DIGESTIVE SYSTEM

PAPER: 1
UNIT: II
DR. RUPALI VAITY
ASSISTANT PROFESSOR
SIES COLLEGE OF ARTS, SCIENCE & COMMERCE (AUTONOMOUS)

DIGESTIVE SYSTEM

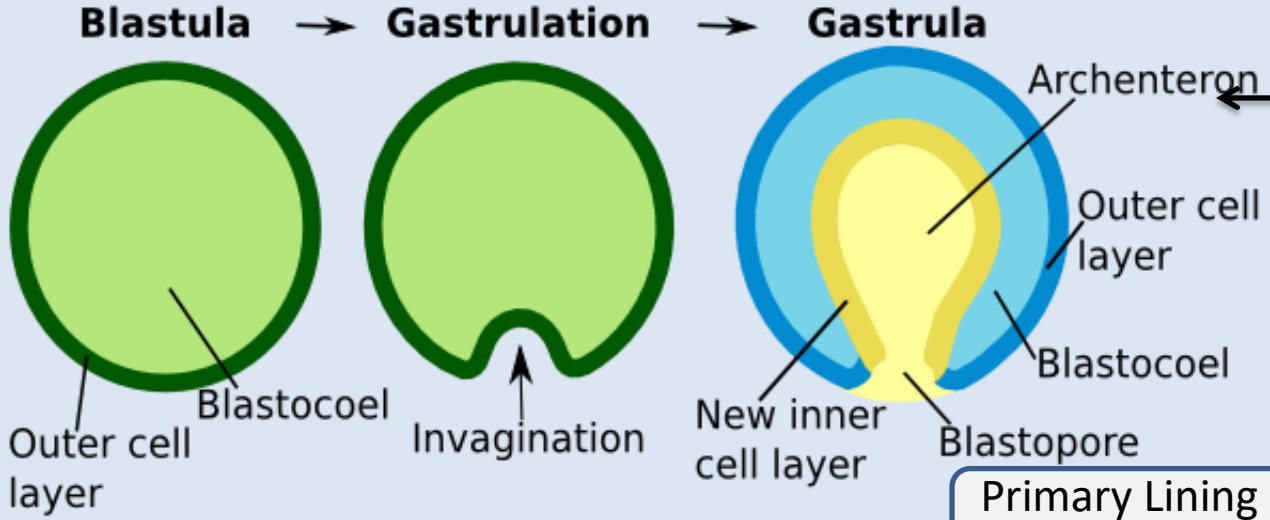
Evolution of digestive tube. Primary divisions of the tube.

Tooth structure & position, teeth in lower vertebrates, mammalian dentition.

Morphology of gut wall
Comparative study of Esophagus, Stomach and Intestine in chordates

DIGESTIVE SYSTEM

Evolution of Digestive Tube



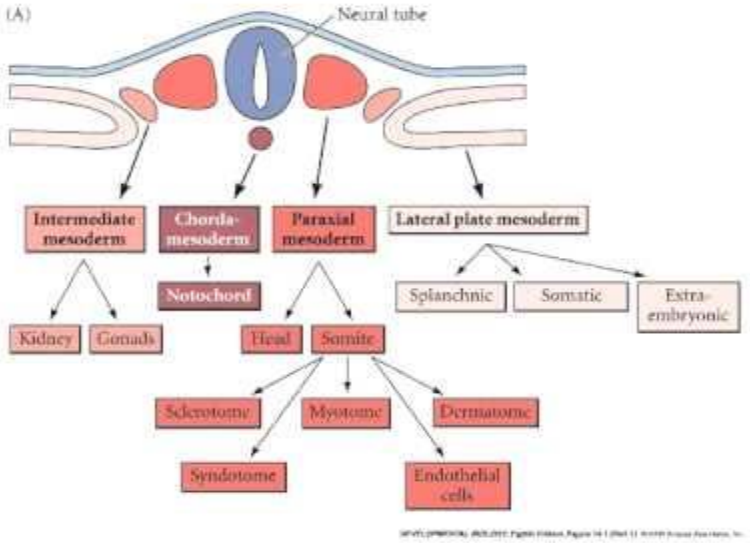
Primary gut that forms during gastrulation

Develops into endoderm and mesoderm

Primary Lining of digestive tract and all its derivatives

DIGESTIVE SYSTEM

Evolution of Digestive Tube



Splanchnic mesoderm

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Adds Layer of Connective tissue and Smooth muscles around archenteron

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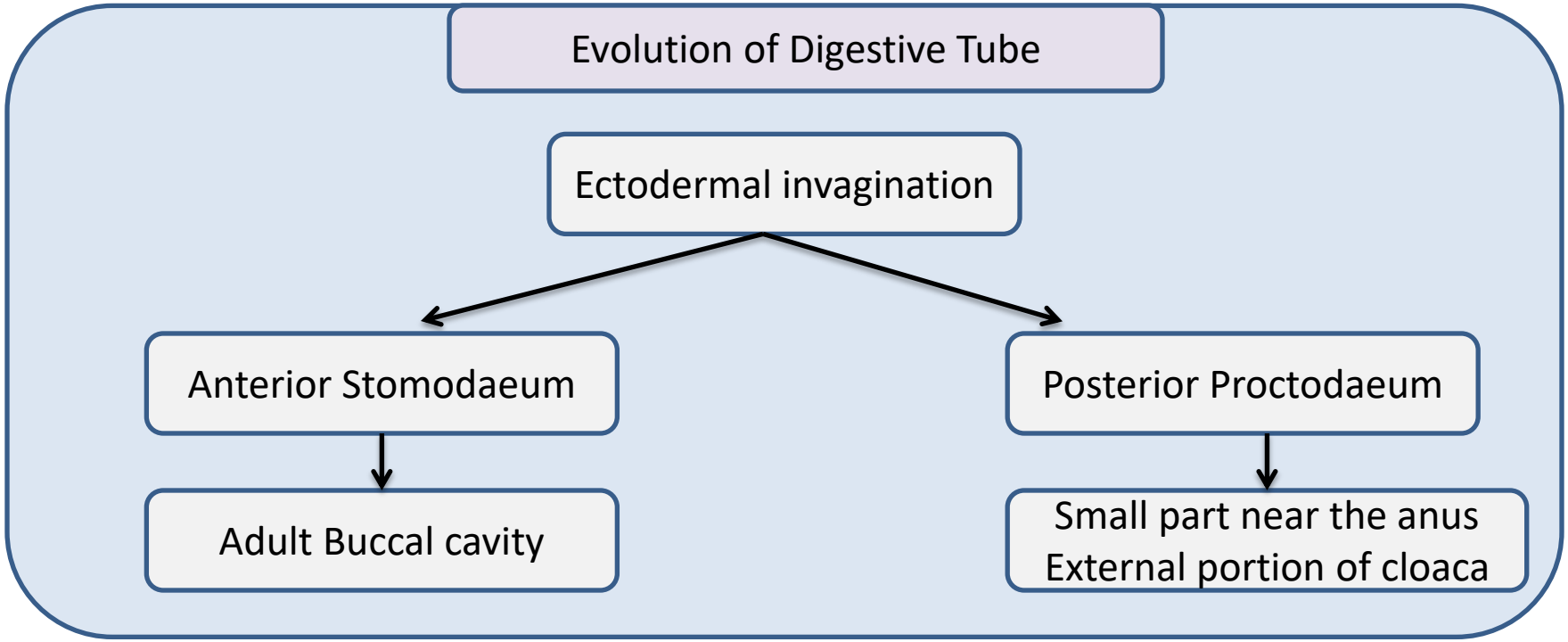


- Ectoderm== Surface-→ Bucal Cavity, Anus/ Cloaca
- Mesoderm== Connective Tissue, Smooth Muscle layers
- Endoderm-→ Digestive system

DIGESTIVE SYSTEM

Evolution of Digestive Tube

Mouth

Buccal Cavity

Pharynx

Esophagus

Digestive Tract

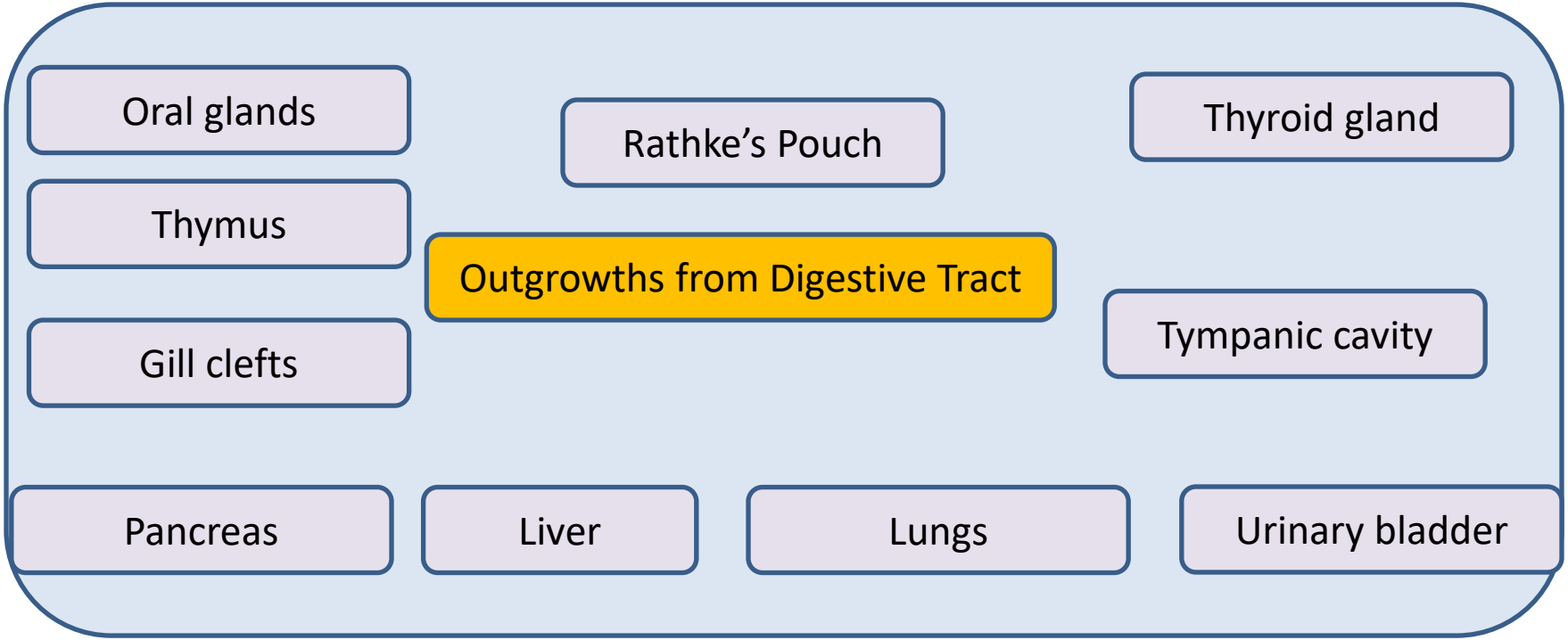
Cloaca

Large intestine

Small intestine

Stomach

DIGESTIVE SYSTEM



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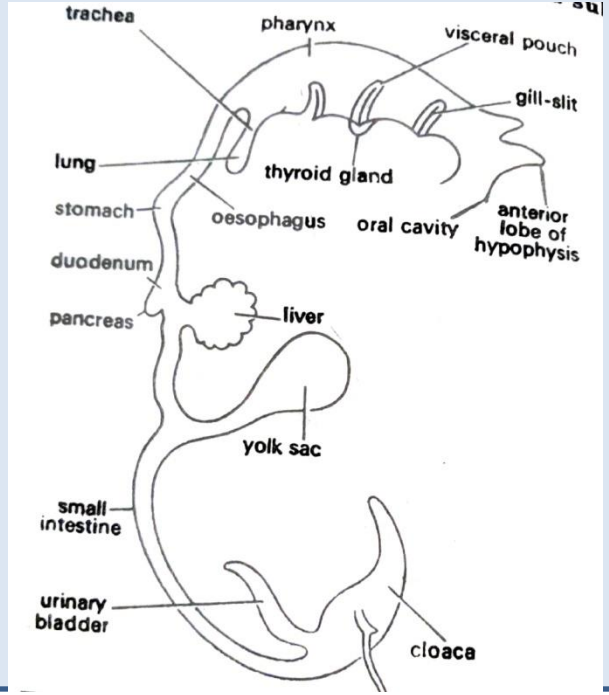

Alimentary canal and its derivatives

- Digestive tract-→ Buccal Cavity--→ Dentition, Tongue, Salivary glands
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine

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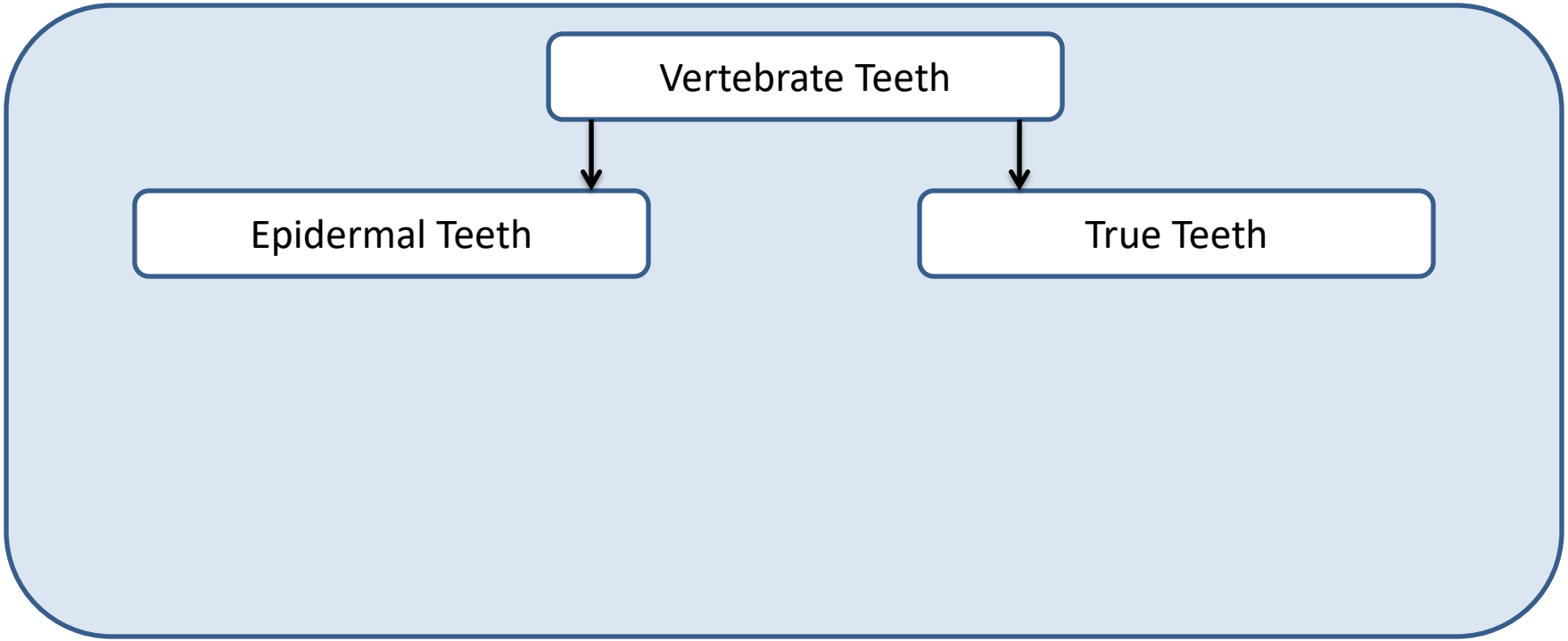


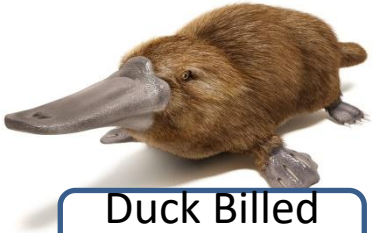
DIGESTIVE SYSTEM

Cyclostomes Teeth

Hard conical structures lying above the dermal papilla

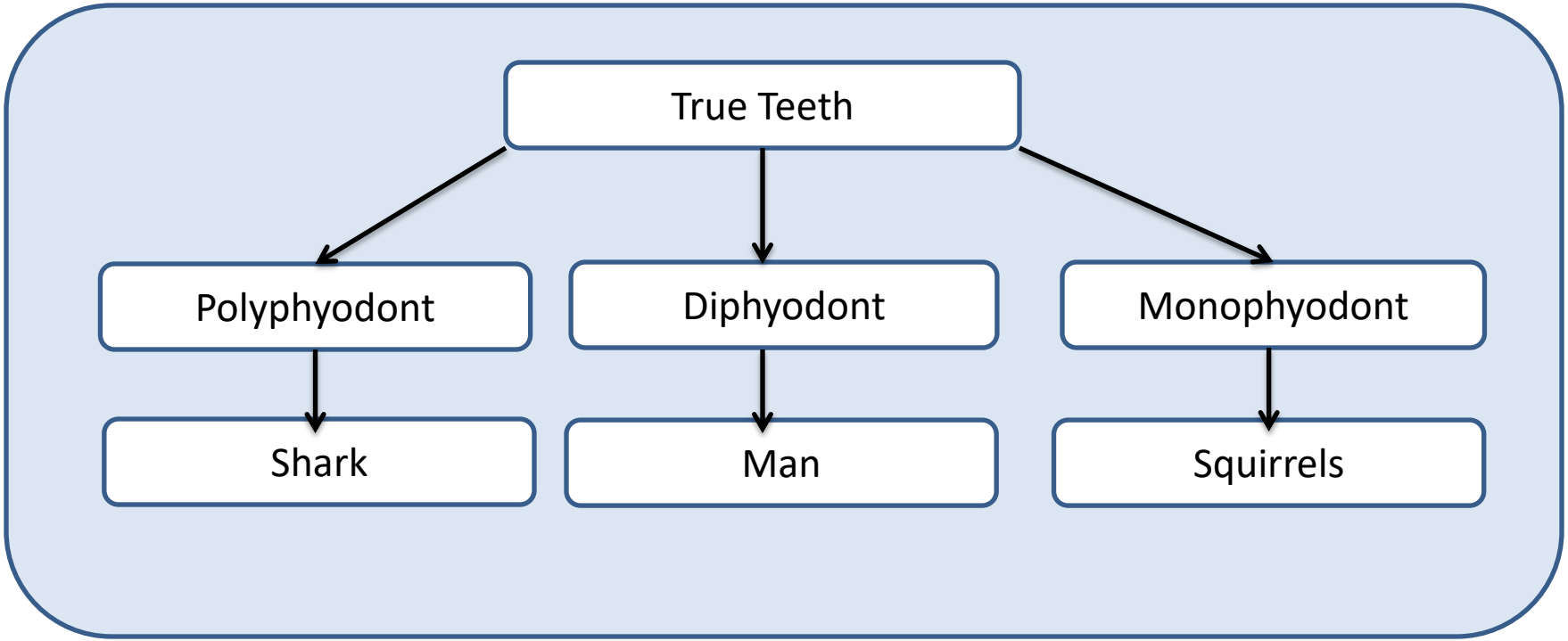
Epidermal Teeth

Tadpoles



Duck Billed Platypus

DIGESTIVE SYSTEM



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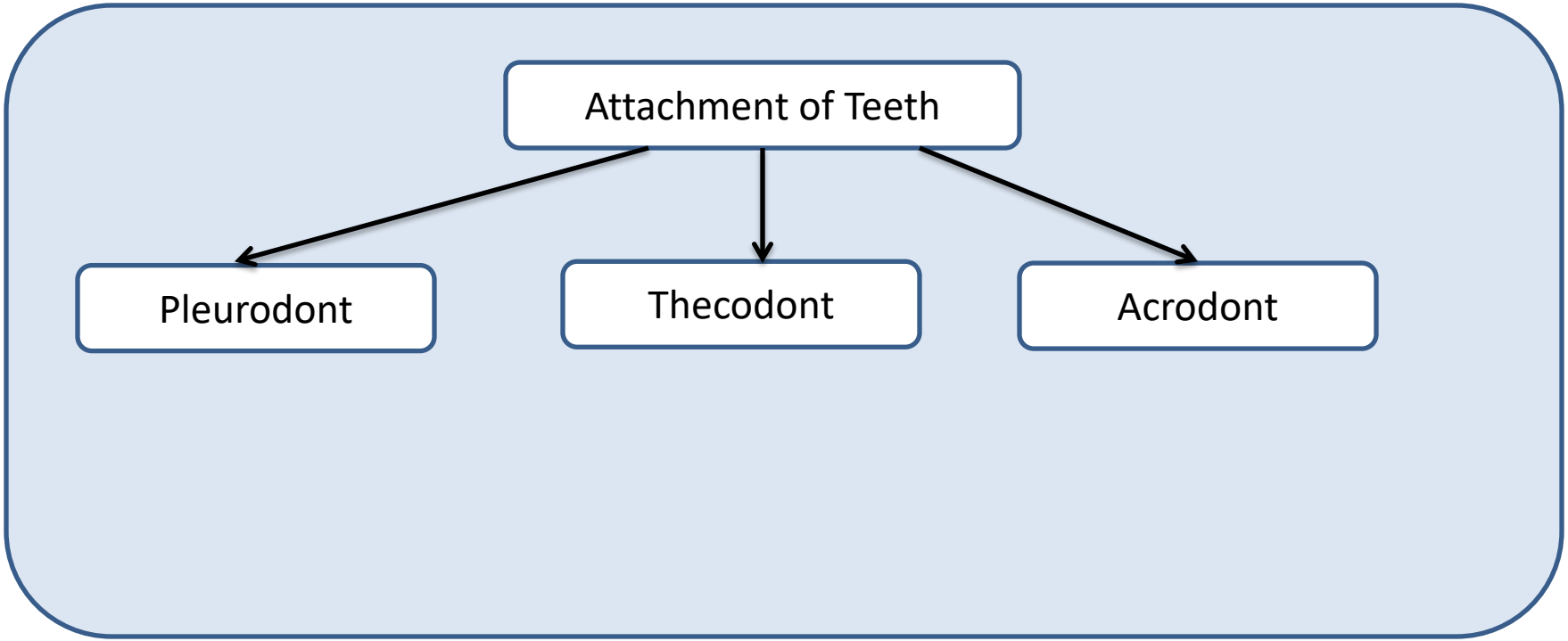
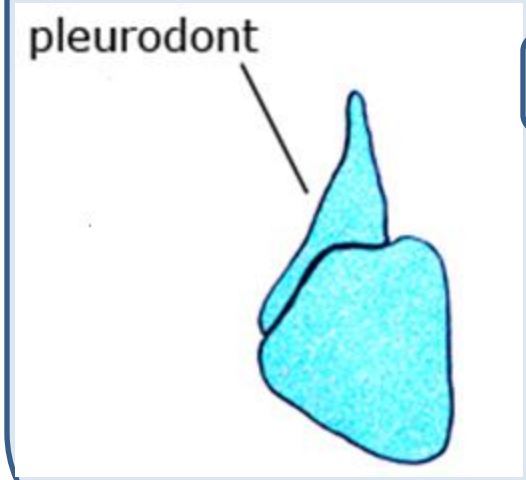


DIGESTIVE SYSTEM

Pleurodont



Teeth is fixed to a shelf like indentations on the inner margins of the jaw

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Primitive condition

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No roots

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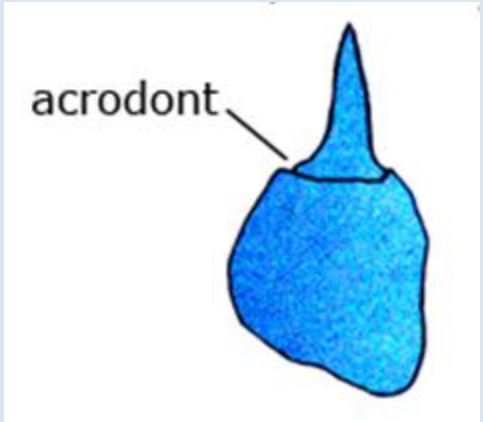

Acrodont

Teeth is attached on the crest of the jaw bone

Found in most of the vertebrates

No roots

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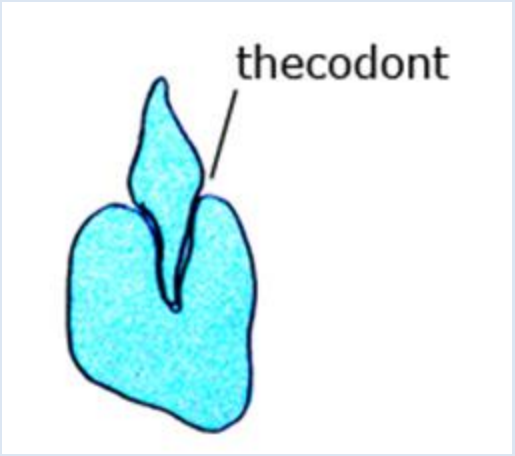


Thecodont

One or more roots

Embedded in the socket of the jaw bone

Crown projects above the socket

DIGESTIVE SYSTEM

Thecodont

In mammals Roots are Longer

Open

Closed

Pulp cavity has wide opening or root canal

Opening of pulp cavity is small

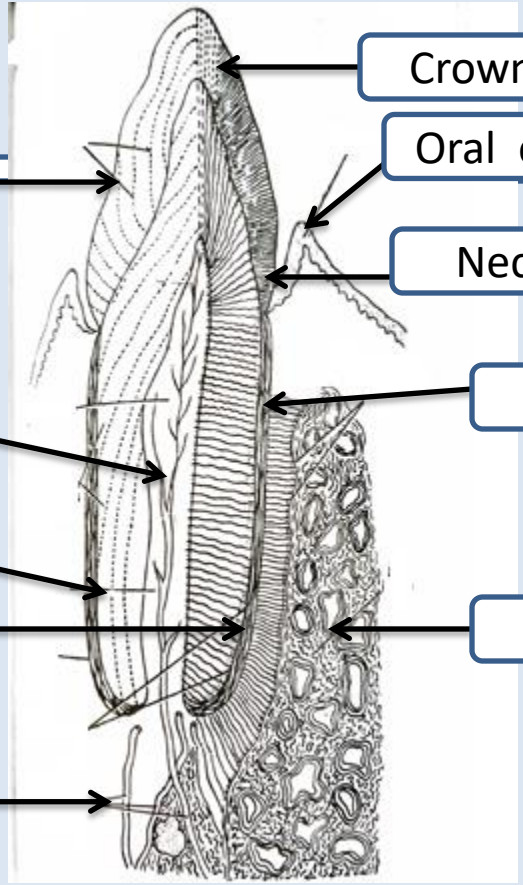
Teeth does not grow after reaching difinite size

