NCERT Exemplar Solutions of Class 11 Biology – Chapter 7: Structural Organisation in Animals

VERY SHORT ANSWER TYPE QUESTIONS

1. State the number of segments in earthworm which are covered by a prominent dark band or clitellum.

Solution: The 14th, 15th, and 16th segments in earthworms are covered by a prominent dark band called clitellum.

Enhanced Explanation:

- The clitellum is a glandular, thickened region
- It secretes mucus and forms the cocoon during reproduction
- It's a characteristic feature of sexually mature earthworms (hermaphrodite)
- During copulation, it helps in exchange of sperm between two earthworms

2. Where are sclerites present in cockroach?

Solution: Sclerites are present in all the body segments of cockroaches. The sclerites are hard chitinous plates present in insects.

Enhanced Explanation:

- Sclerites form the exoskeleton of cockroaches
- They are made of chitin, providing structural support and protection
- Each segment typically has:
    - Tergum (dorsal sclerite)
    - Sternum (ventral sclerite)
    - Pleuron (lateral sclerites)
- Connected by flexible membranes allowing movement

3. How many times do nymphs moult to reach the adult form of a cockroach?

Solution: A nymph requires to moult 13 times to reach the adult cockroach form.

Enhanced Explanation:

- Cockroaches undergo incomplete metamorphosis (hemimetabolous)
- Stages: Egg → Nymph → Adult
- Each moult involves shedding of the exoskeleton
- After 13 moults over several months, wings develop and reproductive maturity is achieved
- No pupal stage unlike complete metamorphosis

4. Identify the sex of a frog in which sound-producing vocal sacs are present.

Solution: Sound-producing vocal sacs are present in male frogs only. They are used for amplifying their mating calls to attract female frogs. They are absent in female frogs.

Enhanced Explanation:

- Vocal sacs are inflatable pouches located near the throat
- They act as resonating chambers to amplify mating calls
- Calls serve multiple purposes:
    - Attracting females during breeding season

    - Establishing territory
    - Species identification
- Only males produce mating calls as part of sexual selection

5. Name the process by which a tadpole develops into an adult frog.

Solution: The process by which a tadpole develops into an adult frog is known as metamorphosis.

Enhanced Explanation:

- Frogs undergo complete metamorphosis
- Key changes include:
    - Development of limbs
    - Absorption of tail
    - Development of lungs and loss of gills
    - Changes in digestive system (herbivorous to carnivorous)
    - Development of reproductive organs
- Controlled by thyroid hormones (thyroxine)

6. What is the scientific term given to earthworm's body segments?

Solution: The earthworm's body segmentation is known as metamerism. It is important for its locomotion.

Enhanced Explanation:

- Metamerism: repetition of similar body segments
- Each segment (metamere) contains:
    - Circular and longitudinal muscles
    - Nerve ganglia
    - Blood vessels
    - Nephridia (except in first few segments)
- Allows peristaltic movement for locomotion
- Provides redundancy and efficient organization

7. A muscle fibre tapers at both ends and does not show striations. Name the muscle fibre.

Solution: Smooth muscle fibres can taper at both ends and do not show any striations. Smooth muscles functioning cannot be controlled directly.

Enhanced Explanation:

- Smooth muscle characteristics:
    - Spindle-shaped (fusiform) cells
    - Single nucleus per cell
    - No striations (unlike skeletal and cardiac muscle)
    - Involuntary control
- Found in:
    - Digestive tract walls
    - Blood vessel walls
    - Respiratory passages

    - Reproductive organs
- Contraction is slower but sustained

8. Name the different cell junctions found in tissues.

Solution: Adhering junction, Gap junction, and Tight junction are the cell junctions found in tissues.

