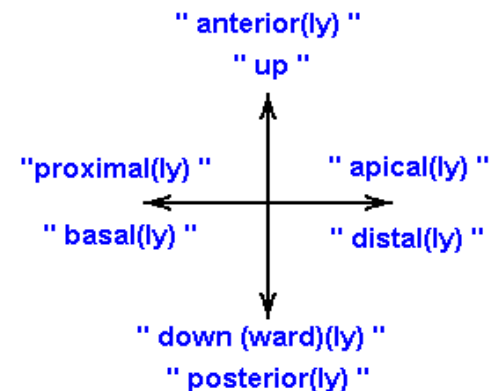
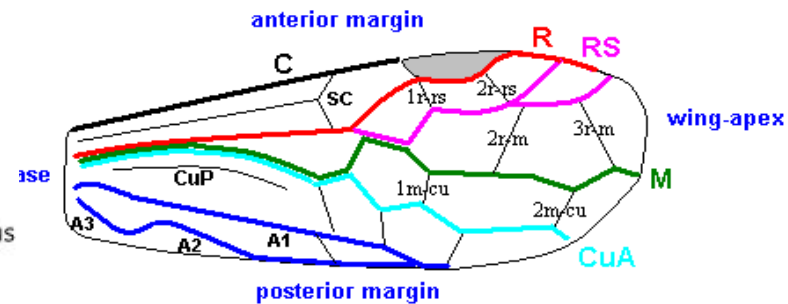
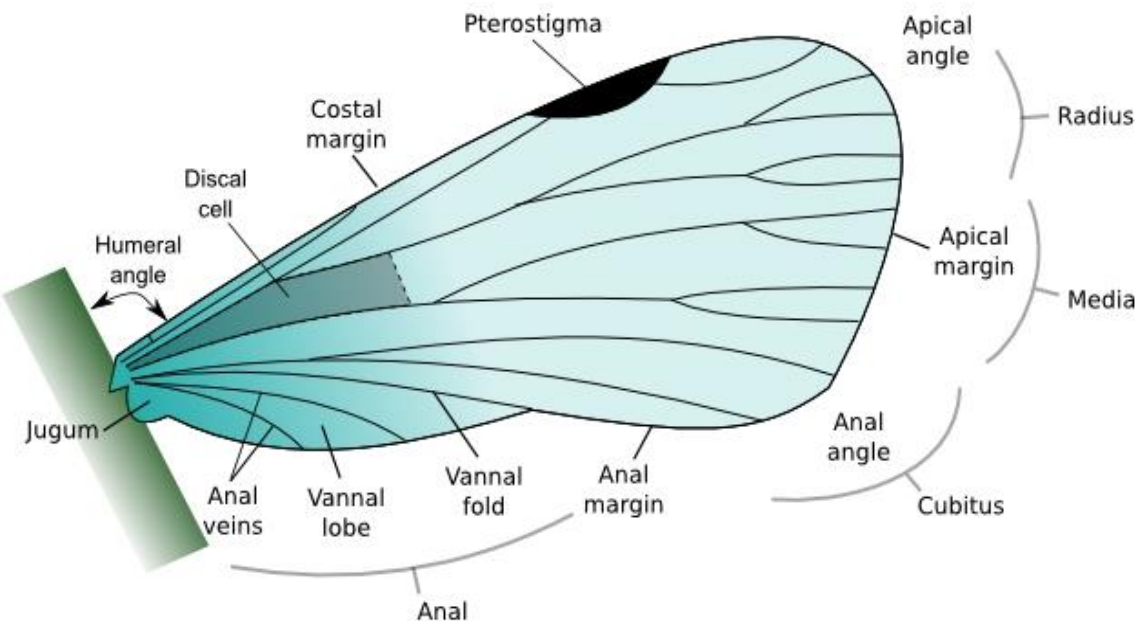


Thorax Appendages

Wing Margins and angles

- anterior border (Costal margin)
- outer border (apical margin)
- inner border (anal margin)
- Three angles:
 - humeral angle (between the costal and anal margins)
 - apical angle (between the costal and apical margins)
 - anal angle (between the anal and apical margins)



