

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.

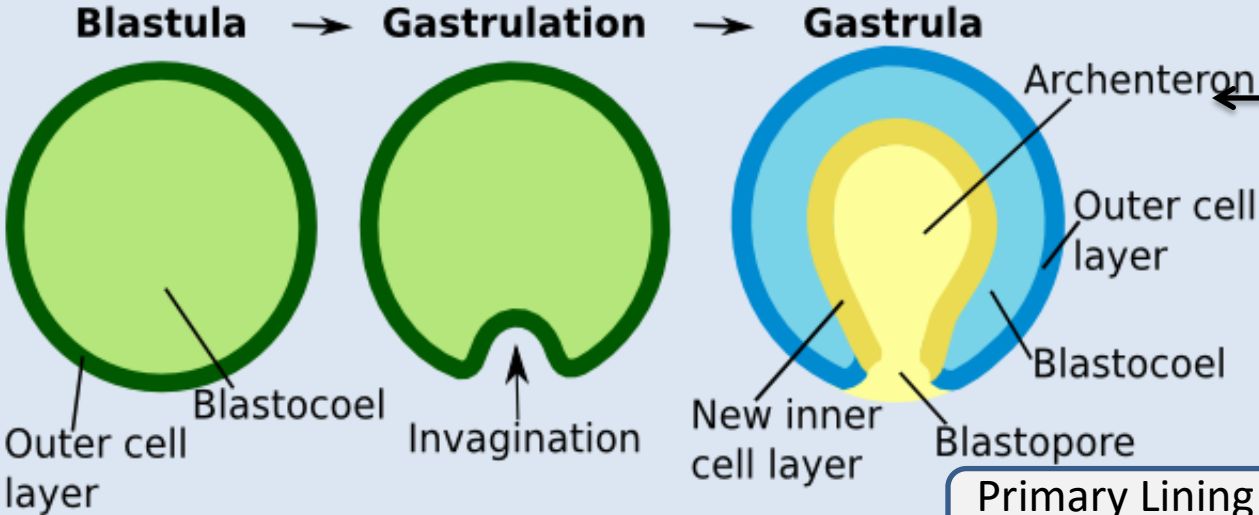
Tooth structure & position, teeth in lower vertebrates, mammalian dentition.

Morphology of gut wall

Comparative study of Esophagus, Stomach and Intestine in chordates

DIGESTIVE SYSTEM

Evolution of Digestive Tube



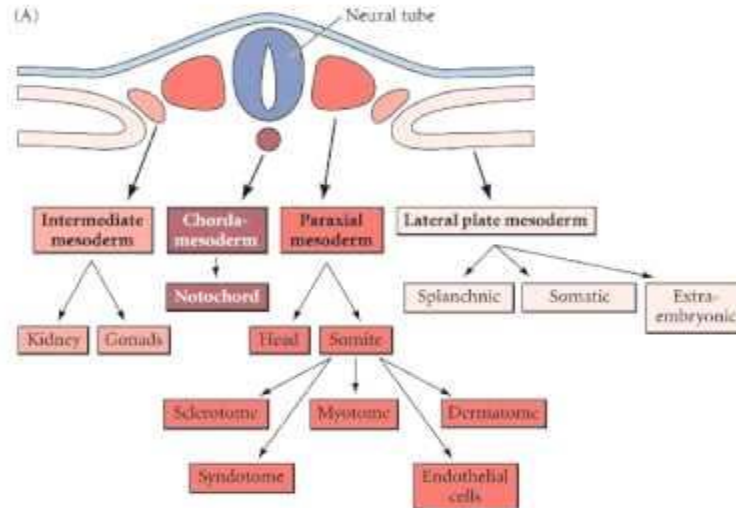
Primary gut that forms during gastrulation

Develops into endoderm and mesoderm

Primary Lining of digestive tract and all its derivatives

DIGESTIVE SYSTEM

Evolution of Digestive Tube



Splanchnic mesoderm

↓
Adds Layer of
Connective
tissue and
Smooth muscles
around
archenteron

DIGESTIVE SYSTEM

Evolution of Digestive Tube

Ectodermal invagination

Anterior Stomodaeum

Posterior Proctodaeum

Adult Buccal cavity

Small part near the anus
External portion of cloaca

- 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

Oral glands

Rathke's Pouch

Thyroid gland

Thymus

Outgrowths from Digestive Tract

Tympanic cavity

Gill clefts

Pancreas

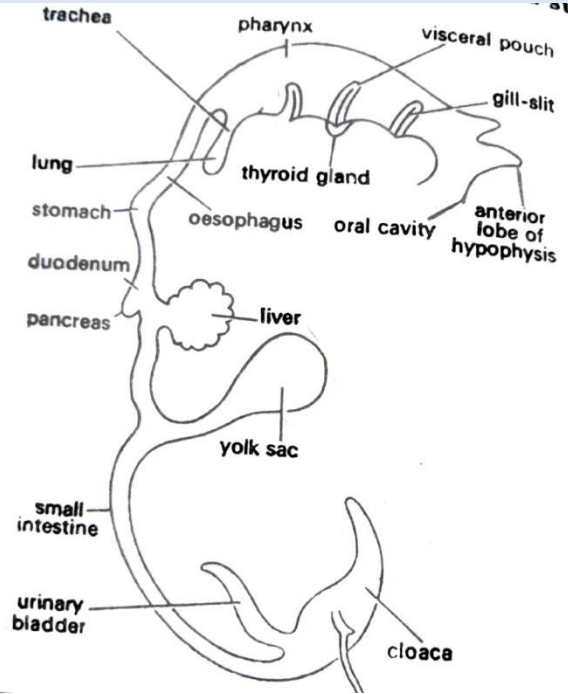
Liver

Lungs

Urinary bladder

DIGESTIVE SYSTEM

Alimentary canal and its derivatives



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

DIGESTIVE SYSTEM

Vertebrate Teeth

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graph TD; A[Vertebrate Teeth] --> B[Epidermal Teeth]; A --> C[True Teeth];
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Epidermal Teeth

