VISION IN ARTHROPODA

Learning outcome

- Different types of receptors in arthropods .
- simple eyes in arthropods .
- Structure of compound eyes and the mechanism of image formation

Arthropods possess various kinds of sensory structures which are sensitive to different kinds of stimuli .

Receptors present in the arthropods body :-

Chemoreceptors	- sensitive to chemical
mechanoreceptors	- sensitive to movement
tectoreceptors	- sensitive to touch
olfactoreceptors	- Sensitive to smell
Audioreceptors	- Sensitive to sound
Photoreceptors	- sensitive to light

VISION

Vision is about how individuals see

Influence of light in animals :-

- Sexual reproductive cycle
- Biological and seasonal rhythm.
- color changes in the skin .
- Hormones secretion
- Various chemical reaction

VISUAL RECEPTORS

OPSIN + CHROMOPHORE (11 cis retinol) = RHODOPSIN

Opsin is a transmembrane protein

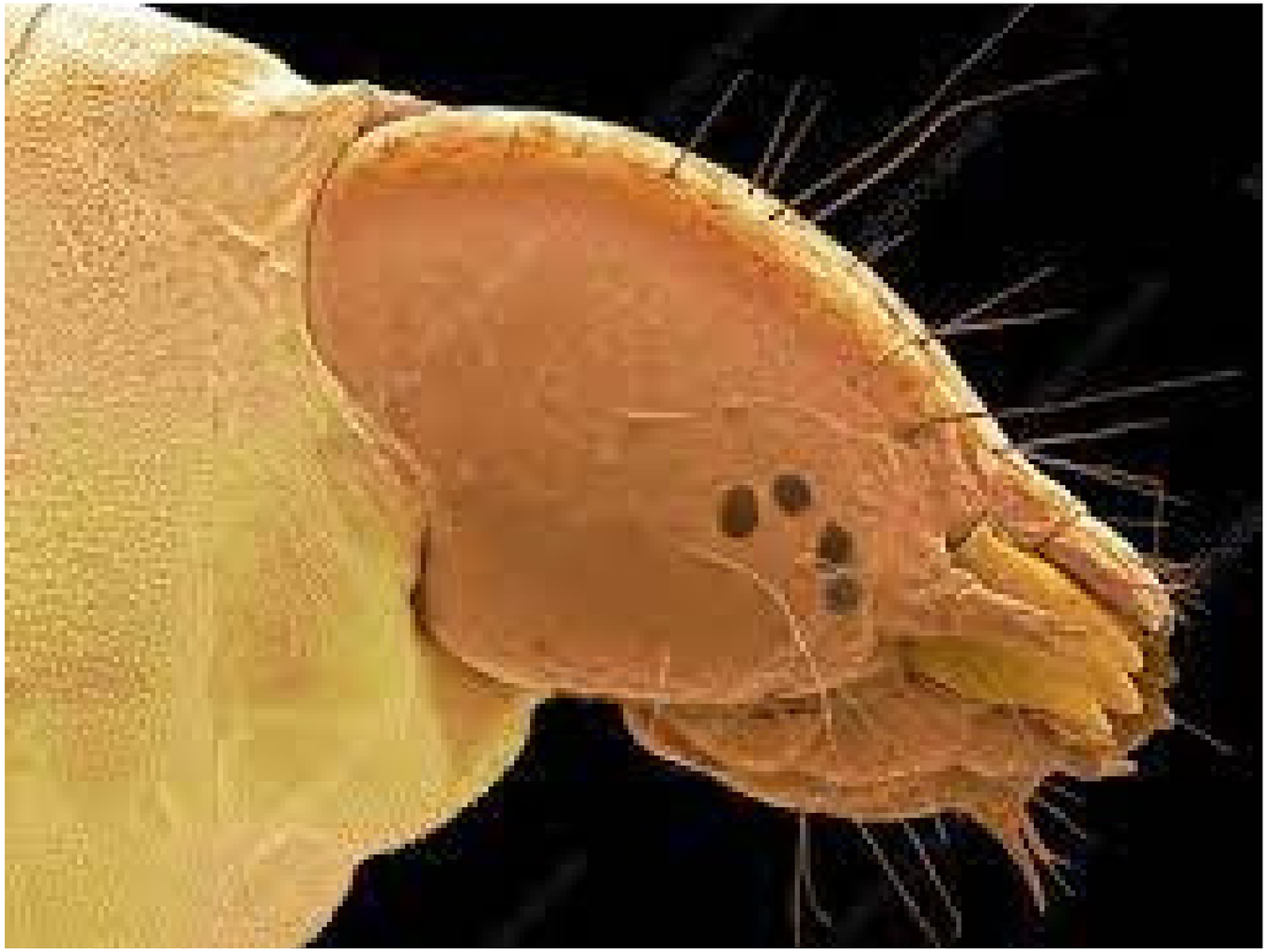
Opsin is species specific, as determined by its amino acid composition