Enhanced Explanation:

- **Tight junctions:** Seal cells together, preventing leakage between cells
- **Adhering junctions (Desmosomes):** Provide mechanical strength and stability
- **Gap junctions:** Allow communication and passage of small molecules between cells
- Additional junctions include:
    - Hemidesmosomes: Anchor cells to basement membrane
    - Plasmodesmata: In plant cells for communication

9. Give two identifying features of an adult male frog.

Solution: i) **Presence of vocal sacs:** Male frogs have saggy-skinned vocal sacs in their necks ii) **Presence of copulation pad:** Male frogs have a copulatory pad on the forelimbs

Enhanced Explanation:

- **Vocal sacs:** Inflatable throat pouches for producing mating calls
- **Copulatory pads (Nuptial pads):** Roughened thumb pads that help grip females during amplexus (mating embrace)
- Additional male characteristics:
    - Generally smaller size than females
    - More muscular forelimbs
    - Territorial behavior during breeding season

10. Which mouth part of cockroach is comparable to our tongue?

Solution: Hypopharynx is the mouth part of cockroach which is comparable to our tongue.

Enhanced Explanation:

- The hypopharynx is a median lobe-like structure
- Functions similar to a tongue:
    - Helps in food manipulation
    - Contains salivary duct opening
    - Assists in swallowing
- Part of the complex mouthpart system including:
    - Mandibles, maxillae, labrum, and labium

11. The digestive system of the frog is made of the following parts. Arrange them in an order beginning from the mouth: Mouth, oesophagus, buccal cavity, stomach, intestine, cloaca, rectum, cloacal aperture

Solution: Mouth → Buccal cavity → Oesophagus → Stomach → Intestine → Rectum → Cloaca → Cloacal aperture

Enhanced Explanation:

- **Mouth:** Entry point for food

- **Buccal cavity:** Contains tongue and teeth for food processing
- **Oesophagus:** Muscular tube for food transport
- **Stomach:** Acidic digestion and protein breakdown
- **Intestine:** Nutrient absorption (small intestine) and water absorption (large intestine)
- **Rectum:** Temporary storage of undigested material
- **Cloaca:** Common chamber for digestive, urinary, and reproductive systems
- **Cloacal aperture:** External opening

12. What is the difference between cutaneous and pulmonary respiration?

Solution: Cutaneous respiration refers to the exchange of gases which occurs through the skin, while pulmonary respiration refers to the exchange of gases through the lungs.

Enhanced Explanation:

Cutaneous Respiration	**Pulmonary Respiration**
Gas exchange through skin	Gas exchange through lungs
Requires moist skin	Uses specialized respiratory organs
Limited surface area	Large surface area with alveoli
Passive diffusion	Active ventilation mechanism
Important in amphibians	Primary in terrestrial vertebrates
No specialized structures	Requires trachea, bronchi, alveoli

13. The special venous connection between liver and intestine and between kidney and intestine is found in the frog, what are they called?

Solution: The special venous connection between the liver and intestine is known as the hepatic portal system, and between kidney and intestine is known as the renal portal system.

Enhanced Explanation:

- **Hepatic Portal System:**
  - Blood from intestine goes to liver before returning to heart
  - Allows liver to process absorbed nutrients
  - Detoxifies blood before systemic circulation
- **Renal Portal System:**
  - Blood from posterior body regions passes through kidneys
  - Enhances filtration and excretion
  - Found in fish, amphibians, and reptiles (reduced in mammals)
  - Provides additional filtration of metabolic wastes

SHORT ANSWER TYPE QUESTIONS

1. Give the location of hepatic caeca in a cockroach. What is their function?

Solution: The hepatic caeca (also known as gastric caeca) are 6-8 narrow and hollow ring-like blind tubules present at the junction of the foregut and midgut. They help in the digestion of food in cockroaches.

Enhanced Explanation:

- **Location:** Junction between crop (foregut) and gizzard (midgut)
- **Structure:** Finger-like projections extending into body cavity
- **Functions:**
    - Secrete digestive enzymes (proteases, lipases, amylases)
    - Increase surface area for digestion
    - Absorb nutrients from partially digested food
    - Similar function to pancreas in vertebrates
- **Number:** Typically 6-8 caeca arranged radially around the gut

2. Frogs are beneficial for mankind, justify the statement.

Solution: They are an important part of the food chain. They help farmers by eating insects and pests and protect from insect infection. They are also used as a food source for humans in some regions of the world. For experiments and research, they have been used.