Continue to grow throughout their life by addition of dentine

Incisors of rodents
Tusks of elephants

DIGESTIVE SYSTEM

Structure of Teeth



Growth lines in enamel

Root canal

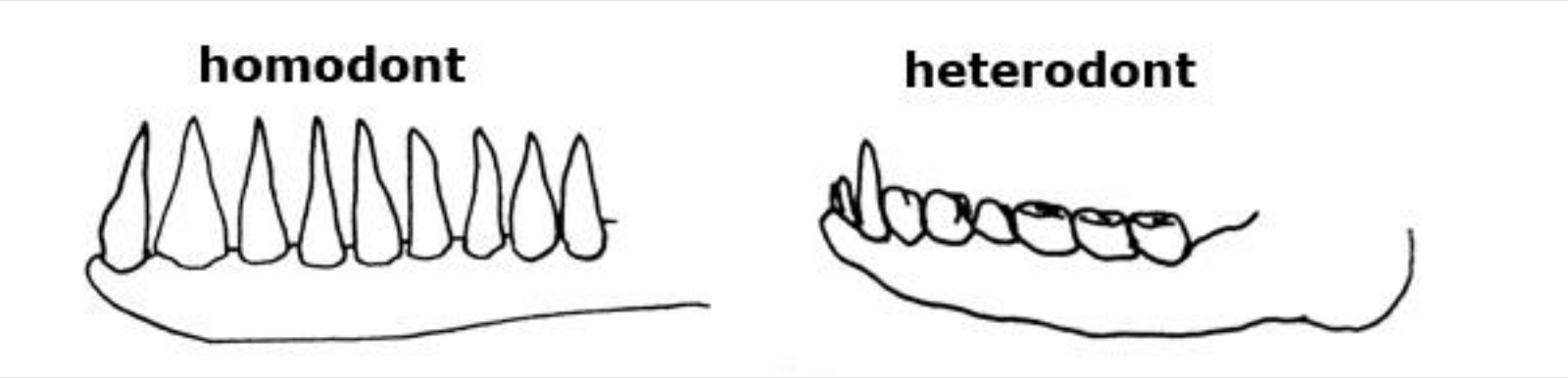
Cement

Cementoblast

Blood vessels & nerves to pulp

DIGESTIVE SYSTEM

Dentition



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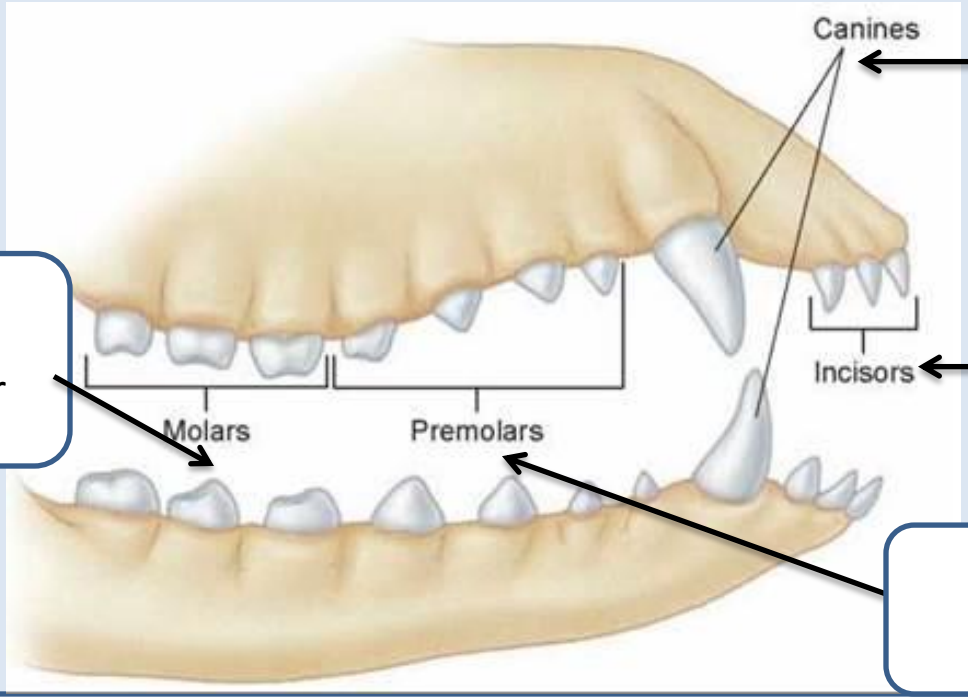


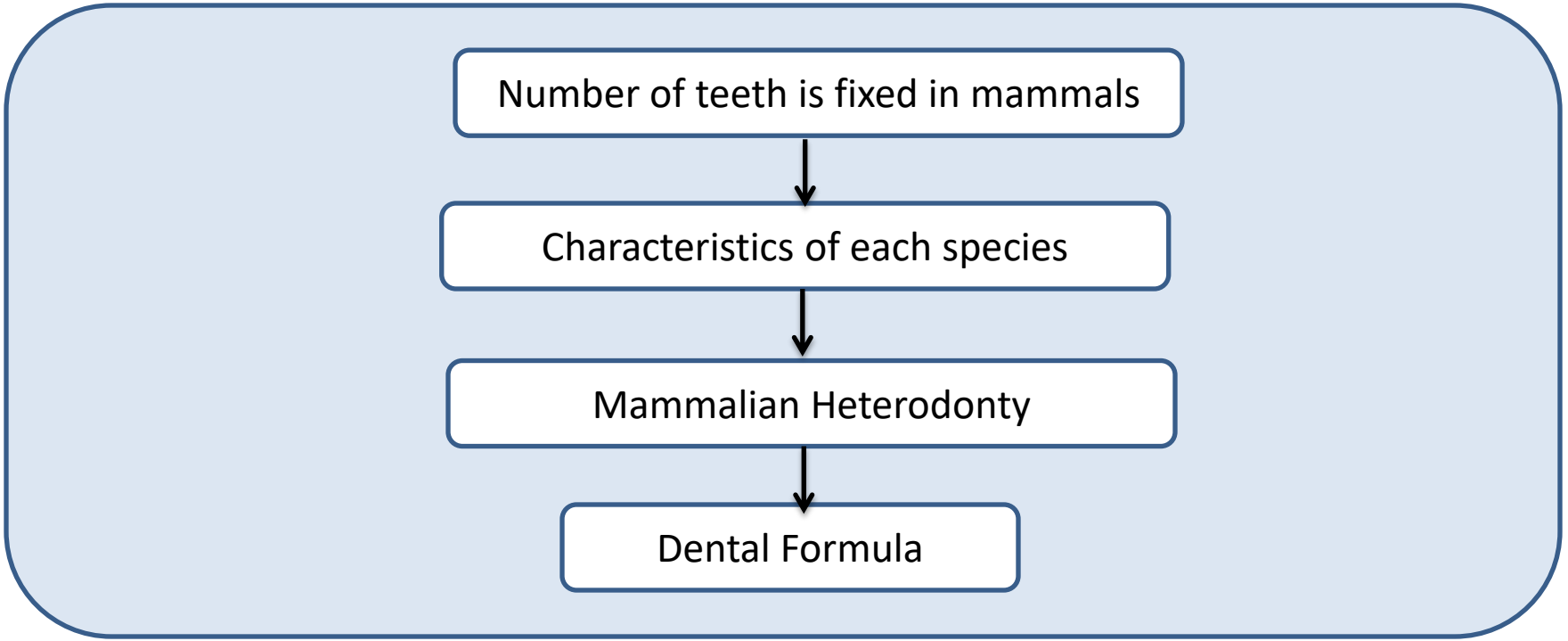
Sharp pointed teeth , Single root

Cheek Teeth
Cusps
Never shed, 2 or more roots

Flat chisel shaped teeth , Single root

Cheek Teeth
Cusps, 1 root
Replaced once

DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

Dental Formula

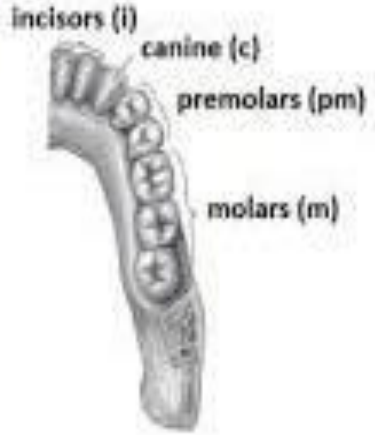
Number of each type of teeth in each half of jaw
Teeth of upper jaw-→ Numerator
Teeth of lower jaw→ Denominator

Dental Formula for human permanent dentition

$$2\left[i\frac{2}{2}\,c\frac{1}{1}\,pm\frac{2}{2}\,m\frac{3}{3}\right]$$

Upper jaw: 16
Lower jaw: 16

Total: 32

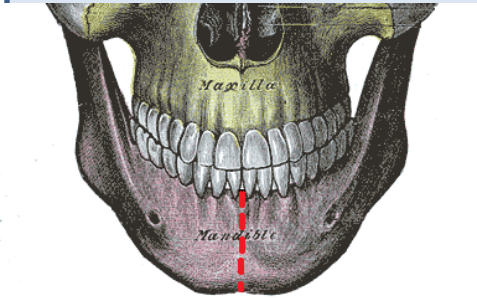


Digestive system-→ Evolution, Histology of digestive tract

- Dentition-→ General structure of teeth
- Denatal formula
- Morphological variants in teeth
- Incisors, Canines, Premolars and Molars

DIGESTIVE SYSTEM

Incisors



Located on either side of the mandibular symphysis

Have one horizontal cutting edge and single root

Best developed in herbivorous mammals

Holding , cropping or gnawing

DIGESTIVE SYSTEM

Rodents

Single pair of large chisel like incisors

Dentin is softer than enamel

Cutting edges of incisors remain sharp

Lagomorphs

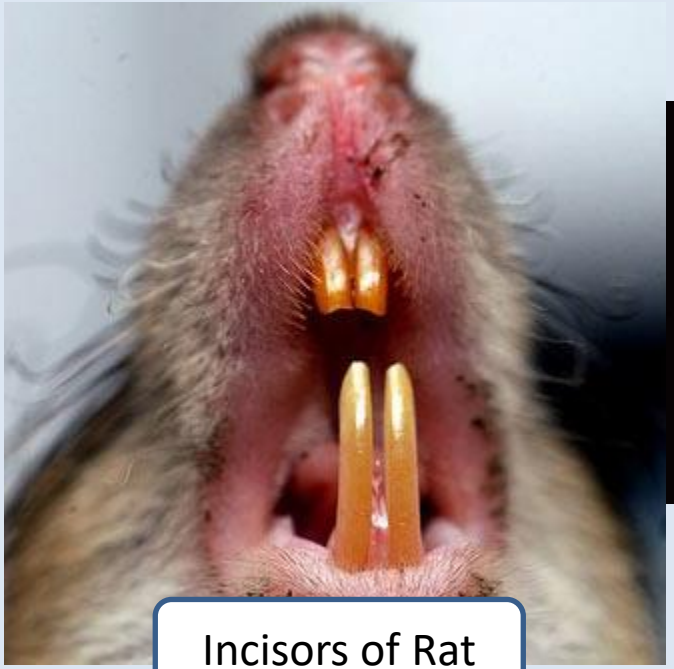
Large front pair
Small second pair of incisors behind