True Teeth

DIGESTIVE SYSTEM



Cyclostomes Teeth

Hard conical structures lying above the dermal papilla

Epidermal Teeth

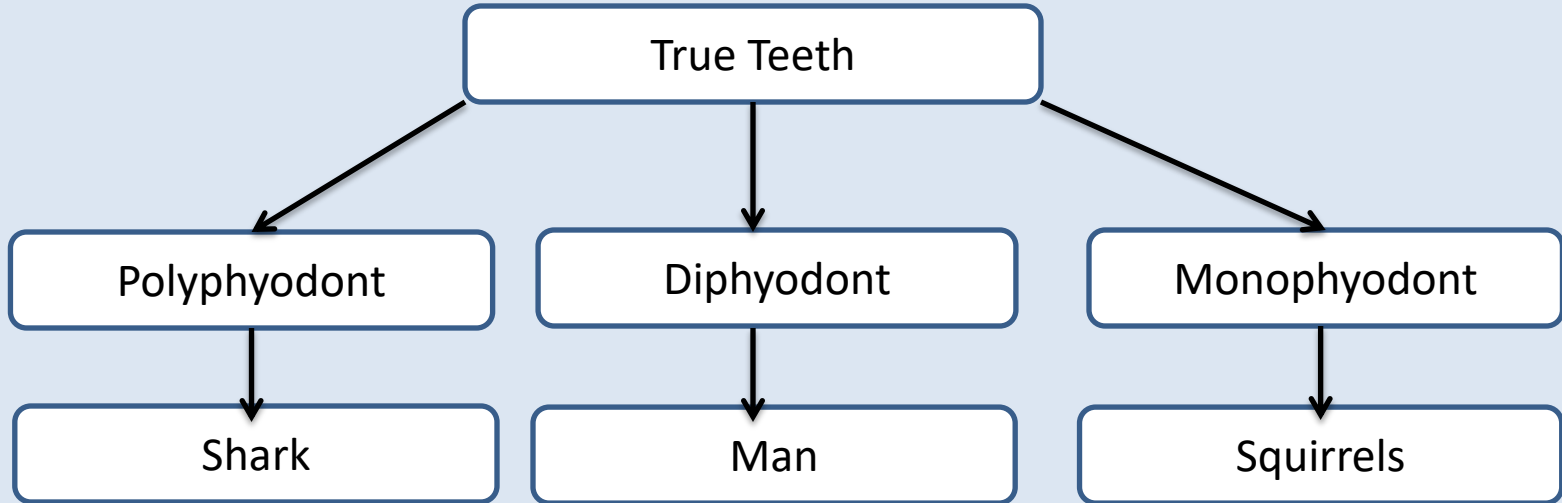


Tadpoles

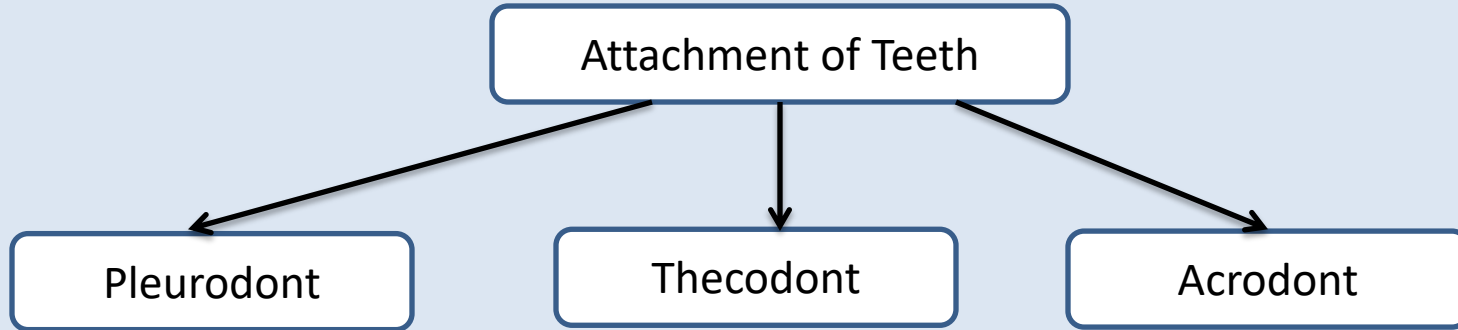


Duck Billed Platypus

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DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

Pleurodont

pleurodont

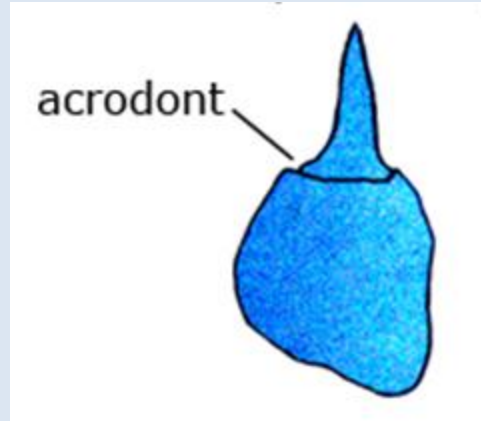


Teeth is fixed to a shelf like indentations on the inner margins of the jaw

Primitive condition

No roots

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Acrodont

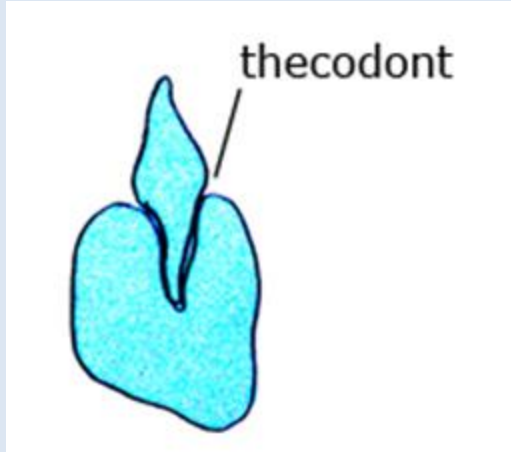
Teeth is attached on the crest of the jaw bone

