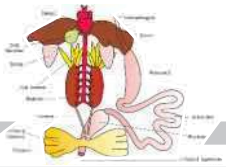


# Chapter - 7

# Structural Organisation

## Points to Remember

**Types of Fundamental Animal Tissues**

| S.No. | Type | Location | Functions |
|---|---|---|---|
| 1. | Epithelial Tissues | Free Surfaces | Protection, Secretion, Excretion, Absorption, Sensory and reproduction |
| 2. | Connective Tissues | All internal, organs in between other tissues, below skin and nervous system. | Holding or binding, support, transport and circulation, protection and storage. |
| 3. | Muscular Tissues | Inside movable parts | Movement and locomotion |
| 4. | Nervous Tissues | Central Nervous System & every organ Peripheral Nervous System. | Communication and control |

**Animal Tissues**

Epithelial | Connective | Muscular | Neural

## Epithelial Tissue

**(A) Simple :** ● Composed of single layer of cells.

● Functions as lining for body cavities, ducts and tubes.

1. Squamous
   - ● single thin layer of flattened cells.
   - ● found in walls of blood vessels, air sacs of lungs.
2. Cuboidal
   - ● single layer of cube like cells.

- found in ducts of glands and tubular parts of nephron.

3. Columnar
   - single layer of tall and slender cells.
   - free surface may have microvilli.
   - found in lining of stomach and intestine
4. Ciliated
   - columnar or cubolidal cells with cilia.
   - move particles or mucus in specific direction, in bronchioles, fallopian tubes.

- Made up of more than one layer of cells.
- Provide protection against chemical and mechanical stresses.
- Cover dry surface of skin, moist cavity, pharynx, inner lining of ducts of salivary glands and pancreatic ducts.

**Glandular epithelium**

| **Exocrine glands** | **Endocrine glands** |
|---|---|
| • secrete mucus, saliva, oil, milk digestive enzymes | • secrete hormones. |
| • products released through ducts. | • secrete directly into the fluid bathing the gland. |

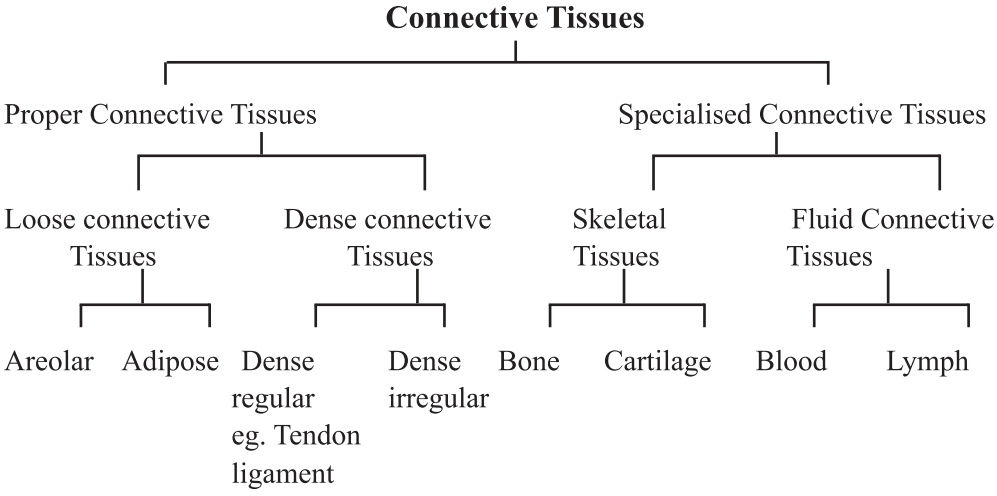
**(B) Compound :**

**Cell junctions**—In nearly all animal tissues, specialised junction provide structural and functional links between its individual cells.

**Three Types of Cell junctions—**

1. **Tight junctions :** Plasma membranes of adjacent cells are fused at intervals. They help to stop substances from leaking across a tissue.
2. **Adhering junctions :** Perform cementing function to keep neighbouring cells together.
3. **Gap junction :** Facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes big molecules.

