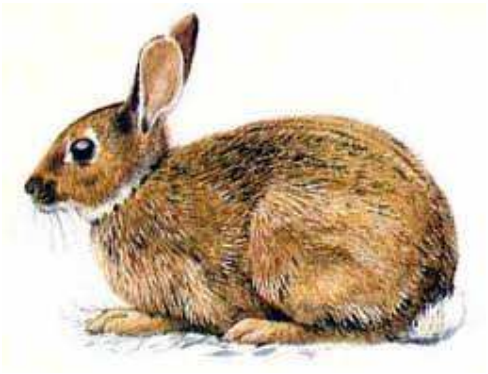
RABBIT: EXTERNAL CHARACTERS UPTO DIGETIVE SYSTEM



Oryctolagus cuniculus



(Openings of burrows)



(warren (net work))

VERY SHORT ANSWER TYPE QUESTIONS

1. What is meant by Warren?
Intricate net formed among spacious tunnel like burrows of rabbits due to interconnections is known as warren. It has many openings to outside.

2. Why rabbits are crepuscular?
Rabbits are active during dawn and dusk. So they are described as crepuscular.

3. What is meant by polygamy?
Rabbits are polygamous where one male mates with many females.

4. What is rhinarium ?
Moist skin that surrounds each nostril in rabbit is known as rhinarium.

5. What is meant by caecophagous ?
Habit of feeding on their own faeces is known as coprophagous or caecophagous.

6. What is harelip in rabbit?
Upper lip in rabbit has cleft and known as hare lip. Through the cleft incisors are visible.

7. Which partition separates thorax and abdomen in rabbit?
A dome shaped muscular membrane 'Diap hragm' separates thorax and abdomen internally.

8. Which part of the body in rabbit is used as a warning signal?
Rabbit uses its tail as warning signal to the other members of the group. It lifts tail to display its white hair as warning signal.
Rabbit thumbs its hind limbs on the ground to produce an alarming sound

9. What are hallux and pollex?
Pollex is the thumb of forelimb. It is present in rabbit also.
Hallux is the thumb of hindlimb. But it is absent in rabbit.

10. What is clitoris?
Clitoris is a rod like structure present in the anterior wall of vestibule in vulva in female rabbit. It is homologous to penis of male.

11. What are vibrissae or whiskers?
Vibrissae are long, stiff, tactile hairs present on either side of upper lip.

12. What are buck, doe and bunny in rabbits?
i) Male rabbit is buck. ii) Female rabbit is doe iii) Young rabbit is bunny.

13. What is nictitating membrane ?
Nictitating membrane is third eye lid which present in the anterior corner of each eye of rabbit. It can be drawn across the cornea to protect the eye from dust particles.



14. What is external auditory meatus?
External auditory meatus or external ear opening present at the basal part of each pinna (external ear) in rabbit.

15. What is vulva?
Slit like urinogenital aperture in female rabbit is known as vulva.

16. What are different types of teeth present in rabbit?
Both the jaws in rabbit have 3 types of teeth only. They are
A)Incisors B)Premolars c) Molars. (Canines are absent.)

17. What is meant by Distema ?
Diastema a large gap present between incisors and premolars due to the absence of Canines in Rabbit.

18. What is Vulva?

Vulva is the freely hanging part of soft palate into the pharynx.

19. Write the dental formula of rabbit.

Incisors 2/1 , Canines 0/0, Premolars 3/2, Molars 3/3.

20. Name four types of papillae present on tongue of rabbit.

Four types of papillae present on tongue are

i)Fungiform papillae -- Margin of tongue
ii)Filiform papillae -- Upper surface of tongue
iii)Circumvallate papillae --- Base of tongue
iv)Foliate papillae ---- Sides of the base of tongue.

21. What are cardia and pylorus?

Cardia is opening of oesophagus into cardiac stomach.

Pylorus is the opening of pyloric stomach into duodenum of intestine.

22. Name the substances secreted by the oxyntic cells of gastric glands.

Oxyntic cells or parietal cells secrete HCl, Castle's intrinsic factor.

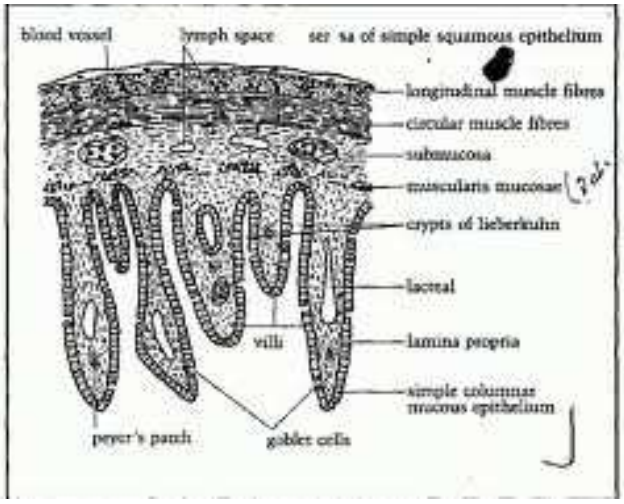
23. What is the nature of gastric juice? Name the constituents in that juice.

Gastric juice is acidic in nature with p^H is 1.5-2.0.

It consists HCl, mucin, pepsinogen, prorenin, and Castle's intrinsic factor.

24. Name the four layers of gastrointestinal tract.

I) outer serous layer ii) Muscle layer iii)Submucosa iv)Mucosa layer.



T.S. OF INTESTINE

25. Where is caecum is present? What is its function?

- Caecum attaches with sacculus rotundus present at the tip of ileum.
- Caecum contains symbiotic bacteria that help in cellulose digestion.

26. Name the four types of salivary glands present in rabbit.

Four types of salivary glands present in rabbit are
a)Parotid glands b)Submaxillary glands c)Sublingual glands d)Infraorbital

27. How does a small intestine provides large surface area for absorption of digested nutrients? What are lacteals?
Finger like elevations known as Villi increase the area of absorption in intestine. Lacteals are lymph capillaries present in villi.

28. Where are Crypts of Lieberkuhn are present? Name the juice secreted by them.

- Crypts of Lieberkuhn are intestinal glands present among villi of ileum.
- Their juice along with brunner's glands of duodenum form intestinal juice or succus entericus.

29. Name the juice secreted by liver? How it helps in digestion of fats?
BILE is secreted by liver. It emulsifies fats with the help of bile salts.

30. What is chime?
Partially digested, acidic, fluid-food formed in stomach is known as chime.

31. What are the major functions of large intestine?

- Large intestine absorbs water from undigested matter and helps in the formation and elimination of faecal matter.
- Caecum lodges symbiotic bacteria which help in cellulose digestion.

32. What is autocoprophagy ?

- Feeding of its own faeces is known as autocoprophagy.
- Rabbit ingests the faeces expelled at night because that faeces contains the nutrients and metabolites needed for cellulose digestion.

33. Name the macronutrient required for proper formation bones and teeth.
Calcium and Phosphorus

34. What are fat soluble vitamins and water soluble vitamins?

Fat soluble vitamins	**Water soluble vitamins**
Vitamins A, D, E, K	Vitamins B & C
Need bile juice for absorption	Directly absorbed by intestine
Lymph transports them to all parts	Blood transports them to all parts

35. Which vitamin is called sunshine vitamin? Name the diseases occur due to deficiency of it?

- Vitamin D or Calciferol or Antirachitic vitamin is sunshine vitamin.
- Deficiency of Vitamin D causes a) Rickets in children b) Osteomalacia in adults

36. Name the chemical name of vitamin C. Which disease occurs in its absence?

- Vitamin C or Ascorbic acid or Antiscorbutic vitamin.

- Its deficiency leads to Scurvy.

37. Name the five lobes of liver in rabbit.

- Liver in rabbit has five lobes. Two on right side and three on left side.
- Right lobes are ---- a) Right central lobe b) Right caudate lobe
- Left lobes are ---- a) Central lobe b) Lateral lobe c) Spigelian lobe

38. Name the only digestive juice without enzymes.

Bile juice

39. Name the components of pancreatic juice.

Pancreatic juice contains trypsinogen, chymotrypsinogen, amylase, carboxypeptidase, lipase (steapsin), nucleases like DNase and RNase.

40. Why is caecum is longer in herbivores like rabbit?

As the caecum lodges symbiotic bacteria for the digestion of cellulose, caecum is longer in herbivores like rabbit. It provides efficient digestion of cellulose.

41. What are kwashiorkor and marasmus ?

A)Kwashiorkor is a disorder in which protein intake is deficient despite normal caloric intake.
B)marasmus is a disorder occurs due to protein-calorie under nutrition.

42. How intestinal juice or succus entericus is formed?

- Brunner's glands are present in submucosa of duodenum
- Crypts of Libeberkuhn are present in mucosa of ileum.
- Secretions of both glands constitute to form intestinal juice.
- Intestinal juice contains enzymes like aminopeptidae, tripeptidase, dipeptidase, maltase, sucrose, lactase, phosphatases and nucleosidases.
- It has enzyme activator like enterokinase.