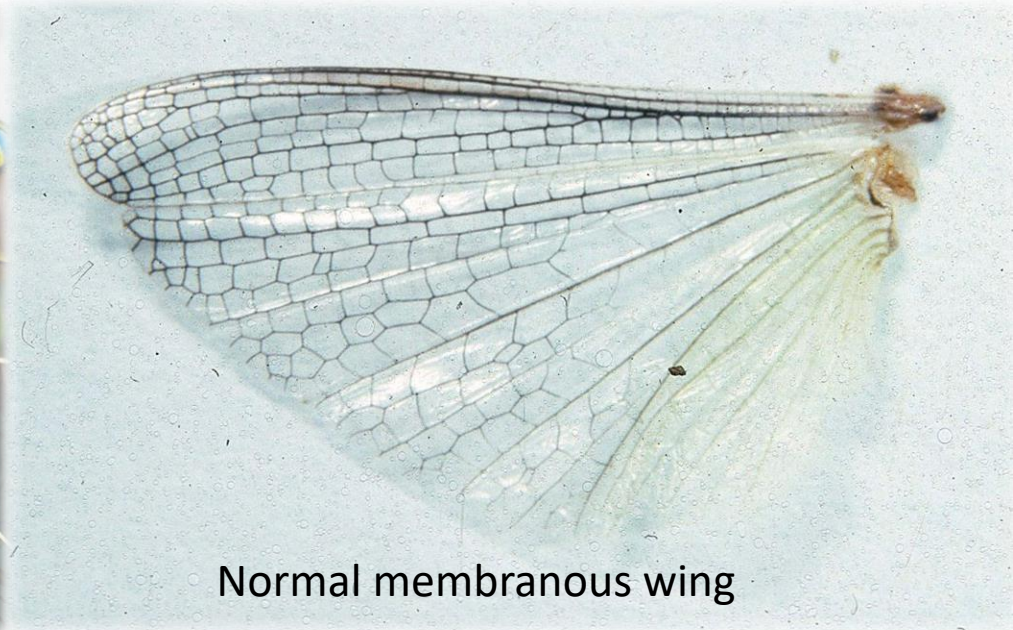
Thorax Appendages

Wing Venation

- The wings of most insects are **membranous**.
- They are supported by a framework of hollow ribs or thickened ridges, the **veins**.
- The arrangement of veins in a wing is called **venation** or neurulation.
- **Longitudinal veins**.
- **Cross veins**.
- Net veined wings with archdictyon (irregular network of veins between longitudinal veins)
e.g. dragonflies, damselflies etc