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

Pulp cavity has wide opening or root canal

Continue to grow throughout their life by addition of dentine

Incisors of rodents
Tusks of elephants

Closed

Opening of pulp cavity is small

Teeth does not grow after reaching difinite size

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Structure of Teeth

Growth lines in enamel

Root canal

Cement

Cementoblast

Blood vessels &
nerves to pulp

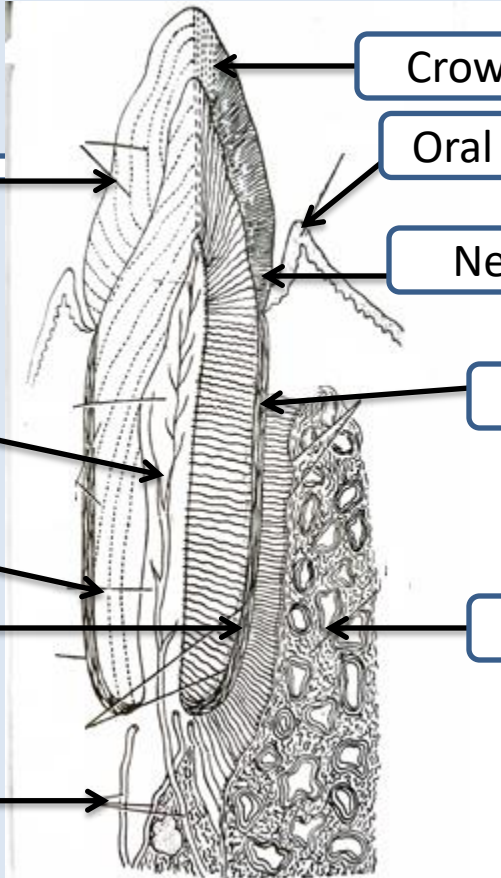
Crown

Oral epithelium

Neck

Root

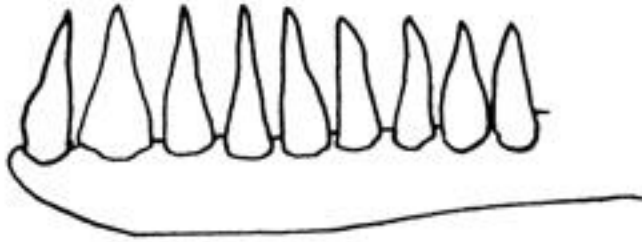
Jaw Bone



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Dentition

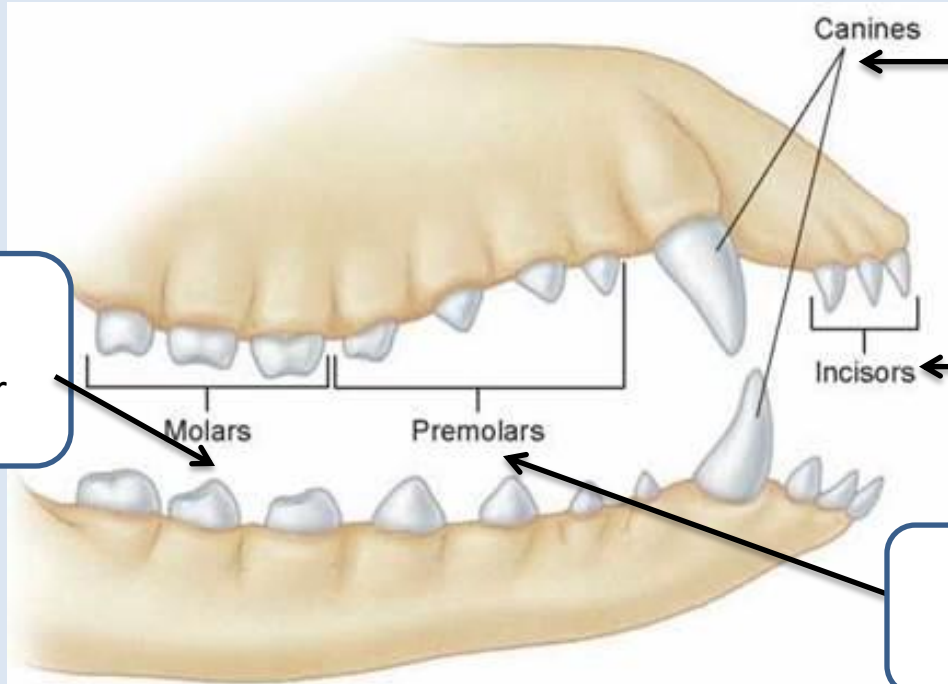
homodont



heterodont



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Sharp pointed teeth , Single root

Flat chisel shaped teeth , Single root

Cheek Teeth
Cusps
Never shed, 2 or more roots

Cheek Teeth
Cusps, 1 root
Replaced once

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Number of teeth is fixed in mammals



Characteristics of each species



Mammalian Heterodonty



Dental Formula

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

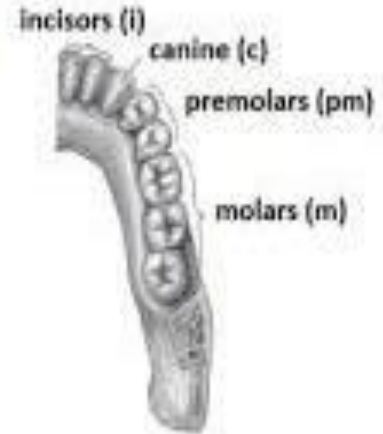
Dental Formula for human permanent dentition

$$2 \left[\begin{array}{cccccc} 2 & 1 & 2 & 3 \\ i & c & pm & m \\ 2 & 1 & 2 & 3 \end{array} \right]$$

Upper jaw: 16

Lower jaw: 16

Total: 32



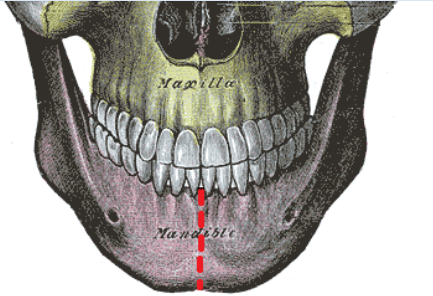
Digestive system-→ Evolution,

Histology of digestive tract

- Dentition-→ General structure of teeth
- Dental 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