SHORT ANSWER TYPE QUESTIONS::

1**. Describe the Buccal cavity of Rabbit.**

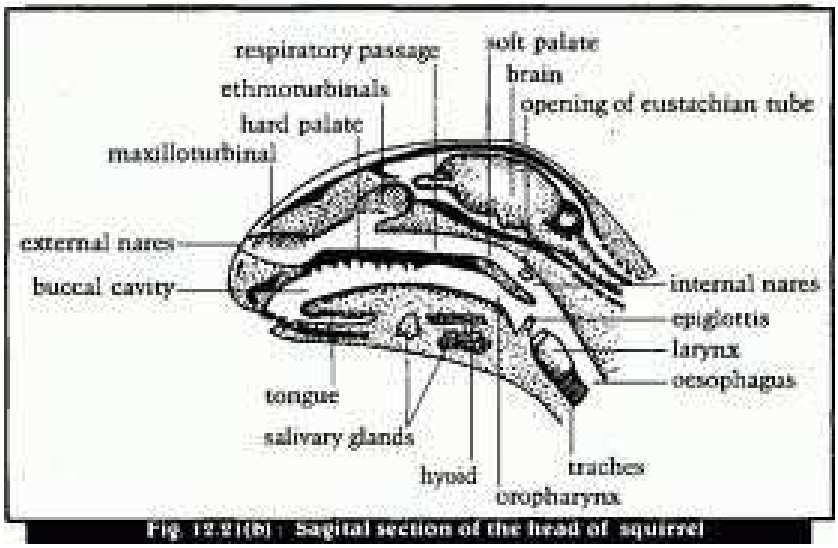


Fig. 12.9(b) : Sagital section of the head of squirrel

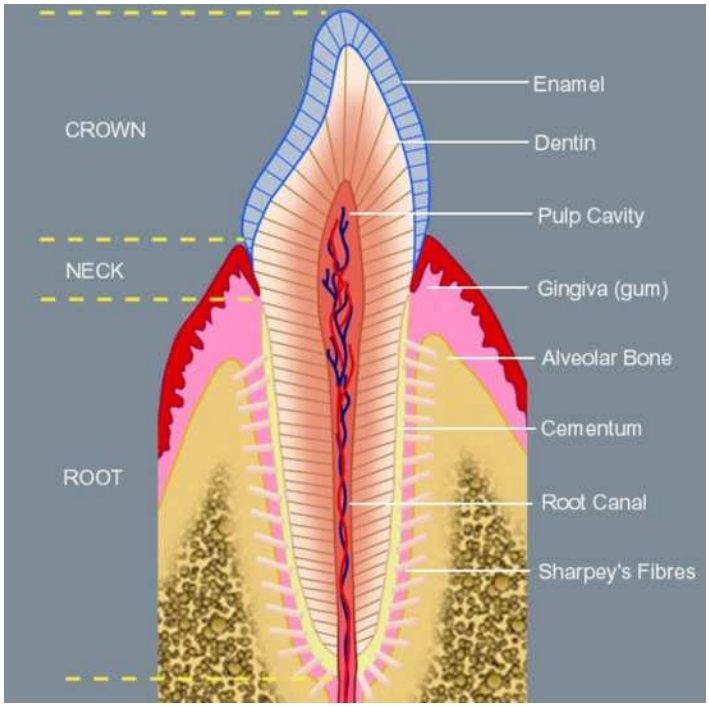
- Mouth leads into buccal cavity through vestibule.
- Roof of buccal cavity is formed by bony secondary palate or pseudopalate or hard palate. It continues as soft palate which hangs in pharynx as Uvula.
- Hard Palate separates buccal cavity into dorsal respiratory (nasal passage) and ventral oral cavity (food passage).
- Animal can breathe while the food is masticated in oral cavity.
- Lower surface of hard palate is lined by an ectodermal membrane, which forms transverse ridges known as Palatine rugae to provide grip over food.
- Buccal cavity contains teeth and tongue.
- A pair of openings of nasopalatine ducts is present in the anterior part of hard palate. They lead into nasal chambers or olfactory chambers.
- Jacobson's organ opens into each nasopalatine duct to recognize different kinds of food.

2. Describe the gastric glands.

Gastric glands are present in the wall of Stomach. They are

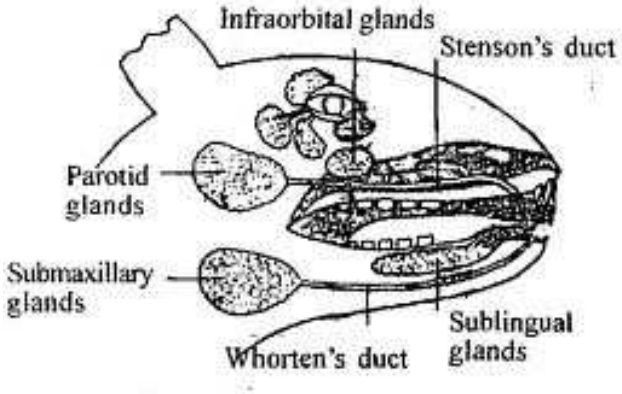
Glands	**Cells**	**Secretions**	**Role**
1. Cardiac glands	Mucous cells	Mucus	Protection to stomach
2. Fundic glands	a)Oxyntic/Parietal	HCl	Conversion of pepsinogen into pepsin
		Castle's intrinsic factor	Absorption of Vit.B_{12}
	b)Neck cells	Mucus	Protection to stomach
	c)Chief / Zymogen	Pepsinogen, Prorennin	Digestion of proteins
	d) Endocrinal cells	Hormones	
3. Pyloric glands	a)Mucous cells	Mucus	Protection to stomach
	b)G cells	Secrete hormone Gastrin.	Stimulates gastric glands t secrete juice

2. Draw a labeled diagram of L.S. of tooth of rabbit.



3. Describe the salivary glands of rabbit.?

Salivary glands	**Location**	**Opens into buccal cavity**	
		AT	THROUGH
1) PAROTID	Base of pinnae	Behind upper incisors	Stenson's duct
2)SUBMAXILLARY	Inner side of angles of lower jaws	Near lower incisors	Wharton's duct
3)SUBLINGUAL	Below tongue	Below free part of tongue	Small ducts
4)INFRAORBITAL	Below orbits	Near upper molars	Ducts



**** In man, infra orbital salivary glands are absent.

4. Describe the process of digestion in Stomach in rabbit.

- Stomach receives the swallowed food.
- Gastric juice has HCl, mucin, pepsinogen, prorennin, lipase and castle's intrinsic factor. Its pH value is 1.5 – 2.0.

- HCl kills bacteria and other microbes present in food. HCl activates pepsinogen into pepsin and prorennin into rennin.
- Calcium – paracaseinate is formed from Casein in milk.
- Pepsin hydrolyses Calcium-paracaseinate into peptones.
- Rennin changes the milk protein casein into paracasein and proteoses.
- Paracasein precipitates into calcium-paracaseinate and then digested by pepsin.
- Castle' s intrinsic factor helps in the absorption of vitamin B_{12} (Cyanocobalamin).
- Mucin protects the lining of stomach from the action of acid and enzymes.
- Small chain triglycerides are digested by gastric lipase.
- Partially digested, acidic, fluid-food formed in stomach is known as Chyme.
- Due to churning movements chyme passes into duodenum through pylorus.

5. Describe the process of absorption of digested food.

- Major part of the digested food is absorbed in ileum.
- Villi increase the area of absorption. Each villus contains an arteriole, a venule and a lymph capillary known as lacteal.
- Microvilli which are formed from the surface of intestinal epithelial cells further increase the efficiency of absorption.
- End products of digestion are absorbed into the blood in the following manner…

END PRODUCTS	**ENTER INTO EPITHELIAL CELLS BY**	**ENTER INTO BLOOD BY**
1.Glucose & Galactose	Secondary Active transport With Na	Facilitated diffusion
2. Fructose	Facilitated diffusion	Facilitated diffusion
3. Amino acids	Secondary Active transport with Na or by Primary Active transport	Diffusion
4. Short chain fatty acids	Diffusion	Diffusion

Absorption of fatty acids:

- Micelles are formed by the combination bile salts with the long chain fatty acids and monoglycerides.
- Micelles absorb the epithelial cell. Long chain fatty acids and monoglycerides diffuse into the intestinal epithelial cells and triglycerides.
- Triglycerides and long chain fatty acids react with phospholipids and cholesterol and are coated with proteins and form Chylomicrons.
- Chylomicrons pass out into the lacteals by exocytosis.
- They transport into left subclavian vein through lymphatic vessels.
- Lipoprotein lipage of endothelia cells breaks down triglycerides in chylomicrons into fatty acids and glycerol. They diffuse into adipose cells and form triglycerides.

6. Describe about Fat soluble vitamins.

VITAMIN	CHEMICAL NAME	COMMON NAME	SOURCES	ROLE	DEFICIENCY LEADS TO
1.A	Retinol	Antixeroph-thalamic vitamin	Fish liver oils, milketc., Beta-carotene in Plants.	Health & vigour of epithelial tissues. Resynthesis of rhodopsin in retina	Nyctalopia(night blindness) Xerophthalmia (dryness of conjunctiva) ; Keratomalacia (dry cornea)
2. D	Calciferol	Antirachitic / Sunshine	Fish liver oils, Milk, Mammalian skin synthesise it from sunlight	Calcium metabolism. Formation of healthy bones and teeth.	Rickets in children. Osteomalacia in adults.
3. E	Tocopherol	Anti-sterility	Wheat germ oil, nut, wheat, maize	Antioxidant and inactivates Oxygen free Radicals. Functioning of gonads	Sterility in males Abortion in females. Muscular dystrophy.
4. K	Naphtho-quinone	Anti haemorrhagic	Green leafy vegetables, Tomato, cheese, eggs, liver	Formation of Prothrombin For blood clotting	Delay in blod clotting.

7. Describe the flow of bile juice from liver into duodenum?

HEPATOCYTES BILE CANALICULI → BILE DUCTS → HEPATIC DUCTS → COMMON HEPATIC DUCT → CYSTIC DUCT → COMMON GALL BLADDER → DUODENUM.

8. Describe the functions of liver?

- Liver secretes bile which helps in emulsification of fats.
- Liver helps in events like gluconeogenesis, glycogenolysis, glycogenesis in carbohydrate metabolism. Liver acts as detoxifying organ.
- Liver helps in cholesterol synthesis and the production of triglycerides.
- Liver produces coagulation factors like I, II, V, VII, IX, X AND XI.
- Liver breaks down haemoglobin and form bile pigments.
- Liver converts ammonia to urea in ornithine cycle.
- Liver stores glycogen, vitaminB_{12}, iron, copper. It activates vitamin D.
- Liver is haemopoietic organ in foetus stage. In adults, it is erythroblastic organ.