Archdictyon (net-veined) wings



Normal membranous wing

Thorax Appendages

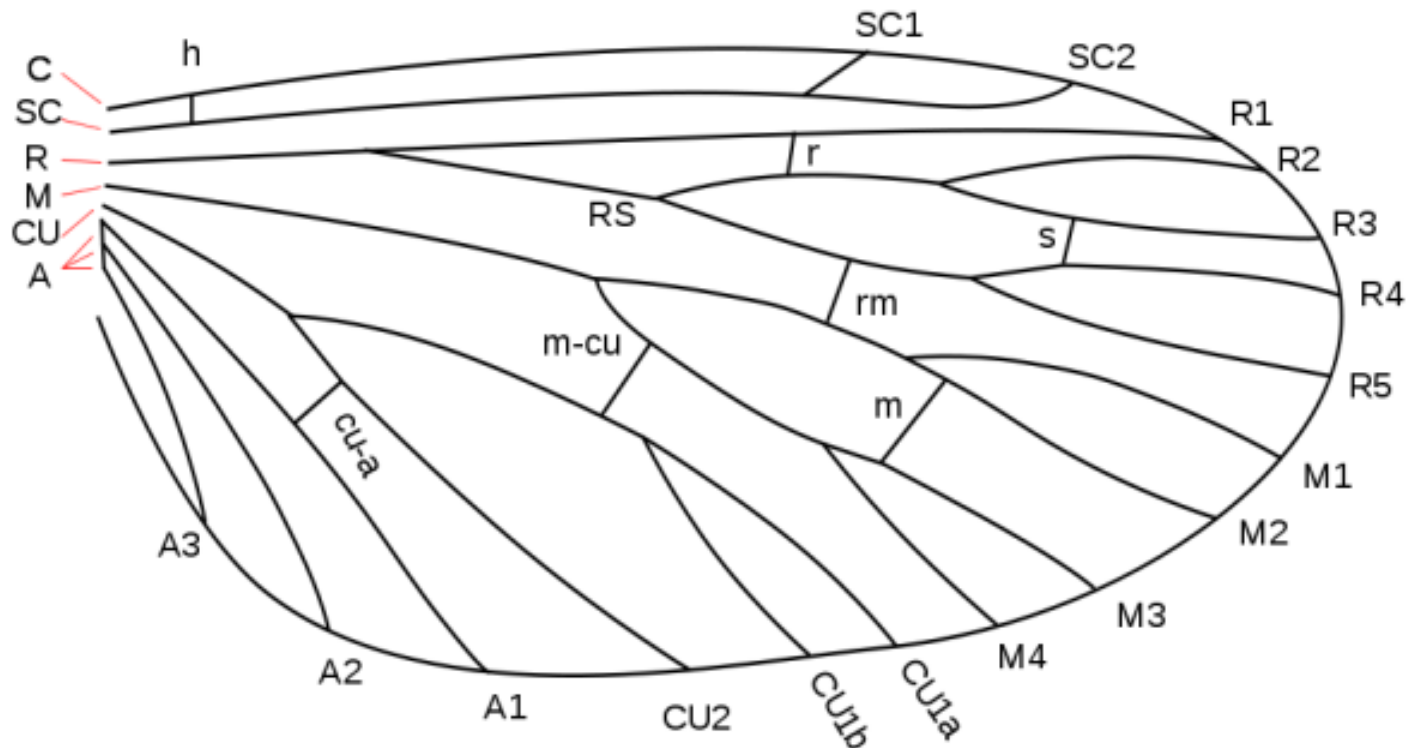
Wing Venation

Longitudinal Veins

1. Costa (C)
2. Subcosta (Sc)
3. Radius (R)
4. Media (M)
5. Cubitus (Cu)
6. Anals (A)

Cross Veins

1. Humeral (h)
2. Radial (r)
3. Sectorial (s)
4. Radiomedial (r-m)
5. Medial (m)
6. Mediocubital (m-cu)

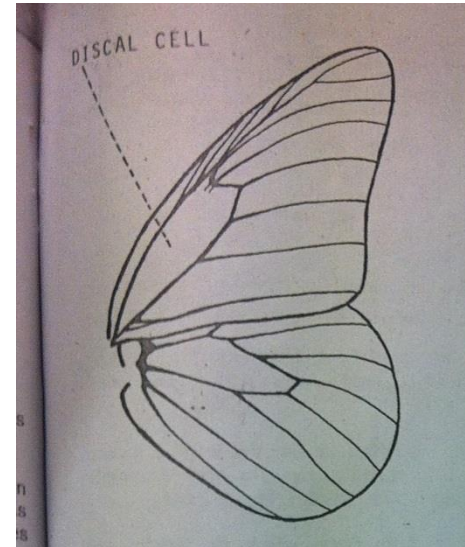


Thorax Appendages

Wing Cells and Areas

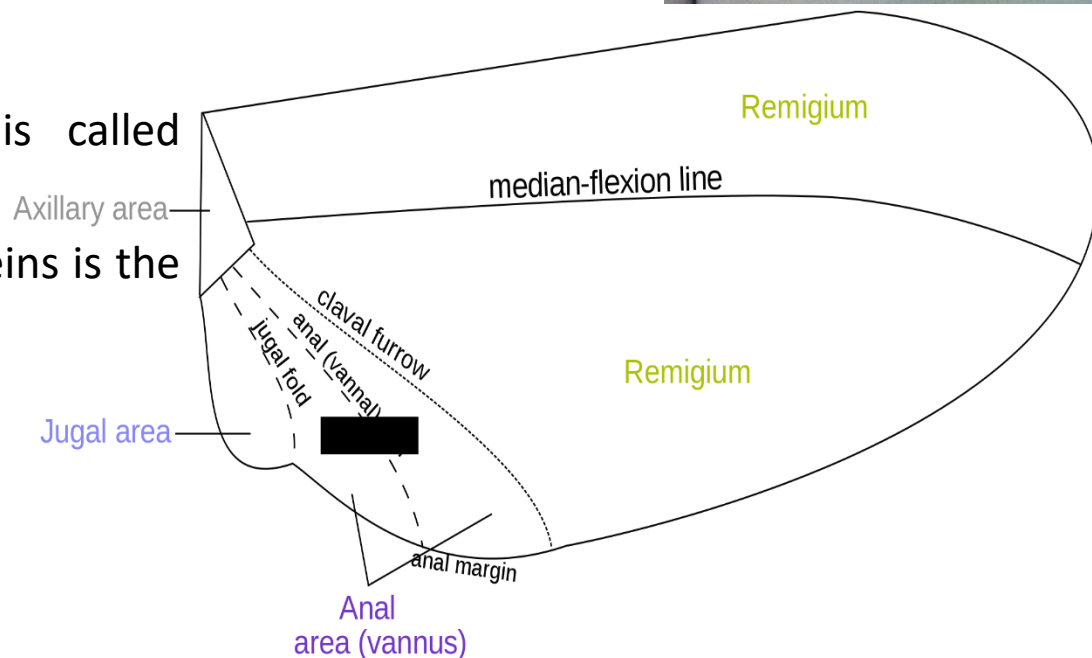
Cells of wings:

- The longitudinal and cross veins forms areas of various shapes called **cells**.
- There are two types of cells.
 - Closed cell
 - Open cell