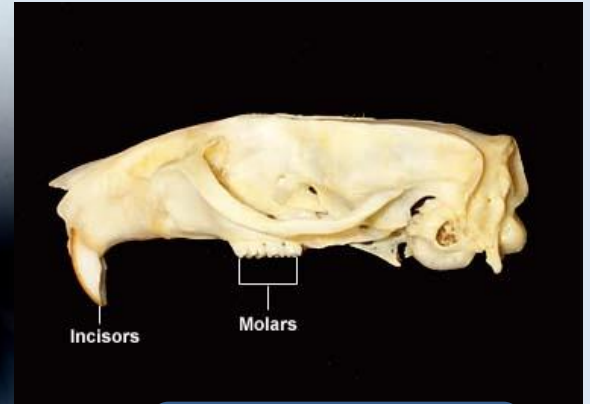
DIGESTIVE SYSTEM



Incisors of
Lagomrphs

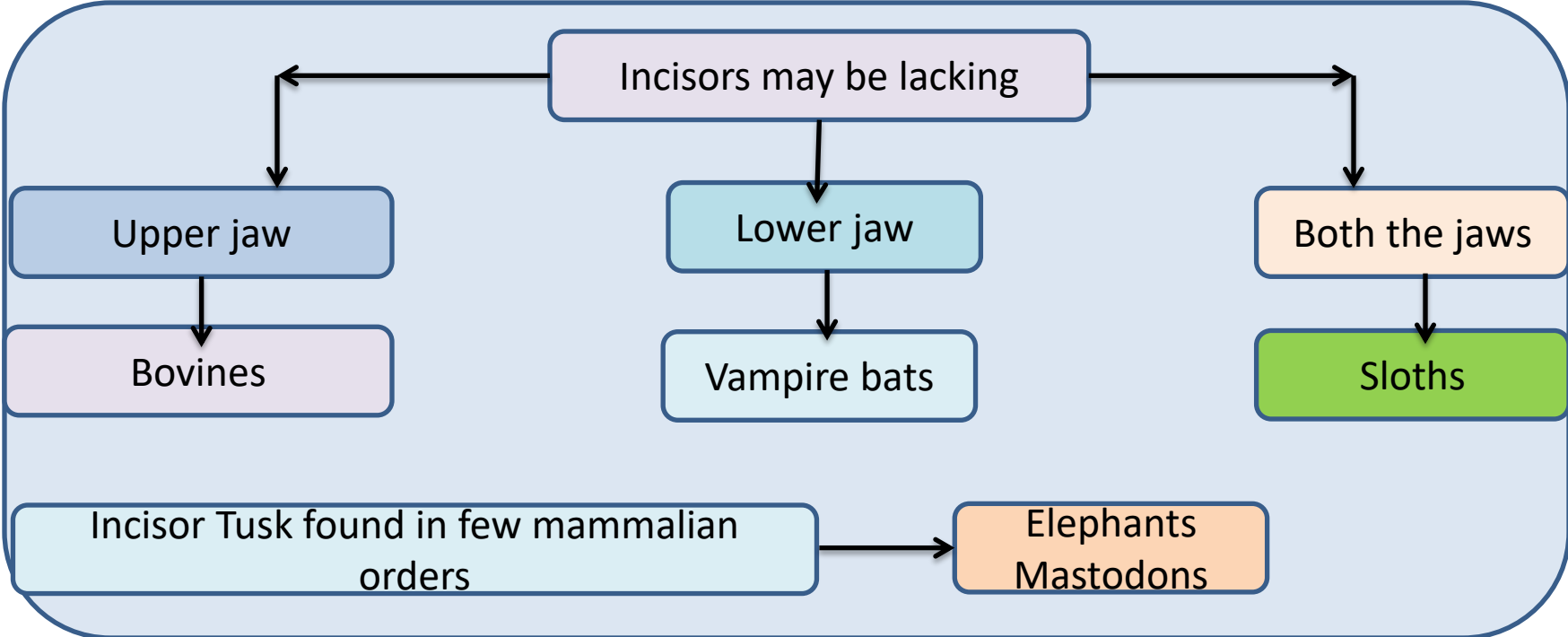


Incisors of Rat



Incisors of
Rodents

DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

Canine Teeth



Teeth lie next to incisors



In generalized animals very little difference in appearance

DIGESTIVE SYSTEM

Canine Teeth

Carnivores

Spear like

Piercing flesh

CARNIVORES



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



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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

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Molars

Three or more cusps-- Tricuspid

In mammals with diphyodont dentition---molars are not second set of teeth-->
Late arrivals of the first set of teeth

Molariform Teeth

Cheek Teeth

Different in Carnivores
and Ungulates

DIGESTIVE SYSTEM

Secodont tooth
of dog.



sharp cutting
edge

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

Ungulates/ Herbivores

Macerating Vegetation, chewing cud

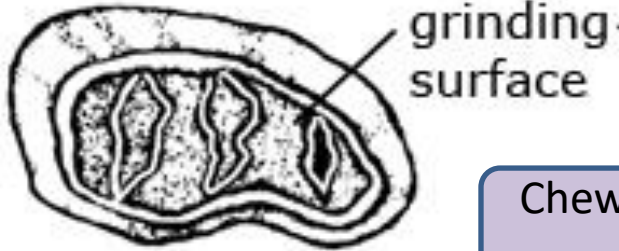
Crowns are tall -> allowing for plenty of abrasion

Wider and longer -> providing broad surface for grinding

Short roots

DIGESTIVE SYSTEM

selenodont tooth



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 crescentic ridges

Ruminant
Herbivores

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

DIGESTIVE SYSTEM

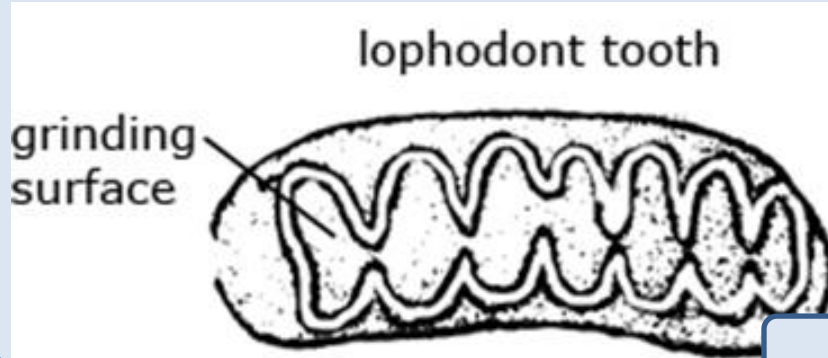
The cusps join to form ridges --→ Lophs

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



lophodont tooth

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

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Most unusual mammalian teeth



Crab eater seal



Teeth are employed to strain small crustaceans and planktons

DIGESTIVE SYSTEM

Oesophagus

Distensible muscular bag extending between pharynx and stomach

Fishes and Neckless
tetrapods

Shortest

Other Amniotes

Long

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

Crop

Extended bag of Oesophagus

Paired or unpaired

Grain eating animals

Storage bag

Enzymes for preliminary digestion

Pigeons and Doves → Crop gland → Cell forming structures

Lactogenic hormone → Anterior pituitary

Chassy Pigeon milk

To feed the young ones

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

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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

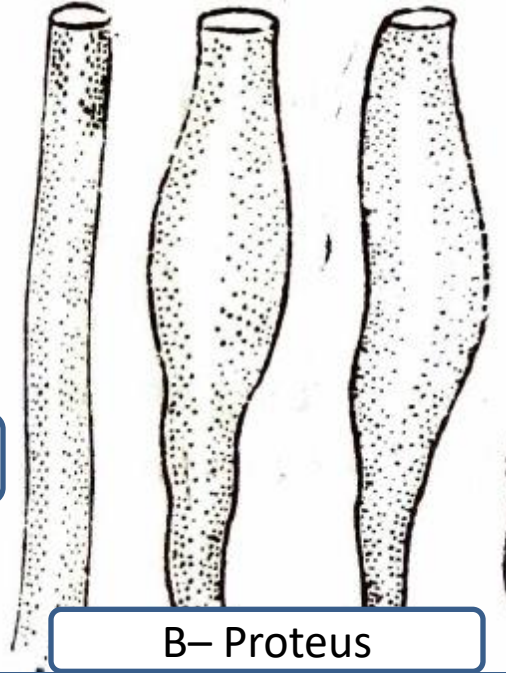
In some fishes and some Urodeles--→ stomach remains straight throughout life

Flexures develop-→ J shaped or U shaped Stomach

DIGESTIVE SYSTEM

Shapes of Stomach

A—Belone

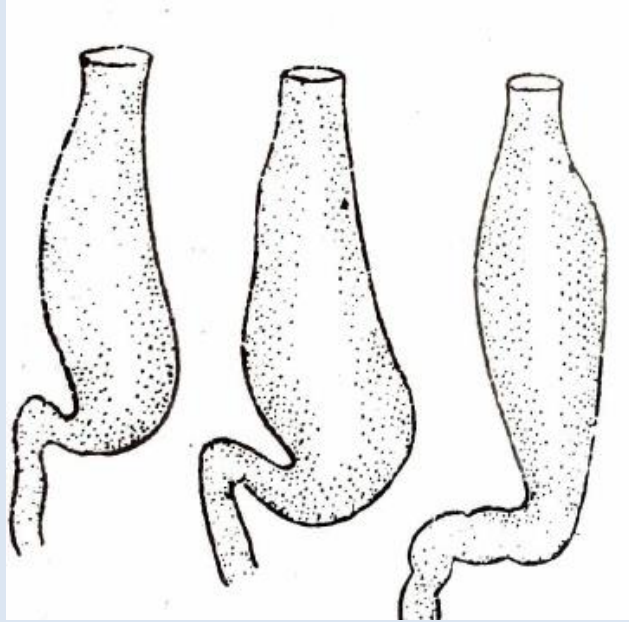


B— Proteus

C— Natrix

DIGESTIVE SYSTEM

Shapes of Stomach



D– Gobius
E– Shark
F– Phoca (Walrus)

