11. Study of Animal Type : Cockroach

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1. Choose correct option

A. Chemical nature of chitin is __

a. protein.

b. carbohydrate.

e. lipid.

d. glycoprotein.

B. Cockroach has type of ___ mouthparts.

a. sponging

b. chewing and biting

c. piercing and Sucking

d. lapping

C. Spiracle is a part of ___ system of cockroach.

a. circulatory

b. respiration

c. reproductive

d. nervous

D. ____ is a part of digestive system.

a. Trachea

b. Hypopharynx

c. Haemocyte

d. Seminal vesicle

E. ___ is also called as brain of cockroach.

a. Supra-oesophageal ganglion.

b. Sub-oesophageal ganglion.

c. Hypo-cerebral ganglion.

d. Thoracic ganglion.

2. Answer the following questions

A. Describe the digestive system of cockroach.

Ans.

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1. The digestive system of cockroach consists of an alimentary canal which is 6 to 7 cm long and a pair of salivary glands.

2. The alimentary canal consists of three main parts, viz., foregut midgut (stomodaeum), (mesenteron) and hindgut (proctodaeum). It begins with mouth and ends with anus. Mouth is narrow bounded by mouth parts. At the base of hypopharynx salivary duct opens.

(1) Foregut: The foregut consists of pharynx, oesophagus, crop and gizzard or proventriculus.

(i) Pharynx : The pharynx is a short, narrow and dilated muscular tube. Both mouth cavity and pharynx are provided with tactile sensilla. The pharynx receives food from mouth and conducts it to oesophagus. **Digestive system of cockroach**

(ii) Oesophagus : The oesophagus is a narrow, tubular passage leading to the crop.

(iii) Crop : The crop stores food. It is a distensible, pear-shaped sac present between neck and 4th/5th abdominal segment.

(iv) Gizzard or proventriculus : The gizzard is provided with a circlet of six chitinous teeth, which crush the food. Bristles present inside are interconnected with each other and form a filter. The gizzard thus acts as a grinding and filtering apparatus.

(2) Midgut: Consists of ventriculus or stomach and eight hepatic caeca, where digestion and absorption takes place.

(i) Ventriculus or stomach: Short and narrow tube where digestion of food occurs.

(ii) Hepatic caeca : Eight hepatic caeca present in a whorl at the anterior end of the stomach. They are thin, transparent and blind tubules which secrete enzymes.

(3) Hindgut: The hindgut consists of ileum, colon and rectum. Malpighian tubules are seen at the junction of midgut and hindgut.

(i) Ileum : Short and narrow part. At anterior end Malpighian tubules open into the ileum. The excretory products are poured into the ileum through these tubules. There is sphincter at the posterior region.

(ii) Colon : The colon is a wide and coiled tube. It reabsorbs water from waste.

(iii) Rectum : The rectum is the last part of the hindgut which leads to the anus which opens to the outside. Anus is situated on the ventral side of 10th segment.

3. Salivary glands : There are two salivary glands lying one on the either side of the crop. They secrete digestive enzymes. long and a pair of salivary glands.

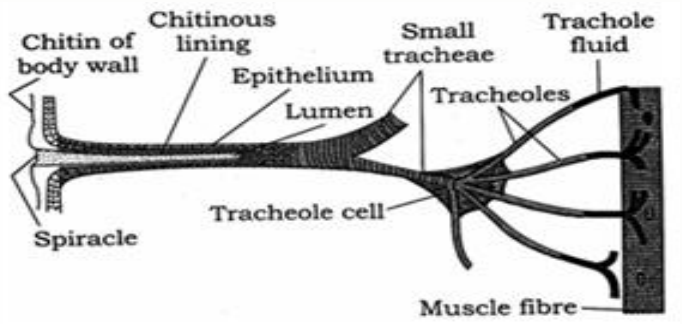
B. Give an account on tracheal system of cockroach.

Ans. (1) Respiratory system of cockroach is also called tracheal system, because it is an internal respiratory system of air tubes.

(2) Air is brought into the body and is in contact with every part of body.

