STRUCTURE AND FUNCTIONS OF INSECT CUTICLE AND MOULTING

Insect body wall is called as **Integument** or **Exoskeleton.** It is the external covering of the body which is ectodermal in origin. It is rigid, flexible, lighter, stronger and variously modified in different body parts to suit different modes of life.

Structure

Body wall consists of an inner cellular layer (**Epidermis**) and an outer non cellular part (**Cuticle**).

Epidermis

It is an inner unicellular layer resting on basement membrane with the following function.

i. Cuticle secretion

ii. Digestion and absorption of old cuticle

iii. Wound repairing

iv. Gives surface look

Cuticle

It is an outer non cellular layer comprising of three sub layers.

i. Endocuticle

Compared to others it is the inner and thickest layer. This layer is made up of **Chitin** and **arthropodin**. This layer is colourless, soft and flexible.

ii.**Exocuticle**

Outer layer, much thicker with the composition of **Chitin** and **sclerotin**. This layer is dark in colour and rigid.

iii. **Epicuticle:** Outer most layer which is very thin. Pore canals present in the exocuticle helps in the deposition of epiculticle. This layer is differentiated into the following layers.

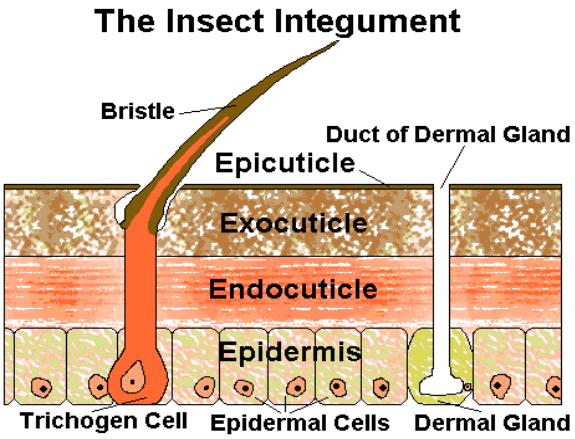
a. Inner epicuticle: It contains **wax filaments**

b. Outer epicuticle: It makes the contact with **cuticulin**

c. Cuticulin : Non chitinous polymerised lipoprotein layer.

d. Wax layer: It contains closely packed wax molecules which prevents desiccation.

e. Cement layer: Outer most layer formed by lipid and tanned protein. It protects wax layer.



Composition of cuticle

i.**Chitin:** It is the main constituent of cuticle, which is Nitrogenous polysacharide and polymer of **N-acetylglucosamine**. It is water insoluble but soluble in dilute acids, alkalies and organic solvents.

ii.**Arthropodin:** An untanned cuticular protein, which is water soluble.

iii.**Sclerotin:** Tanned cuticular protein, which is water insoluble.

iv.**Resilin:** An elastic cuticular protein responsible for the flexibility of sclerites, e.g., wing articulatory sclerites.

ENDOSKELETON

Cuticular in growth of body wall providing space for muscle attachment is known as endoskeleton. There are two types

i.**Apodeme:** Hollow invagination of body wall.

ii.**Apophysis:** Solid invagination of body wall.

CUTICULAR APPENDAGES

Non-cellular: Non-cellular appendages have no epidermal association, but rigidly attached. e.g. minute hairs and thorns.

Cellular: Cellular appendages have eipdermal association.

Unicellular

a. Clothing hairs, plumose hairs. e.g. Honey bee. Bristles. e.g. flies.

b. Scales - flattened out growth of body wall e.g. Moths and butterflies

c. Glandular seta. et. caterpillar

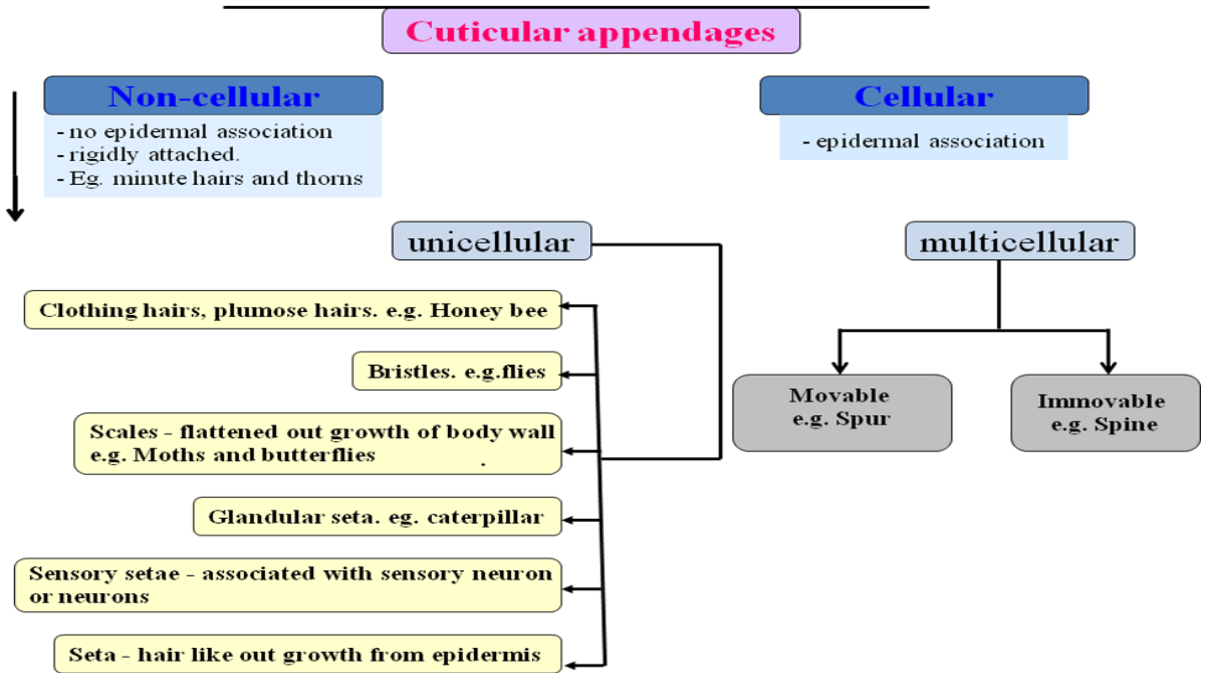
d. Sensory setae - associated with sensory neuron or neurons