Gnawing wears dentin away faster

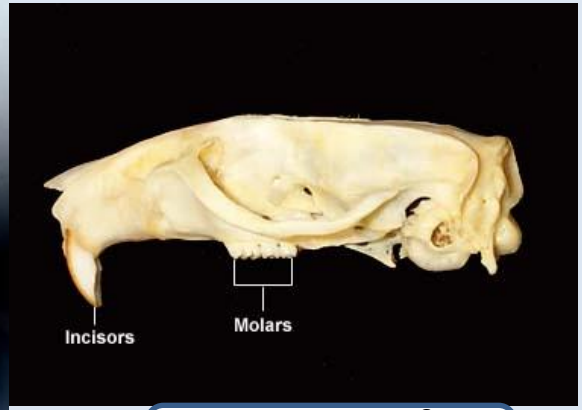
Grow throughout the life

DIGESTIVE SYSTEM

Incisors of Lagomrphs

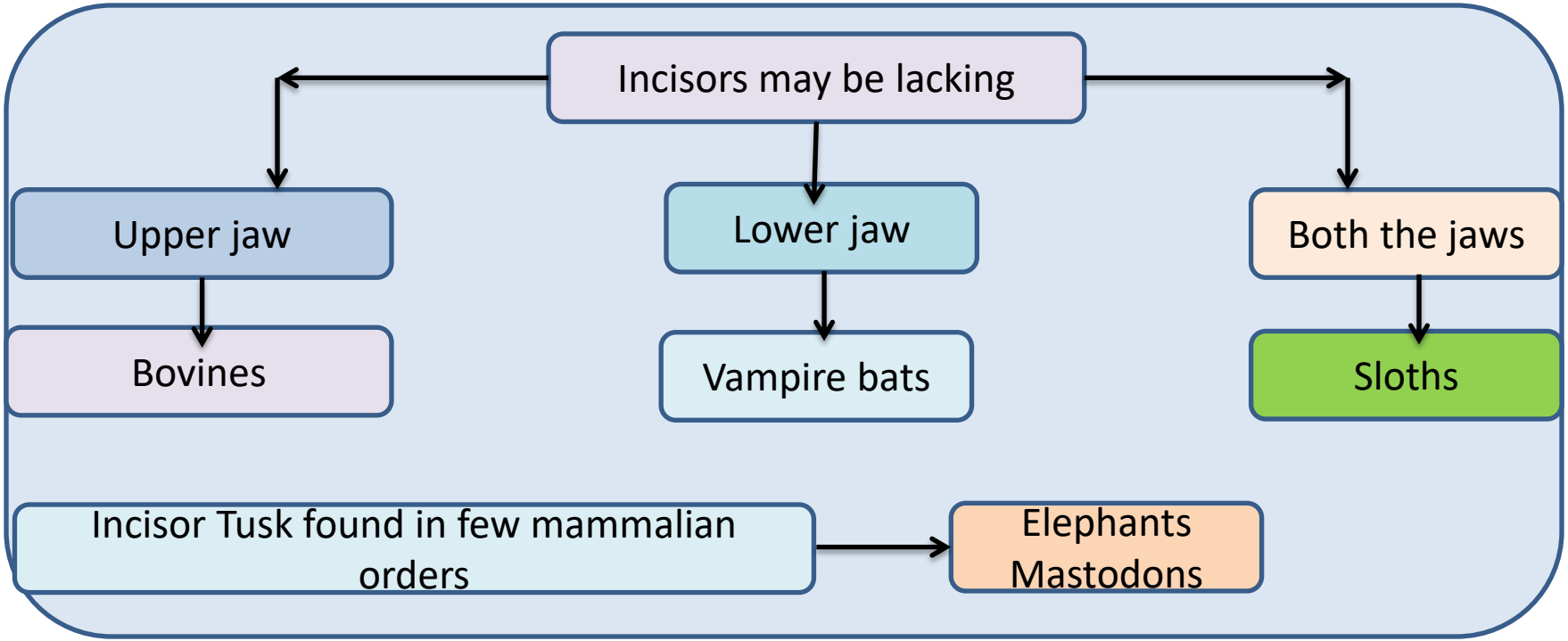


Incisors of Rat



Incisors of Rodents

DIGESTIVE SYSTEM



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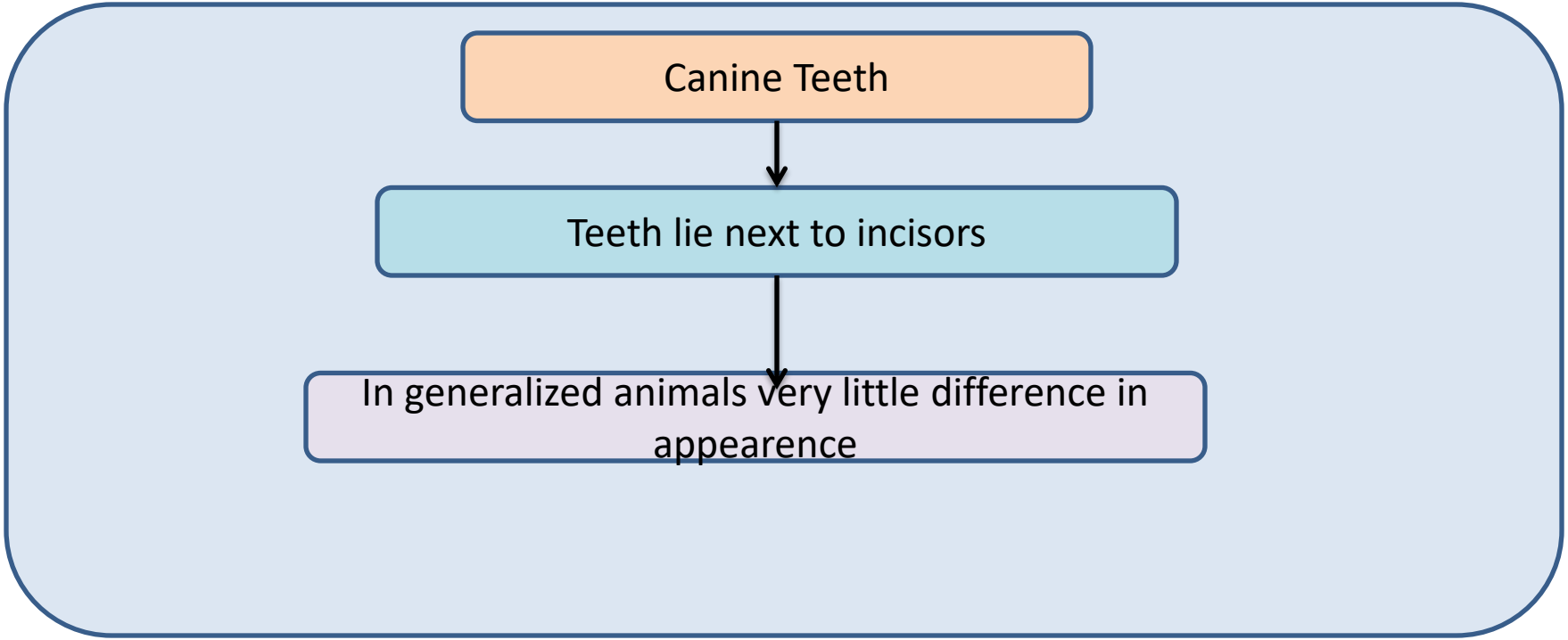

DIGESTIVE SYSTEM

Canine Teeth

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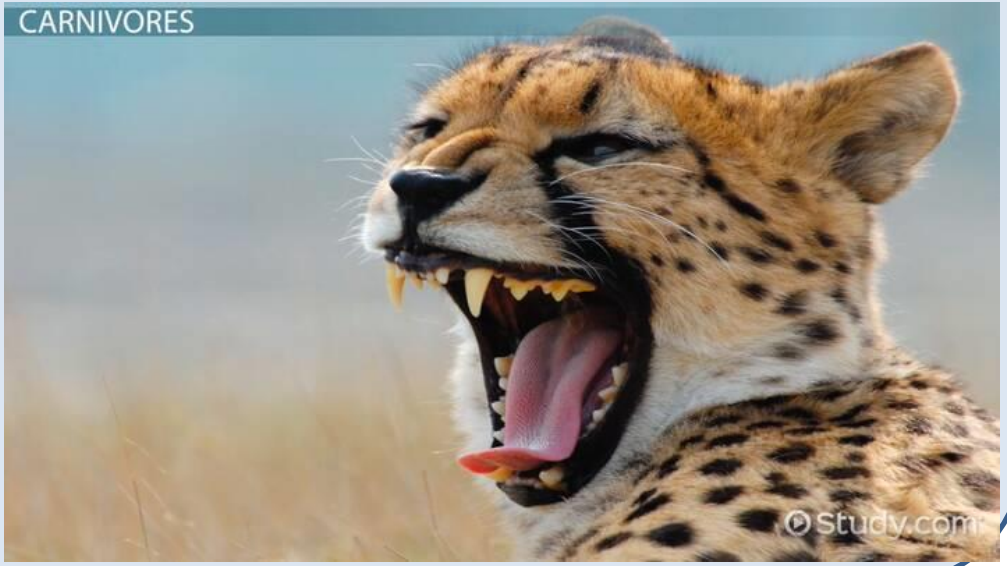
Carnivores

↓

Spear like

↓

Piercing flesh



DIGESTIVE SYSTEM

Canine Teeth

Haul their enormous bodies out of frigid waters

Break ice

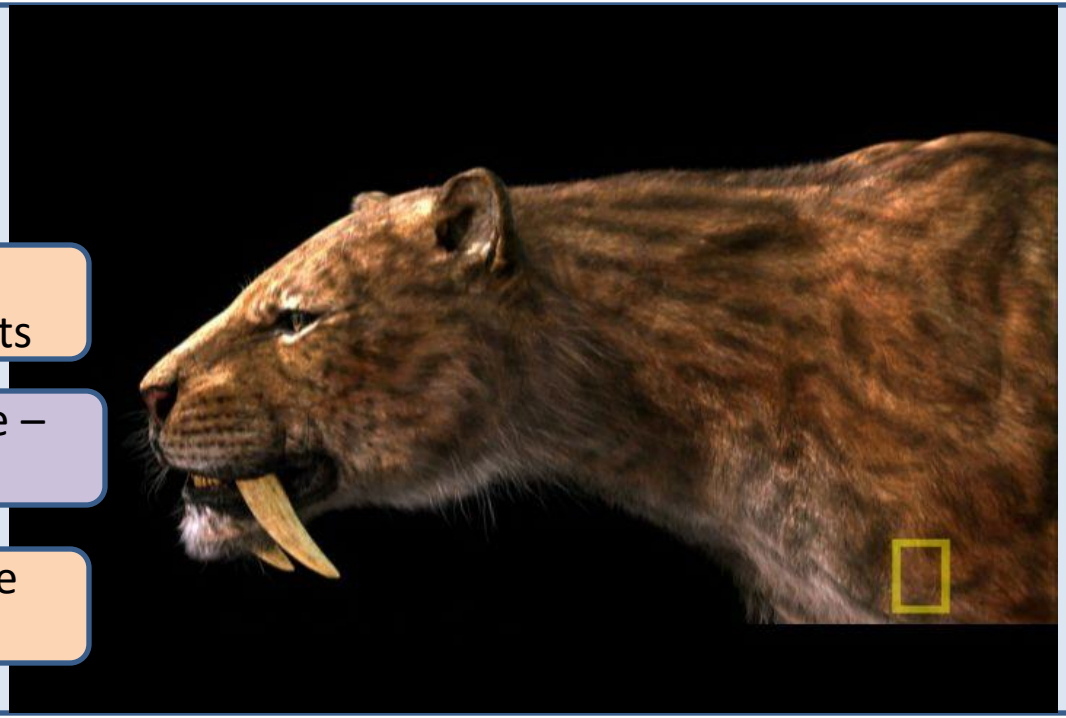
Tusk of Walrus

DIGESTIVE SYSTEM

Canines of
Saber toothed cats

Upper jaw canine –
20cm

Lower jaw canine
reduced



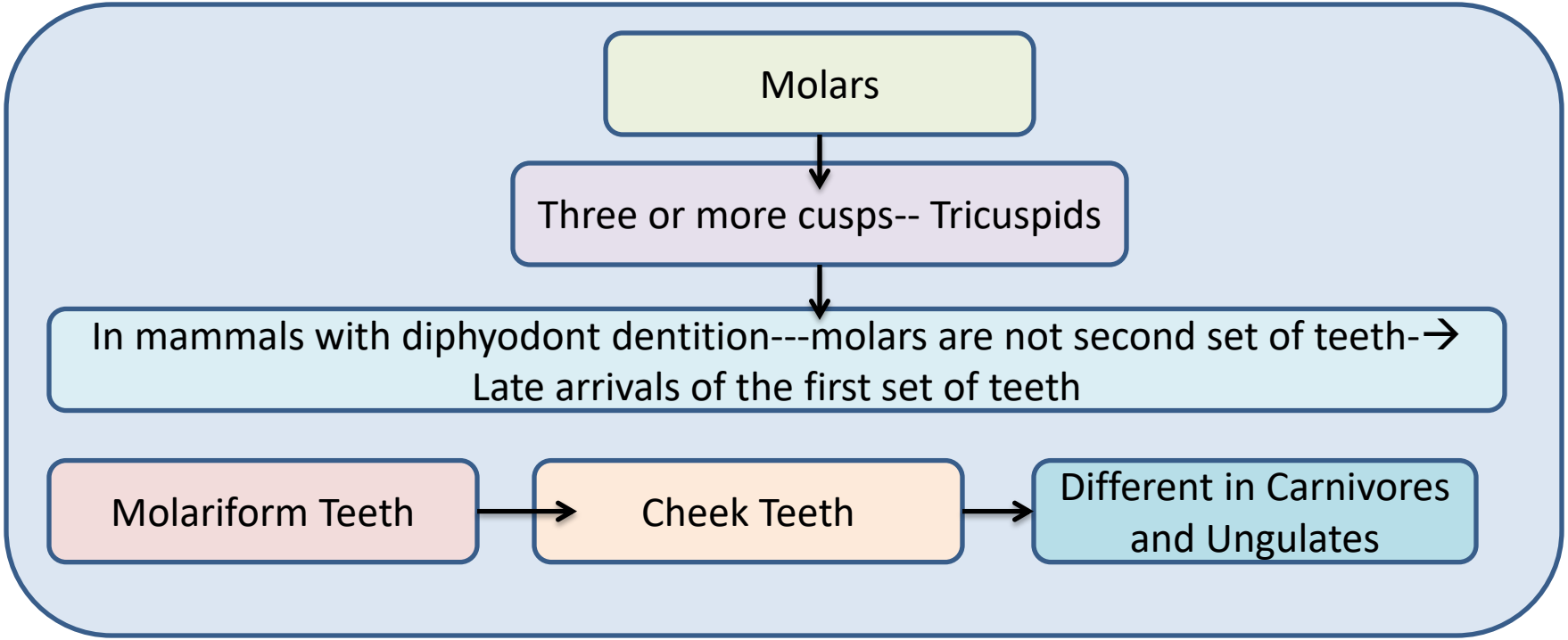
DIGESTIVE SYSTEM

Premolars

In most of the mammals other than ungulates – 2 prominent cusps→ Bicuspid

- One or two roots
- Differ in upper and lower jaw
- Different individuals of same populations

DIGESTIVE SYSTEM



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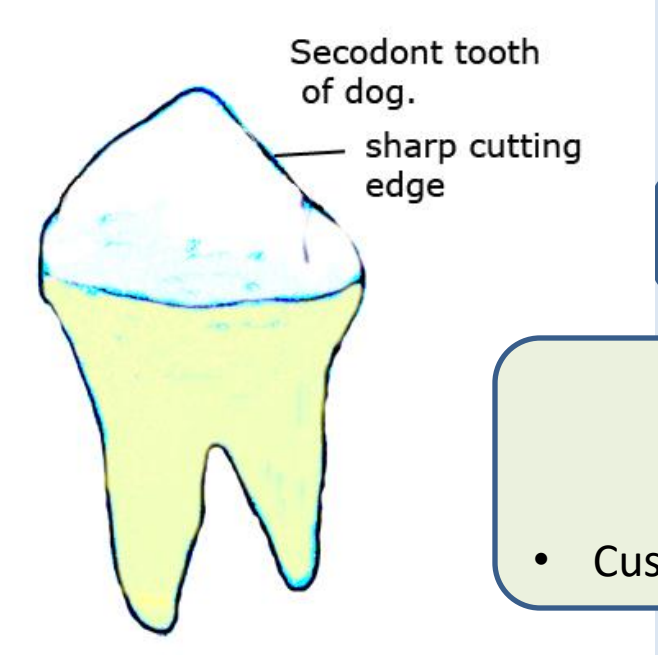


Carnivores

Crushing bones, Shearing & Grinding ligaments, tendons and flesh

Crowns of carnivorous cheek teeth are:

- laterally compressed ,
- roots are long,
- Cusps are interconnected with sharp ridges of enamel

