SUMMARY

CYPRINUS CARPIO

Mouth :

1. The mouth is a medium size cresentic opening slightly ventral to the anterior end of the snout.

2. Both the jaws are covered by thick skin supported by muscles.

3. A thick skin connects the upper jaw and the anterior end of the snout and this enables forward protrusion of the mouth as a wide tube.

Buccopharynx :

1. The buccopharynx is an elongateoval dorsoventrally compressed chamber.

2. The posterior pharynx bears a striangular bony plate on the roof and three large teeth arranged in a row on either side of the floor.

3. The gill rackers are short, thick, soft and whitish in colour.

4. Mucous membrane of the oral chamber is highly vascular except a narrow zone immediately posterior to the mouth.

5. The oral mucosa bears numerous small and round projections.

Tongue :

1. The immovable tongue is triangular and inseparable from the surrounding tissue.

2. It is beset with numerous small, round elevations.

Oesophagus :

1. The oesophagus is a very short and wide tube.

2. The mucous membrane is thrown into a series of large folds.

3. The cells of the epithelium are of two types - tall columnar and mucus secreting, and large goblet cells.

4. Basement membrane is distinct.

5. Circular muscle fibres are arranged in a compact manner in the highly developed tunica propria.

6. Muscularis mucosa is well developed and about double the thickness of tunica propria.

7. Submucosa is a very thin layer of connective tissue in which a few circular muscle fibres are present.

8. Lamina muscularis is well developed - the inner circular muscle layer is thick and the outer longitudinal muscle layer narrow and discontinuous.

9. Serosa is a layer of unequal thickness of loose connective tissue.

10. Serous membrane of the oesophagus, intestinal bulb, intestine and rectum is thin and consists of a single layer of extremely flattened cells.

Intestinal bulb :

1. It is an elongated muscular tube, the last part of which and the adjacent intestine are not distinguishable macroscopically.

2. Mucous membrane is thrown into close set, finger-like villi.
3. Narrow columnar, ciliated cells with granulated cytoplasm and distinct cell membranes constitute the epithelium.
   i. The nucleus is oval and situated towards the basal half of the cells.
   ii. Majority of the cells are secretory in nature.

4. Tunica propria is a very thin layer of a few circular muscle fibres.

5. Muscularis mucosa thick and consists of longitudinal and oblique fibres in the areolar connective tissue, and the lymphocytes are crowded.

6. Submucosa is about half the thickness of muscularis mucosa.

7. Lamina muscularis is quite thick and consists of circular and longitudinal muscular layers.
8. Serosa is thick, uneven in thickness and consists of a compact connective tissue.

Intestine :

1. The intestine is a long, slender, coiled tube distinguishable into an anterior and a posterior portion.

2. The anterior intestine is a thin walled tube.

3. Mucous membrane is thrown into numerous finger-like villi.

4. The cells of the epithelium are narrow and tall columnar. Nucleus is spherical or oval and scattered irregularly.

5. Tunica propria is very thin and constituted by two to three layers of circular muscle fibres.

6. Muscularis mucosa is of varying thickness of areolar connective tissue with lymphocytes crowded at certain places.

7. Submucosa is very thin with circular muscle fibres arranged in a compact manner.

8. Lamina muscularis is thick, the circular muscle layer is compact, and longitudinal muscle layer is only a few fibres at certain points.

9. Serosa is a layer of compact connective tissue.

10. The posterior intestine resembles the anterior intestine except -

    i. Narrower villi.

    ii. Greater number of mucous cells in the epithelium.

    iii. Tunica propria and submucosa better developed.

Rectum :

1. The rectum is a convoluted tube distinguishable from the posterior intestine.

2. Mucous membrane is thrown into a few broad folds.

3. The epithelium consists of tall columnar cells with granulated cytoplasm and irregularly distributed elongateoval nucleus.
   i. Goblet cells are numerous.