**Connective tissue :** Link and support other tissues/organs of the body.




## Loose Connective Tissue

(has cells and fibres loosely arranged in semi-fluid ground substance)

**(i) Areolar Tissue :**

- present beneath the skin.
- contains fibroblasts, macrophages and mast cells.
- serves as a support framework for epithelium

**(ii) Adipose Tissue :**

- located beneath the skin.
- cells are specialised to store fats.

## Dense Connective Tissue

Fibres and fibroblasts are compactly packed.

**(i) Dense Regular**

- Collagen fibres present in rows.
- Tendons attach skeletal muscle to bone.
- Ligaments attach bone to bone.

**(ii) Dense Irregular**

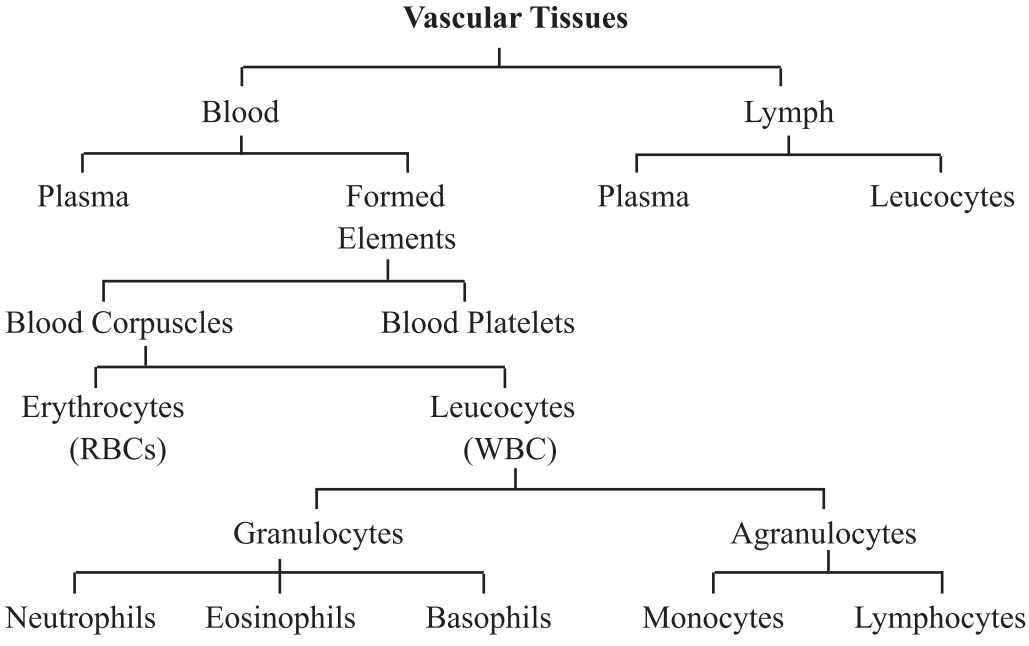
- Has collagen fibres and fibroblasts oriented differently.
- This tissue is present in the skin.

## Specialised Connective Tissues

**(i) Cartilage :** made up of chondrocytes and collagen fibres; inter cellular material is solid and resists compression. Present in tip of nose outer ear joints, etc.

**(ii) Bones :** Ground substance is rich in calcium salts, collagen fibres and Osteocytes are present in lacunae. Bones support and protect softer tissues and organs. They interact with skeletal muscles to bring about movements. Bone marrow in some bones is the site of blood cell formation.

**(iii) Blood :** Fluid connective tissue, consists of plasma and blood cells.




## MUSCULAR TISSUES

**(long, contractile cells called fibres, bring about movement and locomotion)**

| Skeletal Muscle | Smooth Muscle | Cardiac Muscle |
|---|---|---|
| • Striated | • Non-striated | • Striated with intercalated disc for communication |
| • Closely attached to sekeletal bones. | • Forms wall of Internal Organs like blood vessels stomach, intestine | • Occurs in heart only |
| • long cylindrical multinucleated fibres | • Spindle like uninucleated fibres. | • Short cyclindrical uninucleated fibres |

## Neural Tissues

- Neurons are the functional unit and are excitable cells.
- Neurogila cells make up more than half the volume of neural tissue.

They protect and support neurons.

**Cockroach—** *Periplaneta americana* (Phylum-Arthropoda, Class-Insecta)

**Habitat :** Cockroach is a terrestrial, nocturnal, ominivorous, unisexual, oviparous insect. Body convered by a chitinous, hard exoskeleton of hard plates called sclerites.

