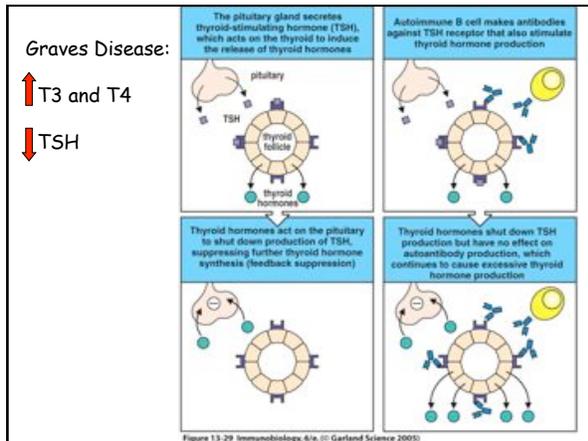
Diffuse goiter

Graves' disease is a common cause of hyperthyroidism, an over-production of thyroid hormone, which causes enlargement of the thyroid and other symptoms such as exophthalmos, heat intolerance and anxiety

Normal thyroid

Enlarged thyroid

#ADAM



Digestive System

Alimentary Canal and Associated Organs

Mouth	<i>Tongue</i>
Esophagus	<i>Teeth</i>
Stomach	<i>Salivary Glands</i>
Small Intestine	Pancreas
Large Intestine	Liver
	Gall Bladder

Alimentary Canal

Barrier: between internal and external environments

Motility: movement of food

Secretion: enzymes, mucous, acid, antibodies

Absorption: products of digestion

Immunological Defense: site of lymphatic tissue

Alimentary Canal

General Structure from Esophagus ---> Anus

Mucosa: Epithelium
Lamina Propria
Muscularis Mucosa (smooth muscle)

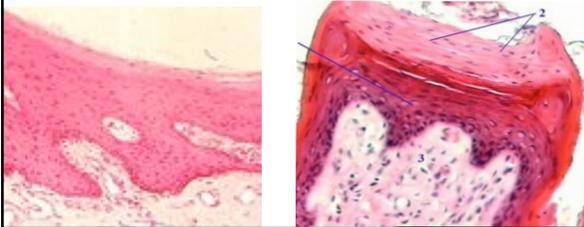
Submucosa: Dense irregular connective tissue

Muscularis externa: Two layers of smooth muscle

Serosa: simple squamous epithelium, connective tissue

Barrier- Epithelium

Oral Cavity: *parakeratinized epithelium*- most superficial cells do not lose nuclei
 tongue, gums, hard palate
 Connective tissue papilla



Barrier- Epithelium

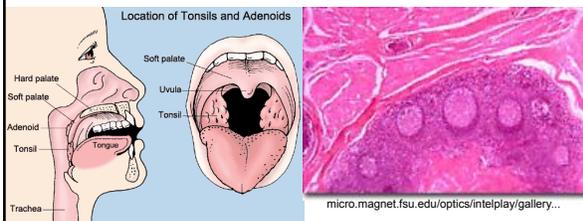
Esophagus: stratified squamous epithelium

Small and Large Intestine- tight junctions between columnar cells of simple epithelium



Immunological Defense

Tonsils: ring of lymphatic tissue (lymphatic nodules or follicles) at entrance to respiratory and digestive tracts

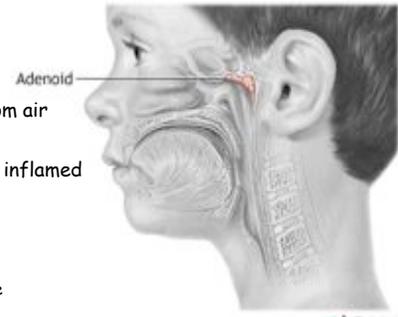


Adenoids: lymphatic tissue located high on the posterior wall of the pharynx.

- similar to tonsils
- clear antigens from air
- reduced in adults
- can be enlarged / inflamed

SYMPTOMS:

- mouth breathing
- snoring
- bad breath
- chronic runny nose
- sleep apnea
- pulmonary hypertension
- right-sided heart failure



Immunological Defense

Gut-associated lymphatic tissue (GALT): diffuse lymphatic tissue and lymphatic nodules in lamina propria of small and large intestine
Striking in Appendix and Ileum=> Peyer's Patches

MALT=Mucous associated lymphatic Tissue

Immunological Defense

Plasma Cells secrete a special form of antibody,
=> secreted IgA

- Dimeric
- Linked via J chain and secretory component
- More stable
- More resistant to enzymatic digestion
- in saliva, milk, and mucous membranes of respiratory and digestive tracts

Possible modes of defense mediated by IgA binding to its receptor, pIgR, (the secretory component, SC).