- Named after anterior border vein
- discal cell of butterflies and moths



Areas of wings:

- Central area is the disc.
- The area with maximum veins is called remigium.
- The area containing only the anal veins is the annal or vannal area.



Thorax Appendages

Wing Special Structures

Pterostigma:

Thick pigmented spot along the costal border e.g. dragonflies, damselflies.

Nodus:

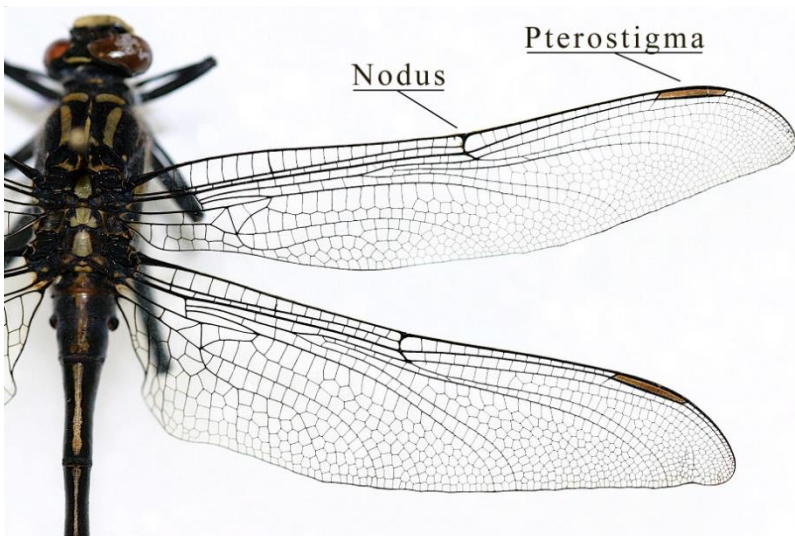
A thick, short, cross vein descends from the middle of the anterior border e.g. dragonfly.

Scales:

The wings of butterflies and moths are covered with scales of various shapes.

Marginal Setae:

Long hairs on rod-like wings of thrips.