**Morphology :**

**Head :** Triangular, formed by fusion of 6 segments. Bears a pair of antennae, compound eyes. Mouth parts consists of labrum (upper lip), a pair of mandibles, a pair of maxillae,labium (lower lip), hypopharynx (acts as tongue).

**Thorax :** 3 segments; prothorax, mesothorax and metathorax.

Bears 2 pairs of wings :

Forewings : tegmina (mesothoracic).

Hindwings : transparent, membranous (metathoracic)

3 pairs of legs in thoracic segments. (one pair in each thoracic segment.)

**Abdomen :** 10 segments. Bears a pair of long, segmented **anal cerci** in both sexes and a pair of short, unjoined **anal styles** in males only 7th segment is boat shaped.

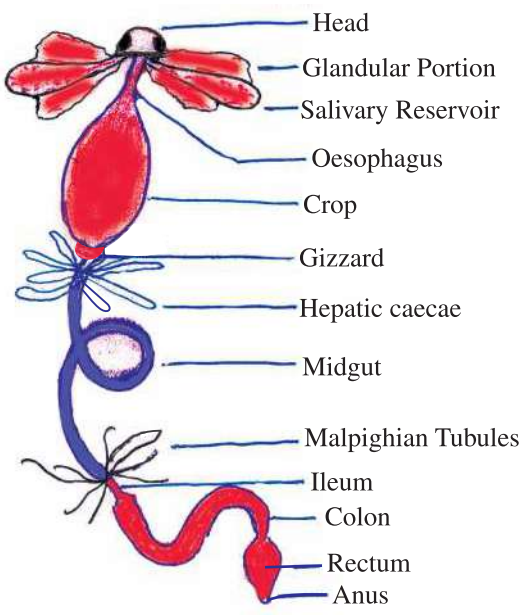
Also has anus and genital aperture at the hind end. Genital aperture surrouonded by external genitalia called **gonapophysis or phallomere.**

| Male Cockroach | Female Cockroach |
|---|---|
| 1. Abdomen long and narrow | 1. Abdomen short and broad |
| 2. All nine sterna visible | 2. Seven sterna visible. (7th sternum fused with 8th and 9th sterna) |
| 3. Anal style present | 3. Anal style absent |

**Anatomy :** Study of the morphology of internal organs.

**Alimentary canal :** Divided into foregut, midgut and hindgut.

Mouth → Pharynx → Oesophagus → Crop (stores food) → Gizzard (grinding of food) → Hepatic caecae (at junction of fore and midgut; secretes digestive juice) → Hindgut (ileum, colon, rectum) → Anus.




**Alimentary Canal of Cockroach**

## Female reproductive system :

A pair of ovaries (with 8 ovarian tubules) → Oviduct → Genital chamber. Sperms transferred through spermatophores female produces 9–10 Ootheca. Fertilised eggs encased in capsules called oothecae (contains 14-16 eggs on an average) development of *P. americana* paurometabolous incompleted metamorphosis). Nymph grows by moulting 13 times to reach adult form.

### Interaction with man

- Destroy food and contaminate it. (Pest)
- Can transmit a variety of bacterial diseases (Vector).

**Blood vascular system :** Open type, visceral organs bathed in haemolymph (colourless plasma and haemocytes).

Heart consists of enlongated muscular tube and differentiated into funnel shaped chambers with ostia on either side. Blood from sinuses enters heart through ostia and is pumped anteriorly to sinuses again. Blood is colourless (haemolymph).

**Repiratory system :** Network of trachea which open through 10 pairs of spiracles. Spiracles regulated by sphincters. Oxygen delivered directly to cells.

**Excretion and osmoregulation :** By malpighian tubules; uricotelic (Uric acid as excretory proudct).

**Nervous system :** Consists of series of fused segmentally arranged ganglia joined by paired longitudinally connectives on the ventral side. Three ganglia in thorax, six in abdomen. Brain represented by supra-oesophageal ganglion. Each eye consist s of 200 hexagonal ommatidia.

## Reproductive system :

Male reproductive system : Pair of testes (4th-6th segments) → vas deferens → ejaculatory duct → male gonophore.