Enhanced Explanation: Ecological Benefits:

- **Pest Control:** Consume large quantities of insects, mosquitoes, and agricultural pests
- **Food Chain:** Serve as prey for birds, snakes, and fish; predators of insects
- **Biodiversity Indicators:** Sensitive to environmental changes, indicating ecosystem health

Economic Benefits:

- **Agriculture:** Reduce need for chemical pesticides
- **Food Source:** Protein source in many cultures
- **Research:** Model organisms for:
    - Developmental biology
    - Toxicology studies
    - Medical research
    - Educational purposes

Environmental Benefits:

- Control disease vectors (mosquitoes)
- Maintain ecological balance
- Nutrient cycling in aquatic ecosystems

3. The body of sponges does not possess tissue level of organisation though it is made of thousands of cells. Comment.

Solution: Most multicellular organisms possess specialized or advanced tissue level, but sponges have a cellular level of organization. They do not form tissues and their bodies are perforated, which allows water to pass through them easily.

Enhanced Explanation: Sponge Organization:

- **Cellular Level:** Cells are not organized into definite tissues
- **Cell Types Present:**
    - Choanocytes (collar cells): Create water currents and capture food
    - Porocytes: Form pores for water entry
    - Amoebocytes: Transport nutrients and form spicules
    - Pinacocytes: Form outer covering

Why No True Tissues:

- Cells lack specialized junctions
- No definite arrangement in layers
- Cells can change function and position
- No coordination between cell groups
- No basement membrane

Functional Adaptations:

- Porous body allows filter feeding
- Water flow brings oxygen and food
- Cells work independently but cooperatively
- Regeneration capability is high

4. Structural organisation in animals attains different levels as cell - organ - organ system. What is missing in this chain? Mention the significance of such an organisation.

Solution: Tissue is missing in the given chain. It should be: **Cell → Tissue → Organ → Organ System**. A tissue is a collection of similar types of cells which together forms an organ, and these organs form an organ system.

Enhanced Explanation: Complete Hierarchy:

1. **Cell:** Basic structural and functional unit
2. **Tissue:** Group of similar cells performing specific functions
3. **Organ:** Different tissues working together for specific functions
4. **Organ System:** Multiple organs coordinating for complex functions
5. **Organism:** All organ systems working together

Significance of Organization:

- **Specialization:** Each level has specific functions
- **Efficiency:** Division of labor increases effectiveness
- **Coordination:** Different levels work together
- **Redundancy:** Multiple levels provide backup
- **Complexity:** Allows complex life processes
- **Evolution:** Progressive increase in organizational complexity

5. Stratified epithelial cells have a limited role in secretion. Justify their role in our skin.

Solution: Stratified epithelial cells help in the protection of dry skin. It has multi-layers and thus does not have much role in secretion.

Enhanced Explanation: Structure of Stratified Epithelium:

- Multiple layers of cells
- Only basal layer in contact with basement membrane
- Outer layers gradually keratinize and die
- Thick, protective barrier

Limited Secretion Because:

- Multiple layers impede transport of secretory products
- Outer layers are dead and keratinized
- Primary function is protection, not secretion
- Specialized for barrier function

Protective Functions in Skin:

- **Physical Protection:** Against mechanical damage
- **Water Loss Prevention:** Reduces dehydration
- **Pathogen Barrier:** Prevents bacterial invasion
- **UV Protection:** Some protection against radiation
- **Chemical Resistance:** Resistant to many chemicals

Secretory Function: Limited to sebaceous and sweat glands in dermis, not epithelium itself

6. How does a gap junction facilitate intercellular communication?

Solution: It occurs by the communication between two cells by passing small signalling molecules from one cytoplasm to adjacent cytoplasm.