(3) Exchange of gases takes place directly between the air and tissues without the need of blood.

(4) Spiracles, trachea ad tracheoles form the tracheal system



(5) Spiracles : (a) Spiracles are paired. present on ventral lateral side of body, in pleural membrane.
They are respiratory openings.

(b) There are two pairs of thoracic and eight pairs of abdominal spiracles.

(c) The spiracles open into a series of air sacs. From these air sacs trachea arise.

(6) Trachea :

(a) The trachea are in definite pattern of transversely as well as longitudinally.

(b) They have spiral or annular thickening of chitin and are about 1 mm thick and the inner lining of chitin prevents the branching tubes. They are arranged trachea from collapsing.

(h) Each trachea further branches into number of smaller tubes called tracheoles.

(7) Tracheole: (a) Fine intracellular tubes that penetrate deep into tissues are the tracheoles.

(b) Tracheoles are thin and not lined with chitin.
(c) They have blind ends in the cells where there is watery fluid.

(d) Through this fluid exchange of gases takes place.

(e) The content of this fluid does not remain stable but changes as per activity of the cockroach. This fluid does not distribute the gases but simply acts as a stationary medium for diffusion.

(f) At high muscular activity, a part of fluid is drawn into the tissues to enable more and rapid oxygen intake.

(g) The rhythmic movements of thoracic and abdominal muscles renew the air in the tracheal system.

C. Describe nervous system of cockroach.

Ans. The nervous system of cockroach has three divisions, viz central nervous system (CNS). peripheral nervous system (PNS) and autonomous nervous system (ANS). It is ventral, solid and ganglionated.

1. Central Nervous System :

(1) The CNS consists of nerve ring and ventral nerve cord. The nerve ring has

paired supra oesophageal ganglia, paired suboesophageal ganglia and pair of circum oesophageal connectives joining the two.

(2) Supra Oesophageal ganglia : (a) The supraesophageal or cerebral ganglia or brain is a bilobed mass situated in the head above the oesophagus between the bases of antenna base.
(b) Three pairs of ganglia, viz. protocerebrum, deutocerebrum and tritocerebrum fuse together to form this ganglionated mass.

(3) Suboesophageal ganglia : The suboeso phageal ganglia are bilobed mass formed by the fusion of three ganglia lying in the head region. They are below oesophagus.

(4) Circumesophageal connectives :

(a) Circumesophageal connectives are pair of lateral nerves arise from supraoesophageal ganglia and connect suboesophageal ganglia encircling the oesophagus.

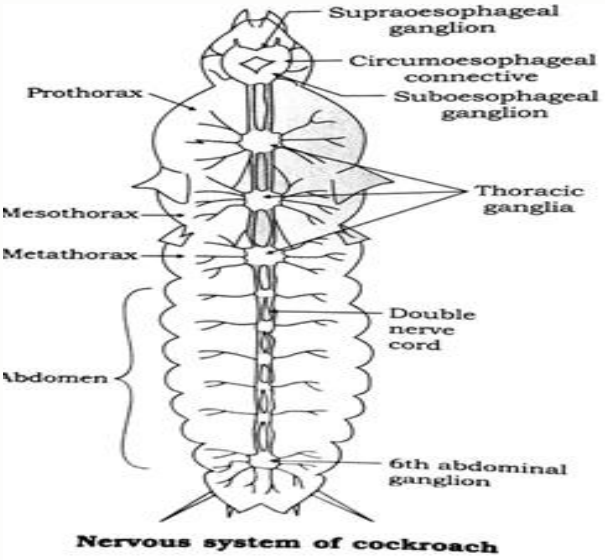
(b) These three structures together form a nerve ring.

(5) Ventral nerve cord :

(a) The ventral nerve cord arises from the suboesophageal ganglia and runs along the entire length of the body. It forms paired segmental ganglia during its course.

(b) There are three pairs of thoracic ganglia and six pairs of abdominal ganglia.

(c) The 6th abdominal ganglion is the largest. It is present in the 7th abdominal segment. There is no ganglion in 6th segment.