e. Seta - hair like out growth (Epidermal cell generating seta is known as **Trichogen**, while the socket forming cell housing trichogen is known as **Tormogen**. Study of arrangement of seta is known as **Chaetotaxy**).

Multicellular

e.g. Spur - movable structure

Spine- Immovable structure



GLANDS

Cuticular glands are either unicellular or multicellular. Following are some of the examples.

i. Wax gland - e.g. Honey bee and mealy bug

ii. Lac gland - e.g. Lac insects

iii. Moulting gland secreting moulting fluid.

iv. Androconia or scent scale - e.g.moth

v. Poison gland - e.g. slug caterpillar

Functions of Body wall

i. Acts as **external armour** and strengthen external organs like jaws and ovipositor

ii. Protects the organs against physical aberation, injurious chemicals, parasites, predators and pathogen.

iii. Internally protects the vital organs, foregut, hindgut and trachea.

iv. Provides space for muscle attachment and gives shape to the body.

v. Prevents water loss from the body.

vi. Cuticular sensory organs helps in sensing the environment.

vii. Cuticular pigments give colour.

MOULTING (**Ecdysis**)

Ecdysis

Periodical process of shedding the old cuticle accompanied by the formation of new cuticle is known as **moulting** or **ecdysis**. The cuticular parts discarded during moulting is known as **Exuvia**. Moulting occurs many times in an insect during the immatured stages before attaining the adult-hood. The time interval between the two subsequent moulting is called as **Stadium** and the form assumed by the insect in any stadium is called as **Instar**.

Steps in moulting

1. Behaviroual changes: Larva stops feeding and become inactive.

2. Changes in epidermis: In the epidermis cell size, its activity, protein content and enzyme level increases. Cells divide miotically and increases the tension, which results in loosening of cells of cuticle.

3. Aolysis: **Detachment of cuticle** from epidermis

4. Formation of **Sub cuticular space**

5. Secretion of **moulting gel** in the sub cuticular space which is rich with chitinase and protease.

6. New epicuticle formation: Lipoprotein layer (cuticulin) is laid over the epidermis.

7. Procuticle formation: Procuticle is formed below the epicuticle.

8. Activation of moulting gel: Moulting gel is converted into moulting fluid rich in enzymes. This activates endocuticle digestion and absorption.

9. Wax layer formation: Wax threads of pore canals secrete wax layer.

10. Cement layer formation : Dermal glands secretes cement layer (Tectocuticle).

11. **Moulting:** This involves two steps

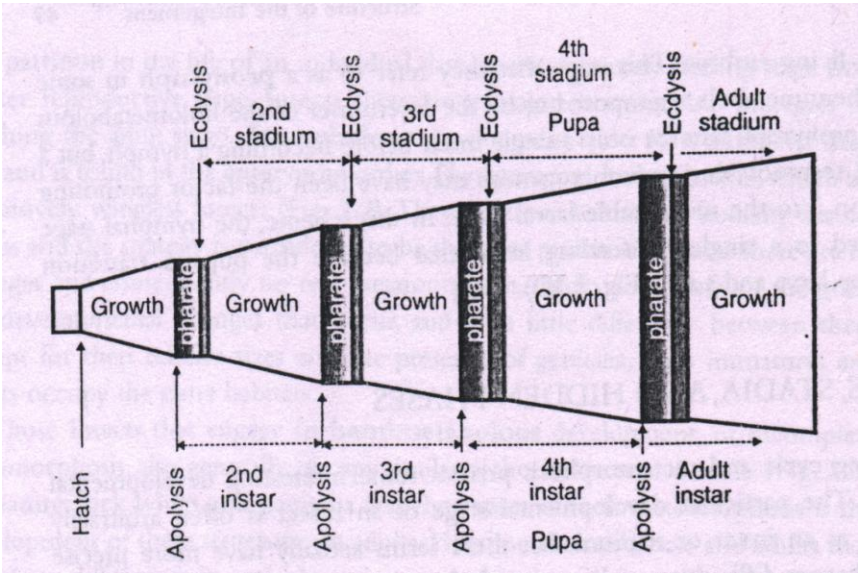
i. **Rupturing of old cuticle:** Insect increases its body volume through intake of air or water which enhances the blood flow to head and thorax. There by the old cuticle ruptures along prede-termined line of weakness known as **ecdysial line**

ii. **Removal of old cuticle:** Peristaltic movement of body and lubricant action of moulting fluid helps in the removal of old cuticle. During each moulting the cuticular coverings discarded are the cuticular of legs, internal linings of foregut and hindgut and trachea.

12. Formation of exocuticle: The upper layer of procuticle develops as exocuticle through addition of protein and tanning by phenolic substance.

13. Formation of endocuticle: The lower layer of procuticle develops as endocuticle through addition of chitin and protein. This layer increases in thickness.

Control of Moulting: It is controlled by endocrine gland like prothoracic gland which secrete moulting hormone. Endocrine glands are activated by prothoracico-tropic hormones produced by neurosecretory cells of brain.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