4. Tunica propria is very thin and made up of circular muscle fibres.

5. Muscularis mucosa is thick and consists of areolar connective tissue with oblique muscle fibres.

6. Submucosa is thickest of all the layers and is about fourfold of that of the muscularis mucosa.

7. Lamina muscularis is well developed and thick.

8. Serosa is rather thick and wavy.

Hepatopancreas :

1. The hepatopancreas is a large, compact, dull brown mass divisible into two elongated lobes.

2. The right and left lobes are almost of equal size, and bear a number of notches and short processes.

3. The pancreatic acini are arranged in groups among hepatic lobules, and more crowded towards the posterior end.

4. Secretory cells with granulated cytoplasm and a large spherical nucleus, and fat cells with a small nucleus constitute a hepatic lobule.

5. The basement membrane is not quite distinct.

6. A pancreatic acinus consists of a few wedge-shaped cells enclosing an extremely narrow lumen at the centre.

7. The cytoplasm is basophilic, densely granulated and the spherical nucleus with a prominent nucleolus is located towards the base of the cells.

8. Endocrine pancreas (islet of Langerhan's) is present in some of the groups of pancreatic acini.

9. An islet consists of lightly stained small cells of irregular shape enclosed by a thin fibrous capsule.

Gall bladder :

1. The gall bladder is a very thin walled, large, somewhat globular sac with a narrow neck.

2. It remains almost always filled up with a greenish hepatopancreatic fluid.

3. A number of narrow ducts from the hepatopancreas unite to form a fairly wide cystic duct.

4. The bile duct opens on the right ventrolateral wall of the intestinal bulb.

5. The wall of the gall bladder consists of an inner mucous membrane and an outer serosa.

6. The lining epithelium consists of short but wide columnar cells with distinct separating cell membranes.

7. The serosa is quite thick and almost equal to that of the mucous membrane.

8. Serous membrane is very thin and consists of a single layer of extremely flattened cells.

OPHICEPHALUS PUNCTATUS

Mouth :

1. The mouth is a large 'U'-shaped opening.
2. The jaws are covered by a thick skin supported by muscles, and bear large number of conical teeth arranged in several rows.
3. Four teeth of the posterior row of the lower jaw on either side are fairly large and directed backward.

4.

Buccopharynx :

1. Buccopharynx is a fairly large pear-shaped chamber.
2. Rows of small pointed teeth are present along the anterior border of the buccopharynx.
3. Two small tooth plates with fine teeth are present at the base of the last pair of gills.
4. Gill rackers are short, bony and bear fine teeth-like structures.

Tongue :

1. The tongue is an anterior extension of the hyomandibular arch and covered with a tough but smooth mucous membrane.
2. It rests on a depression on the floor of the buccal cavity.

Oesophagus :

1. The oesophagus is a short and wide tube, dorsally attached to the roof of the body cavity.

2. It is a thick walled tube and the histology of the dorsal surface differs from that of the ventral surface.

3. The mucous membrane is thrown into folds.

4. Epithelium of the dorsal surface consists of a single layer of narrow columnar cells with distinct cell membranes.

5. A few taste buds are present in the mucous membrane.

6. The taste bud is a bipolar structure, the base being broader than the apex.

   i. Only two types of cells - the gustatory cells having greater affinity for acid dyes and the supporting cells constitute a taste bud.

   ii. The taste cells end in a stiff refractive hairlet.

7. Tunica propria is thick and chiefly occupied by numerous multicellular glands of cuboidal cells.

8. Muscularis mucosa is a thick layer of loose connective tissue with circular fibres.

9. Submucosa is a narrow layer of connective tissue with circular fibres.

10. Lamina muscularis is composed of a thick circular and a narrow, discontinuous longitudinal muscle layer.

11. Serosa of the whole of the alimentary canal consists of loose connective tissue. In Oesophagus it is of unequal thickness.

12. Serous membrane of the oesophagus, stomach, intestine and rectum consists of a single layer of flattened cells.

13. The stratified epithelium of the mucous membrane of the ventral surface is five to six cell layers thick.

14. Almost all the cells secret mucus.

15. Tunica propria is thick and circular fibres are arranged irregularly.

16. Muscularis mucosa is of loose connective tissue and discontinuous.

17. Submucosa is thicker than tunica propria and constituted by longitudinal muscle fibres.

18. Lamina muscularis composed of circular muscle fibres and some of the fibres are striated.

Stomach :

1. The stomach is a large thick walled muscular sac, reddish in colour.

2. The tip is narrow but blunt.

3. The stomach is thick walled.
4. Mucous membrane is thrown into a few large folds, which are absent in the posterior one-fourth.
5. The epithelium is constituted by tall columnar cells with distinct separating cell membranes.
   i. Some of the cells are modified into unicellular mucous gland.
   ii. Goblet cells are present.
6. Tunica propria is almost fully occupied by multicellular glands.
7. Muscularis mucosa consists of areolar connective tissue and circular fibres.
8. Submucosa is thick, composed of loose connective tissue with circular and oblique fibres.
9. Lamina muscularis with inner circular and outer longitudinal layers.
10. Serosa is thick.