- (a) pIgR-driven export of dimeric IgA with J chain (IgA+J)
- (b) Neutralization of infecting virus and transport of viral products from the lumen.
- (c) Intracellular neutralization of endotoxin (LPS) from Gram-negative bacteria.
- (d) Clearance of antigen (Ag) that has breached the mucosal barrier.

From Trends Immunol. 2004, 25:150-57.

Immunological Defense

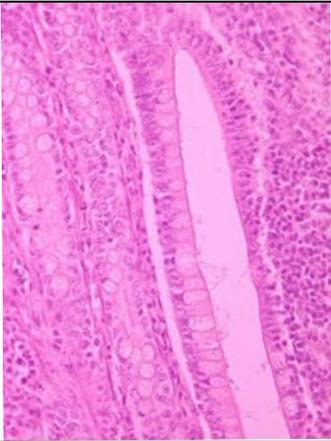
Peyer's Patches

Lymph nodules capped by specialized epithelial cells, =>M Cells

www.bu.edu/histology/p/12001oba.htm

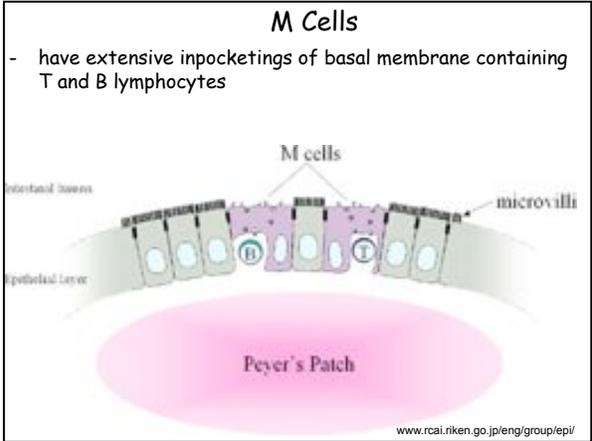
M Cells

- Follicle-Associated Epithelium (FAE): epithelial cells associated with lymph nodules of MALT
- look for absence of goblet cells over Peyer's Patch
- apical surface microfolds rather than microvilli
- connected to neighbors with tight junctions



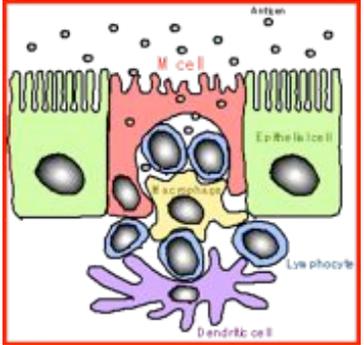
M Cells

- have extensive inpocketings of basal membrane containing T and B lymphocytes



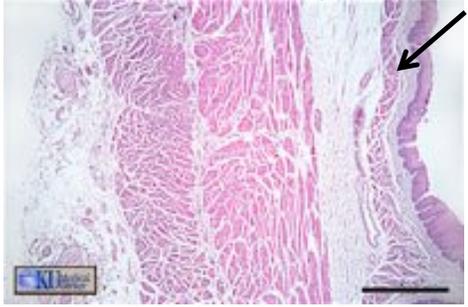
www.rcal.niken.go.jp/eng/group/epi/

M Cells: specialized for transepithelial transport: deliver intact foreign antigens and microorganisms from lumen to immune cells



Motility

Muscularis Mucosa: 2 layers of smooth muscle
inner-circular, outer-longitudinal
responsible for moving the mucosa



Motility

Muscularis Externa: mixes, propels contents of lumen

2 thick layers of smooth muscle

inner layer=> circularly-oriented layer
-tight spiral

outer layer=>longitudinally-oriented layer
-loose spiral

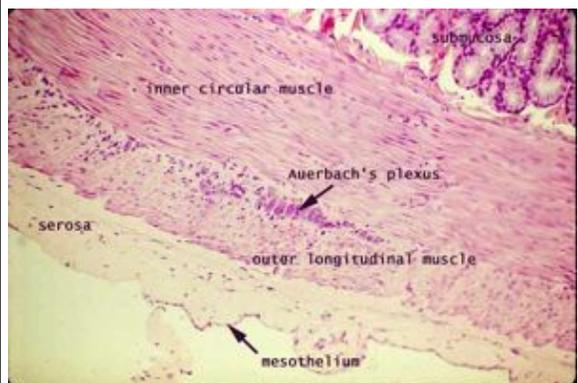
Between muscle layers- Nervous innervation