Enhanced Explanation: Structure of Gap Junctions:

- Made of connexin proteins
- Form channels (connexons) between adjacent cells
- Direct cytoplasmic connections
- Selective permeability (pore size ~1.5 nm)

Communication Mechanisms:

- **Ion Flow:** Electrical signals pass directly between cells
- **Small Molecules:** ATP, cAMP, glucose, amino acids
- **Metabolic Coupling:** Share metabolites and nutrients
- **Electrical Coupling:** Synchronized electrical activity

Functions:

- **Cardiac Muscle:** Synchronized contractions
- **Smooth Muscle:** Coordinated contractions
- **Nervous System:** Electrical synapses
- **Epithelial Tissues:** Coordination of cellular activities

Regulation: Can open/close in response to pH, calcium levels, and voltage

7. Why are blood, bone and cartilage called connective tissue?

Solution: They have a role in the binding and connection of different tissues and organs. They help in providing structural rigidity, support and protection of the body. They help in the transport and exchange of various enzymes, hormones, gases and molecules such as nitrogenous wastes, vitamins, etc.

Enhanced Explanation: Common Characteristics:

- **Extracellular Matrix:** Abundant matrix material between cells
- **Mesodermal Origin:** Derived from mesenchyme
- **Support Function:** Provide structural and functional support

Specific Functions:

Tissue	Matrix	Cells	Functions
Blood	Plasma (liquid)	RBC, WBC, Platelets	Transport, immunity, clotting
Bone	Calcified matrix	Osteocytes, osteoblasts	Support, protection, calcium storage
Cartilage	Chondrin matrix	Chondrocytes	Support, shock absorption

Connecting Functions:

- **Structural:** Framework for organs
- **Transport:** Blood connects all body parts
- **Protection:** Bone protects vital organs
- **Flexibility:** Cartilage allows movement
- **Repair:** All can regenerate to some degree

8. Why are neurons called excitable cells? Mention special features of the membrane of the neuron.

Solution: Neurons are called excitable cells because they have an electrical potential difference.

Special Features:

1. During the resting stage of the neuron, it has a sodium-potassium ion pump (Na^+-K^+ ion pump)
2. A change in the potential difference spreads changes in the entire neuron
3. Stimulus is normally obtained in a place known as trigger zone in which sodium ions (Na^+ ions) are abundantly present

Enhanced Explanation: Why "Excitable":

- Can generate and propagate electrical signals (action potentials)
- Respond to stimuli by changing membrane potential
- Can transmit information over long distances

Special Membrane Features:

Feature	Function
Resting Potential	-70mV inside relative to outside
Na^+-K^+ Pump	Maintains ionic gradients ($3Na^+$ out, $2K^+$ in)
Voltage-gated Channels	Na^+, K^+, Ca^{2+} channels respond to voltage changes
Trigger Zone	Area with high Na^+ channel density
Myelin Sheath	Insulation for faster conduction
Nodes of Ranvier	Gaps in myelin for saltatory conduction

Electrical Properties:

- **Threshold:** Minimum stimulus needed (-55mV)
- **All-or-None:** Action potential magnitude is constant
- **Refractory Period:** Brief period of non-responsiveness
- **Propagation:** Self-regenerating signal transmission

9. Why earthworm is called the friend of a farmer?

Solution: The earthworm is called a friend of farmers because they help farmers by moving through the soil which helps in aeration of the soil. The excreta which is released by them helps in increasing the fertility of the soil.

Enhanced Explanation: Soil Improvement Functions:

1. Soil Aeration:

- Burrow formation creates air passages
- Improves root respiration
- Enhances water infiltration
- Prevents soil compaction

2. Soil Fertility Enhancement:

- **Vermicompost:** Worm castings are rich in nutrients
- **NPK Content:** High nitrogen, phosphorus, potassium
- **Organic Matter:** Increases humus content
- **pH Regulation:** Neutralizes acidic soils

3. Soil Structure Improvement:

- **Mixing:** Brings subsoil minerals to surface
- **Aggregation:** Improves soil particle binding
- **Drainage:** Better water retention and drainage
- **Root Penetration:** Easier root growth through burrows