Nervous system of cockroach

Nervous system of cockroach 2.
Peripheral Nervous System :

(1) The peripheral nervous system consists of nerves arising from supraesophageal ganglion, suboesophageal ganglion, circum oesophageal connectives and segmental ganglia.

(2) From supra oesophageal ganglia 6 pairs of nerves innervate to eyes, antennae and labrum.

(3) From suboesophageal ganglia nerves innervate to mandibles, maxillae and labium.

(4) The nerves from thoracic ganglia innervate to thoracic muscles, wings, legs and other internal organs lying in the thorax.

(5) From the abdominal ganglia the nerves that arise innervate to the abdominal organs.

3. Autonomous Nervous System : The autonomous nervous system comprises of nerves innervating all the vital organs.
It consists of four ganglia. They form retrocerebral complex.

(1) Frontal ganglion : Above the pharynx and in front of brain.

(2) Hypocerebral ganglion : Present on anterior side of oesophagus.

(3) Ingluvial or visceral ganglion : Present on crop.

(4) Ventricular ganglion : Present on gizzard.

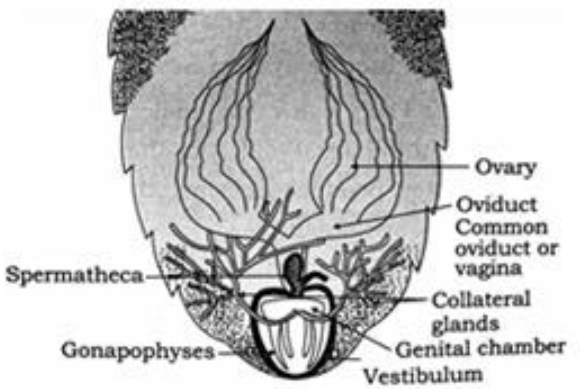
D. With help of neat labelled diagram, describe the female reproductive system of cockroach.

Ans. The reproductive structures in female cockroach are a pair of ovaries, a pair of oviducts, a common oviduct or vagina, spermatheca and accessory reproductive glands.

(1) Ovary : Ovaries are primary sex organs.
They are large and paired. In each ovary there are ovarioles. Each ovariole has a chain of developing 8 ova.

(2) Oviduct: The oviduct is formed by the union of ovarioles from each side. Both oviducts unit to form common oviduct.

(3) Vagina : The vagina is also called a common oviduct. The vagina opens into the genital chamber or bursa copulatrix, which is a female copulatory organ.



Female reproductive system of cockroach

(4) Spermatheca : The spermatheca is situated in the 6th abdominal segment. It receives sperm from male cockroach during copulation.

(5) The collateral or accessory glands are female accessory glands. The secretion of collateral glands helps in the formation of leathery, dark brown egg case or ootheca. The ootheca protects the fertilized eggs. There are about 14 to 16 eggs in one ootheca.
(6) Female gonapophyses have six chitinous plates which surround the genital pore.

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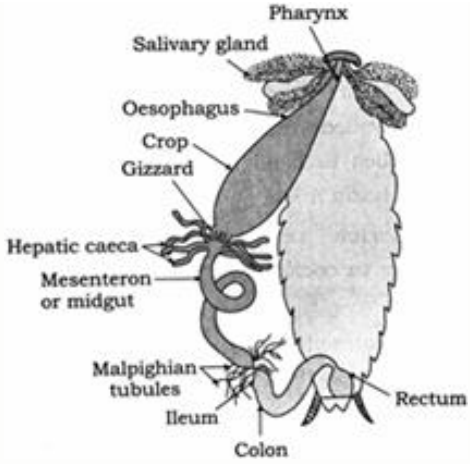

Digestive system of cockroach

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F. A student observed that the cockroaches are killed for dissection by simply putting them in soap water. He inquired whether soap is so poisonous. Teacher said it is due to its peculiar respiratory system. How ?

Ans. The spiracles located on the lateral sides of the body, allows the water to enter the system. When immersed in soap water, therefore, cockroach tissues will get bathed with soap solution. Further the spiracles, lead to trachea and tracheoles. Tracheoles have the body fluid for diffusion. But if the body fluid gets full of soap solution, naturally there will be a death of cockroach.