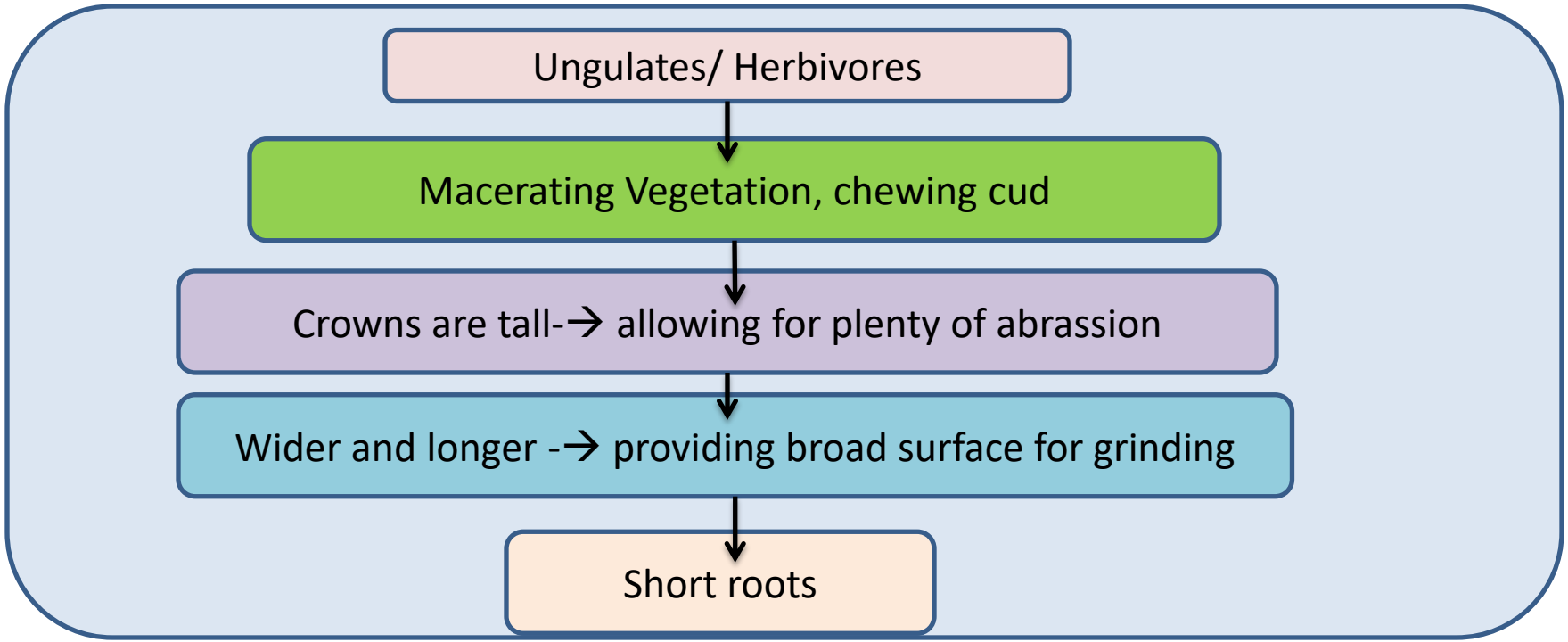
DIGESTIVE SYSTEM

Cusps of cheek teeth of lower jaw and upper jaw fit between one another, when the jaws are closed-→ Sharp enamel ridges -→ Shearing effect-→ Maceration

The last upper premolar and first lower molar are functional for maceration

Carnassial teeth

DIGESTIVE SYSTEM



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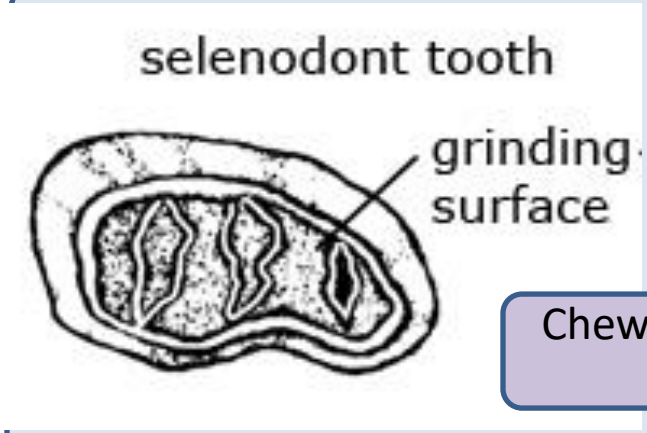


Crescentic columns of dentin surrounded by enamel

↓

Naked dentin is exposed to grinding surface

↓

Chewing causes softer dentin to wear more quickly than the enamel, thereby providing sharp cresentic ridges

↓

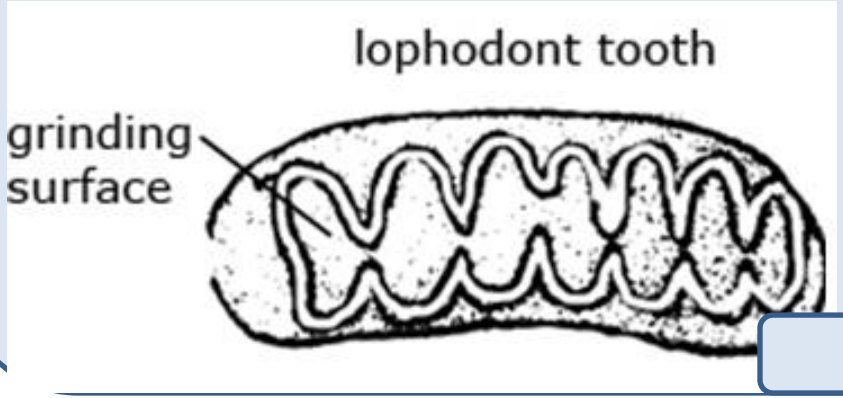
Ruminant Herbivores

Macerating food--→ side to side or forward backward movement of jaw

DIGESTIVE SYSTEM

The cusps join to form ridges --→ Lophs

Intricately folded to form sharp transverse ridges covered with enamel and between the ridges dentin is present



Grinding plants

30 cm in length, 10 cm in width

Elephants

DIGESTIVE SYSTEM

Bunodont teeth

Small separate and rounded cusps for grinding

Lack sharp edges and pointed cusps

Omnivores and Herbivores → Man and Monkey, Rhinoceros

bunodont molar

DIGESTIVE SYSTEM

Most unusual mammalian teeth

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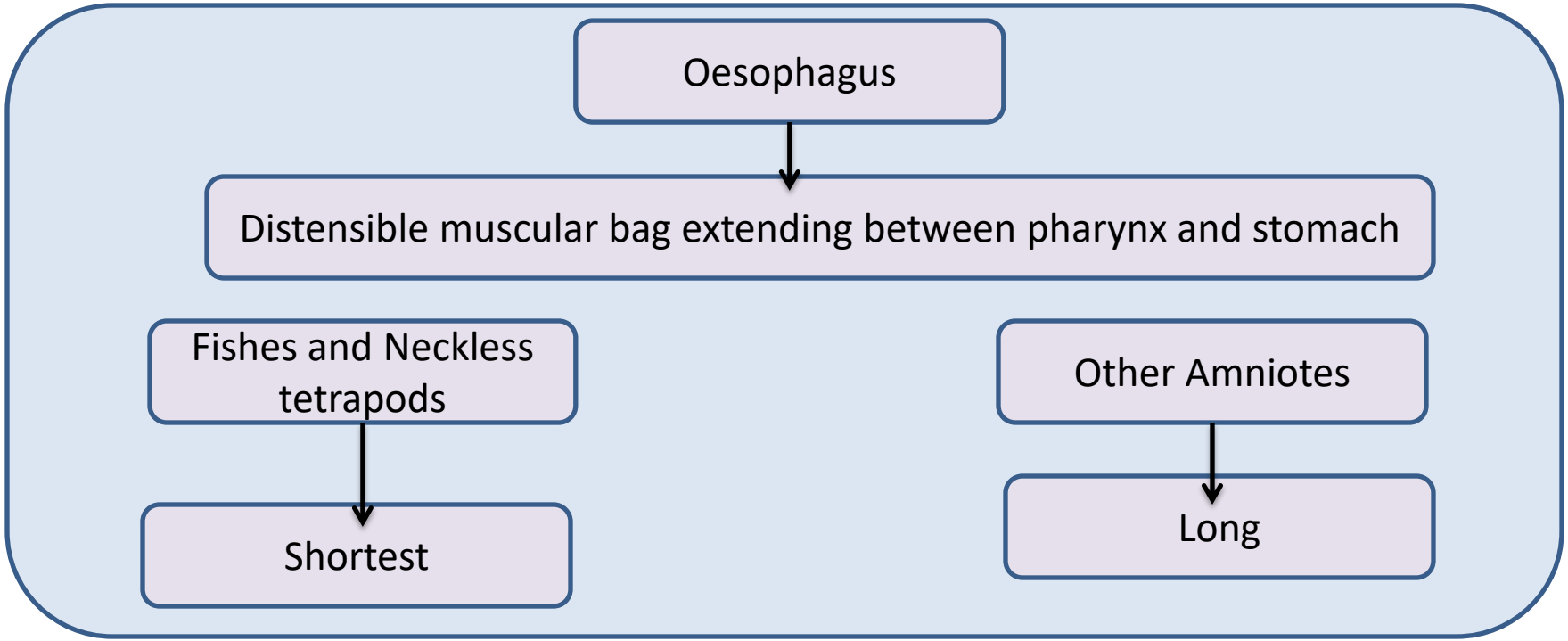
Crab eater seal

↓

Teeth are employed to strain small crustaceans and planktons

DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

Function: Conduct food material from pharynx to stomach

Gland: Mucus secretion → for smooth passage of food material

Muscles: Striated→Striated + Smooth→ Smooth

Cud chewing animals---→ Striated muscles

DIGESTIVE SYSTEM

Stratified squamous epithelium-→ Cornified-→Terrestrial turtles, few mammals and birds

↓

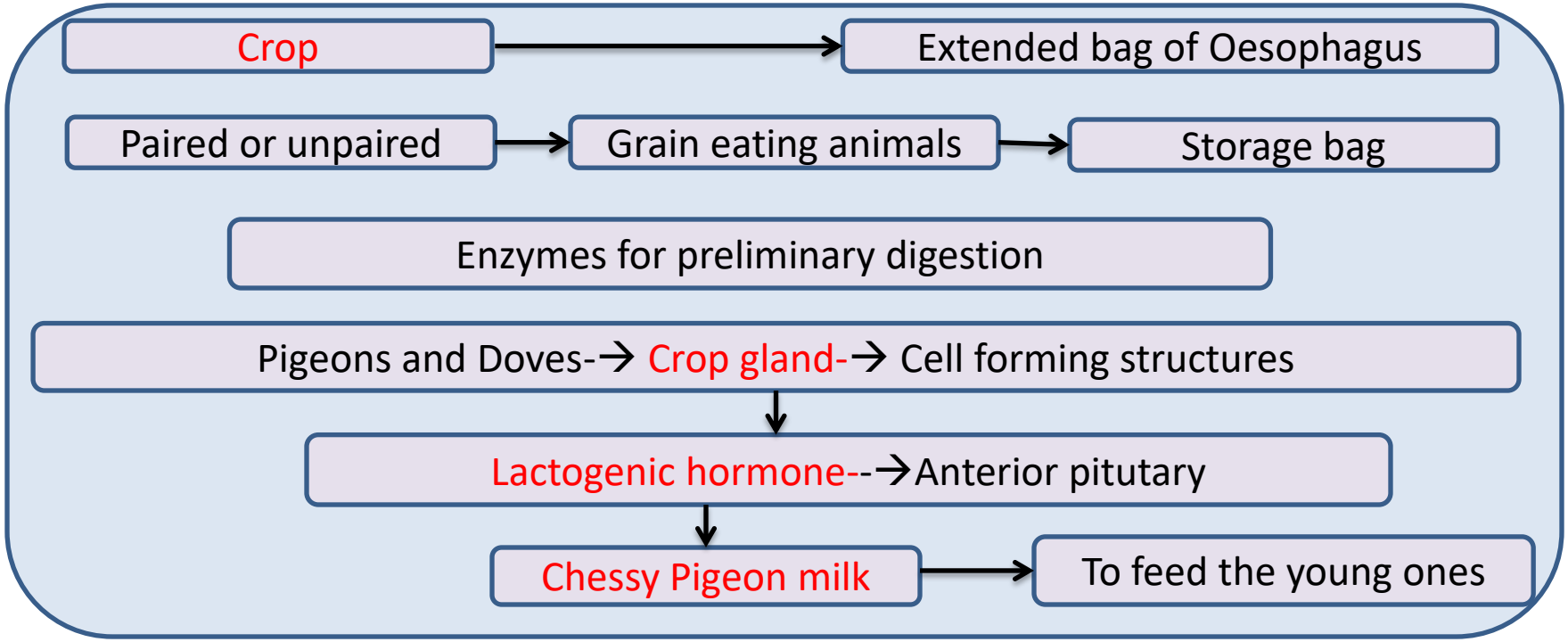
Withstand any abrasion caused by roughage of diet

Marine turtle-→ Horny papillae→ Directed backwards

↓

Easy swallowing of sea-weeds

DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

Histologically oesophagus differs from the rest of the alimentary canal

No visceral peritoneum

It lies outside the coelom

Adventitia -→ Outer most layer

Muscle fibres

Mucous membrane lining is made of stratified squamous epithelial cell and not columnar epithelial cells

DIGESTIVE SYSTEM

Stomach

Dilated bag for storage and digestion of food

In cyclostomes and some fishes stomach is absent

DIGESTIVE SYSTEM

Shape of the stomach

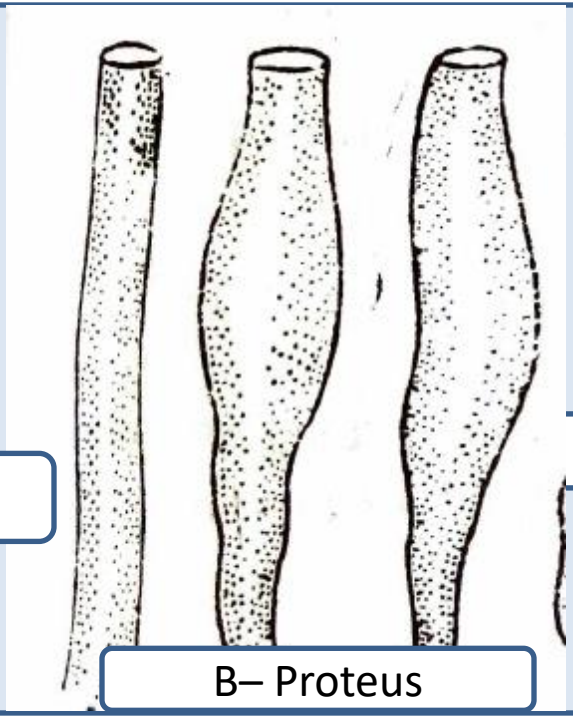
Straight when it first differentiates in embryo