4. Biological Benefits:

- **Decomposition:** Break down organic matter
- **Nutrient Cycling:** Release nutrients from organic matter
- **Microbial Activity:** Enhance beneficial soil microorganisms

Economic Impact:

- Reduces need for chemical fertilizers
- Improves crop yields
- Enhances soil health naturally
- Sustainable farming practice

10. How do you distinguish between dorsal and ventral surface of the body of earthworm?

Solution: The dorsal surface of the body of earthworm has a dark dorsal median line, while the ventral surface of the body of earthworm is lighter in color.

Enhanced Explanation: Distinguishing Features:

Dorsal Surface	Ventral Surface
Darker color	Lighter color

Dorsal Surface	Ventral Surface
Dark median line (dorsal blood vessel)	No median line
More rounded	Flattened
Setae absent on dorsal line	Setae present
Genital pores absent	Genital pores present
Clitellum more prominent	Clitellum less prominent

Additional Identification Features:

- **Prostomium:** Finger-like projection over mouth (ventral)
- **Genital Segments:** Male pores on 18th segment (ventral)
- **Spermathecal Pores:** On 6th, 7th, 8th, 9th segments (ventral)
- **Setae Arrangement:** Four pairs per segment on ventral side

Functional Significance:

- **Dorsal:** Contains main blood vessels and nerve cord
- **Ventral:** Contact with substrate during movement
- **Locomotion:** Setae help in gripping surface

11. Correct the wrong statements among the following:

a. In earthworm, a single male genital pore is present.

b. Setae help in locomotion of earthworm.

c. Muscular layer in the body wall of an earthworm is made up of only circular muscles.

d. Typhlosole is the part of the intestine of earthworm.

Solution:

a. Wrong statement.

In earthworms, there is the presence of a pair of male genital pores.

b. Correct statement

c. Wrong statement

The muscular layer in the body wall of the earthworm is not only made up of circular muscles but it also has longitudinal muscles.

d. Correct statement.

Enhanced Explanation:

Corrected Statements:

a. Male Genital Pores:

- **Correct:** Two male genital pores present on 18th segment
- **Location:** Ventral surface, lateral to ventral setae
- **Function:** Release sperms during copulation

c. Muscle Layers:

- **Outer Layer:** Circular muscles (constrict body)
- **Inner Layer:** Longitudinal muscles (extend body)
- **Coordination:** Both work together for peristaltic movement
- **Movement Pattern:**

- Circular muscles contract → body elongates and moves forward
- Longitudinal muscles contract → body shortens and thickens

Additional Details:

b. Setae Function:

- Chitinous bristles, 4 pairs per segment
- Provide grip during movement
- Can be protruded or retracted
- Absent from first and last segments

d. Typhlosole:

- Internal fold of intestinal wall
- Increases surface area for absorption
- Extends from 27th segment onwards
- Contains blood vessels and increases digestion efficiency

12. Why nephridia in earthworm that are similar in structure classified into three types? Mention the names of each.

Solution: Nephridia in earthworms are similar in structure but classified into different types based on their location.

Types:

1. **Septal Nephridia:** Located on both sides of the intersegmental septa from the 15th segment till the end
2. **Pharyngeal Nephridia:** Located in the 4th, 5th and 6th segment of the earthworm
3. **Integumentary Nephridia:** Located in the body wall (integument) of the earthworm

Enhanced Explanation:

Classification Basis: Location and developmental origin, not structural differences

Detailed Description:

Type	Location	Number	Function
Septal	Intersegmental septa (15th segment onwards)	40-50 pairs	Primary excretion
Pharyngeal	Segments 4, 5, 6	3 pairs	Excretion in anterior region
Integumentary	Body wall of most segments	Numerous	Supplementary excretion

Structure (All Types):

- **Nephrostome:** Ciliated funnel opening into coelom
- **Nephridial Tubule:** Coiled tube for filtration and reabsorption
- **Nephridiopore:** External opening for waste discharge