Intestine :

1. It arises from the right ventral portion of the stomach.
2. The anterior intestine is reddish in colour while the posterior portion is cream coloured.
3. The anterior intestine is thick walled.
4. Mucous membrane is thrown into a few large folds.

5. The cells of the epithelium are narrow columnar with granulated cytoplasm.
   i. Some of the cells are modified to mucous cells.
   ii. Goblet cells are a few in number.

6. Tunica propria is a very narrow layer of a few circular fibres.

7. Muscularis mucosa is thick and composed of loose connective tissue with oblique and circular fibres.

8. Submucosa is thinner than muscularis mucosa.

9. Lamina muscularis - inner circular muscle layer thick, outer longitudinal muscle layer narrow.

10. Mucous membrane of the posterior intestine is thrown into numerous finger-like villi.

11. Narrow columnar cells with distinct separating cell membranes constitute the epithelium.
   i. Mucous and goblet cells are present.

12. Tunica propria is a very narrow layer of circular muscle fibres.

13. Muscularis mucosa ill developed.

14. Submucosa is of unequal thickness.

15. Lamina muscularis-circular muscle layer thick; longitudinal muscle layer thin.

Intestinal caeca :

1. The intestinal caeca are two, reddish in colour and arise from the intestine very near its origin.

2. Histologically it is similar to posterior intestine except the following:

   i. Epithelial cells shorter in length.

   ii. Goblet cells absent.

   iii. Muscularis mucosa thinner and with longitudinal fibres.

   iv. Circular muscle layer thinner and the longitudinal layer is narrow and restricted to a few sites only in lamina muscularis.

Rectum :

1. The rectum is slightly wider than the posterior intestine and lighter in colour.

2. It is similar to the posterior intestine except—

   i. Folds of the muscularis mucosa are a few in number.

   ii. Mucous and goblet cells are less in number.

   iii. Large number of lymphocytes are present in tunica propria.

   iv. Serosa is thick.

Hepatopancreas :

1. It is a large, compact dull brown, bilobed structure.
2. The left lobe is short and the right lobe is long and narrow.

3. Major bulk is constituted by hepatic lobules and pancreatic tissue almost negligible.

4. Hepatic lobule consists of fairly large polyhedral or wedge-shaped cells enclosing a very narrow lumen at the centre.
   i. Fat cells and secretory cells are present.
   ii. Cytoplasm of the secretory cells granulated.

5. Pancreatic acini small and scattered in the mass of the hepatopancreas.

6. Exocrine pancreas is bounded by a thin layer of membraneous connective tissue enclosing blood capilaris also.
   i. The cytoplasm of the cells of the acinus is granulated and strongly besophilic.

7. Endocrine pancreas is present among the aggregation of a number of pancreatic acini.
   i. The cells are eosinophilic in nature, and of one type only.

Gall bladder :

1. The gall bladder is a pear-shaped thin walled sac.

2. Number of fine ducts from the hepatopancreas join to form a large cystic duct opening at the narrow anterior end of the bladder.

3. The bile duct separates from the main duct to open in the

anterior intestine immediately posterior to its junction with the anterior caecum.

4. The wall consists of a mucous membrane and a serosa.
5. Epithelial cells narrow columnar with granulated cytoplasm.
6. Secretory cells are a few.
7. Serosa is of loose connective tissue and the serous membrane made up of extremely flattened cells.

BUFO MELANOSTICTUS

Oral cavity :

1. The oral cavity is a large transversely wide, triangular chamber.

2. The mouth is a wide triangular opening slightly ventral to the snout and bounded by two toothless jaws, extending behind the eyes.