9. Describe the vitamin B complex & vitamin C?

Vitamin	Chemical name	Common name	Role	Deficiency leads
1.B_1	Thiamine	Antiberiberi factor	Functioning of nervous system, Co factor for enzymes in Cho and amino acid metabolism	Beriberi Polyneuritis (degeneration of myelin sheath)

2.B_2	Riboflavin		Component of FMN and FAD for intermediary metabolism.	Cheilosis Glossitis, Seboric dermatitis
3.B_6	Pyridoxine		Coenzyme for enzymes for protein metabolism. Helps in utilization of Fe in haemoglobin synthesis, production o antibodies	Hypochromic microcytic anaemia
4.B_{12}	Cyanocobalamin		Coenzyme for maturation of RBC, formation methionine ;helps in synthesis of DNA	Pernicious anaemia, degenerative changes in spinal cord
5.Niacin or Nicotinic acid		Antipellagra vitamin	Part of coenzymes like NAD and NADP Which are essential for the formation of ATP.	Pellagra (diarrhea,dermatitis and dementia
6.Folacin	Folic acid		Synthesis of Adenine,guanine and thymine for DNA and RNA. Helps in formation of RBC and WBC	Macrocytic anaemia, delay in replication of DNA, Leucopenia
7.Panto – thenic acid			Part of coenzyme A.	Poor growth, early aging, premature graying of hair.
8.Biotin			Coenzyme for carboxylases.	Present in person who consume raw eggs with avidin.
9.VITAMIN ‘ C’	Ascorbic acid	Antiscorbutic Vitamin	Maintains the matrix of cartilage, bone and dentine, integrity of endothelium. Provides resistance, dissolve cholesterol in blood, wound repair, increases iron absorption.	SCURVY Skin eruptions, swollen and bleeding gums of teeth, haemorrhage, por healing of wounds

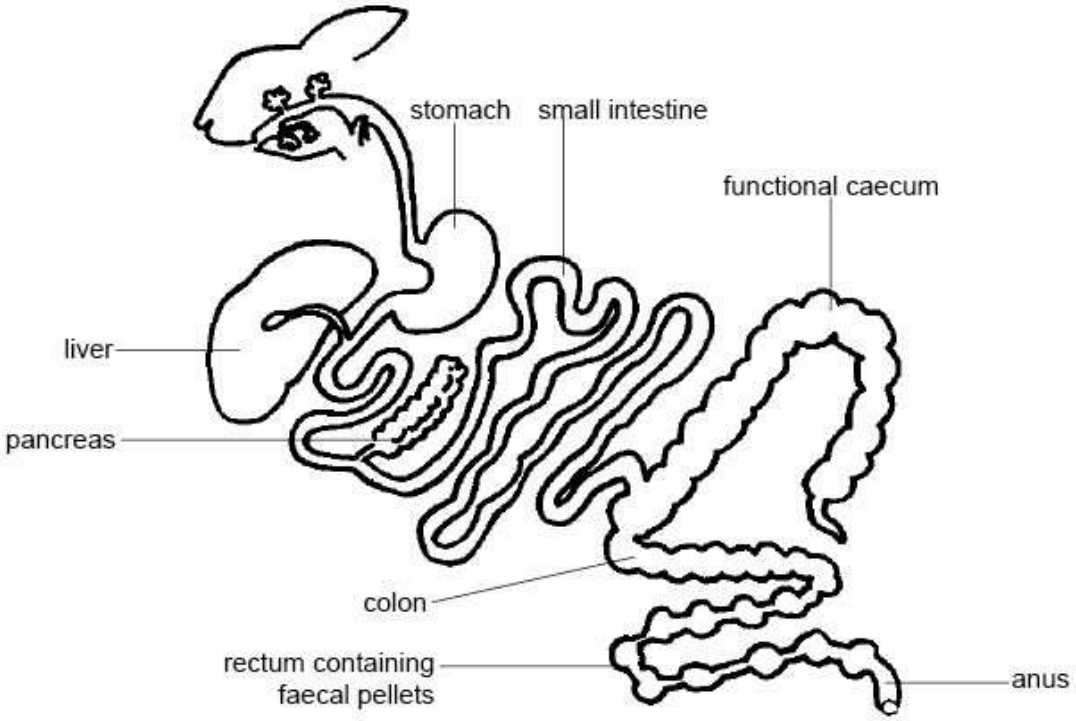
11. Describe the various digestive juices?

DIGESTIVE JUICE	pH& NATURE	COMPONENTS
1.Saliva	6.9 , slightly acidic	Mineral slats, mucin,Ptyalin or salivary amylase
2.Gastric juice	1.5 – 2.0 ; Acidic	HCl, mucin, pepsinogen, prorennin, castle’s intrinsic factor
3. Bile juice	7.0 – 7.6	Bile salts,
4.Pancreatic juice	8.0 Alkaline	Trypsinogen, Chymotrypsinogen,Carboxypeptidas

		Mylase, lipase (steapsin), lipase, Nucleases like DNase and RNase.
5.Intestinal juice (succus entericus)	7.6 alkaline	Aminopeptidases, tripeptidase, Dipeptidase, maltase, sucrose, lactase, phosphatases and nucleosidases.

LONG ANSWER TYPE QUESTIONS:

1. Draw a labeled diagram of digestive system of rabbit and describe the process of digestion in intestine.



- When the acidic chyme enters the duodenum, bile juice, pancreatic juice and intestinal juice are mixed with it.
- Bile juice is without any enzymes but performs the following functions.

i) Emulsification of fats
ii) absorption of digested fats
iii) Conversion of acidic food of stomach into alkaline food.

I) **<u>DIGESTION OF PROTEINS IN INTESTINE</u>** :

- Enterokinase of intestinal juice activates trypsinogen into trypsin.
- Trypsin converts chymorypsinogen into chymotrypsin.
- Trypsin and chuymotrypsin digest native proteins, proteases and peptones into polypeptides.
- Carboxypeptidases break the terminal amino acid at the carboxylic end of polypeptides and expose the carboxyl group and thus digest the polypeptides into small peptides and amino acids.
- Aminopeptidases cleave terminal amino acid at amino end of polypeptides and expose amino group. They hydorlyse the polypeptide into free amino acid and tripeptide.
- Tripeptidases convert tripeptides into dipeptides and amino acids.
- Dipeptidases digest the dipeptides into amino acids.

II) <u>DIGESTION OF FATS IN INTESTINE</u> :

- Digestion of fats includes three phases like preparatory, transport and transportation phases.

- Preparatory phase includes the digestion of fats in intestine and stomach.
- Transport phase includes the transport of fatty acids and glycerol into epithelia cells and intestinal villi.
- Transportation phase includes the entry of fats into lacteals from epithelial cells.
- Bile salts emulsify the fats present in chyme.
- Lipase of pancreatic juice (Steapsin) and intestinal lipase digest the emulsified simple fats into fatty acids and glycerol.

III) **DIGESTION OF CARBOHYDRATES IN INTESTINE** :

- Amylase of pancreatic juice converts carbohuydrates into disaccharides like maltose, sucrose, lactose etc.
- Disaccharidases of intestinal juice digest them into monosaccharides like glucose, fructose and galactose.
- Maltase converts maltose into glucose molecules.
- Sucrase acts on sucrose and covert them into glucose and fructose.
- Lactase converts lactose into glucose and galactose.

IV) **DIGESTION OF NUCLEIC ACIDS** ;

- RNase and DNase of pancreatic juice digest RNA and DNA into nucleotides.
- Phosphatases of intestinal juice hydrolyse ester bond to release the phosphate from nucleotides.
- Nucleosidases of intestinal juice hydrolyse the glycosidic bond to digest nucelosides into pentose sugars and nitrogen bases.

RABBIT --- RESPIRATORY SYSTEM

VSAQ s:

1. What are conchae?

- Conchae or turbinals are three thin, twisted bony plates present in respiratory part of each nasal chamber.

2. Which muscles help in breathing movements in rabbit?

- i)Muscles of diaphragm (phrenic muscles) ii)External intercostals muscles iii) Internal intercostal muscles iv) Abdominal muscles

3. What is rima glottidis ?

- Rima glottidis is the space between the two vocal cords in larynx.

4. Name different lobes of right and left lungs in rabbit.?

- i)Right lung has 4 lobes like Anterior azygous lobe Right anterior lobe, Right posterior lobe, Posterior azygous lobe.
- ii) Left lung has 2 lobes like Left anterior lobe Left posterior lobes.

5. Describe the histology of respiratory membrane?

- Respiratory membrane is thin membrane made up of two layers of simple squamous epithelium (one belongs to alveolus and the other belongs to endothelium of blood capillaries), and their basement membranes.
- Through this membrane exchange of gases takes place.

6. Name the muscles that contract during normal inspiration?

- Muscles of diaphragm and external intercostals muscles.

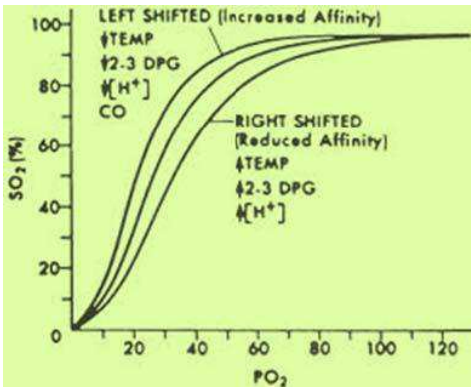
7. Why is normal expiration is passive while forceful expiration is an active process?

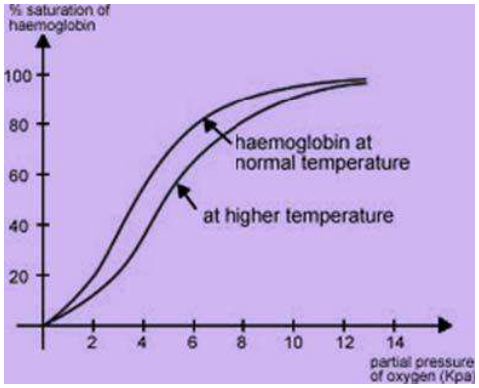
- Normal expiration is a passive process as it involves relaxation of muscles or does not involves contraction of muscles.
- Forceful expiration is an active process; as it involves contraction of internal inter costal muscles and abdominal muscles.

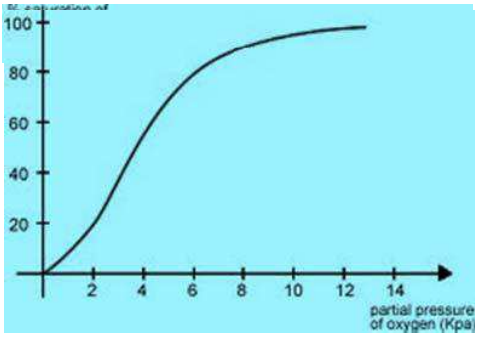
8. What is Bohr Effect?

- Effect of CO_2 and H^+ ions on the oxygen-affinity of Haemoglobin is Bohr effect.