VISUAL ORGANS IN ARTHROPODS

Three basic kinds of photoreceptors in arthropods :-

Dorsal ocelli

Stemmata

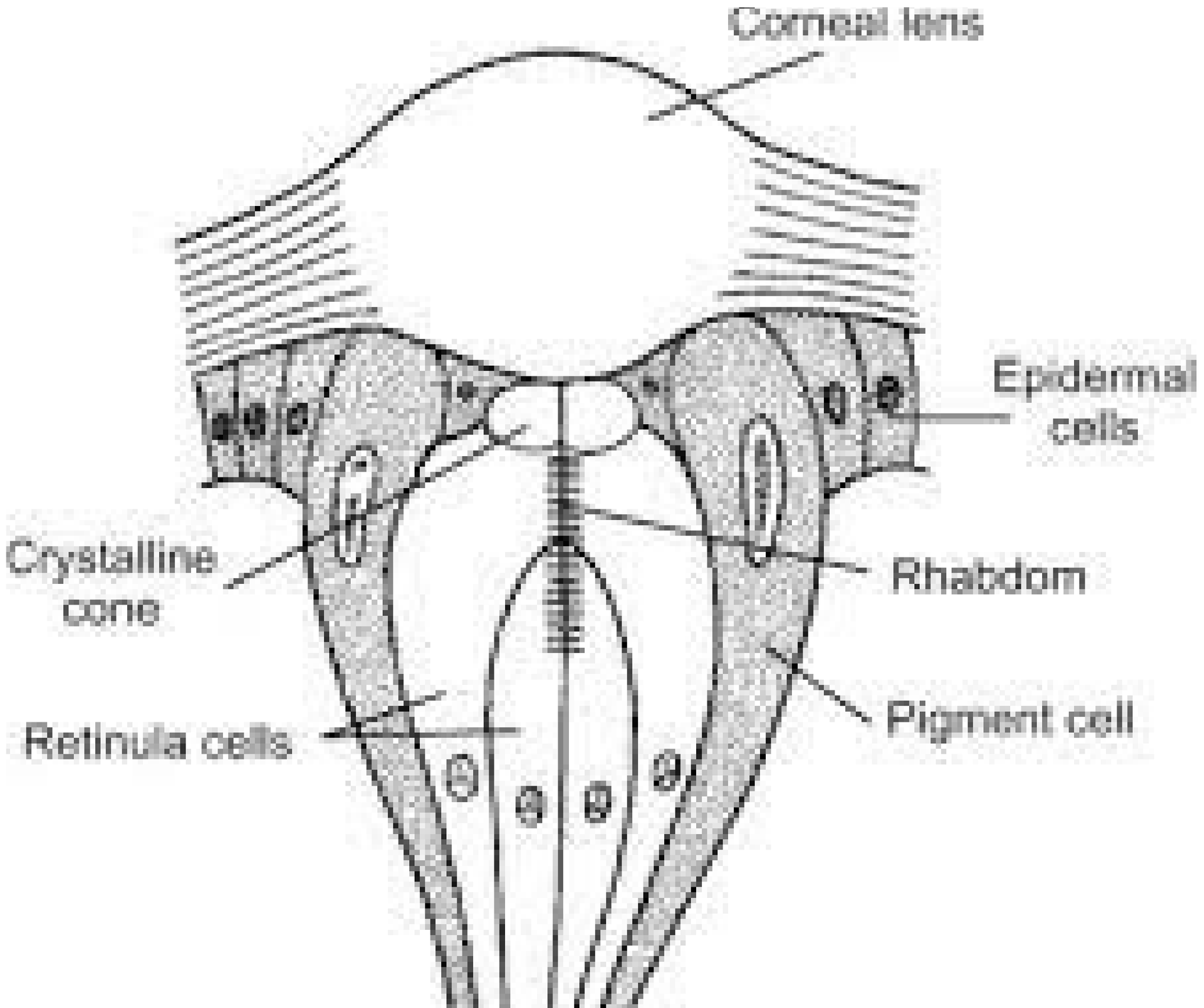


Compound eye

Dorsal ocelli

Simple eyes with single lens for collecting and focusing light .

- Found in adult insects and the larvae of hemimetaboluos insects.
- Mostly found on the dorsal or front surface of the head.
- Appear clustered in a triangular pattern on the head between the compound eyes in the winged adults of most orders and in the larvae of hemimetabola .