3. The oral mucosa is thin.

Tongue :

1. It is a large,soft, fleshy, elongated structure placed on the middle of the floor of the oral cavity.

2. The base is placed immediately behind the lower jaw, while the tip reaches near the posterior limit of the oral cavity.

3. The dorsal and dorsolateral surfaces of the tongue bear numerous small, elevated structures.

Pharynx :

1. It is very short.

Oesophagus :

1. It is a stout muscular tube.
2. Mucous membrane is thrown into a number of narrow finger-like folds.

3. The epithelium is constituted by narrow ciliated columnar cells.
   i. Mucous and goblet cells are plenty.

4. Tunica propria is a thin layer of loose connective tissue in which lymphocytes are crowded.

5. Muscularis mucosa is very thick, the connective tissue is strengthened by numerous oblique fibres.

6. Submucosa is a thin layer of oblique and longitudinal fibres.

7. Lamina muscularis - circular muscle layer thick and with oblique fibres, the longitudinal layer very thin and discontinuous.

8. Serosa is a thin layer of loose connective tissue.

9. Serous membrane of the oesophagus, stomach, duodenum, intestine and rectum is very thin and formed of a single layer of extremely flattened cells.

Stomach :

1. It is a slightly curved muscular sac.

2. Mucous membrane is thrown into a few large folds.

3. The cells of the epithelium are short columnar and the cytoplasm bears fine granules and spherical or oval nucleus.
   i. Goblet cells are a few.

4. Tunica propria is a thick layer, the major portion being occupied by numerous multicellular glands.
   i. The rest of the tunica propria consists of loosely arranged circular muscle fibres.

5. Muscularis mucosa is a thin layer of loosely arranged longitudinal fibres.

6. Submucosa is a layer of areolar connective tissue of unequal thickness.

7. Lamina muscularis is thick - the circular fibres are compactly arranged; the longitudinal layer is of a few narrow isolated bands.

8. Serosa is a well developed layer of loose connective tissue.

Duodenum :

1. It is a muscular tube. The junction of the stomach and the duodenum is demarcated by a sharp constriction.

2. Mucous membrane is thrown into numerous finger-like villi.

3. The cells of the epithelium are tall, narrow columnar, with distinct separating cell membranes.
   i. Mucous and goblet cells are a few in number.

4. Tunica propria - a few layers of loose circular fibres.
   i. Lymphocytes are crowded in this layer.

5. Submucosa is a narrow layer of loose connective tissue.

6. Lamina muscularis is made up of compactly arranged circular fibres.

7. Serosa is a thick layer of connective tissue.

Intestine :

1. It is a coiled tube held together with the rectum and duodenum by mesentery.

2. The histology of the intestine is similar to that of the duodenum except -

   i. Mucous cells are a few more in number.

   ii. The circular muscle layer of lamina muscularis is a little thicker.

   iii. Serosa is of unequal thickness.

Rectum :

1. It is an elongateoval sac, sharply narrows down posteriorly to open in the cloaca.

2. Mucous membrane is almost completely devoid of folds.

3. The epithelial cells are large columnar.
   i. Mucous cells and big goblet cells are plenty.

4. Tunica propria is a layer of loose connective tissue in which lymphocytes are present.

5. Submucosa is a very thin layer of loose connective tissue with isolated circular fibres.

6. Lamina muscularis - circular layer thick and compact, longitudinal layer thin and discontinuous.

7. Serosa is a layer of loose connective tissue.

Liver :

1.. It is a dark brown mass consisting of two lobes - the left one is about double in size to that of the right lobe.

2. It is a compact mass ensheathed by a very thin membraneous capsule.

3. Deep melanin pigment is scattered in the mass of the gland.

4. Hepatic lobules small and with a few cells, mostly wedge-shaped.

   i. The cells enclose a fine lumen at the centre.

   ii. The cytoplasm is highly granulated and nucleus located at the base.

Pancreas :

1. It is a prominent branched, cream white, long, filamentous mass situated in the loop formed by the duodenum with the stomach and held in position by mesentery.

2. Exocrine pancreas consists of numerous small, closely packed acini.

   i. The cells are wedge-shaped, basophilic, and bear numerous granules.

3. The duct formed by the union of a few initial ducts is supported by two to three layers of loosely arranged circular muscle fibres.