Myenteric plexis (Auerbach's plexis)

Motility: Muscularis Externa



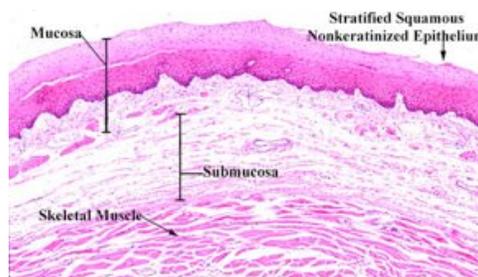
Motility: Muscularis Externa



Motility

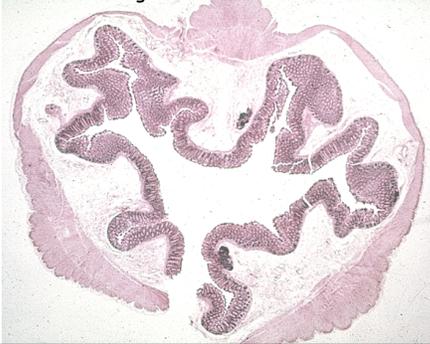
MUSCULARIS EXTERNA EXCEPTIONS:

Striated muscle in proximal esophagus (upper 1/3) and anus



MUSCULARIS EXTERNA EXCEPTIONS:

Teniae Coli: 3 thickened bands of longitudinal layer large intestine-

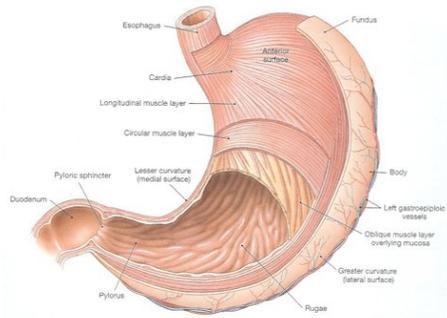


Secretion

- carried out by epithelial cells and associated glands
- secretions include:
 - Antibodies: IgA*
 - Lubrication substances
 - Aid for digestion: hydrochloric acid & enzymes
 - Hormones
 - Water
- secretions from salivary glands, stomach, small and large intestine

Anatomy of the Stomach

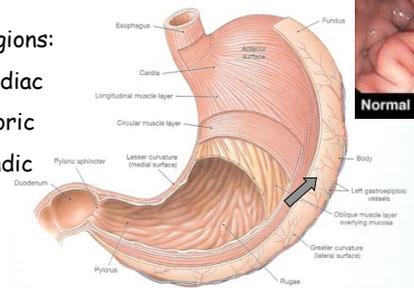
- 3 regions:
 Cardiac
 Pyloric
 Fundic



Rugae: longitudinal folds or ridges on inner surface

Anatomy of the Stomach

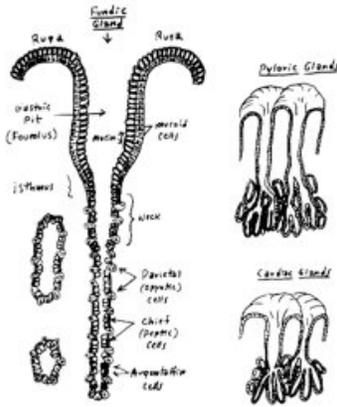
- 3 regions:
 Cardiac
 Pyloric
 Fundic



Rugae: longitudinal folds or ridges on inner surface
 Simple columnar epithelium

Each stomach region has distinctive glands.

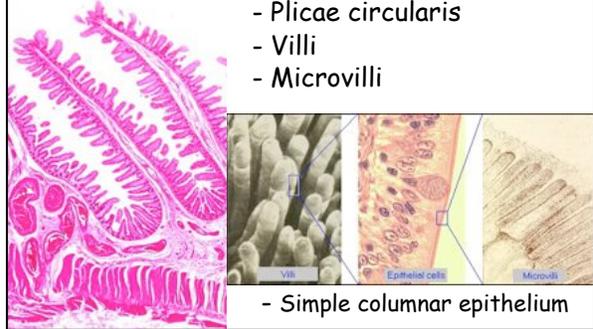
- Cardiac glands
- Pyloric glands
- Fundic glands
 - gastric pits
 - isthmus
 - cell replication
 - neck
 - base or fundus



Anatomy of the Small Intestine

3 components: Duodenum, Jejunum, Ileum

- Plicae circularis
- Villi
- Microvilli



- Simple columnar epithelium

Anatomy of the Small Intestine