Thorax Appendages

Stunning beauty of Insect Wings

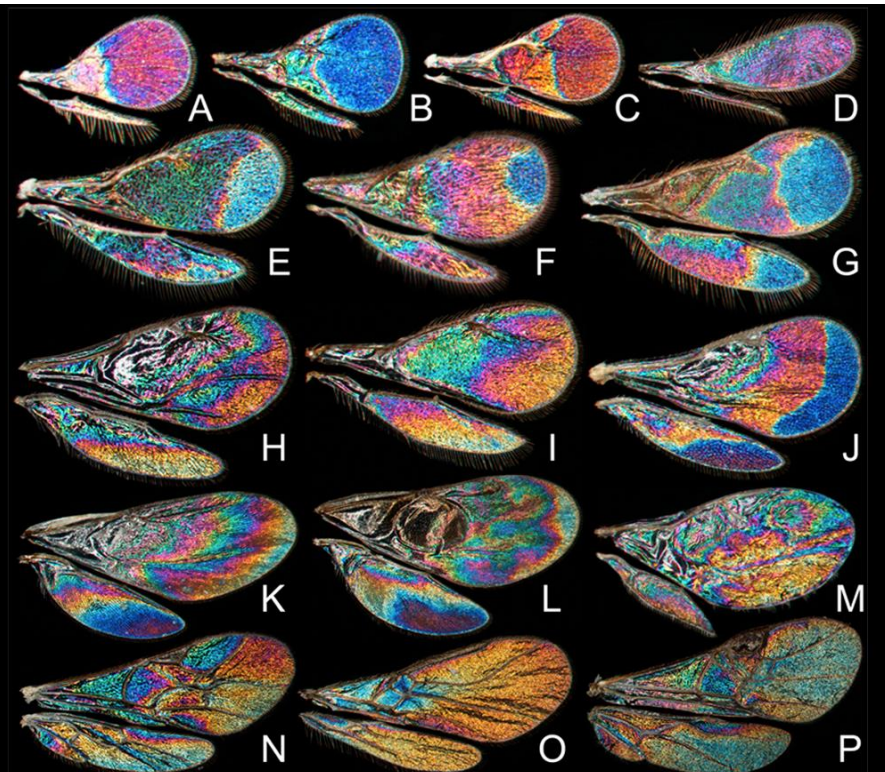
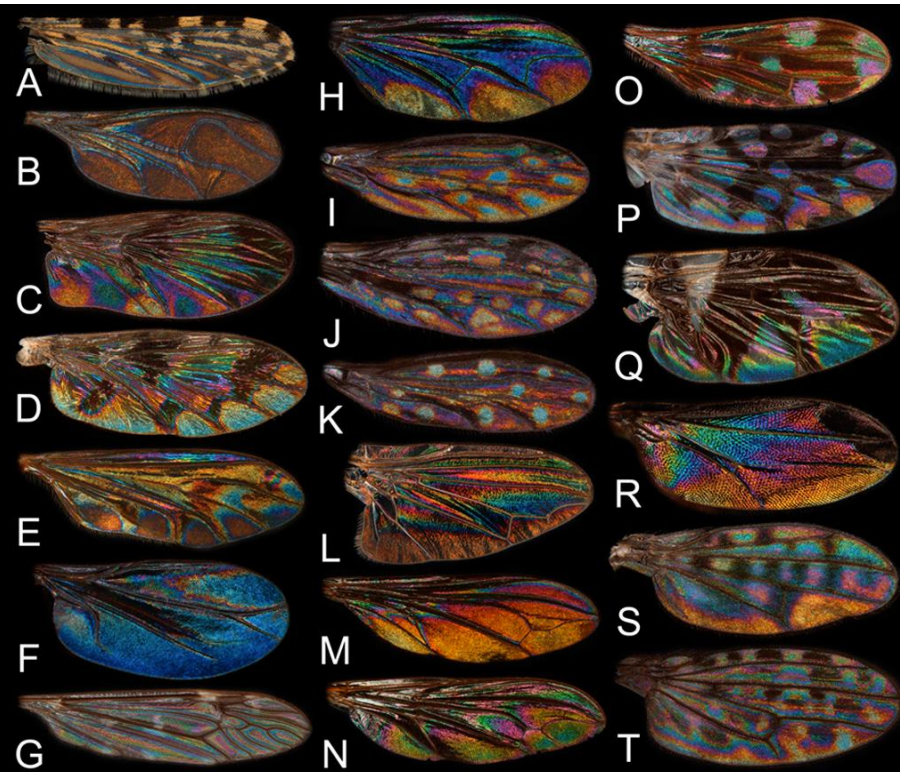