9. Draw diagram of Oxygen dissociation curve.







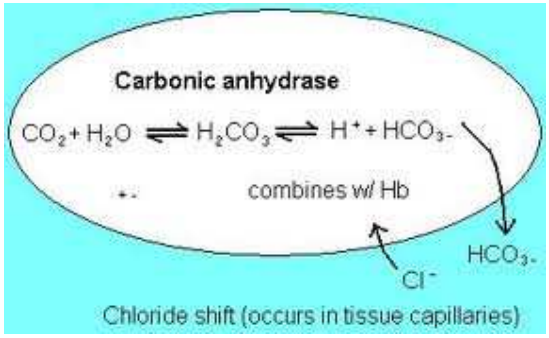
10. Name the three forms of transportation of Carbon dioxide?

I) Dissolved state -- 7 % II)Carbaminocompounds --- 23 %

III) Bicarbonates --- 70 %.

11. What is meant by chloride shift?

- As the bicarbonate ions diffuse into blood plasma, Cl ions diffuse from plasma into RBC to maintain electrical balance. It is also known as Hamberger phenomenon.



12. What is Oxygenation?

- Binding oxygen with haemoglobin to form oxyhaemoglobin is oxygenation.

13. Differentiate external respiration, internal respiration and cellular respiration?

- External respiration : exchange of gases between the air in alveoli and blood in pulmonary capillaries.
- Internal respiration : Exchange of gases between the blood in systemic capillaries and tissue cells.

- Cellular respiration: Oxidation of food which takes place within the cell. It produces ATP.

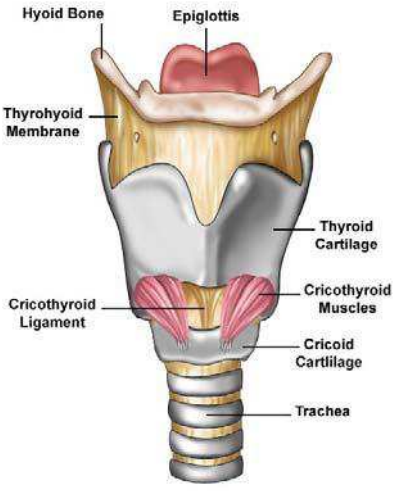
14. What is epiglottis?

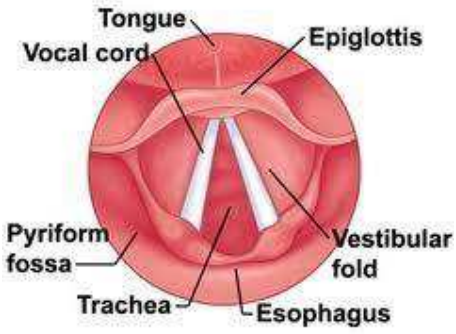
Epiglottis is a lid made up of elastic cartilage which guards the glottis and prevents the entry of food and water into larynx. It arises from thyroid cartilage.

SAQ s:

1. Describe the structure of Larynx in rabbit.

- Larynx is the voice box. It is short tube like structure.
- Laryngopharynx opens into larynx through glottis.
- Larynx is supported by different types of cartilages. They are
  a) **Thyroid cartilage**: Largest. It forms ventral and lateral walls of larynx. It gives epiglottis.
  b) **Cricoid cartilage**: present behind thyroid. It is a ring like cartilage.
  c) **Arytenoid cartilages**: one pair of arytenoids is present on dorsal side of larynx.
  d) **Cartilages of santorini**: Present at the tips of arytenoids.
- Two fibro elastic strands known as vocal cords are extend between thyroid and arytenoids. Their vibrations produce sound.
- Rima glottidis is the space between two vocal cords.
- Larynx opens into trachea.





2. Describe the structure of lungs in rabbit?

➔ One pair of pinkish, spongy lungs is present in thoracic cavity.

➔ Each lung is enclosed in a double layered peritoneum known as pleural membrane.

With outer parietal pleura and inner visceral pleura. Pleural cavity between them is filled with pleural fluid. It acts as a lubricant.

➔ Right lung has four lobes like a) Anterior azygous b)Right anterior
c) Right posterior d) Posterior azygous

➔ Left lung has two lobes like a) Left anterior b) Left posterior lobe.

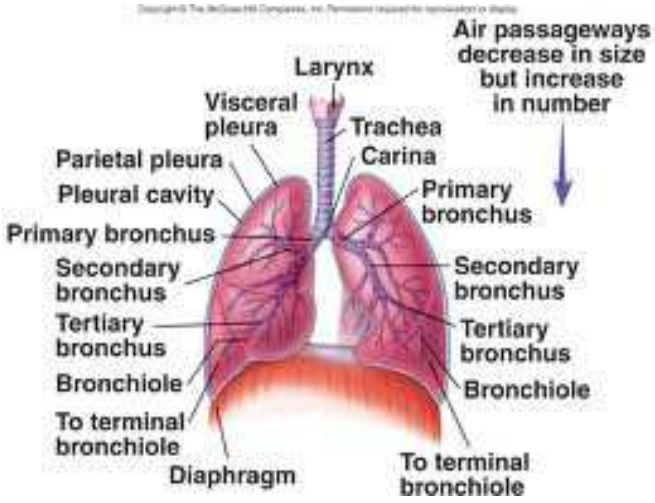
➔ Alveolar ducts end in alveolar sacs in each lung.

➔ Each alveolar sac is formed of small round or oval chambers known as Alveoli.

➔ Each alveolus is lined by simple squamous epithelium present basement membrane.

➔ Pulmonary capillaries are present on outer surface of alveoli.

➔ Respiratory membrane is formed by two layers of simple squamous epithelium and their basements membranes. Through this exchange of gases takes place.



3. Describe the structure of Bronchial tree in rabbit?

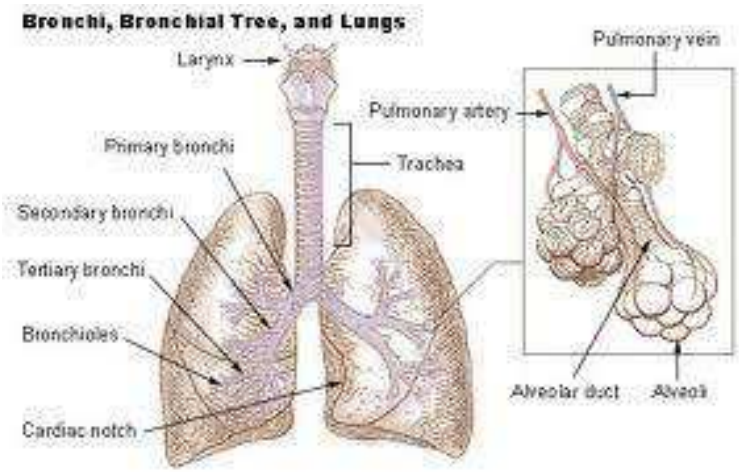
➔ Trachea or wind pipe passes through neck on ventral side of oesophagus.

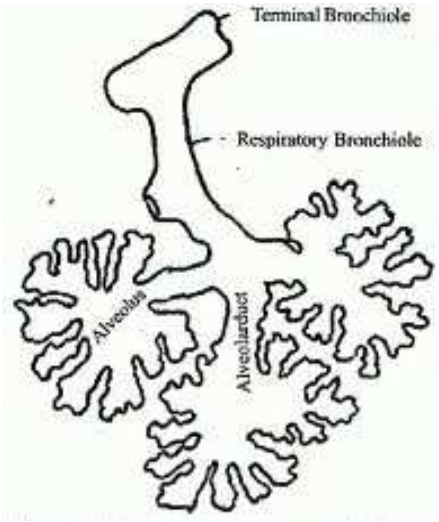
➔ Trachea bifurcates into two Primary bronchi in thorax. Each primary bronchus enters the lung and divides into secondary bronchi which further divide into Tertiary bronchi.

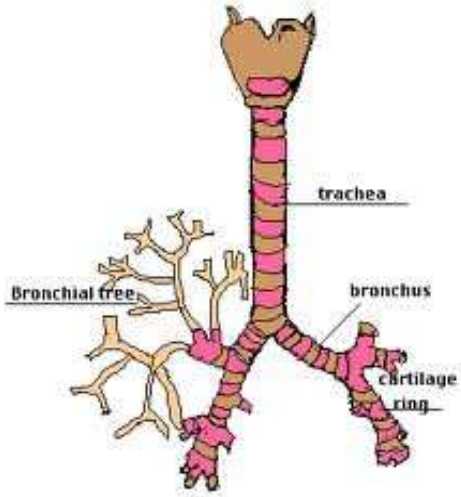
➔ Tertiary bronchi are divided into many branches known as Bronchioles in the order of Primary bronchioles, Secondary bronchioles, Tertiary bronchioles, Terminal bronchioles and respiratory bronchioles.

➔ Each respiratory bronchiole terminates in a cluster of Alveolar ducts.

➔ This extensive branching from trachea resembles an inverted tree and known as Bronchial tree.







4. Describe the Mechanism of Breathing in rabbit…?

- ➔ Breathing is the action of taking air into lungs and sending it out of lungs.
- ➔ Thoracic cavity in rabbit is bound dorsally by vertebral column, ventrally by sternum, posteriorly by a dome shaped muscular diaphragm and laterally by 12 pairs of ribs.

A) INSPIRATION ;

- ➔ It involves the contraction of muscles. So it is an active process.
- ➔ Contraction of muscles of diaphragm makes the diaphragm flat which increases the volume of thoracic cavity anteroposteriorly.
- ➔ Contraction of External intercostals muscles moves the rib cage forward and downward. It results the increase in the volume of thoracic cavity dorsoventrally and laterally.
- ➔ When thoracic cavity expands, air pressure in lungs decreases.
- ➔ Atmospheric air is drawn into alveoli of lungs.
- ➔ Contraction of diaphragm accounts for 75% of air that enters the lungs.