DIGESTIVE SYSTEM

Shapes of Stomach

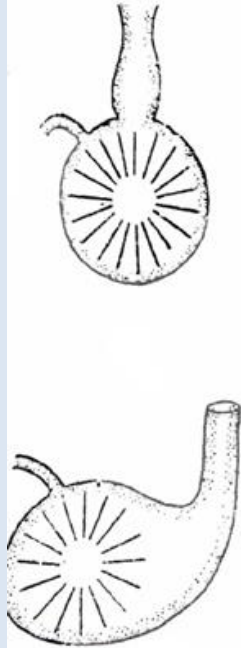


Testudo

J- Land Tortoise

DIGESTIVE SYSTEM

Shapes of Stomach



Birds

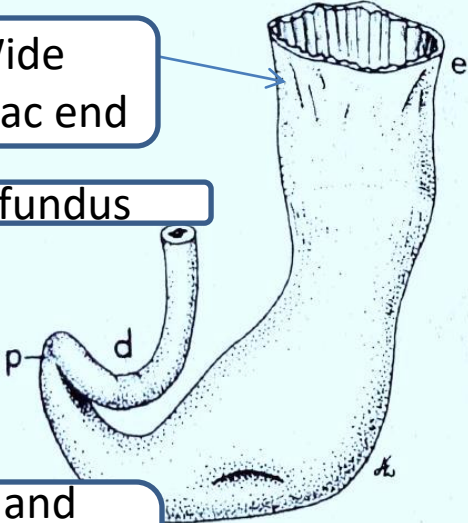
DIGESTIVE SYSTEM

Shapes of Stomach

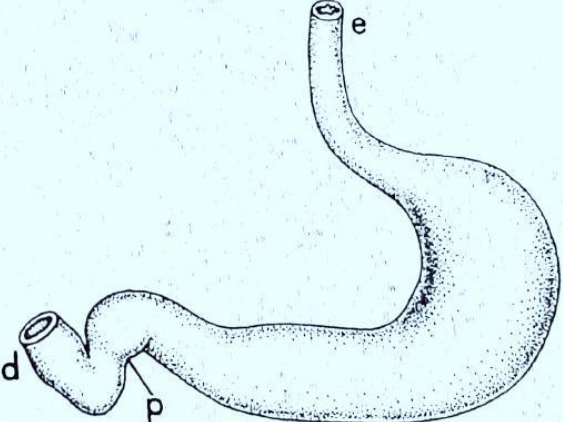
Wide Cardiac end

No fundus

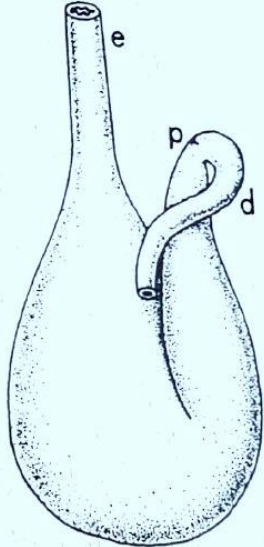
Short and narrow pyloric end



FROG



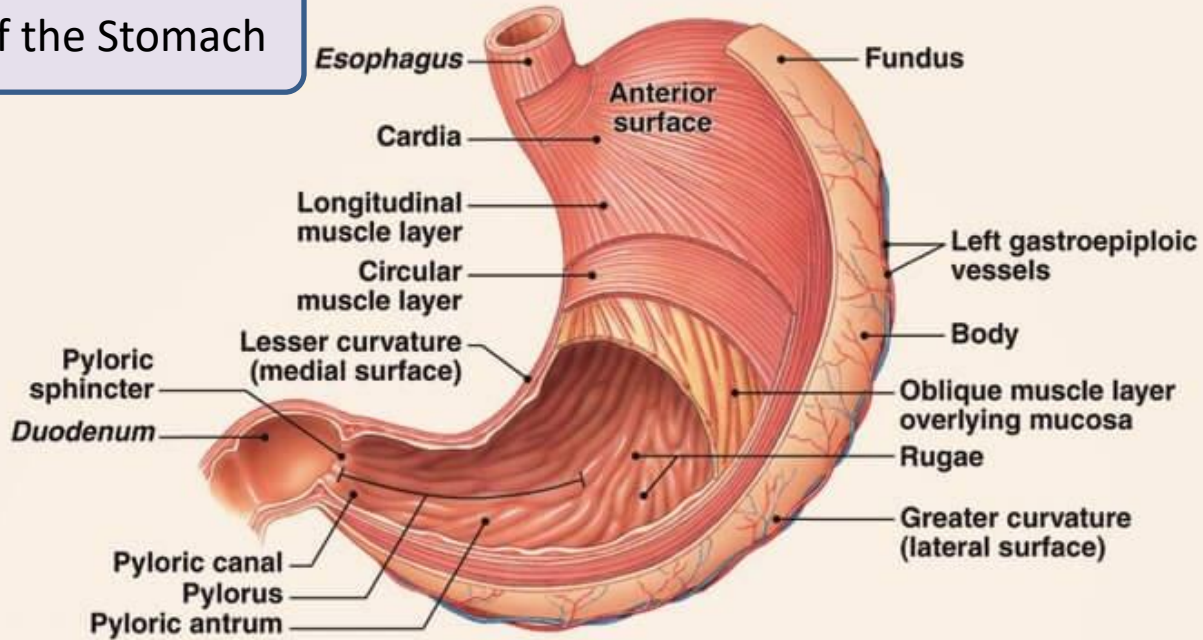
TURTLE



LIZARD

DIGESTIVE SYSTEM

Parts of the Stomach



DIGESTIVE SYSTEM

Stomach--- Modifications

Crocodiles and Birds

Proventriculus

Gastric glands

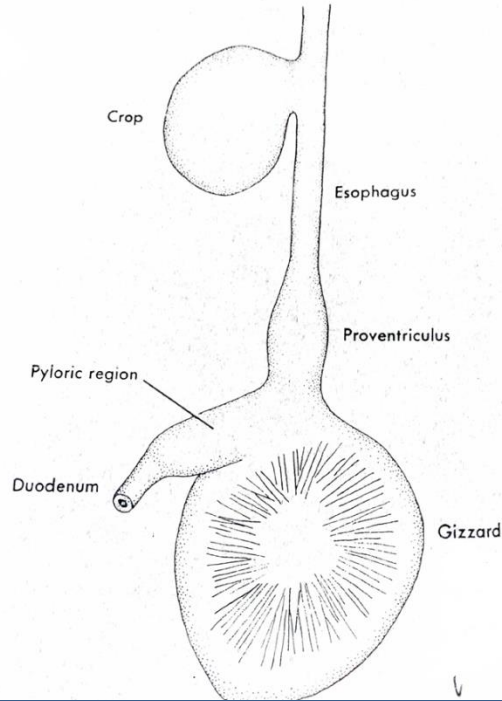
Gizzard

Represent the pyloric region

Hard cornified lining

Grinding

DIGESTIVE SYSTEM