In some fishes and some Urodeles--→ stomach remains straight throughout life

Flexures develop-→ J shaped or U shaped Stomach

DIGESTIVE SYSTEM

Shapes of Stomach



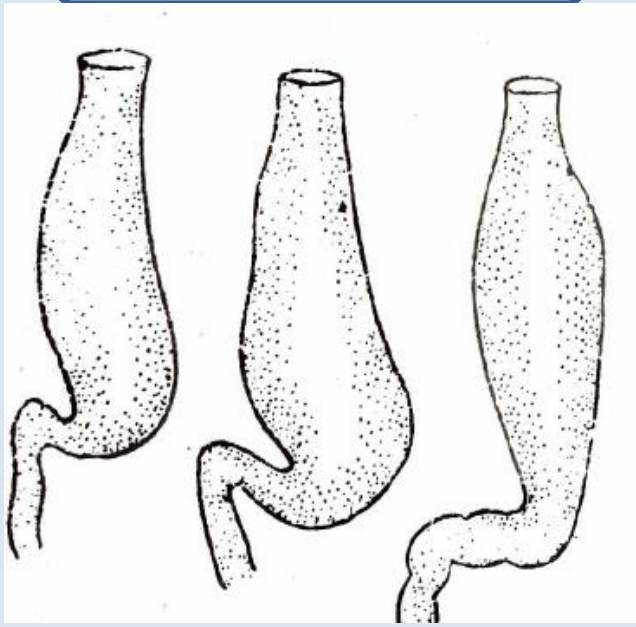
A—Belone

B– Proteus

C– Natrix

DIGESTIVE SYSTEM

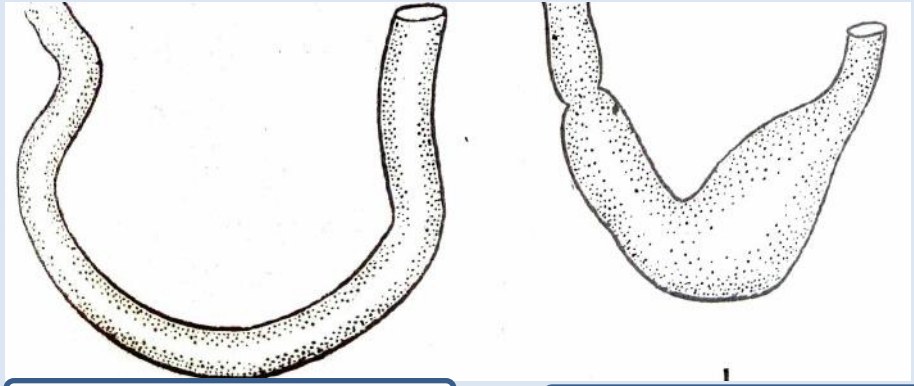
Shapes of Stomach



D– Gobius
E– Shark
F– Phoca (Walrus)

DIGESTIVE SYSTEM

Shapes of Stomach

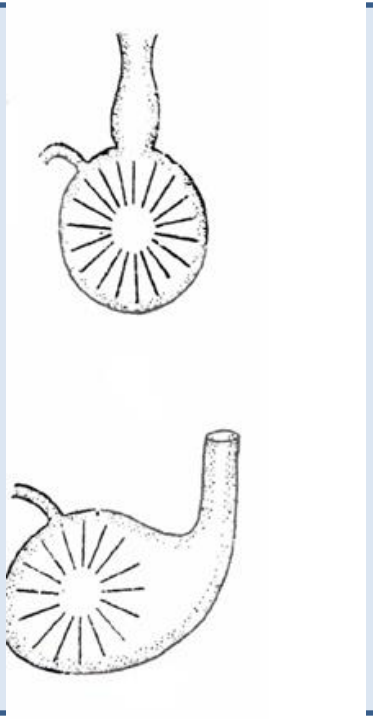


Testudo

J- Land Tortoise

DIGESTIVE SYSTEM

Shapes of Stomach



Birds

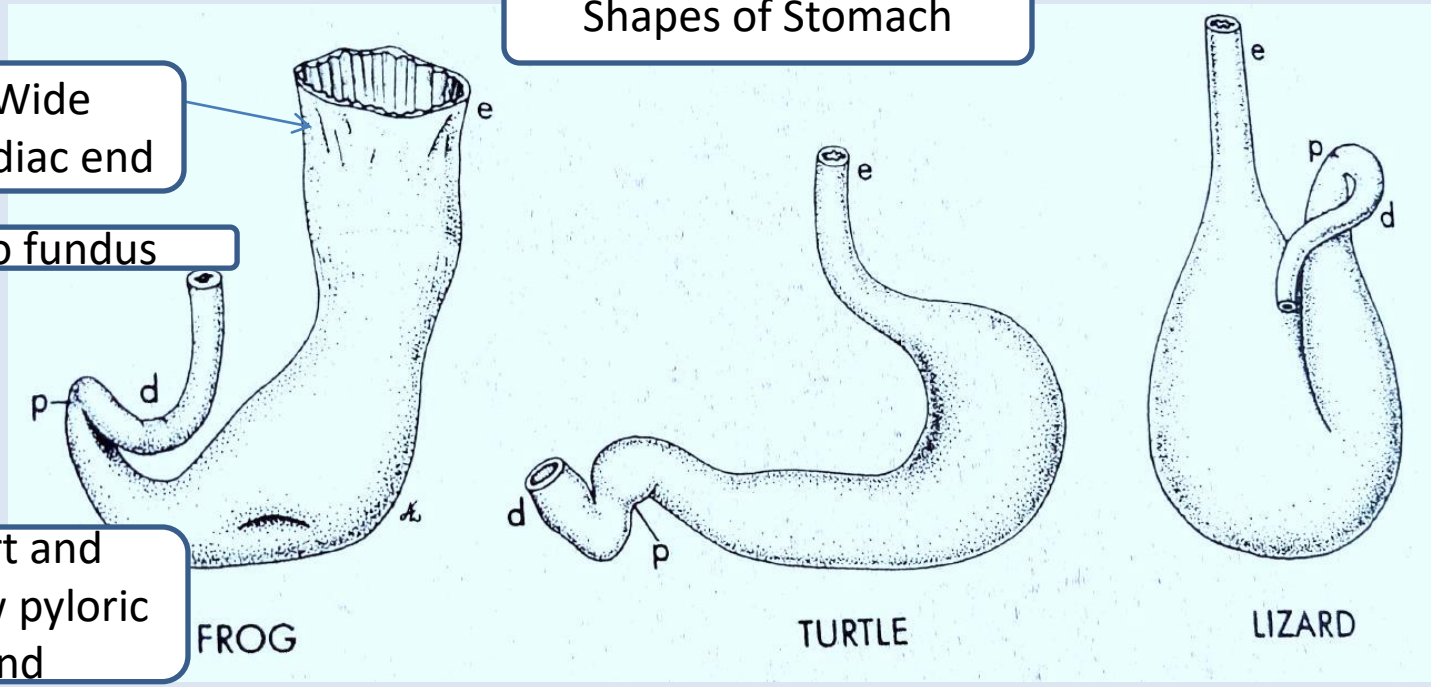
DIGESTIVE SYSTEM

Shapes of Stomach

Wide Cardiac end

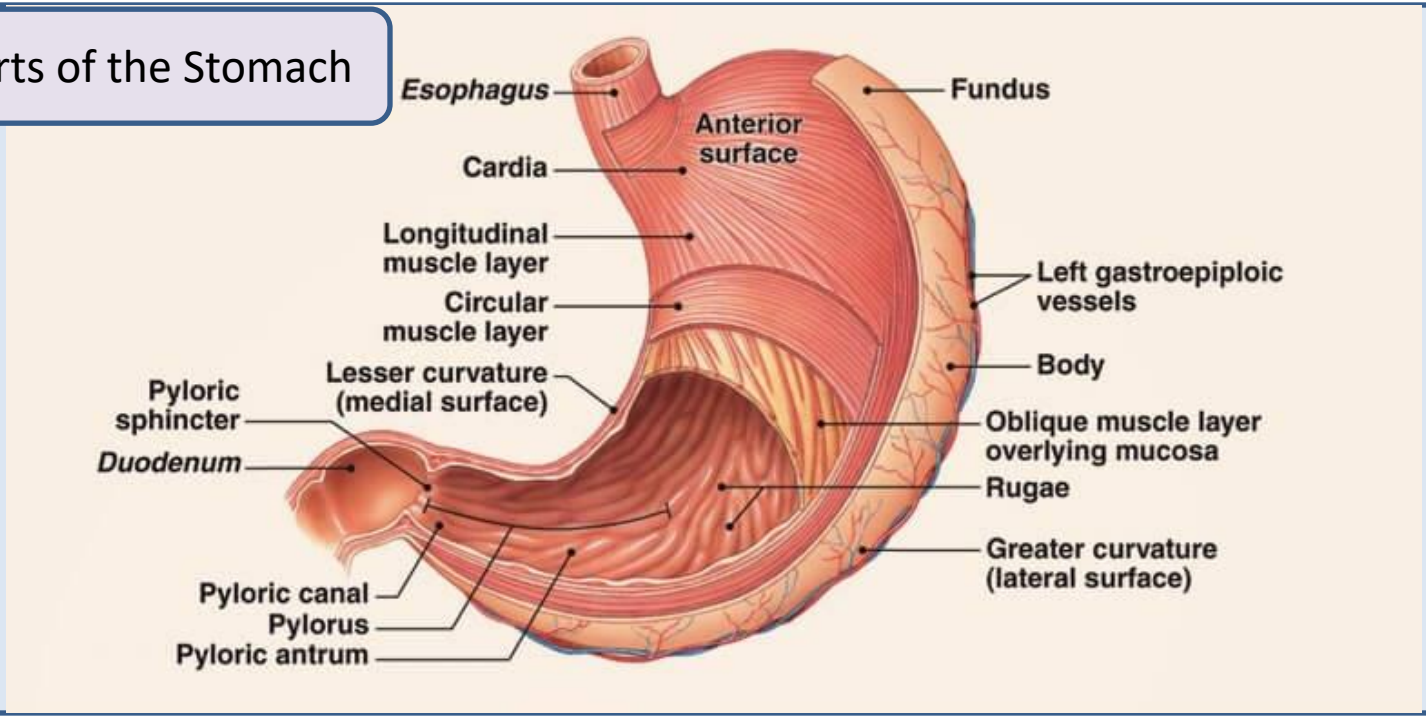
No fundus

Short and narrow pyloric end



DIGESTIVE SYSTEM

Parts of the Stomach



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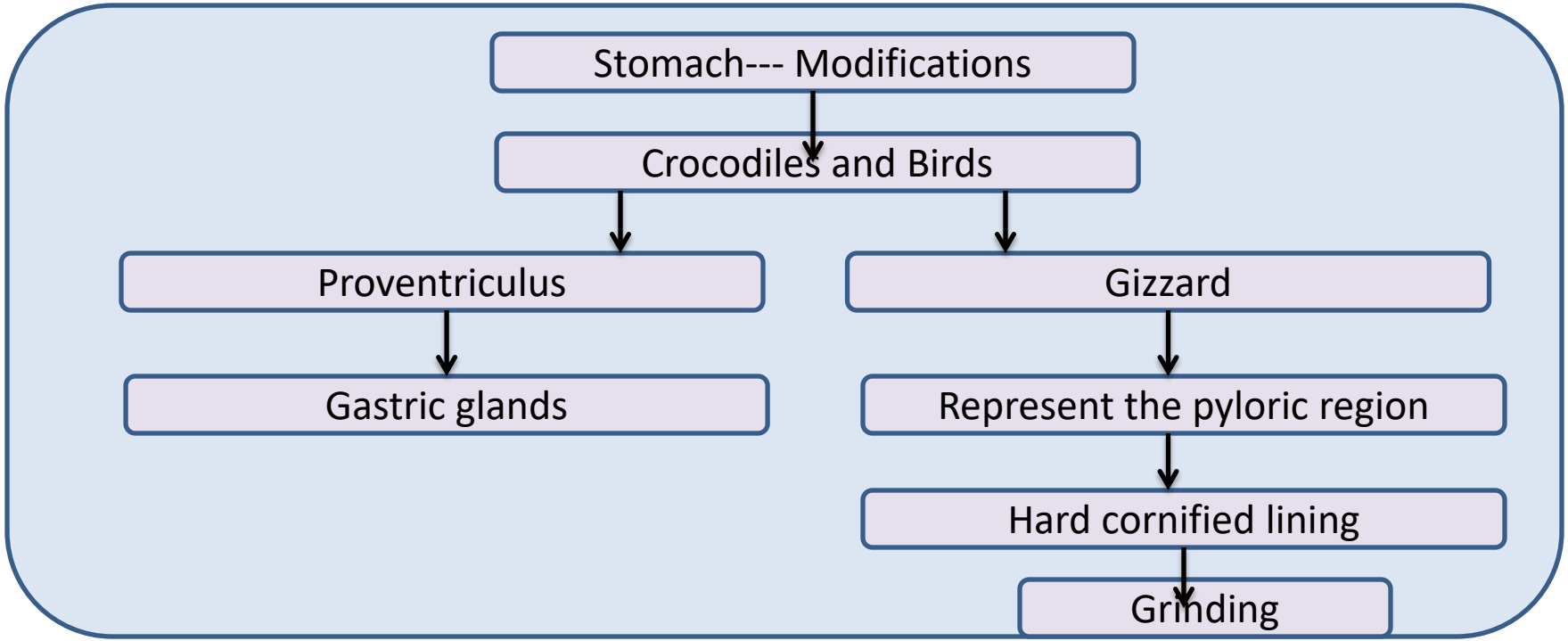