4. Endocrine pancreas is scattered in the mass of the exocrine pancreas.

5. The islets are of varying shape and size and separated from the surroundings by a very thin connective tissue.

6. The number of cells in an islet varies from a few to many.

   i. Two to three different types of cells are distinguishable.

Gall bladder :

1. It is a round sac placed between the lobes of the liver.

2. A mucous membrane and a serosa constitute the wall.

3. The cells of the epithelium of the mucous membrane are large cuboidal with granulated cytoplasm and a big spherical or oval nucleus at the centre

4. Serosa is made up of loose connective tissue.

5. Serous membrane is of a single layer of extremely flattened cells.

MABUIA CARINATA

Oral cavity :

1. The oral cavity is a small, narrow, triangular chamber.

2. The jaws are covered with a thin but tough integument, and bear small, conical teeth.

3. The oral mucosa is very thin and thrown into a few narrow, longitudinal folds in the region of hard palate.

4. The mucosa of the floor between the tongue and lower jaw bears one or two large longitudinal folds on either side.

Tongue :

1. It is a massive, elongated but triangular structure and the narrow tip directed anteriorly.

2. Deep brown pigment is present on the dorsal surface.

3. The anterior one-third of the tongue is free and frenulum linguae is prominent.

4. The whole of the dorsal surface is beset with numerous small, close set papillae.

Oesophagus :

1. It is a thin walled tube, narrower posteriorly, and firmly attached to the roof of the thoracic cavity by mesentery.

2. The mucous membrane is thrown into a number of folds of varying size.

3. The epithelium consists of columner cells of unequal length.
   i. The cytoplasm is densely granulated, nucleus very small, and restricted to the base.
4. Tunica propria is a thin layer of connective tissue.
5. Lymphoid tissue is present immediately beneath the epithelium pushing the tunica propria away from it.
6. Muscularis mucosa is a thin layer of connective tissue with isolated circular and longitudinal fibres.
7. Submucosa thick and compact, and with oblique fibres.
8. Lamina muscularis - inner circular layer thick and outer longitudinal layer thin.
9. Serosa is thick and compact in oesophagus and stomach.
10. Serous membrane in oesophagus, stomach, duodenum and intestine is very thin and consists of extremely flattened cells.

Stomach :

1. The stomach is a cylindrical muscular tube.
2. Mucous membrane is thrown into a few large folds.
3. Epithelium consists tall columnar, nonciliated cells.
4. Tunica propria is largely occupied by glands.
   i. The glands are of different shape and size.

ii. The cells of the glands are both wedge-shaped and cuboidal, arranged in a single layer enclosing a lumen at the centre.

5. Submucosa thin and with interwoven muscle fibres at places.
6. Lamina muscularis consists of an inner circular and an outer longitudinal muscle layer.
7. Serosa is a thick layer of connective tissue.

Duodenum :

1. It is a wide, thin walled tube.
2. The junction of pyloric stomach and the duodenum is demarcated by a sharp constriction.
3. Mucous membrane is thrown into a number of folds, one of which is very large and bears folds of the second order.
4. The epithelium consists of narrow columnar cells with granulated cytoplasm, elongateoval or spherical nucleus and distinct separating cell membranes.
5. Tunica propria consists of 2-3 layers of loosely arranged circular fibres.
   i. Intestinal glands (crypts of Lieberkühn) and lymphocytes are present in different folds.
6. Muscularis mucosa is thin.

7. Submucosa little thicker than muscularis mucosa.

8. Lamina muscularis consists of an inner circular and an outer longitudinal muscle layer.

9. Serosa of the duodenum and intestine is narrow and made up of loose connective tissue.

Intestine :

1. It is a thin walled tube, narrower posteriorly.

2. Mucous membrane is thrown into a series of finger-like villi.

3. The cells of the epithelium are tall, ciliated, narrow columnar with granulated cytoplasm.
   i. Mucous cells are plenty.

4. Tunica propria, muscularis mucosa and submucosa are similar to those in the duodenum.

5. Lamina muscularis - circular layer thick and compact, longitudinal layer consists of muscle bands.

Rectum :

1. It is a slightly thick walled tube.

2. The rectum bears a caecum at its beginning.

3. Mucous membrane is thrown into numerous folds of unequal size.

4. Epithelium consists of narrow columnar cells with distinct separating cell membranes.

i. Mucous cells are a few.

ii. Goblet cells are numerous.