G. Describe the circulatory system of cockroach.

Ans. (1) In cockroach there is open type of circulatory system. It consists of colourless haemolymph, a dorsal blood vessel having heart and dorsal aorta and haemocoel.

(2) Haemolymph :

(a) Haemolymph colourless without any pigment. Its constituents are plasma and seven types of haemocytes.

(b) Plasma is rich in nutrients and has water.

(c) There are nitrogenous wastes such as uric acid.

(3) Haemocoel:

(a) Coelom is divided into three sinuses by two diaphragms i.e. dorsal and ventral diani diaphragm.

(b) They are thin, fibrovascular septa which are attached to terga along lateral sides at intermittent points.

(c) Dorsal diaphragm has 12 pairs (2 thoracic and 10 abdominal) pain like triangular alary muscles. Their pointed end attached to terga at lateral side and broad end lies between heart and dorsal diaphragm.

(d) Ventral diaphragm is flat and present above the ventral nerve cord. Laterally, it is attached to sterna at intermittent points.

(4) Sinuses :

(a) Coelom of cockroach is divided into three sinuses as pericardial, perivisceral and perineural sinus due to septa

(b) Pericardial sinus is dorsal, very small and contains dorsal vessel.

(c) Perivisceral sinus is middle and largest containing fat bodies and all major visceral organs of alimentary canal and reproductive system.

(d) Perineural sinus is ventral, small and contains ventral nerve cord. This sinus is continuous into legs.

(e) All the three sinuses communicate with each other through pores present between two successive points of attachments of diaphragm.

(5) Dorsal blood vessel :

(a) It is present in pericardial sinus, just below the tergum.

(b) It has two parts: Posterior heart and anterior aorta. Also called a dorsal aorta or cephalic vessel.

(c) Heart is about 2.5 cm long, narrow, muscular tube which opens anteriorly but is closed posteriorly.

(d) It starts from oth abdominal segment and extends anteriorly upto 1st thoracic segment. Heart has thirteen chambers (10 abdominal and 3 thoracis).

(e) Each chamber has a pair of vertical slit like opening called ostium.

(f) Ostia are present along lateral side in posterior region of first 12 chambers.

(g) Each ostium has lip-like valves that allow flow of blood from sinus to heart only.
(h) Heart is continued by a short, thin walled vessel called as dorsal aorta. It lies in head region and opens in the haemocoel.

3. Answer the following questions.

A. How will you identify male or female cockroach?

(1) Cockroaches exhibit sexual dimorphism.

(2) In male cockroach, anal styles are present in segment 9.

(3) In female cockroach, anal styles are absent.

(4) The genital openings are present on different segments.

(5) The gonapophyses are also different in both the sexes.

(6) Last abdominal segment is boat-shaped and enlarged in females but not so in males.

(7) Therefore male and female cockroaches can be identified externally.

B. Write a note on : Gizzard of cockroach.

Ans. (1) The gizzard is the last part in the foregut of cockroach.

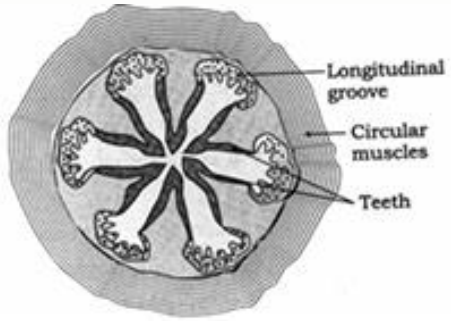
(2) It is also called proventriculus.

(3) There is a circlet of six chitinous teeth in the gizzard. With the help of these teeth, the food is crushed.

(4) Behind this circlet there are backwardly directed fine chitinous bristles present in the groove of gizzard.

(5) These are interconnected to form a filter.

(6) The gizzard thus acts as efficient grinding and straining apparatus.