Thorax Appendages

Highly Specific Wing Color Patterns

Diptera (flies)

Hymenoptera (Wasps)



Thorax Appendages

Types of Wings

Tegmina:

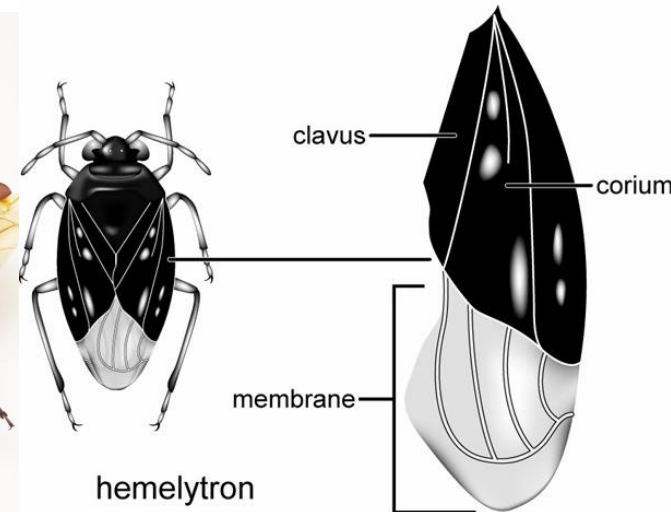
Modified fore wings as long, narrow, hard and thick structure. e.g. grasshopper, mantids, cricket

Elytra:

Modified fore wings as very thick and hard structures. e.g. beetles, weevils and earwig.

Hemelytra:

Basal part of fore wing is thick & hard, the apical part is thin & membranous. e.g. true bugs.



Thorax Appendages

Types of Wings

Halteres:

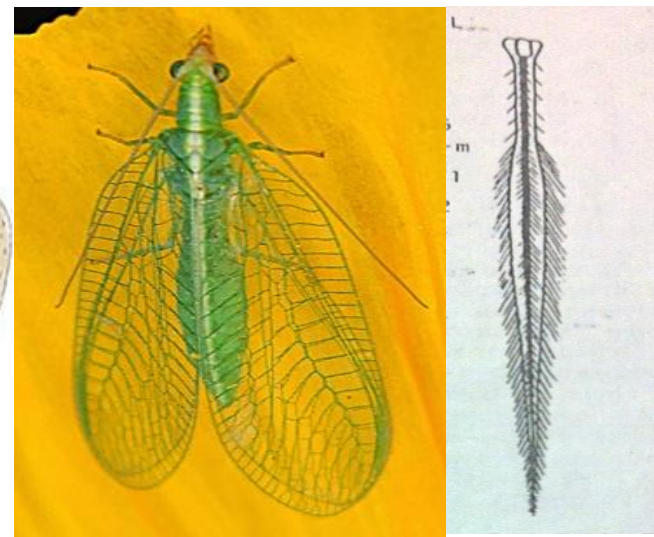
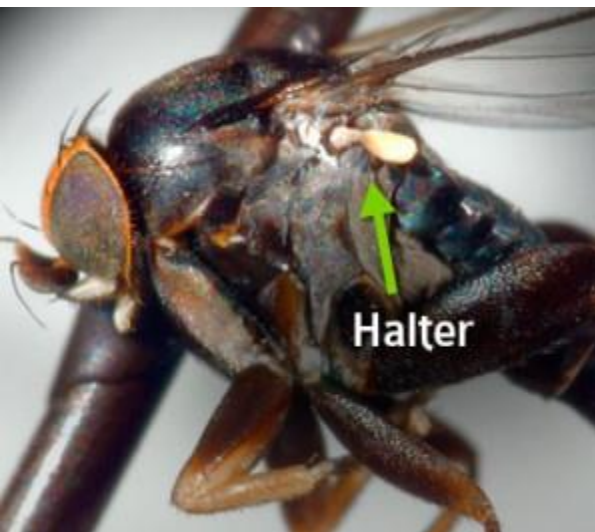
Modified hind wings as tiny, knobbed structures, e.g., flies, male coccids (mango mealybug).