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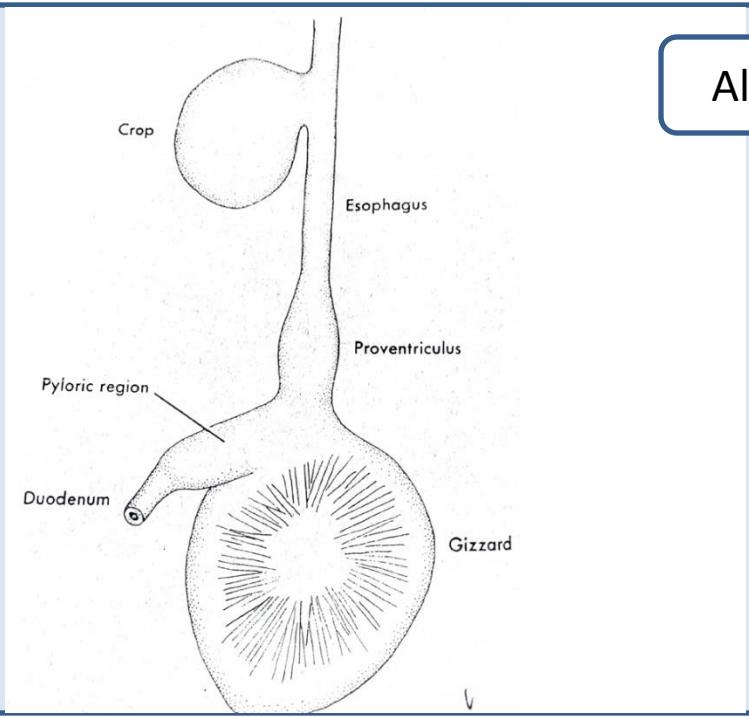
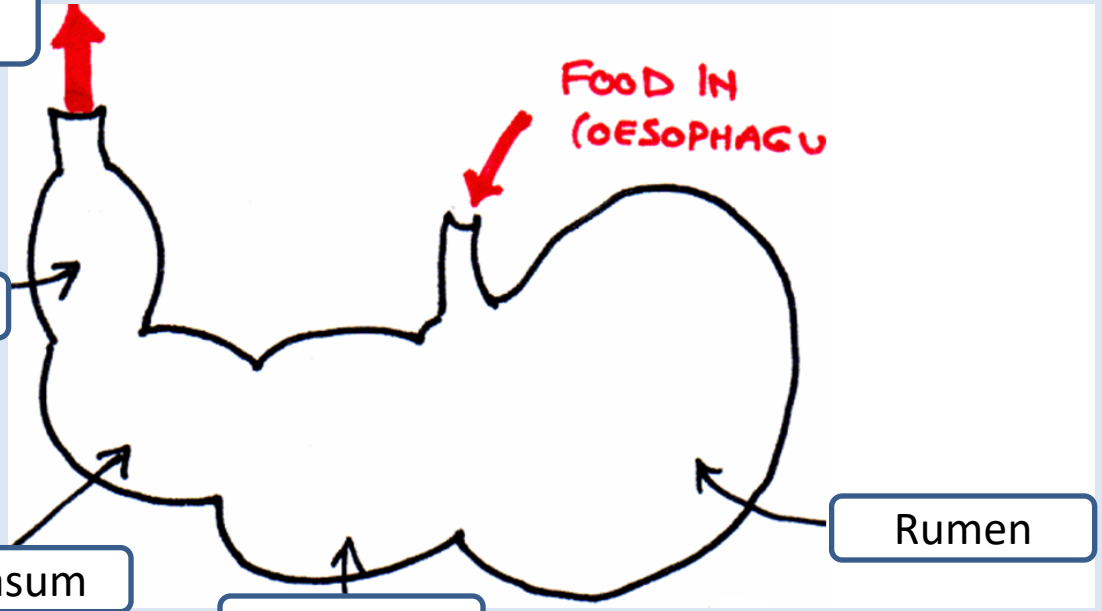


Alimentary canal of Grain eating bird

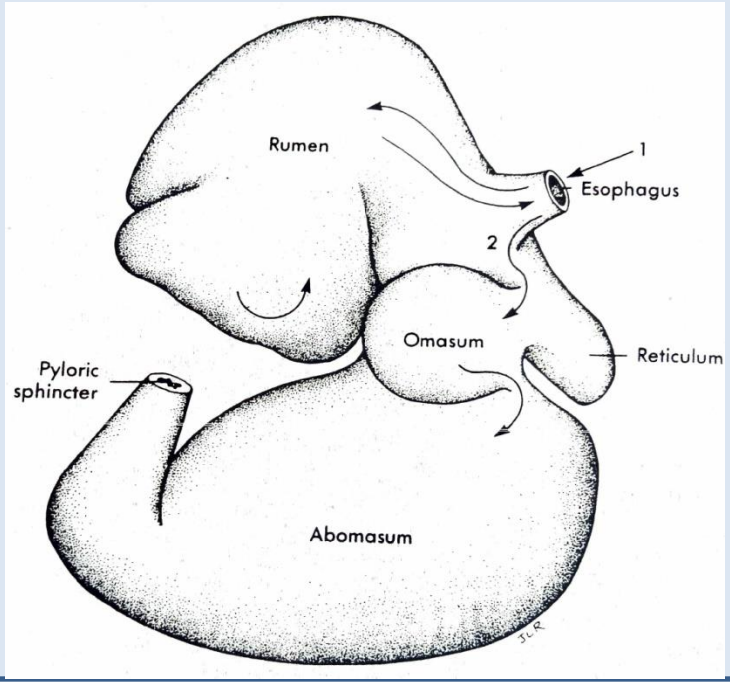
DIGESTIVE SYSTEM

Stomach of Ruminant Animals



DIGESTIVE SYSTEM

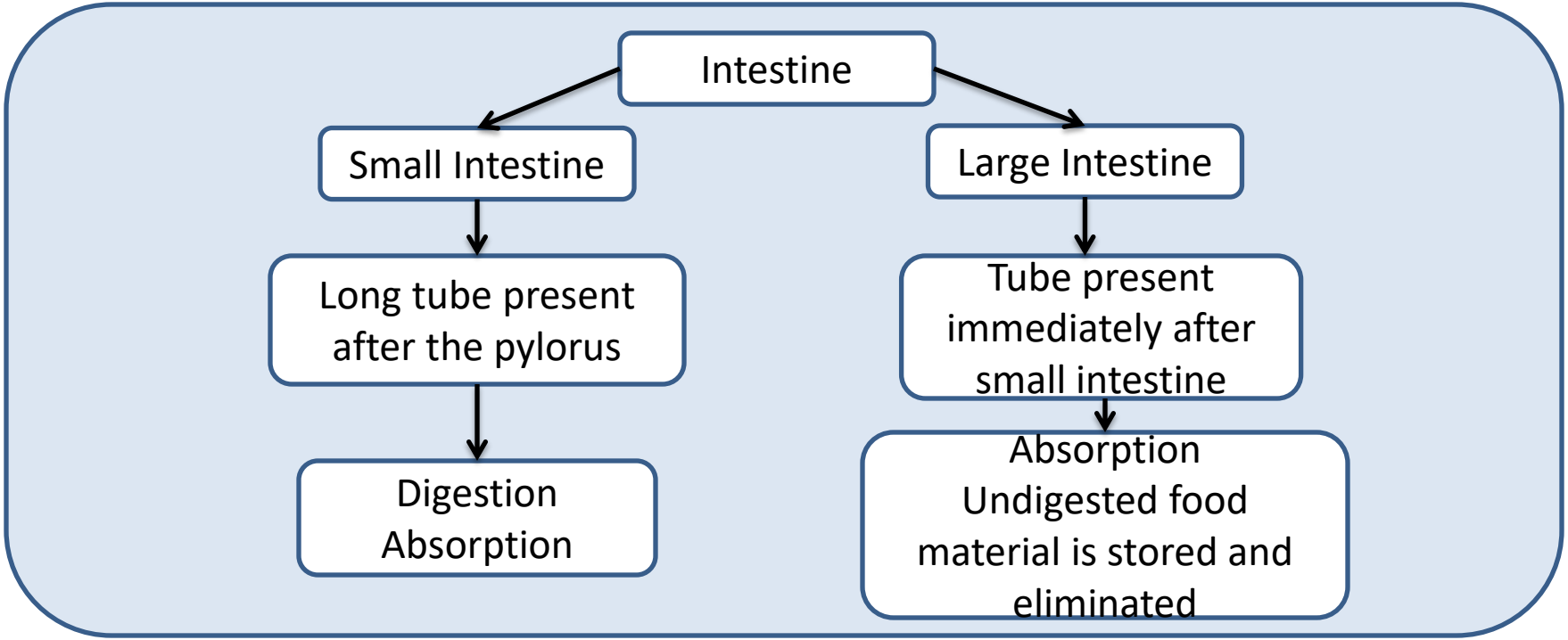
Stomach of Ruminant Animals



DIGESTIVE SYSTEM

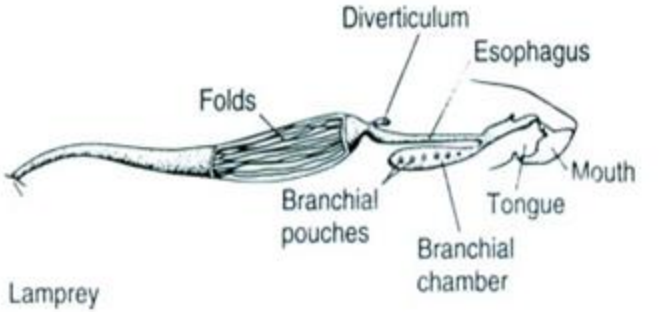
Cell Types	Substance Secreted
Goblet cells	Mucus (protects stomach lining)
Parietal cells	Gastric acid (e.g. hydrochloric acid)
Chief cells	Pepsinogen (protease precursor)
D cells	Somatostatin (inhibits acid secretion)
G cells	Gastrin (stimulates acid secretion)