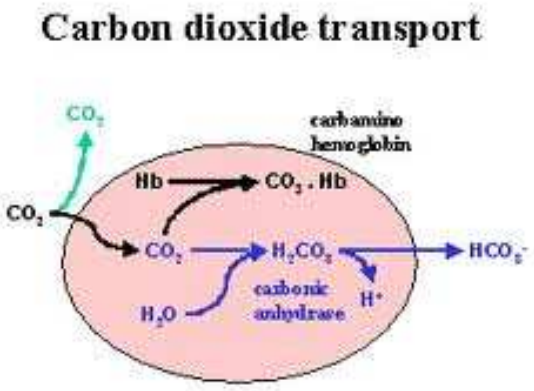
B) EXPIRATION:

- ➔ Normal expiration is a passive process as it does not involves contraction of muscles.
- ➔ Relaxation of muscles of diaphragm makes the diaphragm dome shaped. It decreases the volume of thoracic cavity anteroposteriorly.
- ➔ Relaxation of external intercostal muscles moves the rib cage to its original position which decreases the volume of thoracic cavity dorsoventrally.
- ➔ Decrease in thoracic cavity causes elastic recoil of lungs and expulsion of air from alveoli into atmosphere. Forceful expiration is an active process.

5. Explain pulmonary gas exchange and systemic gas exchange.

- ➔ Partial pressure is the pressure exerted by an individual gas in a mixture of gases.
- ➔ The rate of gas exchange depends on 1)partial pressure of gases
  2) Solubility of gases 3) Surface area 4) Distance of diffusion
- ➔ I)PULMONARY GAS EXCHANGE (external respiration)
  Differences in PO_2 and PCO_2 of alveolar air and pulmonary capillaries favour diffusion of O_2 from alveolar air into blood of capillaries and diffusion of CO_2 in the opposite direction
- ➔ II) **SYSTEMIC GAS EXCHANGE** (internal respiration)
  Differences in PO_2 and PCO_2 of oxygenated blood in systemic capillaries and those of the tissues favour diffusion of O_2 from systemic capillaries into tissues and diffusion of CO_2 in the opposite direction.

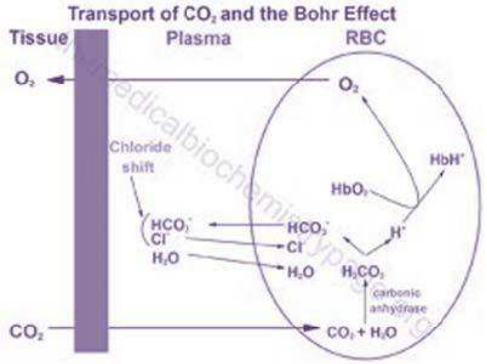
6. Explain how CO_2 is transported as bicarbonate ions.

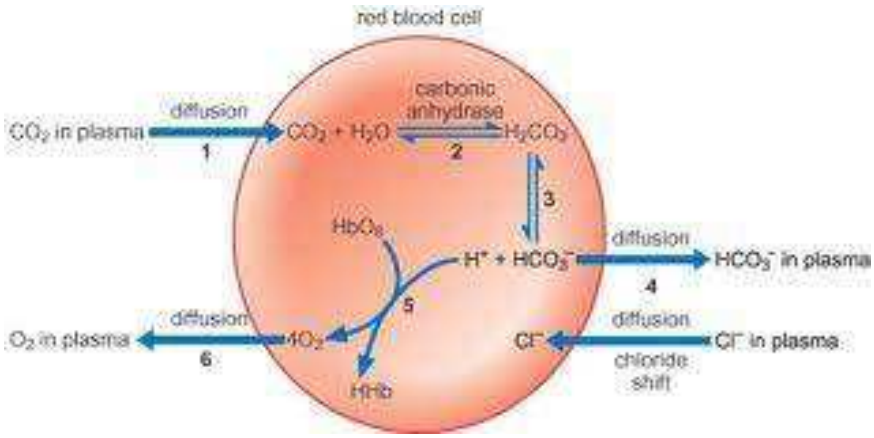


- ➔ About 70% of CO_2 is transported as bicarbonate ions.
- ➔ CO_2 reacts with water in RBC of systemic capillaries to form Carbonic acid (H_2CO_3). This reaction occurs about 5000 times faster in RBC than in plasma due to the enzyme Carbonic Anhydrase in RBC.

  $H_2O + CO_2 \Leftrightarrow H_2CO_3 \Leftrightarrow H^+ + HCO_3$
- ➔ Carbonic acid dissociates into hydrogen ions and bicarbonate ions.
- ➔ Due to the action of carbonic anhydrase concentration of bicarbonates increases in RBC. These bicarbonate ions diffuse into blood plasma from RBC.

- To maintain electrical balance, Cl^{---} ions diffuse from plasma into RBC. This exchange of chloride and bicarbonate ions between RBC and plasma is known as Chloride shift or Hamberger's phenomenon.
- H^+ ions combine with deoxyhaemoglobin to form HHb.
- At lungs, as haemoglobin loads oxygen, its affinity for H^+ ions decreases. So H^+ ions dissociate from haemoglobin and binds with bicarbonate and form H_2CO_3 that dissociates into CO_2 and H_2O. It is catalysed by carbonioc anhydrase.
- CO_2 diffuses into alveoli and is exhaled.
- As concentration of HCO_3 declines in RBC, HCO_3 ions diffuse from plasma into RBC in exchange for Cl^{---} (Reverse chloride shift).





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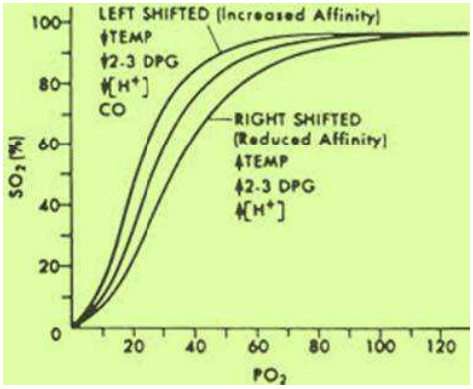
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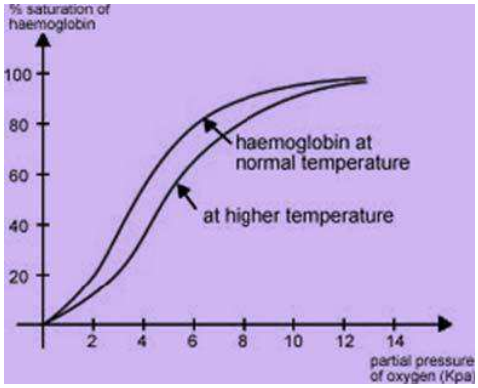
7. Explain Oxygen – haemoglobin dissociation curve.

- It explains the relationship between percent saturation of haemoglobin and PO_2.
- PO_2 is plotted on X – axis and percent saturation of haemoglobin on Y—axis.

% saturation of Hb	**Number of O_2 Molecules bind with Hb**
100%	4
75%	3
50 %	2

- About 97 % of Hb is saturated in systemic arteries, where PO_2 is about 95 mm Hg.
- About 75 % of Hb is saturated in resting cells where PO_2 is about 40 mm Hg.
- Very less % of Hb is saturated in active tissues like skeletal muscles where PO_2 is much below 40 mm Hg. Here dissociation of oxyhaemoglobin occurs.
- Decrease in pH, increase in CO_2, increase in temperature increase unloading of O_2 from oxyhaemoglobin.
- In these conditions, oxygen-haemoglobin dissociation curve shifts to the right side. Effect of CO_2 and H^+ ions on oxygen-affinity of Hb is known as Bohr Effect





LONG ANSWER QUESTIONS:

1. Explain the transportation of Oxygen and Carbondioxide.

Blood transports O_2 from lungs to tissues and CO_2 from tissues to lungs.

A) **TRANSORT OF O_2**: Plasma and RBC transport O_2.

I) **As Dissolved Oxygen:** O_2 does not easily dissolve in water so only about 3 % of O_2 is transported in dissolved state in blood plasma.

II) **As Oxyhaemoglobin**:

- About 97 % of O_2 binds with haemoglobin and form Oxyhaemoglobin.
- Each haemoglobin molecule can carry 4 O_2 molecules at one time.
- At lungs Oxyhaemoglobin is formed by the binding of O_2 with haemoglobin due to high O_2 tension in lungs.

$$Hb + O_2 \Leftrightarrow Hb\ O_2$$

- At tissues, where O_2 tension is low, oxyhaemoglobin dissociates into Haemoglobin & O_2

III) **Oxygen-Haemoglobin Dissociation Curve**

- It explains the relationship between percent saturation of haemoglobin and PO_2.
- PO_2 is plotted on X – axis and percent saturation of haemoglobin on Y—axis.

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- In these conditions, oxygen-haemoglobin dissociation curve shifts to the right side.
- Effect of CO_2 and H^+ ions on oxygen-affinity of Hb is known as Bohr Effect.

B) **TRANSPORT OF CARBON DIOXIDE**;

Transport of CO_2 occurs in 3 forms—

➔ **As dissolved CO_2** : About 7 % of CO_2 is dissolved in plasma at tissues. In lungs, it diffuses into alveolar air.

$$H_2O + CO_2 \Leftrightarrow H_2CO_3$$

➔ **As Carbaminocompounds** : about 23 % of CO_2 is transported as carbamino compounds. CO_2 combines with amino groups of plasma proteins and amino groups of amino acids of haemoglobin and form carbaminohaemoglobin.