Pseudohalteres:

Fore wings are modified into halters. e.g., male stylopids

Filohalteres:

Hind wings are modified as very long, thread-like structures. e.g., some lacewings (Croce sp.).

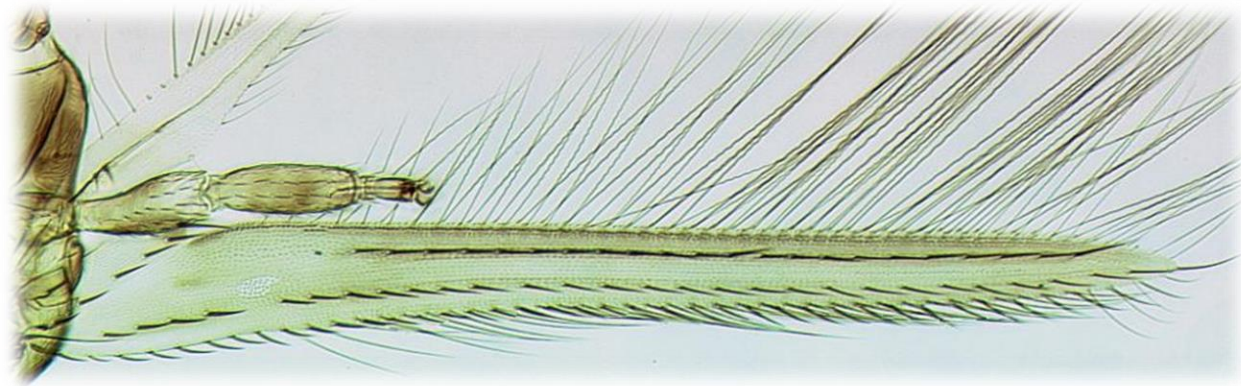


Thorax Appendages

Types of Wings

Stripy:

The wings are modified as strips or rod-like structures fringed with long hairs, e.g. thrips.



Thorax Appendages

Wing coupling apparatus

Overlapping:

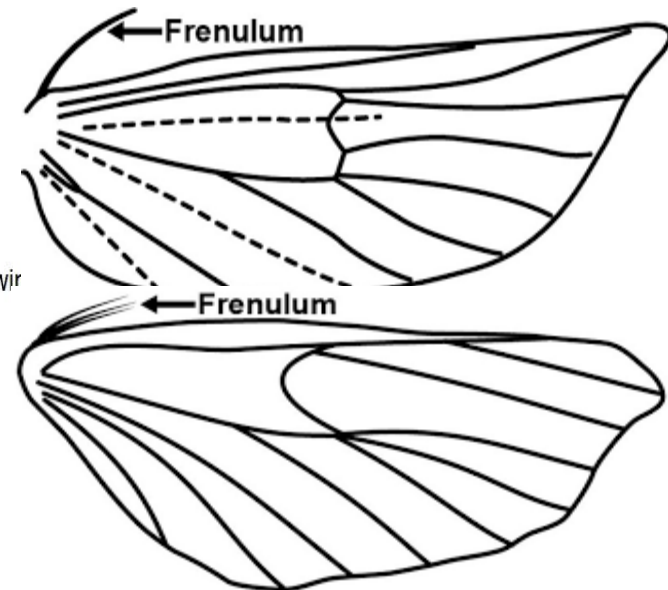
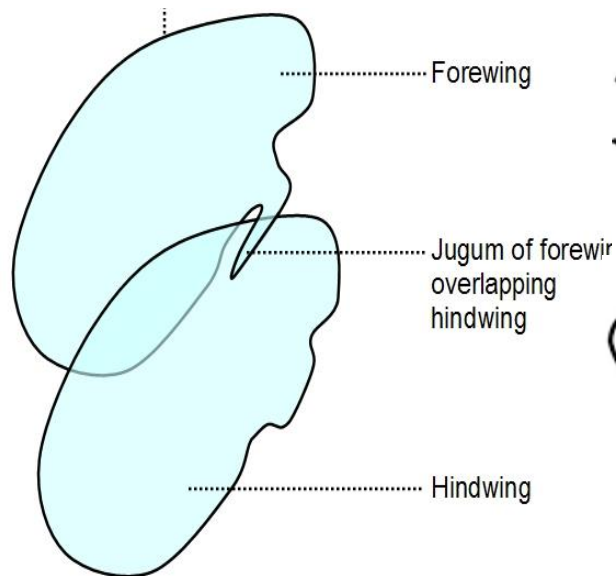
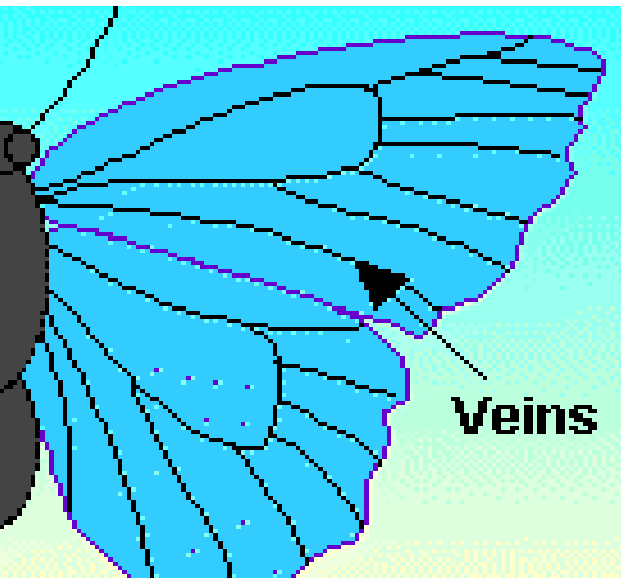
Fore wings overlaps the anterior border of the hind wings, e.g., butterflies.