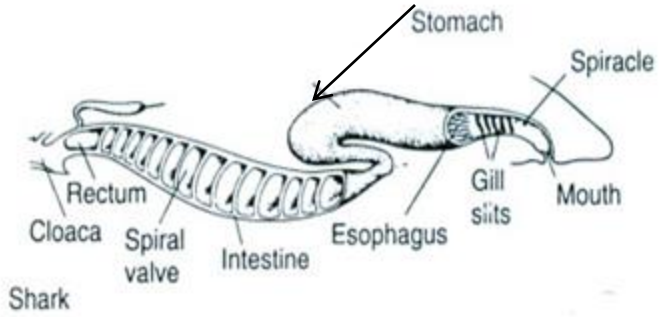
DIGESTIVE SYSTEM

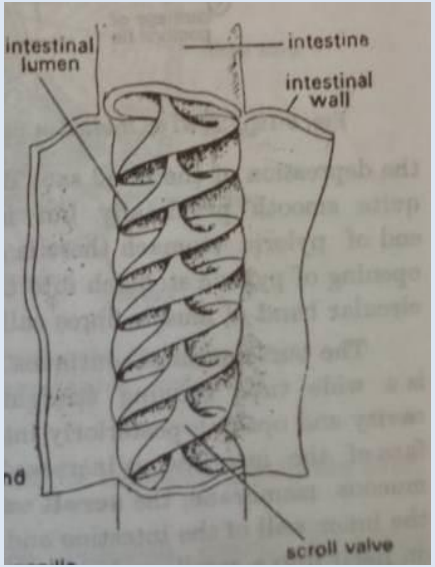


DIGESTIVE SYSTEM

Intestine in fishes

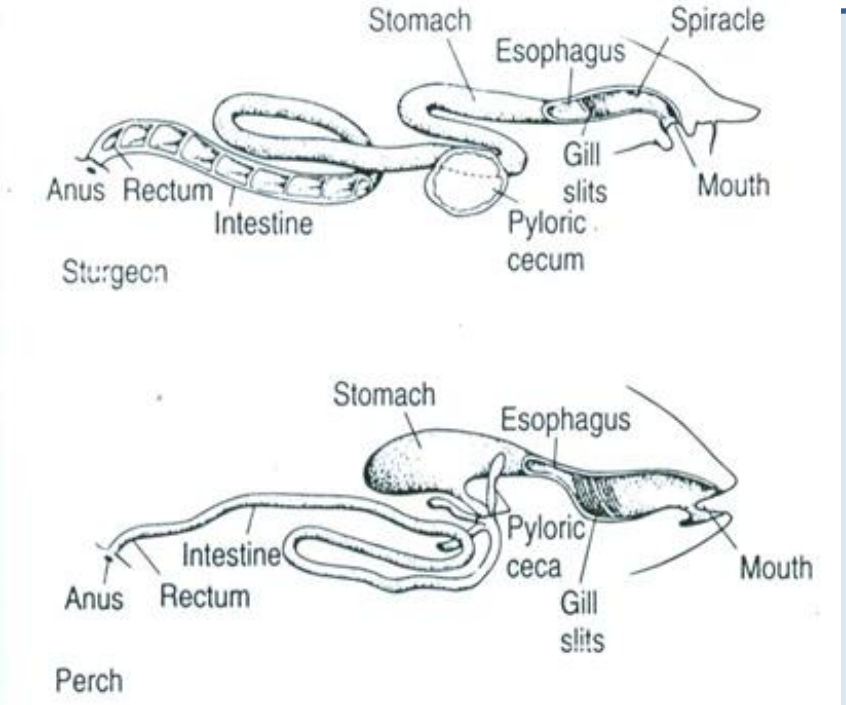






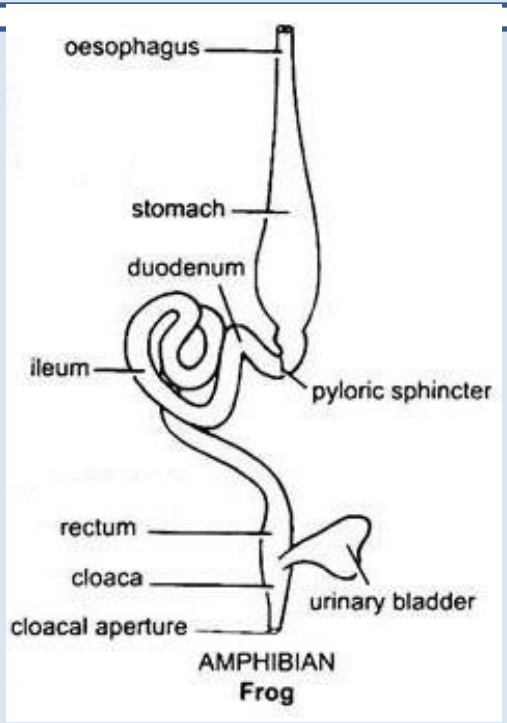
DIGESTIVE SYSTEM

Intestine in fishes



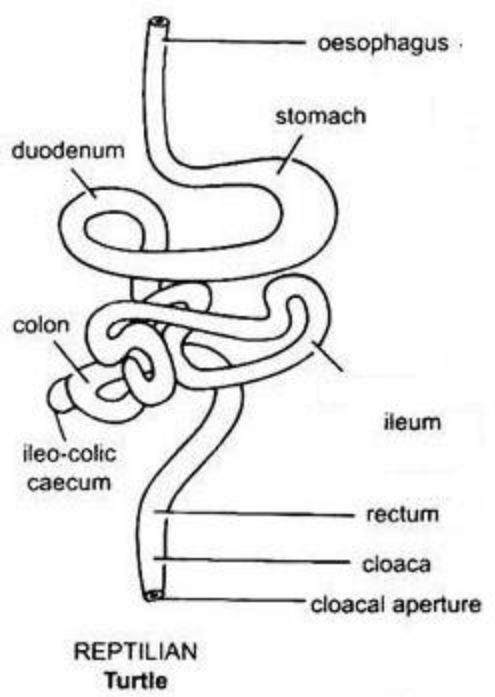
DIGESTIVE SYSTEM

Fan line mysentry
Small intestine
Large intestine
Duodenum--- Us haped-→ Transverse folds-→ Increase surface
Ileum-→ Short andhighly coiled-→ Longitudinal folds
Rectum-→ short and broad→Cloaca

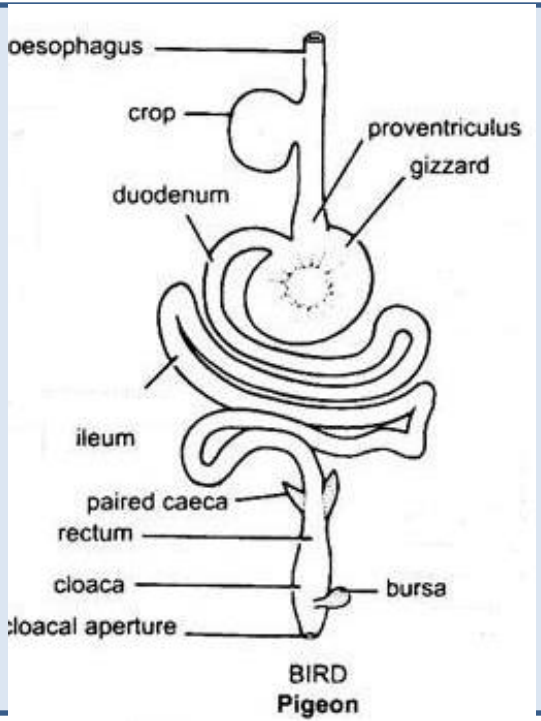


DIGESTIVE SYSTEM

Duodenum-→ 2 ducts-→ Pancreas, Bile juice salts
Ileum→ Short with few coils-→ Large intestine-→ Proximal Colon and Distal Rectum
Blind pouch -→ Caecum



DIGESTIVE SYSTEM



BIRD
Pigeon

DIGESTIVE SYSTEM

Small intestine

Duodenum-→ Pancreatic juice, Bile salts

Bruner's glands/ Duodenal glands-→ Neutralizing gastric acid

Jejunum

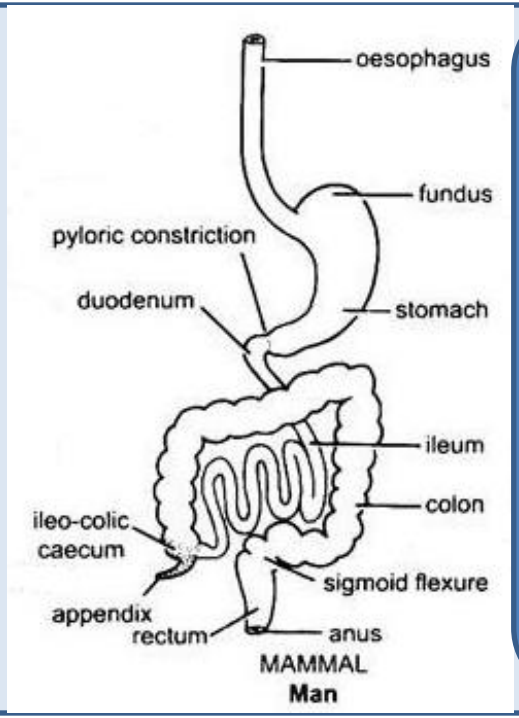
Ileum---→ Large intestine

Absorptive cells

Goblet cells

Enteroendocrine cells

Paneth cells

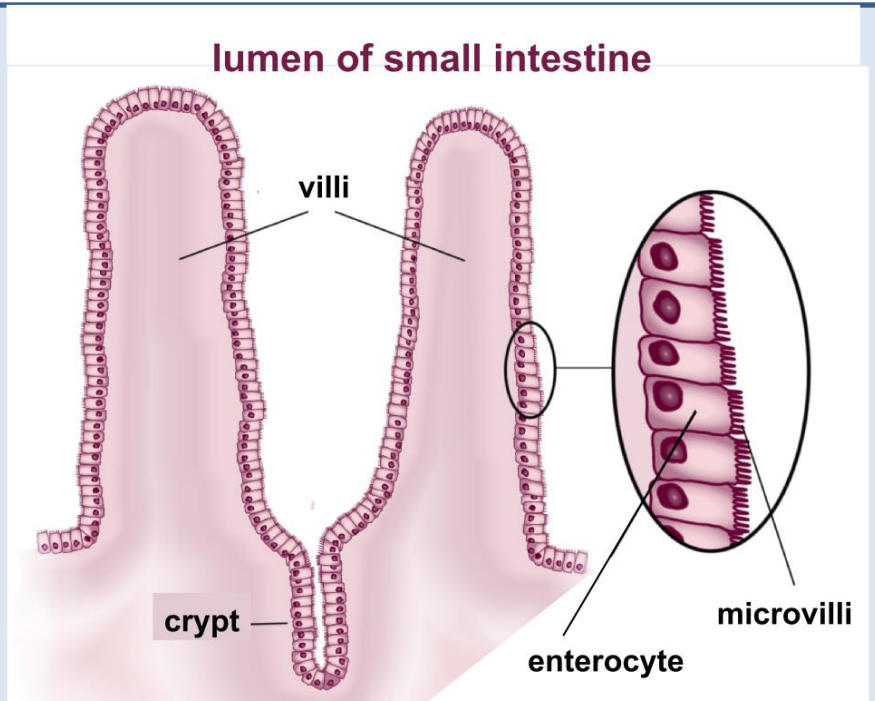


MALT-→ Mucosa Associated Lymphoid Tissue

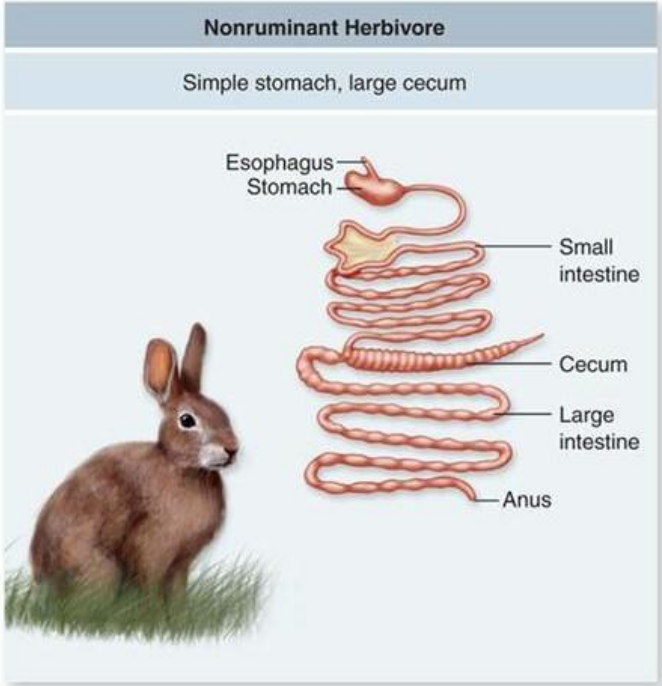
Ileum-→ aggregates of Lymphatic follicles-→Peyer's Patch

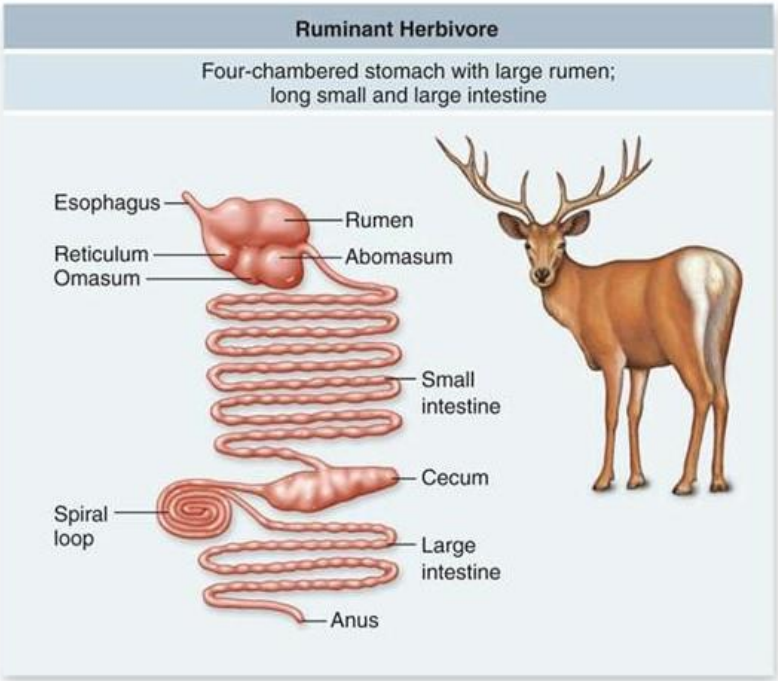
Immune response

DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

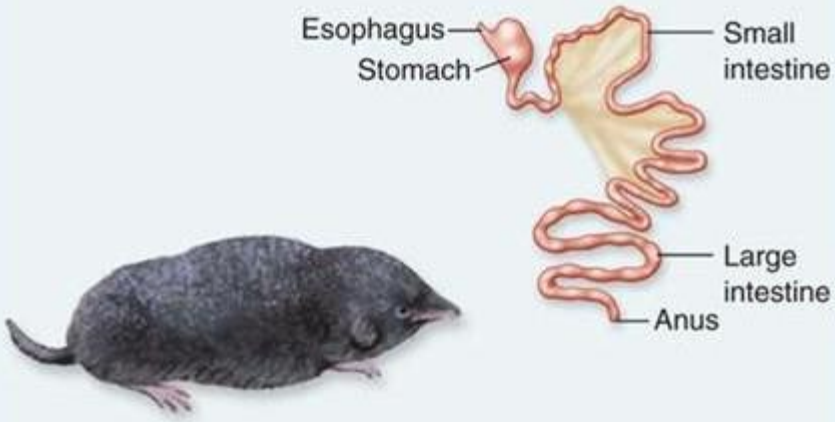




DIGESTIVE SYSTEM

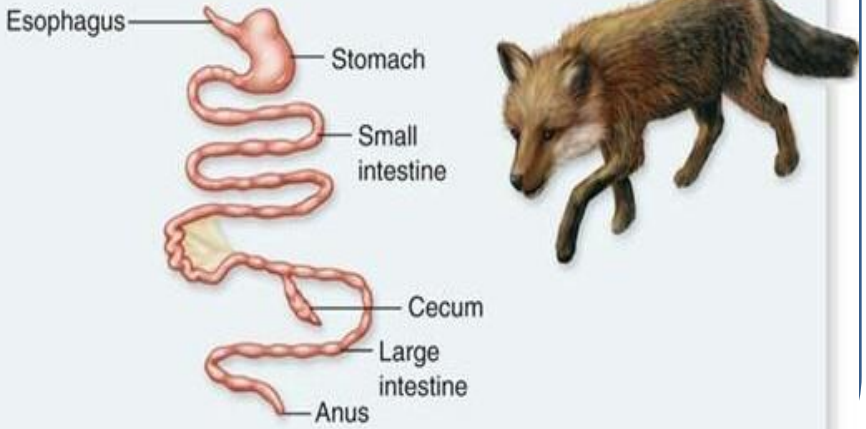
Insectivore

Short intestine, no cecum



Carnivore

Short intestine and colon, small cecum



- Q.1 with the help of neat labelled diagram comment of evolution of digestive tube.
- Q.2 Describe briefly general histology of Digestive tract
- Q.3 Explain with the help of diagram structure of tooth
- Q.4. Describe briefly dentition in mammals
- Q.5. Give a comparative account of:
- esophagus in different vertebrates
- Stomach in different vertebrates
- Intestine in different vertebrates

- https://www.notesonzoology.com/wp-content/uploads/2017/07/clip_image010-47.jpg