Functional Significance:

- **Redundancy:** Multiple systems ensure efficient waste removal
- **Regional Specialization:** Different segments have specific needs

- **Developmental Adaptation:** Different types develop at different stages

Excretory Process:

1. Coelomic fluid enters through nephrostome
2. Selective reabsorption in tubule
3. Waste discharge through nephridiopore

13. The common name of some animals are given in Column A, write their scientific name in Column B.

Column A	Column B
a. Tiger	Panthera tigris
b. Peacock	Pavo cristatus
c. Housefly	Musca domestica

Enhanced Explanation:

Scientific Nomenclature Rules:

- **Binomial System:** Genus + species
- **Format:** Genus capitalized, species lowercase, both italicized
- **Authority:** Often includes author name and year

Additional Information:

Tiger (Panthera tigris):

- **Family:** Felidae
- **Order:** Carnivora
- **Status:** Endangered species
- **Habitat:** Asian forests and grasslands

Peacock (Pavo cristatus):

- **Family:** Phasianidae
- **Order:** Galliformes
- **Status:** National bird of India
- **Habitat:** Forests and cultivated areas

Housefly (Musca domestica):

- **Family:** Muscidae
- **Order:** Diptera
- **Significance:** Disease vector and model organism
- **Habitat:** Human habitations worldwide

14. Complete the following statements:

a. In cockroach grinding of food particle is performed by _____ b. Malpighian tubules help in removal of _____ c. Hind gut of cockroach is differentiated into _____ d. In cockroach blood vessels open into spaces called _____

Solution: a. In cockroach grinding of food particle is performed by **gizzard**. b. Malpighian tubules help in removal of **nitrogenous excretory products**. c. The hindgut of cockroach is

differentiated into **ileum, colon and rectum**. d. In cockroach blood vessels open into spaces called **haemocoel**.

Enhanced Explanation:

a. Gizzard Function:

- **Location:** Part of foregut, after crop
- **Structure:** Muscular chamber with chitinous teeth
- **Function:** Mechanical breakdown of food particles
- **Analogy:** Similar to bird gizzard or mammalian molars

b. Malpighian Tubules:

- **Number:** About 150 blind tubules
- **Function:** Primary excretory organs
- **Process:** Filter haemolymph, convert metabolic waste to uric acid
- **Advantage:** Water conservation in terrestrial insects

c. Hindgut Regions:

- **Ileum:** Absorption of water and minerals
- **Colon:** Further water absorption, waste concentration
- **Rectum:** Temporary storage before defecation
- **Coordination:** Sequential processing of digestive waste

d. Haemocoel (Open Circulatory System):

- **Structure:** Body cavity filled with haemolymph
- **Function:** Bathes organs directly with body fluid
- **Advantage:** Efficient in small arthropods
- **Components:** Heart, blood vessels, haemolymph

15. Mention special features of an eye in Cockroach.

Solution:

1. They have compound eyes that contain numerous small visual units
2. Ommatidia is known as the visual unit in their eye
3. Their eyes have a lower resolution but higher sensitivity

Enhanced Explanation:

Compound Eye Structure:

- **Ommatidia:** Individual visual units (about 2,000 per eye)
- **Components of Each Ommatidium:**
    - Cornea (lens)
    - Crystalline cone
    - Photoreceptor cells (retinula cells)
    - Rhabdom (light-sensitive region)

Functional Characteristics:

Feature	Description	Advantage
Multiple Units	Thousands of ommatidia	Wide field of view (mosaic vision)

Feature	Description	Advantage
Light Sensitivity	High sensitivity to light changes	Excellent motion detection
Resolution	Lower than vertebrate eyes	Adequate for insect lifestyle
Color Vision	Can see UV light	Important for navigation and food finding

Behavioral Advantages:

- **Predator Detection:** Quick response to shadows and movement
- **Flight Navigation:** Use polarized light and landmarks
- **Food Location:** UV patterns on flowers
- **Mate Recognition:** Visual courtship signals

Comparison with Human Eyes:

- **Field of View:** Nearly 360° vs 180° in humans
- **Motion Detection:** Superior to human eyes
- **Acuity:** Much lower than human eyes
- **Color Range:** Extended into UV spectrum

16. Frog is a poikilotherm, exhibits camouflage and undergoes aestivation and hibernation. How are all these benefits to it?