Glands–Seminal vesicle (stores sperms), mushroom shaped gland (6th-7th segment).

### Frog : *Rana tigrina* (Class : Amphibia)

Cold blooded or poikilotherms. Camouflage with surrounding, undergo summer sleep (aestivation) and winter sleep (hibernation).

### Morphology

The body is divided into head and trunk.

**Head :** A pair of nostrils above mouth is present, bulged eyes covered with nictitating membrane (protect eye in water), membranous tympanum on either side of eyes.

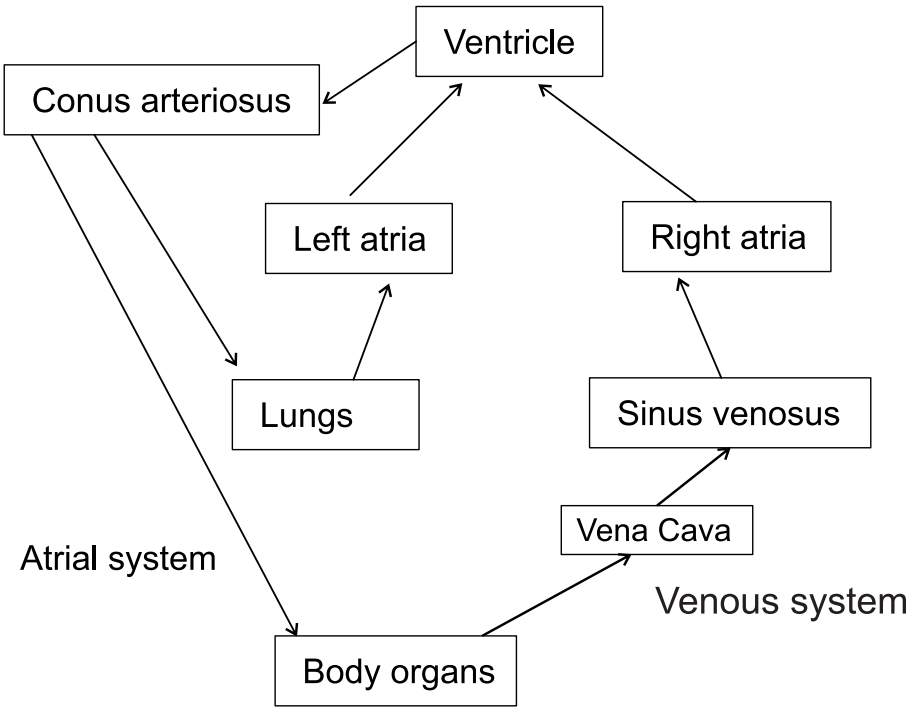
**Trunk :** Hind legs are large and muscular than forelimb and end in five digits, Forelimb end in four digits.

| Male frog | Female frog |
|---|---|
| Vocal sac present | No vocal sac present |
| Copulatory pad on the first digit of forelimb | No copulatory pad present |

### Anatomy

**Digestive system :** Mouth → buccal cavity → pharynx → esophagus → stomach → intestine → rectum → rectum opens into cloaca

Stomach secreted HCl and digestive juices for digestion and convert food into chyme. Duodenum receives chyme from stomach, Pancreatic juice (from pancreas) and bile (from gall bladder) through common bile duct that help in digestion. Final digestion and absorption (through microvilli) take place in small intestine.




**Respiratory system :** Frogs respire both on land and in water.

**In Water :** through skin via diffusion (cutaneous)

**On Land :** Air → Nostrils → Buccal cavity → Lungs (A pair of elongated pink colored sac like structure)

**Blood vascular system :** Closed type, Heart three chambered (two atria and one ventricle covered with pericardium), blood contains plasma and cells (nucleated RBC with hemoglobin, WBC and platelets)

Hepatic and renal portal system exists along with lymphatic system. Hepatic portal system = venous connection between liver and intestine. (venous connection between kidney and lower body part)

**Excretion and osmoregulation :** Ureotelic

Excretory waste though blood reaches to a pair of kidney, then to cloaca via two ureters and finally reaches urinary bladder (stores urine) Urine is released via cloacal aperture.