Alimentary canal of Grain eating bird

DIGESTIVE SYSTEM

Stomach of Ruminant Animals

Chyme out into intestine

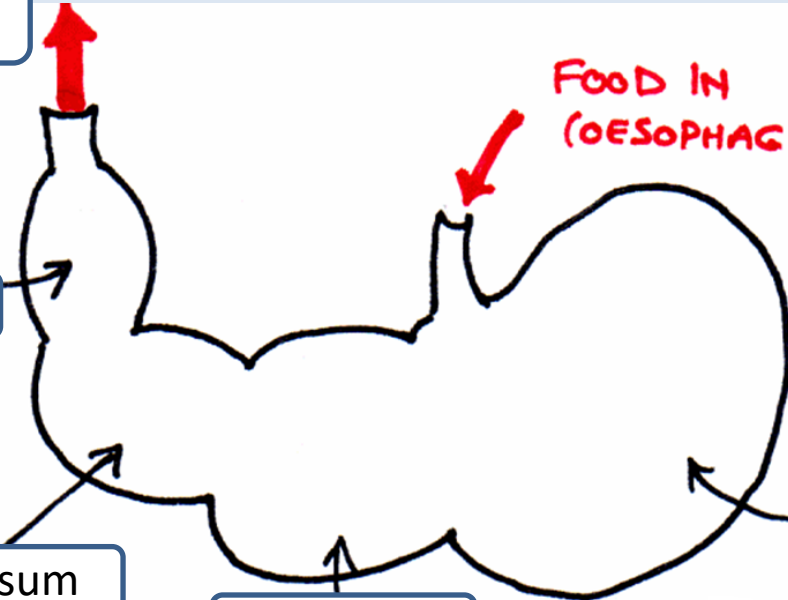
FOOD IN (OESOPHAGUS)

Abomasum

Omasum

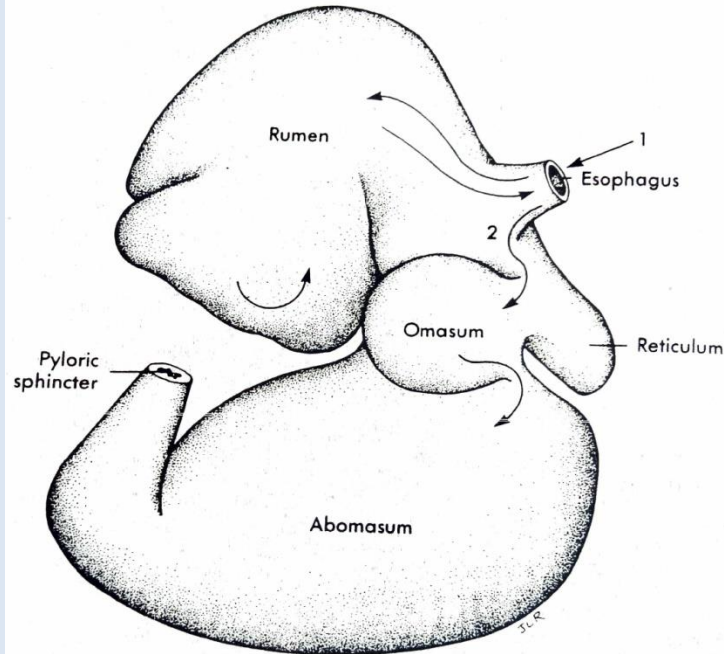
Reticulum

Rumen



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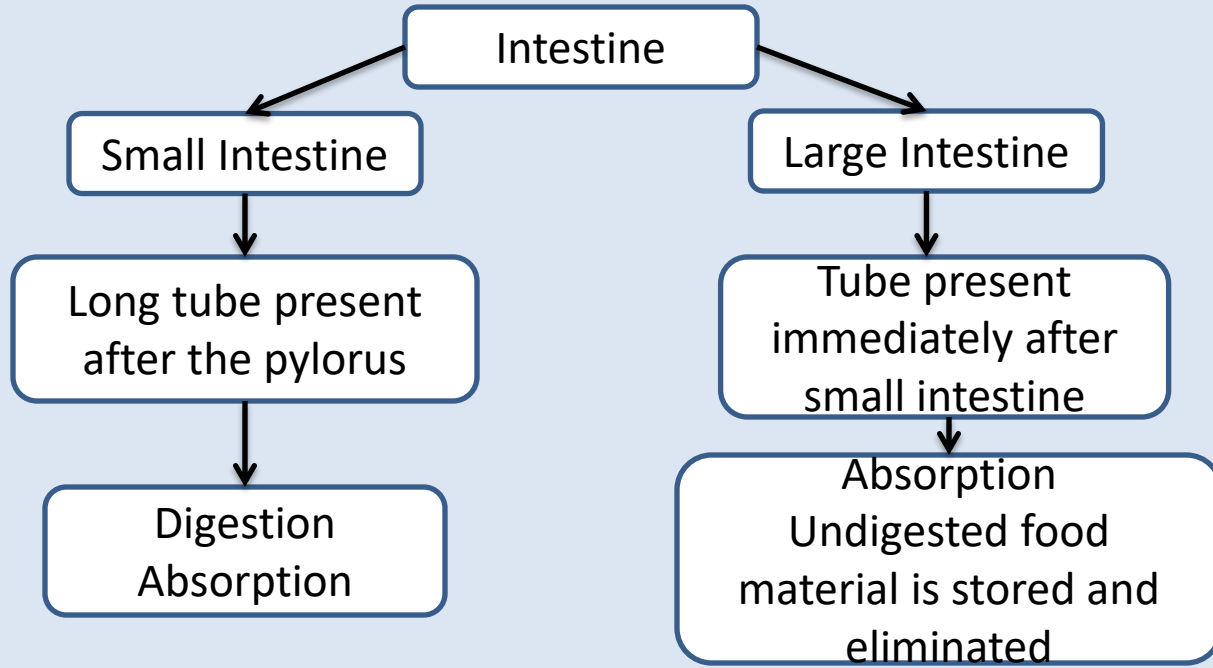
Stomach of Ruminant Animals



DIGESTIVE SYSTEM

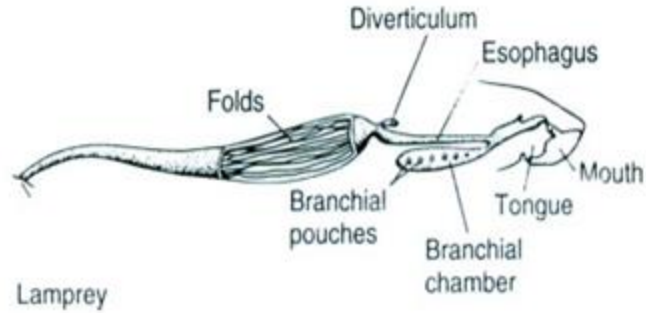
Cell Types	Substance Secreted
Goblet cells	Mucus (protects stomach lining)
Parietal cells	Gastric acid (e.g. hydrochloric acid)
Chief cells	Pepsinogen (protease precursor)
D cells	Somatostatin (inhibits acid secretion)
G cells	Gastrin (stimulates acid secretion)