Solution: During hibernation and aestivation, it sleeps and uses the stored energy in the body and emerges after the harsh environmental temperature has passed. Camouflage helps in the frog's protection and catching prey.

Enhanced Explanation:

1. Poikilothermic Nature:

- **Definition:** Body temperature varies with environment
- **Benefits:**
    - Lower energy requirements (no energy for thermoregulation)
    - Can slow metabolism during unfavorable conditions
    - Efficient energy utilization
    - Adaptation to variable environments

2. Camouflage:

- **Mechanism:** Chromatophores change skin color and pattern
- **Benefits:**
    - **Predator Avoidance:** Blend with surroundings
    - **Prey Capture:** Ambush hunting strategy
    - **Thermoregulation:** Dark colors absorb heat, light colors reflect
    - **Communication:** Color changes for territorial displays

3. Aestivation (Summer Dormancy):

- **Conditions:** Hot, dry periods
- **Benefits:**
    - Water conservation
    - Reduced metabolic rate

- Survival during drought
- Protection from desiccation

4. Hibernation (Winter Dormancy):

- **Conditions:** Cold temperatures
- **Benefits:**
  - Energy conservation
  - Reduced oxygen requirements
  - Protection from freezing
  - Survival without food

Integrated Survival Strategy:

- All features work together for environmental adaptation
- Energy efficiency throughout the year
- Survival in amphibious lifestyle (aquatic and terrestrial)

17. Write the functions in brief in column B, appropriate to the structures given in column A.

Column A	Column B
a. Nictitating membrane	i. Third eyelid that protects the frog from water and land environment
b. Tympanum	ii. Present behind the eyes, helps in transmitting soundwaves to the inner ear
c. Copulatory pad	iii. Present on forelimbs of males, helps in holding female tightly during mating

Enhanced Explanation:

a. Nictitating Membrane:

- **Structure:** Transparent, movable third eyelid
- **Movement:** Can cover eye horizontally
- **Functions:**
  - **Underwater Protection:** Protects eye while swimming
  - **Moisture Retention:** Keeps eye moist on land
  - **Debris Protection:** Shields from particles
  - **Vision:** Allows some vision while protected

b. Tympanum:

- **Structure:** Circular membrane behind and below eye
- **Size:** Larger in males than females
- **Functions:**
  - **Sound Reception:** Receives airborne sound waves
  - **Sound Transmission:** Transfers vibrations to inner ear
  - **Frequency Detection:** Sensitive to specific frequencies
  - **Species Recognition:** Distinguishes mating calls

c. Copulatory Pad (Nuptial Pad):

- **Structure:** Roughened, swollen thumb pad
- **Seasonal:** Develops during breeding season
- **Functions:**
    - **Grip Enhancement:** Secure hold during amplexus
    - **Mating Duration:** Maintain position for hours
    - **Sperm Transfer:** Facilitate external fertilization
    - **Male Recognition:** Secondary sexual characteristic

18. Write the appropriate type of tissues in column B according to the functions mentioned in column A.

Column A	Column B
a. Secretion and absorption	i. Cuboidal epithelium
b. Protective covering	ii. Stratified epithelium
c. Linking and supporting framework	iii. Connective tissue

Enhanced Explanation:

a. Secretion and Absorption - Cuboidal Epithelium:

- **Structure:** Cube-shaped cells, single layer
- **Locations:** Kidney tubules, glands, ducts
- **Specializations:**
    - **Microvilli:** Increase surface area for absorption
    - **Secretory Granules:** Store secretory products
    - **Tight Junctions:** Control permeability
- **Examples:** Thyroid follicles, pancreatic ducts

b. Protective Covering - Stratified Epithelium:

- **Structure:** Multiple cell layers
- **Locations:** Skin, mouth, esophagus
- **Types:**
    - **Keratinized:** Outer skin (waterproof)
    - **Non-keratinized:** Internal surfaces (moist)
- **Function:** Protection from mechanical damage, dehydration

c. Linking and Supporting Framework - Connective Tissue:

- **Components:** Cells + extracellular matrix
- **Types:** Loose, dense, specialized (bone, blood, cartilage)
- **Functions:**
    - **Structural Support:** Framework for organs
    - **Connection:** Links tissues and organs
    - **Transport:** Blood circulation
    - **Protection:** Bone protects organs
    - **Storage:** Fat storage, calcium in bones

19. Using appropriate examples, differentiate between false and true body segmentation.

Solution:

1. **False or pseudo body segmentation** is the segmentation of the ectoderm. For example: In tapeworms, it shows external segmentation but does not have internal segmentation.
2. **True body segmentation** is the series of repetition of a body part. It shows external segmentation as well as internal segmentation. For example: It is observed in arthropods like earthworms.

Enhanced Explanation:

False (Pseudo) Segmentation:

Characteristic	Description	Example
Definition	Only external division	Tapeworm (Taenia)
Internal Structure	Organs not segmentally arranged	Continuous organ systems
Development	Surface constrictions only	Body wall folding
Function	Primarily for growth	Proglottid formation
Evolution	Secondary development	Adaptation for reproduction

True (Metameric) Segmentation:

Characteristic	Description	Example
Definition	Both external and internal division	Earthworm, insects
Internal Structure	Organs repeated in segments	Nephridia, ganglia per segment
Development	Embryonic segmentation	Mesoderm segmentation
Function	Locomotion and organ redundancy	Efficient movement
Evolution	Primitive characteristic	Ancestral feature

Examples Comparison:

Tapeworm (False):

- Proglottids: External segments
- Continuous nerve cord
- No segmental blood vessels
- Reproductive focus

Earthworm (True):

- Metameres: Complete segments
- Segmental ganglia
- Segmental blood vessels
- Functional redundancy

Evolutionary Significance:

- True segmentation allows specialization
- Provides evolutionary flexibility

- Enables complex locomotion patterns
- Allows regional body modifications

20. What is special about tissue present in the heart?

Solution: Cardiac muscle tissue is an extremely specialized tissue which is only found in the heart. It has similar characteristics of skeletal as well as smooth muscles. It can sustain contraction and relaxation rapidly. They are involuntary.

Enhanced Explanation:

Cardiac Muscle Characteristics:

Unique Features:

- **Location:** Exclusively in heart (myocardium)
- **Cell Structure:** Branched, interconnected fibers
- **Nuclei:** Usually one nucleus per cell (sometimes two)
- **Striations:** Cross-striped like skeletal muscle
- **Control:** Involuntary (autonomous)

Special Properties:

Property	Description	Significance
Intercalated Discs	Specialized junctions between cells	Synchronous contractions
Gap Junctions	Allow electrical coupling	Coordinated heartbeat
Automaticity	Self-excitable	Independent rhythm
Rhythmicity	Regular, rhythmic contractions	Continuous pumping
Refractory Period	Long recovery time	Prevents tetanic contractions

Functional Adaptations:

- **Endurance:** Resistant to fatigue
- **Metabolism:** High mitochondrial content
- **Blood Supply:** Rich capillary network
- **Regeneration:** Limited regenerative capacity

Comparison with Other Muscles:

Feature	Cardiac	Skeletal	Smooth
Striations	Yes	Yes	No
Control	Involuntary	Voluntary	Involuntary
Speed	Moderate	Fast	Slow
Fatigue	Resistant	Fatigable	Resistant
Branching	Yes	No	No

Clinical Significance:

- Heart attacks damage cardiac muscle
- Limited repair ability
- Arrhythmias affect coordination

- Exercise improves cardiac efficiency