- The axons from retinula cells synapse with a small number of inter neurons so that fewer axons enter the brain than the numberof receptor cells present, effectively limiting its resolution even further.


Corneal lens
Epidermal cells
Crystalline cone
Rhabdom
Pigment cell
Retinula cells

Stemmata (Complex lensed ocelli)

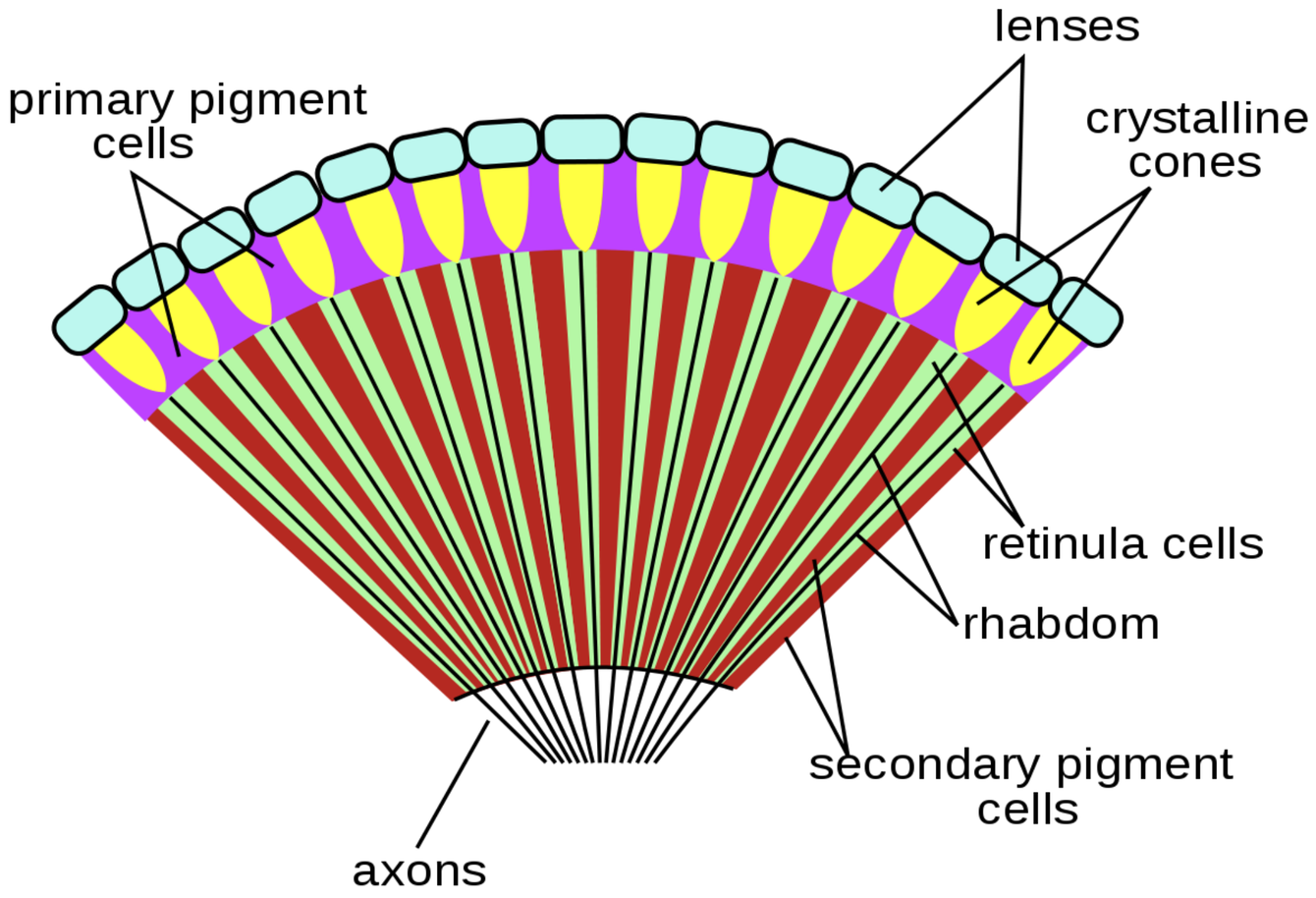
- Only the visual organs of larval holometabolous insects (caterpillar) and certain adults such as springs tails, silver fish , fleas and stylops .
- Present in the lateral region of the head.
- Number varies from one to six on each side of the head