5. Tunica propria is more or less similar to that in the duodenum.
6. Muscularis mucosa is a fairly thick layer of loose connective tissue.
7. Submucosa is thin and compact.
8. Lamina muscularis consists of an inner circular and an outer longitudinal layers.
   i. Diffused lymphoid tissue is present in between the two layers at certain places.
9. Serosa is thick and compact.
10. Serous membrane is thin but thicker than that in the rest of the gut.

Liver :

1. It is a compact, dark brown, heavily pigmented mass, triangular in shape and bounded by a thin membraneous connective tissue.
2. Posteriorly the liver is forked and extends backward in the form of two lobes being narrower gradually.
3. Large amount of dense melanin pigment is scattered in the mass of the liver.

4. Distinct portal canals are lacking.

Pancreas :

1. The pancreas is a light cream, narrow, filamentous mass.

2. A number of narrow ducts from the pancreas open in the common bile duct.

3. The pancreas consists of exocrine glands in which endocrine glands are scattered irregularly.

4. Exocrine pancreas consists of numerous acini.
   i. The cells of an acinus are large, wedge-shaped, cytoplasm basophilic and highly granulated.

5. The initial pancreatic duct is narrow and consists of small wedge-shaped cells.

6. Endocrine pancreas-islets are of varying size, number of cells varies from a few to several hundred.

7. Two to three types of cells are distinguishable.

Gall bladder :

1. The gall bladder is a small round structure. The anterior end of which is drawn into a short neck.

2. A large cystic duct is formed by the union of a few narrow ducts from the right lobe of the liver.

3. Two large ducts formed by the union of a number of ducts from the median and left side of the liver and the pancreatic duct, join together to form a duct.

4. The common duct opens on the anterodorsal border of the duodenum.

5. The wall consists of mucous membrane and serosa, the former being thrown into small folds.

   i. The cells of the epithelium are tall, narrow columnar, with granulated cytoplasm.

   ii. Considerable percentage of the epithelial cells is secretory.

6. The basement membrane is homogeneous and not always discernible.

7. The serosa is of areolar connective tissue.

8. Serous membrane is very thin and made up of extremely flattened cells.

Amylase

(mg. of maltose liberated by the enzyme present in 100 mg. tissue)

	Cyprinus	Ophicephalus	Bufo	Mabuia
Oesophagus	41.00	2.40	0	2.00
Intestinal bulb	42.60	-	-	-
Stomach	-	11.80	1.20	2.60
Anterior intestine	48.20	26.20	-	-
Duodenum	-	-	1.80	15.80
Posterior intestine	43.40	35.80	-	-
Intestine	-	-	1.60	2.00
Hepatopancreas	50.00	28.40	-	-
Liver	-	-	10.80	6.80
Pancreas	-	-	68.00	21.00
Bile	45.80	0.40	0	0.80

Proteinase

(Units of proteolytic activity present in 50 mg. tissue)

	Cyprinus	Ophicephalus	Bufo	Mabuia
Oesophagus	20.83	20.83	16.66	16.66
Intestinal bulb	41.66	-	-	-
Stomach	-	25.00	29.17	25.00
Anterior intestine	29.17	25.00	-	-
Duodenum	-	-	33.33	16.66
Posterior intestine	33.33	25.00	-	-
Intestine	-	-	20.83	16.66
Hepatopancreas	37.50	33.33	-	-
Liver	-	-	25.00	25.00
Pancreas	-	-	41.66	141.66
Bile	29.17	29.17	25.00	16.66

Esterase

(μ moles esteric linkage split)

	Cyprinus	Ophicephalus	Bufo	Mabuia
Oesophagus	11.66	38.16	9.54	13.88
Intestinal bulb	15.90	-	-	-
Stomach	-	43.46	9.75	15.90
Anterior intestine	20.14	53.94	-	-
Duodenum	-	-	19.08	17.38
Posterior intestine	16.96	34.98	-	-
Intestine	-	-	13.25	16.96
Hepatopancreas	23.32	50.88	-	-
Liver	-	-	31.80	39.22
Pancreas	-	-	20.14	19.08
Bile	21.20	18.08	8.48	3.18