**Control and coordination**

**Chemical coordination**

Achieved through hormones secreted by endocrine glands e.g., endocrine glands found in frog are pituitary, thyroid, parathyroid, thymus, pineal body, pancreatic islets, adrenals and gonads.

**Nervous coordination**

**Nervous system :** consists of central nervous system (Brain and spinal cord), peripheral nervous system (cranial and spinal nerves) and autonomic nervous system (sympathetic and parasympathetic).

**Brain :** Enclosed in brain box (cranium), divided into fore-brain, mid-brain and hind brain. 10 cranial nerves arise from brain.

**Forebrain** includes olfactory lobes, paired cerebral hemispheres and unpaired diencephalon.

**Midbrain** is characterised by a pair of optic lobes.

**Hind-brain** consists of cerebellum and medulla oblongata. The medulla oblongata passes out through the foramen magnum and continues into spinal cord, which is enclosed in the vertebral column.

**Sense organ :** different types of sense organs, namely organs of touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum with internal ears) present.

## Reproductive system :

**Male reproductive system :** A pair of yellowish ovoid testes → Vasa efferentia (10-12 in number) → Enters into kidneys on their side → Open into Bidder's canal → Urinogenital duct → Cloaca

**Female reproductive system : A pair of ovaries → A pair of oviduct → Cloaca**

A mature female can lay 2500 to 3000 ova (eggs) at time. Fertilisation is external and takes place in water. Development involves a larval stage called tadpole. Development is indirect as tadpole undergoes metamorphosis to form the adult.

**Benefits of frog for mankind :**

- They eat insects and protect the crop.
- Maintain ecological balance because these serve as an important link of food chain and food web in the ecosystem.
- In some countries the muscular legs of frog are used as food by man.

## Questions

### (SRT) Select Response Type Questions (1 mark each)

1. Name the tissue which contains Haversian canals.
   (a) Epithelial tissue (b) Areolar tissue
   (c) Cartitilage (d) Mammalian Bone
2. Mention any two properties of nervous tissue.
   (a) Excitability & conductivity (b) contraction & relaxation
   (c) lining & packaging (d) Excitablity & movement
3. Name the large cells present in adipose tissue.
   (a) Adipocytes (b) Mast cells
   (c) Collagen (d) Fibroblasts

### CONSTRUCTED RESPONSE TYPE (CRT)

### Very Short Answer Questions (1 mark each)

4. Name the cells responsible for clotting of blood.
5. What are exocrine glands ?
6. Differentiate between tendon and ligament.
7. Where are RBC's formed ?
8. A muscular fiber having no striations and tapers at both ends. Name it.
9. Mention the site,where sclerite is present in cockroach.
10. Name the mouth part of cockroach which is comparable to our tongue.
11. "Sexual dimorphism is found in cockroach". Explain the statement.

### Short Answer Questions–I (2 marks each)

12. What is the function of ciliated epithelium ? Where do we find this epithelium ?

13. What are the two types of fibres of connective tissues ? Distinguish between the two.
14. To which tissue do the following belong to :
    (a) Osteocytes (b) Chondrocytes
    (c) Neuroglia (d) Intercalated discs
15. Give the location of hepatic caecae in cockroach ? What is their function ?
16. Name the locomotory appendages of cockroach on the basis of external morphology.
17. Differentiate between Male and Female frog.

## Short Answer Questions–II (3 marks each)

18. Differentiate between skeletal and smooth muscles.
19. Differentiate between male and female cockroach on the basis of external morphology.
20. (a) What is open circulatory system ?
    (b) Explain the respiratory system of cockroach.
21. (a) Give the common name of *Periplaneta americana* & *Rana tigrina*
    (b) How many spermathecae found in cockroach ?
    (c) What is the position of ovaries in cockroach ?
    (d) How many segments are present in the abdomen of cockroach ?
    (e) Where do you find malpighian tubules ?
    (f) What is mosaic vision ?
22. Name the different cell junctions found in tissues.
23. Mention the special features of eye in cockroach.
24. Write the appropriate type of tissue in column B accounting to the functions mentioned is column A.

| | Column A | Column B |
|---|---|---|
| a. | Linking and supporting frame work | ..... |
| b. | Protective covering | ..... |
| c. | Secretion and absorption | ..... |

25. Diagrammatically represent the blood flow pathway in frog.
26. Explain the mechanism of respiration in frog.
27. What are the benefits of frog for mankind?
28. Neatly draw the labelled diagram of male reproductive system of frog.
29. Why frogs are not seen during peak summer and winters?