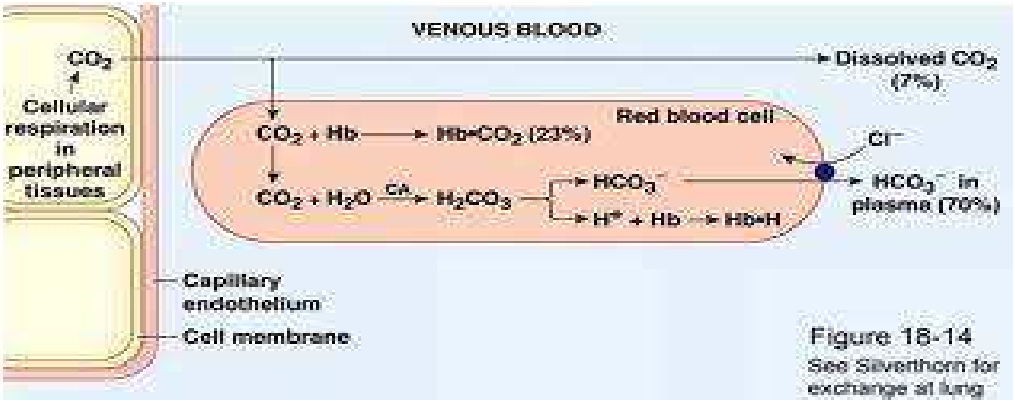
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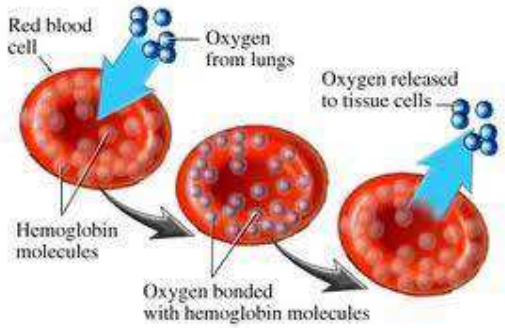
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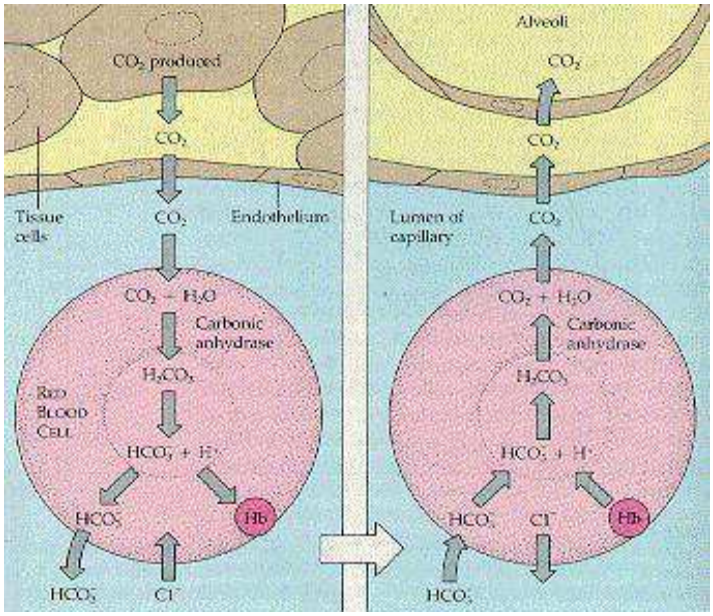
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Pulmonary gas exchange and systemic gas exchange.

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- ➔ The rate of gas exchange depends on 1)partial pressure of gases

2) Solubility of gases 3)Surface area 40Distance of diffusion

I) PULMONARY GAS EXCHANGE (external respiration)

Differences in PO_2 and PCO_2 of alveolar air and pulmonary capillaries favour diffusion of O_2 from alveolar air into blood of capillaries and diffusion of CO_2 in the opposite direction

II) SYSTEMIC GAS EXCHANGE (internal respiration)

Differences in PO_2 and PCO_2 of oxygenated blood in systemic capillaries and those of the tissues favour diffusion of O_2 from systemic capillaries into tissues and diffusion of CO_2 in the opposite direction.

RABBIT --- CIRCULATORY SYSTEM

VSAQ s :

1. How many pace makers are present in the heart of rabbit? Name them.

- Two pace makers are present in the heart of rabbit.
- They are a) Sinoatrial node (SA node) b) Atrioventricular node (AV node).

2. Which valves guard the left and right atrioventricular apertures?

- Bicuspid valve or Mitral valve ---- left atrioventricular aperture
- Tricuspid valve ---- Right atrioventricular aperture.

3. Name the pore present on the inter atrial septum in embryonic stage and the patch formed due to closure in the heart of rabbit.

- Foramen ovale is the pore present on the inter atrial septum in embryonic stage.
- Fossa ovalis is the patch present in adult due to closure of foramen ovale.

4. Where is the valve of Thebesius is present?

- Opening of coronary sinus into Left precaval vein is bound by a crescentic fold known as valve of Thebesius.

5. Name the aortic arches arise from ventricles in rabbit?

- A) Pulmonary arch -- arises from right ventricle
- B) Left systemic arch -- arises from left ventricle.

6. Name the heart sounds. When they are caused?

- First heart sound is 'LUBB'. It occurs due to closure of AV valves. It is due to the contraction of ventricles that raises the pressure in ventricles.
- Second heart sound is 'DUPP'. It occurs due to the closure of semilunar valves. It is due to the diastole of atria which leads to the fall of pressure in ventricles than that of aortic arches.

7. Name the blood vessels that supply blood to gonads in male and female rabbits.

- In males gonadal arteries are spermatic arteries.
- In females gonadal arteries are ovarian arteries.

8. Which veins unite to form hepatic portal vein?

- Four types of veins unite to form hepatic portal vein. They are

Lienogastric vein	: collects blood from stomach and spleen.
Duodenal vein	: collects blood from duodenum and pancreas.
Anterior mesenteric vein	: collects blood from ileum, caecum and colon.
Posterior mesenteric vein	: collects blood from colon and rectum.

9. Name the first four factors that play a role in blood clotting ?

NUMBER	FACTOR
Factor I	Fibrinogen
Factor II	Prothrombin
Factor III	Tissue thromboplastin or Tissue Factor
Factor IV	Calcium ions

10. What are haemostasis and Homeostasis?

- Haemostasis is stoppage of bleeding by a sequence of responses.
- Homeostasis is the maintaining of constant concentration of body fluids.

11. What are thrombus and embolus?

- Thrombus is an abnormal clot formd in a blood vessel
- Embolus is a free flowing clot in the blood stream.
-

12. What are coronary sulcus and auricular appendix?

- Coronary sulcus is a deep groove that separates atria and ventricles.
- Auricular appendix is a small conical pouch projecting from the upper portion of each atrium of heart which extends over the ventricle.

13. Name the various types of valves present in the heart of rabbit.

NAME OF THE VALVE	LOCATION
1.Valve of Thebesius	Opening coronary sinus into left precaval vien
2. Valve of Eustachian	Opening of postcaval vein into right atrium in Embryonic stage.(Nonfunctional in adult)
3. Tricuspid valve	Between Right atrium and right ventricle
4. Bicuspid (MITRAL) valve	Between left atrium and left ventricle
5. Pulmonary valve	Opening of Right ventricle into pulmonary arch
6. Aortic valve	Opening of Left ventricle into systemic arch

14. What is a portal vein?

- A vein that begins with capillaries in one organ and supplies it to another organ other than the heart is known as portal vein.
- Rabbit has hepatic portal system only where liver is the mediator.

SAQ s:

1. Describe the ventricles of the heart of rabbit.

- Two ventricles (right & left) form the posterior part of the heart.
- They are separated by interventricular septum.

- Left ventricle is larger and has thickest walls comparted to that of right ventricle as the left ventricle must force the blood to all the parts of body.
- Inner surface of ventricles is raised into muscular ridges known as columnae corneae. Some of them are large and conical and known as papillary muscles.
- Tendon-like cords known as Chrodae tendineae are present between atrioventricular valves and papillary muscles. They prevent the cusps of valves from bulging too far into atrium.

2. Describe the atria of the heart of rabbit.

- Two atria (right & left) form the anterior part of heart.
- They are separated by interatrial septum. It has a small pore known as Foramen Ovale in the embryonic stage. Later it is closed and appears as an oval patch known as Fossa ovalis.
- Right atrium is larger than left and receives deoxygenated blood from different parts of the body through three major veins like two precaval veins and one Post caval vein.
- Opening of postcaval vein is guarded by a membranous fold which is a remnant of embryonic Valve of Eustachian. It functional in embryo and directs the blood from postcaval vein into left atrium through foramen ovale.But it is nonfunctional in adult.
- Cornonary sinus which collects blood from the wall of heart opens into the left precaval vein.This opening is guarded by a crescentic fold, the Valve of Thebesius.
- Left atrium receives oxygenated blod from lungs through a pair of pulmonary veins which open into the lfeft atrium through a common pore.
- Atrioventricular septum separates atria and ventricles. It has right and left atrioventricular apertures.
- Tricuspid valve guards the right atrio ventricular aperture.
- Bicuspid (Mitral) valve guards the left atrio ventricular aperture.

3. Explain the mechanism of blood clotting?

- Haemostasis is a sequence of responses that stops bleeding.
- Blood clots within 3 to 6 minutes after rupture of a blood vessel.
- Clotting is cascade of complex enzymatic reactions.
- Coagulation prevents further loss of blood and seals the wound.
- Clotting involves three major steps.

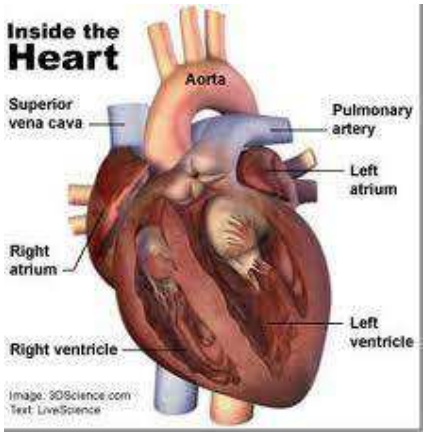
Step I … Formation of Prothrombinase : It is formed by two pathways.
i) Intrinsic pathway --- from damaged platelets. It is helped by Calcium ions (factor IV and Hageman factor(factor XII).
ii) Extrinsic pathway …. From damaged tissues. It is helped by factor IV.

Step –II --- conversion of prothrombin into thrombin by prothrombinase.

Step –III .. Conversion of soluble fibrinogen into soluble fibrin. It consists of fibrin monomers held together by hydrogen bonds.

It is stabilized by factor XIII (Fibrin stabilizing factor) as insoluble fibrin fibres. Factor XIII links the fibrin monomers by covalent bonds.
Clot plugs the ruptured area of the blood vessel and stops bleeding.
Clot retraction is the tightening of the fibrin clot.

4. Draw labeled diagram of L.S. of heart of rabbit.



5. Describe the various arteries formed from dorsal aorta of rabbit.

- ❖ Systemic arch runs posteriorly as dorsal aorta and passes through diaphragm.
- ❖ Dorsal aorta gives off a series of branches to various organs.

IN THORACIC REGION :

i)5-7 pairs of intercostals arteries : supply blood to ribs and intercostals muscles.
ii)a pair of Phrenic arteries : supply blood to muscles of diaphragm.