DIGESTIVE SYSTEM

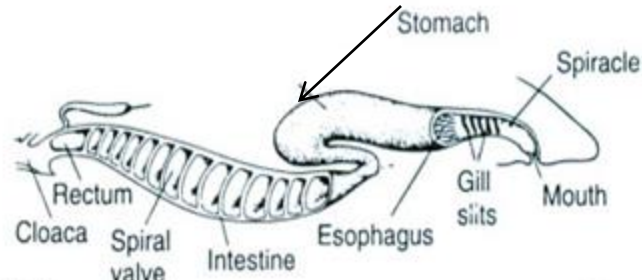


DIGESTIVE SYSTEM

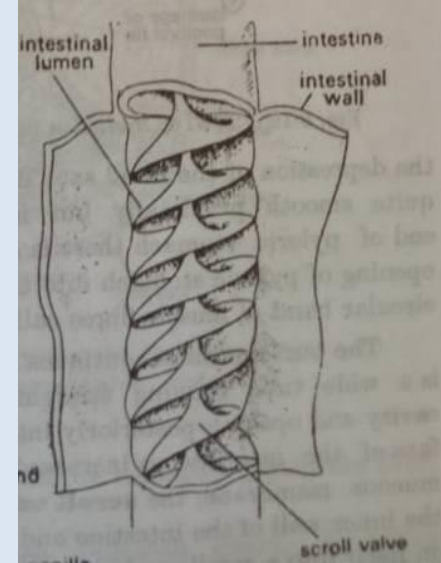
Intestine in fishes



Lamprey

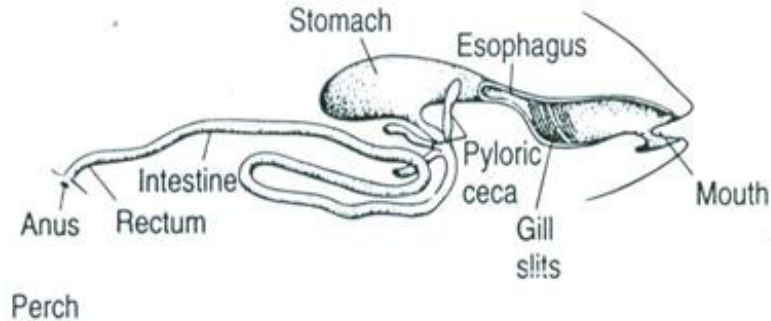
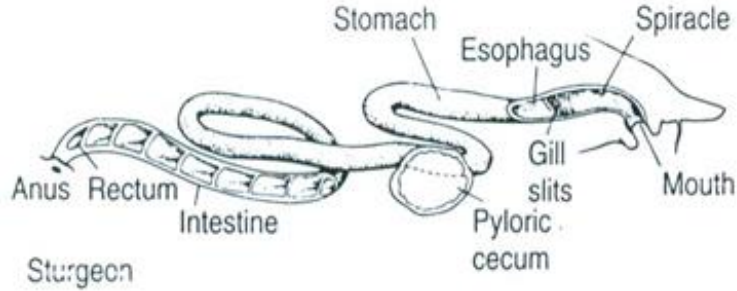


Shark



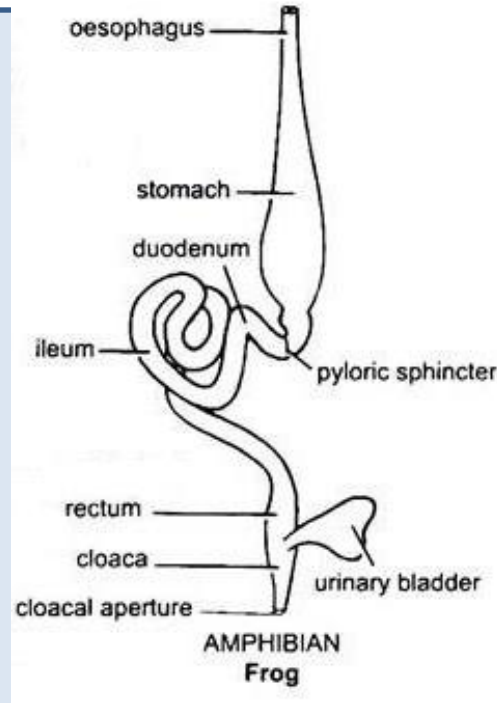
DIGESTIVE SYSTEM

Intestine in fishes



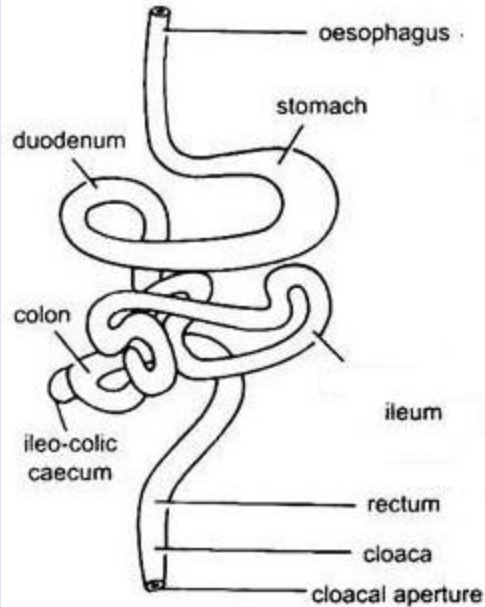
DIGESTIVE SYSTEM

Fan line myosin
Small intestine
Large intestine
Duodenum--- U-shaped → Transverse folds → Increase surface
Ileum → Short and highly coiled → Longitudinal folds
Rectum → short and broad → Cloaca