## Long Answer Questions (5 marks each)

30. (a) What is compound epithelium ? What are their main function ?
    (b) Where do we find areolar tissue ?
    (c) How is adhering junction different from gap junction ?
31. Make a neat and well labelled diagram showing alimentary canal of cockroach.
32. Assign a term for following :
    (a) Animal that secretes urea
    (b) Winter sleep.
    (c) Camouflaging with environment.
    (d) Summer sleep.
    (e) the process that tadpole undergoes to become adult.
    (f) A small, median chamber passes faecal matter, urine and sperms to the exterior in frog.

## Case Based/Source Based

Read and observe the following, to answer the questions given below

The common Indian frog leads and amphibious life. It can live both on land and water. Female frogs always lay 2500-3000 eggs in water, the fertilization is external. They are cold blooded animals, with a three chambered heart.

Direction in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) If both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) If both (A) and (R) are true, but (R) is not the correct explanation of (A).
(c) If (A) is true but (R) is false.
(d) If both (A) and (R) are false.

33. Assertion: Frog is a ureotelic animal.
    Reason: Frog excretes urea.
34. Assertion: Eyes of frog are covered with nictitating membrane
    Reason: On either side of the eyes, the membranous tympanum receives sound signals.

## Answers

### (SRT) Select Response Type Questions (1 mark each)

1. (d) Mammalian bone.
2. (a) Excitability and conductivity.
3. (a) Adipocytes.

### CONSTRUCTED RESPONSE TYPE (CRT)

### Very Short Answers (1 mark each)

4. Blood platelets.
5. Glands which discharge their secretions into ducts.
6. 

| **Tendon** | **Ligament** |
|---|---|
| Attach skeletal muscles to bones | Attach bone to bone |

7. Bone narrow
8. Smooth or non striated muscle fibre.
9. In the exoskeleton all over the body.
10. Hypopharynx
11. Male and female cockroaches show morphological differences.

### Short Answers–I (2 marks each)

12. Refer 'Points to Remember'.
13. White and yellow fibres. White fibres are thin, unbranched, inelastic, occur in bundles and formed of protein collagen. Yellow fibres are thick, straight, elastic, branched, occuring singly, formed of protein elastin.
14. (a) Bone tissue (b) Cartilage
    (c) Neural tissue (d) Cardiac muscle
15. Refer 'Points to Remember'.

16. Three pairs of legs and two pairs of wings.
17. Refer 'Points to Remember'.

## Short Answers-II (3 marks each)

18. Refer 'Points to Remember'.
19. Refer 'Points to Remember'.
20. Refer 'Points to Remember'.
21. (a) American Cockroach & Frog
    (b) One pair, present in 6th segment.
    (c) Between 2nd and 6th abdominal terga.
    (d) 10 segments.
    (e) At the beginning of ileum in cockroach.
    (f) Vision where several images of an object are formed by compound eye. Helps to detect movement of objects very efficiently.
22. (i) Gap junctions
    (ii) Tight junctions
    (iii) Adhering junctions
23. See text in NCERT at
    (i) Situated at dorsal surface of head.
    (ii) Each eye consists of about 2000 hexagon ommatidia.
    (iii) It can receive several images of an object.
    (iv) This kind of vision is known as mosaic vision.
    (v) It has high sensitivity but has less resolution.
24. (a) Connective tissues
    (b) Stratified epithelium
    (c) Columnar epithelium
25. Refers 'Points to Remember'.
26. Refers 'Points to Remember'.
27. Refers 'Points to Remember'.
28. Refer to NCERT

29. Frog are not seen during peak summer and winter. During this period, they take shelter in deep burrows to protect themselves from extreme heat and cold. This is known as summer sleep (aestivation) and winter sleep (hibernation) respectively.

## Long Answers (5 marks each)

30. Refer 'Points to Remember'.
31. Refer NCERT Text Book of Biology class-XI.
32. A. Ureotelic, B. Hibernation, C. Mimicry, D. Aestivation, E. Metamorphosis, F. Cloaca.
33. (a)
34. (b)