- A stemma bears - a cuticular corneal lense above a crystalline cone.
- A portion of the plasma membrane of the retinular cells is specialized as a rhobdomere that contain the visual pigment

compound eyes

As their name indicates , compound eyes comprise from a few to many distinct photoreceptive units ,called ommatidia

Each ommatidium is supplied with its own nerve tracts leading to the major optic nerve, and each has its own field of vision through square or hexagonal cuticular facets on the eye surface.



Structure of an ommatidium

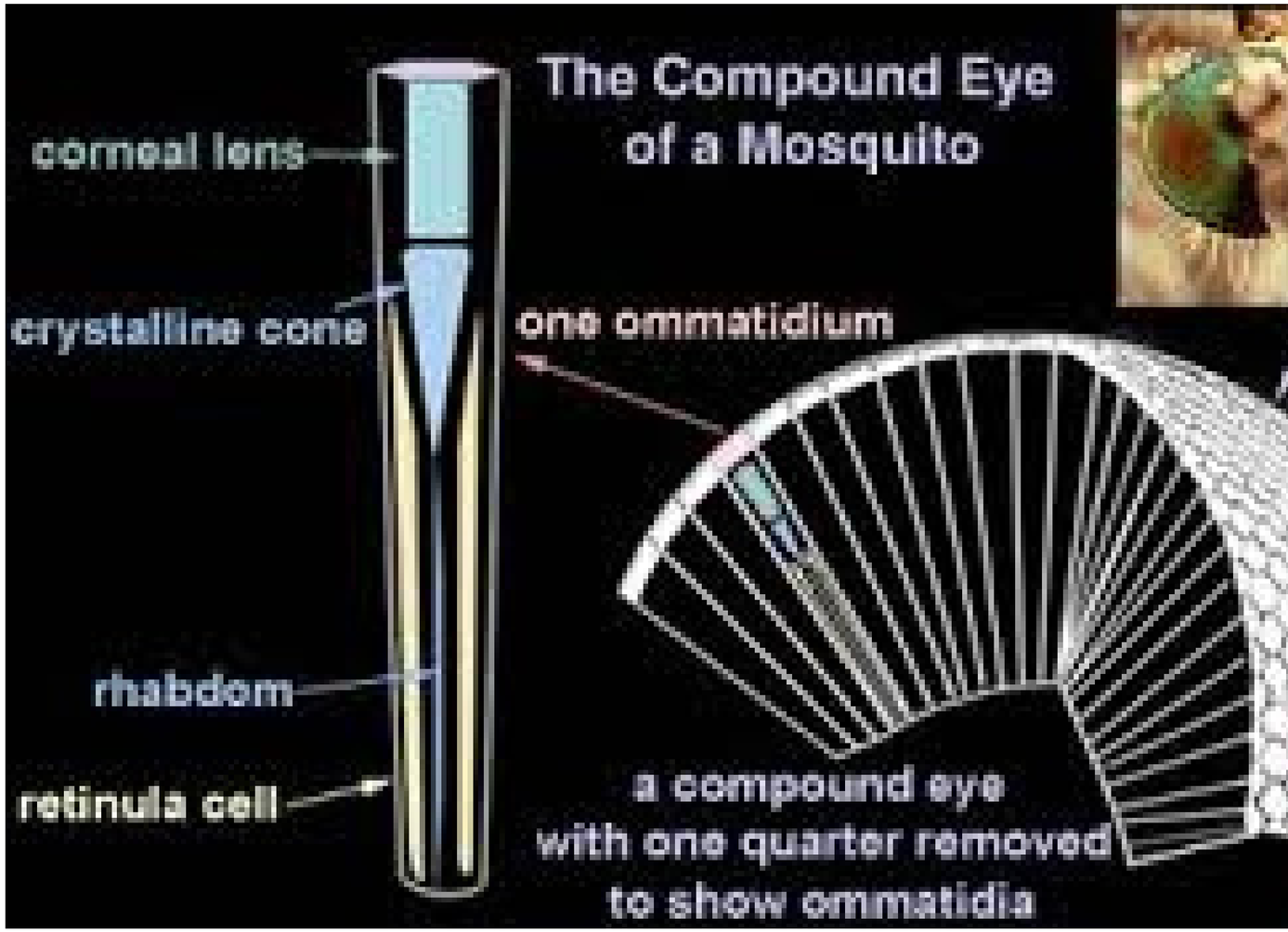
1.Cornea 2. Crystalline cone 3. Rhabdome 4.Pigment cells