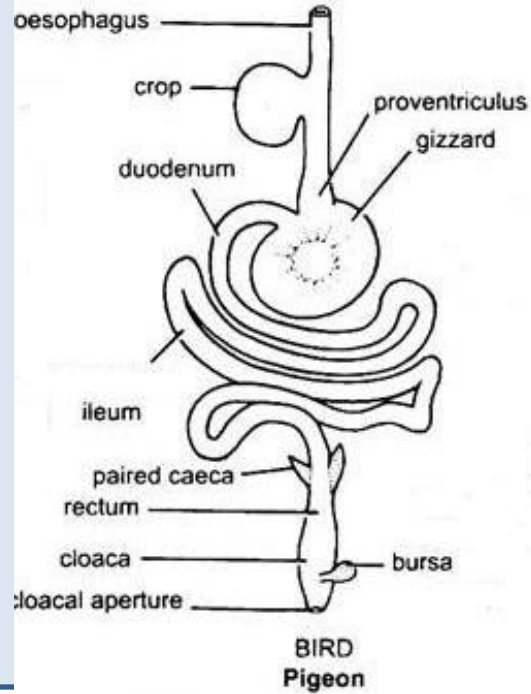
DIGESTIVE SYSTEM

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



REPTILIAN
Turtle

DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

Small intestine

Duodenum →

Pancreatic juice, Bile salts

Brunner's glands/
Duodenal glands →

Neutralizing gastric acid

Jejunum

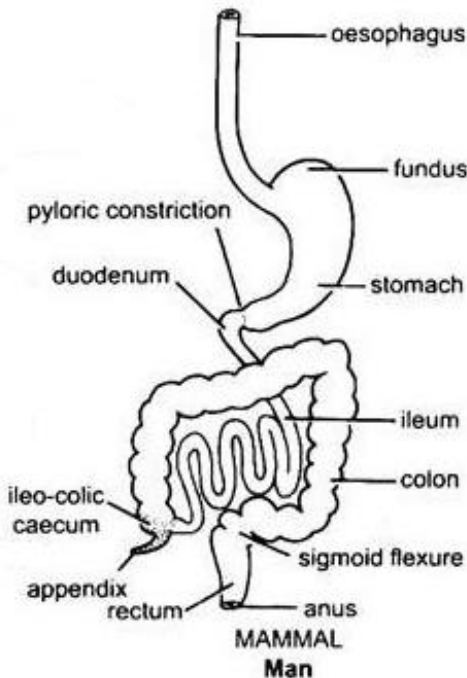
Ileum --- → Large intestine

Absorptive cells

Goblet cells

Enteroendocrine cells

Paneth cells

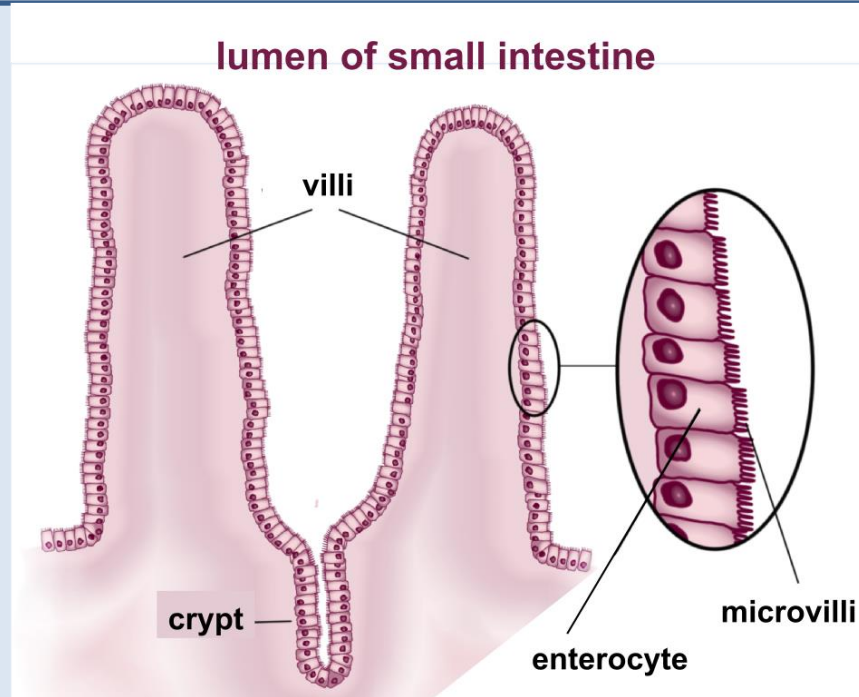


MALT →

Mucosa Associated Lymphoid Tissue

Ileum → aggregates of Lymphatic follicles → Peyer's Patch
Immune response

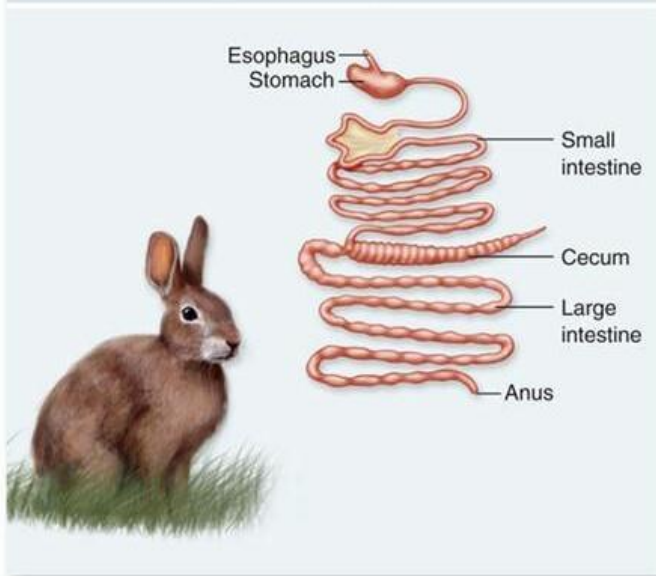
DIGESTIVE SYSTEM



DIGESTIVE SYSTEM

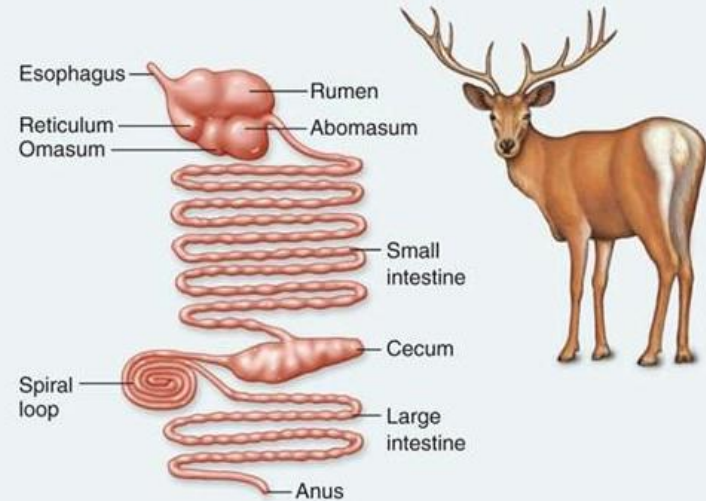
Nonruminant Herbivore

Simple stomach, large cecum



Ruminant Herbivore

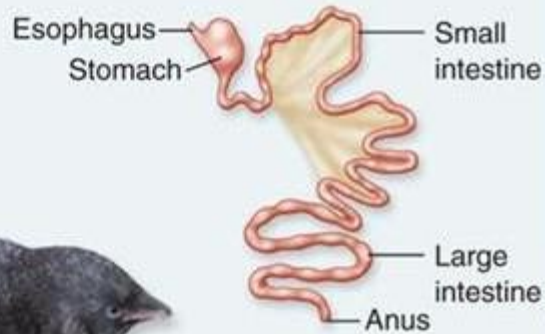
Four-chambered stomach with large rumen;
long small and large intestine



DIGESTIVE SYSTEM

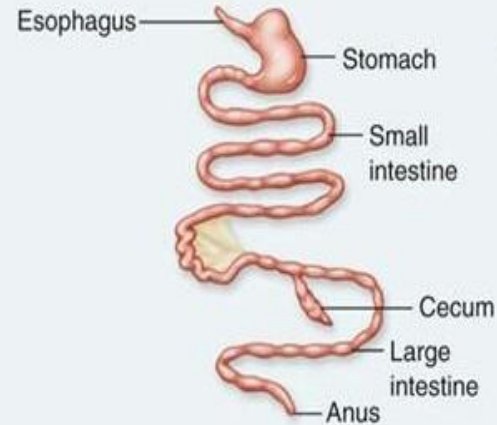
Insectivore

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