C. Give the systematic position of cockroach.

Ans. Systematic position of cockroach:

(1) Kingdom : Animalia

Reason : Cockroach is an animal with heterotrophic mode of nutrition and locomotory abilities.

(2) Phylum : Arthropoda

Reason: Cockroach bears jointed appendages. Body shows segmentation and is covered over by chitinous exoskeleton.

(3) Class : Insecta

Reason: Cockroach possesses three pairs of walking legs and two pairs of wings.

(4) Genus : Periplaneta

Reason: Cockroach has straight wings and chewing type of mouth parts. It is nocturnal in habit.

(5) Species : americana

Reason: Cockroach has origin in America, hence the species name is americana.

D. What would have happened if cockroach did not have gizzard ?

Ans. If cockroach is devoid of gizzard, the crushing of food will not take place. The bristles in the gizzard filter the food. But due to absence of gizzard, the food will not get filtered. Thus ultimately the digestion is affected due to absence of gizzard.

E. What is the functional difference between eyes of cockroach and human being?

Ans. The cockroach eye is a compound eye made up of aggregation of ommatidia. The image obtained by the cockroach is thus blurred and mosaic. Each ommatidium forms a very small part of visual field.
On the other hand human eye is simple eye and thus there is only one clear image on its retina.
This image can be perceived due to optic nerve carrying the message to the brain. The image is therefore clear and single.

F. What is the functional difference between respiratory system of cockroach and human being ?

Ans. Cockroach has open circulatory system in which the colourless blood bathes every tissue.
The diffusion of respiratory gases takes place between the blind ends of tracheoles and the body fluid.

Unlike this in human beings, there is closed circulatory system. The blood never comes out of the blood vessels when in body. Their blood cells like red blood cells carry respiratory pigment, haemoglobin which is a carrier of respiratory gases. At the time of internal respiration, the body fluid of cockroach acts as a stationary medium and does not distribute the gases. On the other hand, the blood cells of human beings distribute the respiratory gases by creating gradient.

4. Explain the following in short

A. What are anal cerci ?

Ans. (1) Anal cerci are the appendages which emerge from 10th abdominal segment of both male and female cockroach.

(2) They are visible in both dorsal and ventral views

(3) Anal cerci are sensitive to air movements.

(4) They can pick up the sound waves.

(5) They are sensitive to ground vibrations.
Thus they are said to be sensory in function.

B. What is the Ganglion ?

Ans. Ganglion is a cluster of nerve cells forming a swollen structure in the nervous system. In cockroach the bilobed ganglion present in the head region is referred to as brain. In all other regions of the body, the ganglia are located which control the nervous functions.

C. What is the role of hypopharynx ?

Ans. (1) Hypopharynx is long prominent and medially placed mouth part.

(2) It is also known as lingua.

(3) The salivary duct opens at the base of hypopharynx.

(4) It bears comb like plates called super lingua on both the sides.

(5) Hypopharynx helps in the process of feeding and mixing saliva with food.

D. What is mesenteron?

Ans. Mesenteron in cockroach means middle portion of the gut or mid-gut. It consists of stomach and hepatic caecae.

E. Location of tergum.

Ans. (1) Tergum is the chitinous plate located on the dorsal side of the cockroach body.

(2) Each segment has a dorsal tergum and ventral sternum.

(3) In the abdominal regions, laterally tergum is joint to sternum by soft cuticle called pleura.

F. What is ootheca ?

Ans. (1) Ootheca is egg case of capsule in which there are certain number of eggs glued together.

(2) Ootheca is formed by the secretion of collaterial glands.

(3) Ootheca is dark reddish to blackish brown capsule having length of about 8 mm.

(4) It contains about 14 to 16 fertilized eggs in two rows.

(5) Female deposits the ootheca or glues them to a suitable surface.

(6) She prefers cracks or crevices with humid and moist surrounding and vicinity of food source. On an average, a female produces 9 to 10 oothecae.

G. How many chambers are present in heart of cockroach ?

Ans. (1) Cockroach chambers heart has thirteen

(2) There are three chambers located in the thoracic region

(3) Ten chambers are located in the abdominal regions,