1. Cornea

- The cornea functions as a biconvex lens .
- The special epidermal cells called corneagen cells.
- Hexagonal / square corneal facet

Crystalline cone

- Semper cell produce a second lens the crystalline cone.
- Surrounded by 4-6 elongated cone cells,called vitrellae.
- Region of each ommatidium ,from cornea till the end of cone cells, is termed as DIOPTRICAL REGION .



3.Photoreceptor unit

- Rhabdome.
- Retinula cells 7-8 light sensitive photoreceptor cells
- Basement membrane - basal lamina.

Rhabdome and retinula cells collectively form the receptor region of the eye

Pigment cells

- The primary pigment cell -present in the proximal region of the ommatidium .
- The secondary pigment , also called the retinal pigment ,surrounds the rhabdome and retinal cells in the distal region of the ommatidium .

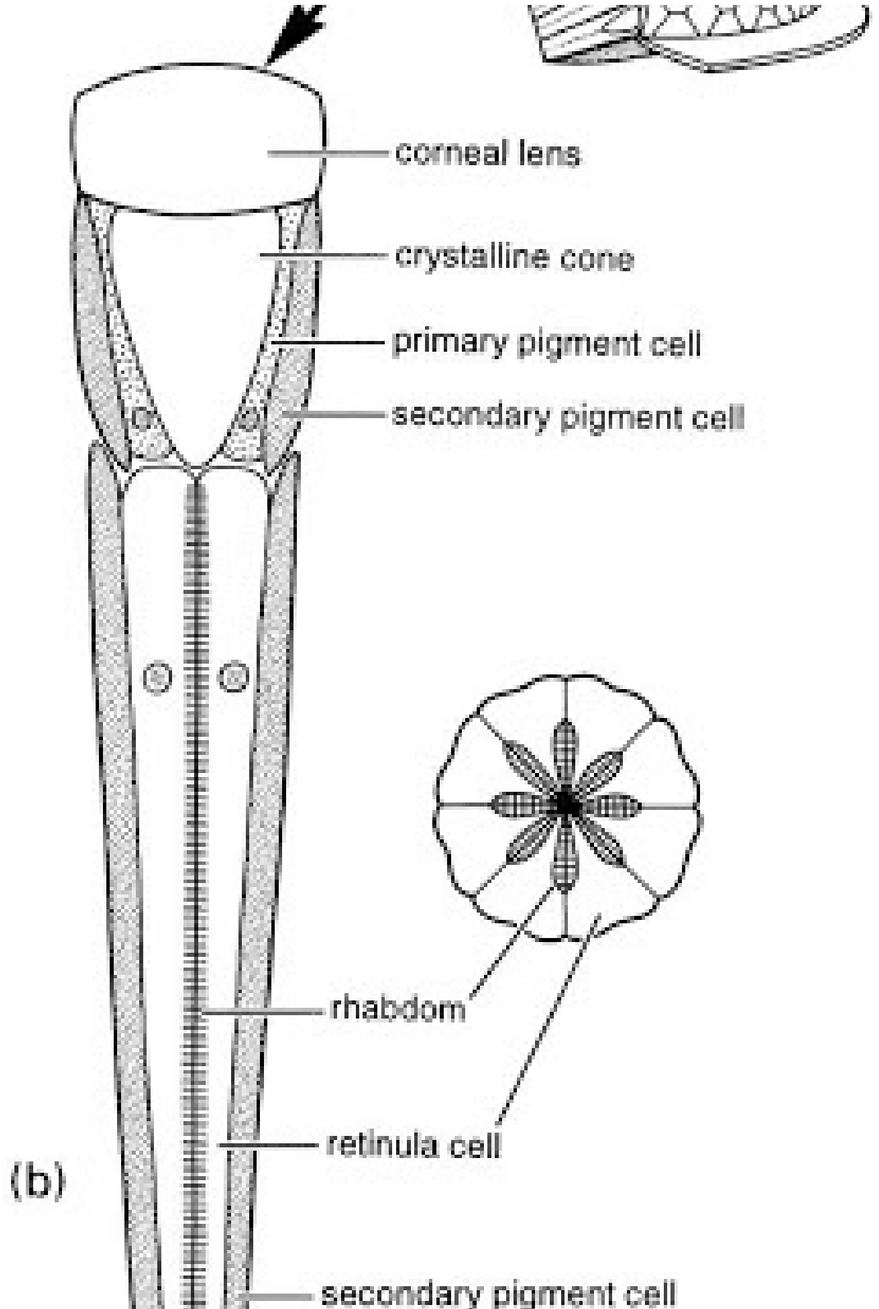


IMAGE FORMATION IN COMPOUND EYES

Mosaic vision

compound eyes form image with the help of inputs received from ommatidia.Each ommatidium forms a separate image of the object. Thus, the image formed consists of several pieces . This type of vision is called mosaic vision .

Apposition image

Superposition image

Apposition image

The compound eyes form apposition image in the bright light.

- In bright light ,both proximal and distal pigments extend and act as a screen to prevent light rays from passing from one ommatidium to another.

1. Light rays which fall perpendicularly on the cornea form the point of an image .

Superposition image

The superposition image is formed in the dim light.

- In dim light proximal and distal pigments retract. The ommatidia do not remain optically isolated.
- The oblique rays as well those fall perpendicularly on the cornea form the point of an image.

DIFFERENCES BETWEEN APPOSITION EYE AND SUPERPOSITION EYE

FEATURES	APPOSITION EYE	SUPERPOSITION EYE
Light intensity	Stimulated by strong light	Stimulated by low intensity
Screening pigment	Well developed	Present may be reduced or absent in some
Length of crystalline cone	Approx. equal to the focal length	Twice as long as the focal length
Rhabdome	Longer, extends the full length of the photoreceptor cells	Shorter, clear zone exist between the rhabdoms and the lens systems
Retinular cells	Long extending till the basal membrane of retina	Shorter restricted to the base of ommatidium
Light rays	Enter through single ommatidium through axial region	Enter through several ommatidia through all regions
Examples	Diurnal species, such as Butterfly	Nocturnal species, such as Cockroaches, Moths