IN ABDOMINAL REGION :

i)a Coeliac artery … It divides into hepatic artery to liver and a leinogastric artery to stomach and spleen.
ii)An anterior mesenteric artery … supply blood to duodenum, ileum caecum,colon and pancreas.
iii)Renal arteries : supply blood to kidneys.
iv)Gonadial arteries : supply blood to gonads. They are Spermatic arteries in males and ovarian arteries and females.
v) Posterior mesenteric artery : supplies blood to colon and rectum.
vi) Ileolumbar arteries : supplies blood to dorsal abdominal wall and muscles of back.
vii) Common iliac : each common iliac artery divides into internal and external iliac
a)Internal iliac or Hypogastric artery : supplies blood to dorsal part of pelvic region.
b)External iliac artery : It continues as femoral artery to hind limbs after giving the following 3 branches…

i)Uterine artery : to uterus
ii)Posteior epigastric artery : ventral abdominal wall.
iii)Vesicular artery : to urinary bladder.
ix) Caudal artery : to tail.

4. Describe the events in a cardiac cycle in related to man.?

- Cardiac cycle consists of the sequence of events that take place during a single heartbeat.
- A cardiac cycle consists of systole and diastole of atria, and systole and diastole of ventricles.
- Cardiac cycle is divided into three phases … Atrial systole,Ventricular systole and atrioventricular diastole.

A) **ATRIAL SYSTOLE** : It lasts about 0.1 seconds.

- Atria contract which helps in the flow of blood into ventricles.
- It accounts for about 20% of filling of ventricles in each cardiac cycle.
- The end of atrial systole is also the end of ventricular diastole.
- Each ventricle contains about 120 ml. blood at the end of its diastole (End Diastolic Volume)

B)**VENTRICULAR SYSTOLE** : It lasts about 0.3 sec.

- Ventricles contract and atria relax during this phase.
- Contraction of ventricles raises the pressure in ventricles due to which AV valves are closed.
- It causes the first heart sound, LUBB.
- When pressure in ventricles exceeds the pressure in aortic arches, semilunar valves open. It results the flow of blood from ventricles into aortic arches.
- At the end of ventricular systole, each ventricle contains about 50 mL of blood (End Systolic Volume).

C) **COMPLETE CARDIAC DIASTOLE**: It last about 0.4 sec.

- Ventricles relax. Atria are also in diastolic condition.
- When pressure in ventricles falls below that in aortic arches, semilunar valves are closed. It causes the second heart sound, DUPP.
- When pressure in ventricles alls below atrial pressure, AV valves open and ventricular filling begins.

5. Explain about precaval veins in rabbit.

- Anterior vena cavae or right and left precaval veins collect blood from anterior parts of the body. They open into right atrium through separate openings..
- Right and left precaval veins are formed by the union of following veins…

FORMATION OF RIGHT PRECAVAL VEIN: It is formed by following veins….

a) External jugular vein: collects blood from muscles of jaws, tongue and head.
A transverse 'JUGULAR ANASTOMSIS' connects external jugular veins of both sides.
b) INTERNAL JUGULAR VEIN: collects blood from brain and muscles of neck.
c) SUBCLAVIAN VEIN: collects blood from fore limb and shoulder.
d) INTERNAL MAMMARY VEIN: collects blood from mammary glands, diaphragm and pericardium.
e) ANTERIOR INTERCOSTAL VEIN : collects blood from anterior ribs and intercostals

muscles.

f) AZYGOS VEIN: collects blood from posterior ribs and intercostal muscles of right side.

FORMATION OF LEFT PRECAVAL VEIN:

a) External jugular vein b)Internal jugular vein c)Subclavian vein
d) Internal mammary vein e)Anterior intercostals vein
f) Hemizygous vein ---- collects blood from posterior ribs and intercostals muscles of left side and supply that blood to azygos vein through Transverse anastomosis.

One pair of coronary veins collects blood from muscles of heart and opens into Coronary sinus which opens into left precaval vein.This opening is guarded by VALVE OF THEBESIUS.

6. What is a portal vein? Describe the hepatic portal system in rabbit.

- A vein that begins with capillaries in one organ and supplies it to another organ other than the heart is known as portal vein.
- Rabbit has hepatic portal system only. It collects blood from stomach, intestine etc., and supplies it to the liver.
- Hepatic portal vein is formed by the union of the following veins.

Lienogastric vein	:	collects blood from stomach and spleen.
Duodenal vein	:	collects blood from duodenum and pancreas.
Anterior mesenteric vein	:	collects blood from ileum, caecum and colon.
Posterior mesenteric vein	:	collects blood from colon and rectum.

Hepatic portal vein opens into liver as capillaries.

- Liver decreases glucose level and ammonia level in the blood and send it to heart through hepatic veins and postcaval vein.

7. Describe the post caval vein in rabbit.

- ➔ Posterior vena cava or post caval vein collects blood from tail, hind limbs and parts of abdomen.
- ➔ A pair of internal iliac and a pair of external iliac veins open into postcaval vein.
- ➔ Various veins that join with postcaval vein and their collecting regions are….

VEIN	COLLECTS BLOOD FROM
1.Internal iliac(Hypogastric)	Dorsal part of Pelvis
2.External iliac	
a)Femoral vein	Hind limbs
b)uterine vein	Uterus in femae
c)vesicular vein	Urinary bldder
d)Posterior epigastric vein	Ventral abdominal wall
3. caudal vein	Tail
4. Iliolumbar vein	Dorsal abdominal wall and muscles of back
5.Gonadial veins	Gonads (Ovarian in females, Spermatic in males)
6. Renal veins	Kidneys
7.Hepatic veins (2 pairs)	Liver
8.Phrenic veins	Muscles of diaphragm

8. Draw neat labeled diagram of arterial system in rabbit?

9. Draw neat labeled diagram of venous system in rabbit.

LAQ s :

1. Describe the structure of the heart of rabbit. Draw a neat labeled diagram of L.S of heart.?

ANS : The heart is 4 chambered in rabbit with 2 atria and 2 ventricles.

STRUCTURE OF ATRIA ;

- Two atria (right & left) form the anterior part of heart.
- They are separated by interatrial septum. It has a small pore known as Foramen Ovale in the embryonic stage. Later it is closed and appears as an oval patch known as Fossa ovalis.
- Right atrium is larger than left and receives deoxygenated blood from different parts of the body through three major veins like two precaval veins and one Post caval vein.
- Opening of postcaval vein is guarded by a membranous fold which is a remnant of embryonic Valve of Eustachian. It functional in embryo and directs the blood from postcaval vein into left atrium through foramen ovale.But it is nonfunctional in adult.
- Cornonary sinus which collects blood from the wall of heart opens into the left precaval vein.This opening is guarded by a crescentic fold, the Valve of Thebesius.
- Left atrium receives oxygenated blod from lungs through a pair of pulmonary veins which open into the lfeft atrium through a common pore.
- Atrioventricular septum separates atria and ventricles. It has right and left atrioventricular apertures.
- Tricuspid valve guards the right atrio ventricular aperture.
- Bicuspid(Mitral) valve guards the left atrio ventricular aperture.

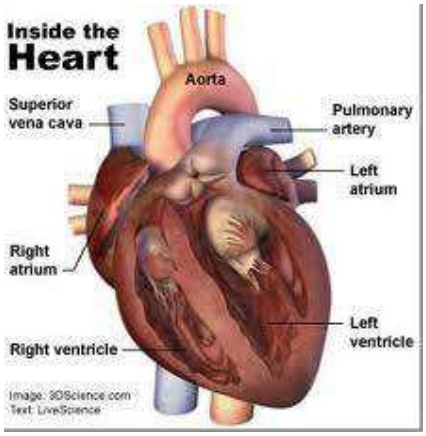
STRUCTURE OF VENTRICLES:

- Two ventricles (right & left) form the posterior part of the heart.
- They are separated by interventricular septum.
- Left ventricle is larger and has thickest walls comparted to that of right ventricle as the left ventricle must force the blood to all the parts of body.
- Inner surface of ventricles is raised into muscular ridges known as columnae corneae. Some of them are large and conical and known as papillary muscles.
- Tendon-like cords known as Chrodae tendineae are present between atrioventricular valves and papillary muscles. They prevent the cusps of valves from bulging too far into atrium.

C) AORTIC ARCHES:

Rabbit has two aortic arches. They are left systemic arch and pulmonary arch.

- ❖ Pulmonary arch arises from the left anterior angle of the right ventricle. It carries deoxygenated blood to lung. Its opening from right ventricle is guarded by pulmonary valve made with 3 semilunar valves.
- ❖ Left systemic arch arises from left ventricle to distribute oxygenated blood to various parts in the body. Its opening is also guarded by a set 3 semilunar valves known as Aortic valve.
- ❖ A fibrous strand known as Ligamentum arteriosum is present t the point of contact of the systemic arch and pulmonary arch. It is a remnant of ductus arteriosus (ductus Botalli) which connects the systemic and pulmonary arches in the embryonic stage.



1. Write notes on working of the heart of rabbit.

ANS : Heart in verterbrates is myogenic heart.

I) CONDUCTING SYSTEM OF THE HEART :

- ❖ Pacemaker is formed by modified cardiac muscle. So this heart is known as myogenic heart.
- ❖ Sinoatrial node (SA node) is the pacemaker. It is present in the wal of right atrium near the eustahian valve.
- ❖ Atrioventricular node (AV node) is present in the posterior right border of interatrial septum. It gives bundle of His. It enters the interventricular septum and divides into two main branches that extend towards the aex of heart then spread into the walls of ventricles as Purkinje fibres.

II) ORIGIN AND CONDUCTION OF THE HEART BEAT :

- ❖ The wave of atrial depolarization orgiginates in S.A. node and spreads over the atria. The two atria contract. This depolarization reaches the A.V. node which conducts it into the walls of ventricles through bundle of His and Purkinje fibres. Thus ventricles contract.

III) COMPLETE CARDIAC CYCLE:

- ✹ Cardiac cycle consists of the sequence of events that take place during a single heartbeat.
- ✹ A cardiac cycle consists of systole and diastole of atria, and systole and diastole of ventricles.
- ✹ Cardiac cycle is divided into three phases … Atrial systole, Ventricular systole and atrioventricular diastole.

B) ATRIAL SYSTOLE: It lasts about 0.1 seconds.

- Atria contract which helps in the flow of blood into ventricles.
- It accounts for about 20% of filling of ventricles in each cardiac cycle.

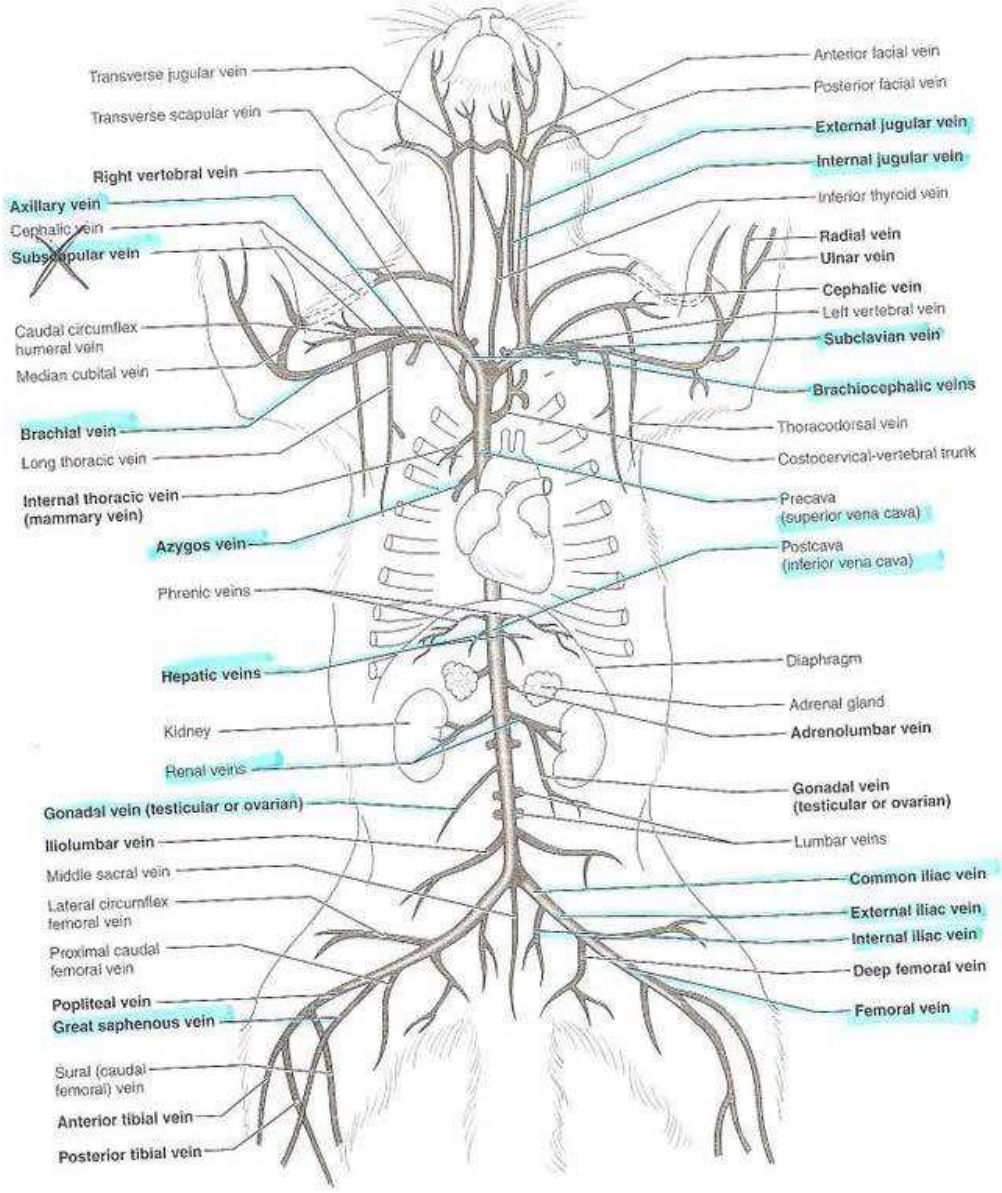
- The end of atrial systole is also the end of ventricular diastole.
- Each ventricle contains about 120 ml. blood at the end of its diastole (End Diastolic Volume)

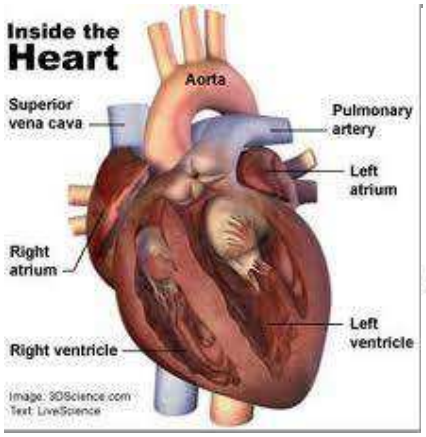
B)VENTRICULAR SYSTOLE : It lasts about 0.3 sec.

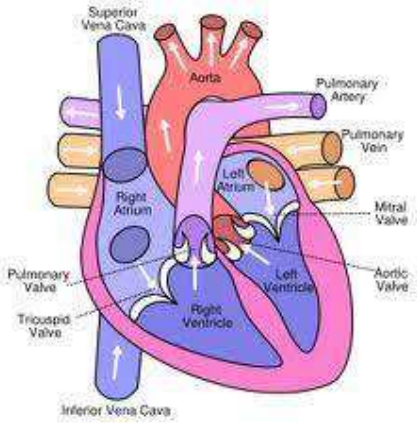
- Ventricles contract and atria relax during this phase.
- Contraction of ventricles raises the pressure in ventricles due to which AV valves are closed.
- It causes the first heart sound, LUBB.
- When pressure in ventricles exceeds the pressure in aortic arches, semilunar valves open. It results the flow of blood from ventricles into aortic arches.
- At the end of ventricular systole, each ventricle contains about 50 mL of blood (End Systolic Volume).

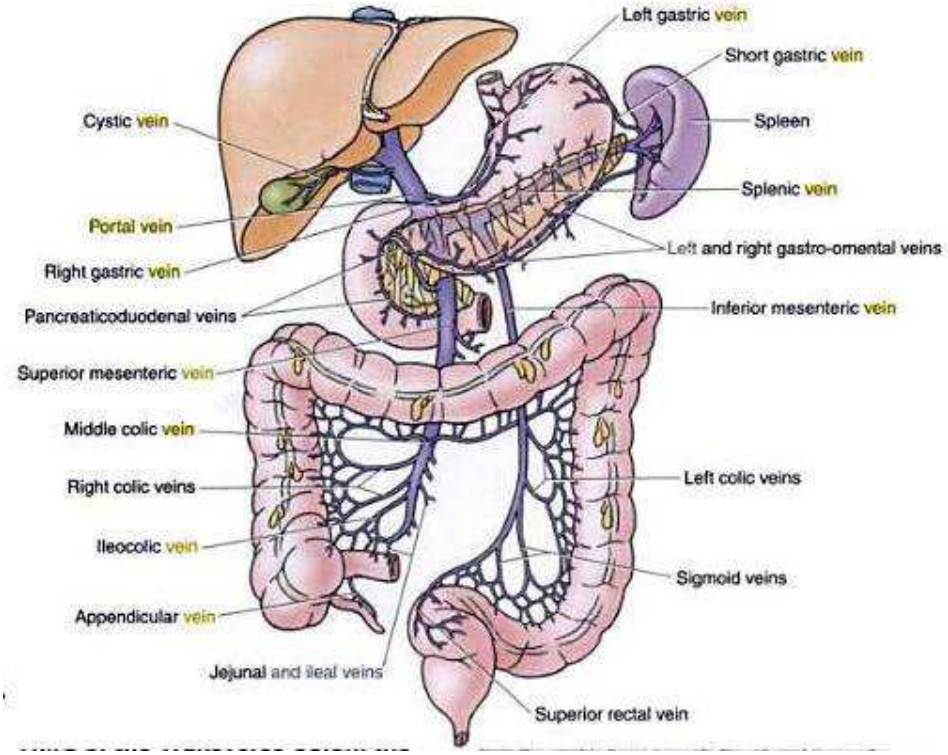
C) COMPLETE CARDIAC DIASTOLE: It last about 0.4 sec.

- Ventricles relax. Atria are also in diastolic condition.
- When pressure in ventricles falls below that in aortic arches, semilunar valves are closed. It causes the second heart sound, DUPP.
- When pressure in ventricles alls below atrial pressure, AV valves open and ventricular filling begins.


Transverse jugular vein
Transverse scapular vein
Right vertebral vein
Axillary vein
Cephalic vein
Subscapular vein
Caudal circumflex humeral vein
Median cubital vein
Brachial vein
Long thoracic vein
Internal thoracic vein (mammary vein)
Azygos vein
Phrenic veins
Hepatic veins
Kidney
Renal veins
Gonadal vein (testicular or ovarian)
Iliolumbar vein
Middle sacral vein
Lateral circumflex femoral vein
Proximal caudal femoral vein
Popliteal vein
Great saphenous vein
Sural (caudal femoral) vein
Anterior tibial vein
Posterior tibial vein
Anterior facial vein
Posterior facial vein
External jugular vein
Internal jugular vein
Inferior thyroid vein
Radial vein
Ulnar vein
Cephalic vein
Left vertebral vein
Subclavian vein
Brachiocephalic veins
Thoracodorsal vein
Costocervical-vertebral trunk
Precava (superior vena cava)
Postcava (inferior vena cava)
Diaphragm
Adrenal gland
Adrenolumbar vein
Gonadal vein (testicular or ovarian)
Lumbar veins
Common iliac vein
External iliac vein
Internal iliac vein
Deep femoral vein
Femoral vein


Inside the Heart
Aorta
Superior vena cava
Pulmonary artery
Left atrium
Right atrium
Left ventricle
Right ventricle
Image: 3DScience.com
Text: LiveScience


Superior Vena Cava
Aorta
Pulmonary Artery
Pulmonary Vein
Left Atrium
Right Atrium
Mitral Valve
Pulmonary Valve
Aortic Valve
Left Ventricle
Tricuspid Valve
Right Ventricle
Inferior Vena Cava


Left gastric vein
Short gastric vein
Cystic vein
Spleen
Splenic vein
Portal vein
Left and right gastro-omental veins
Right gastric vein
Pancreaticoduodenal veins
Inferior mesenteric vein
Superior mesenteric vein
Middle colic vein
Left colic veins
Right colic veins
Ileocolic vein
Sigmoid veins
Appendicular vein
Jejunal and ileal veins
Superior rectal vein