Jugum:

This a finger-like process at the base of the posterior border of the fore wing which projects under the hind wing e.g. , jugate moths

Frenulum:

This is a single stout spine (in males) or several spines (in females) on the humeral angle of the hind wing, e.g., geometrid moths

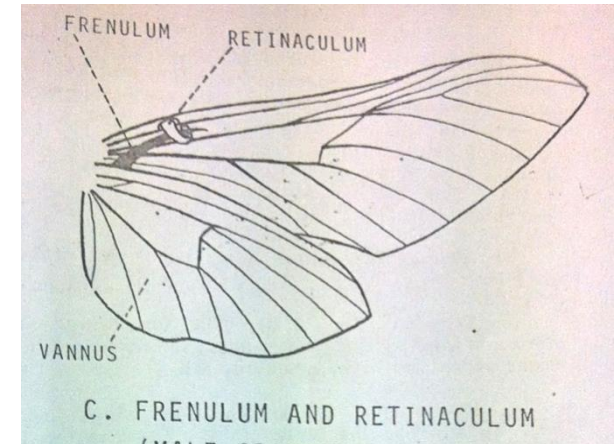
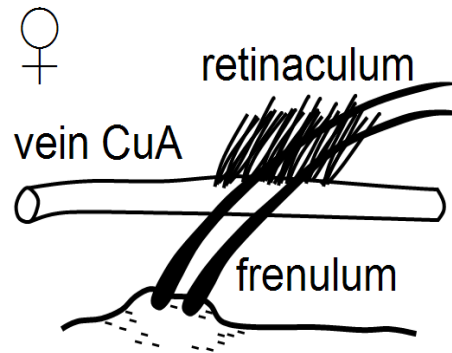
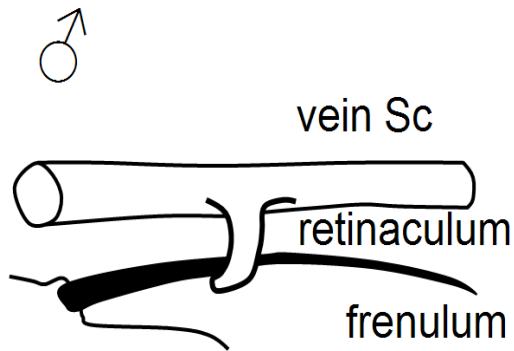


Thorax Appendages

Wing coupling apparatus

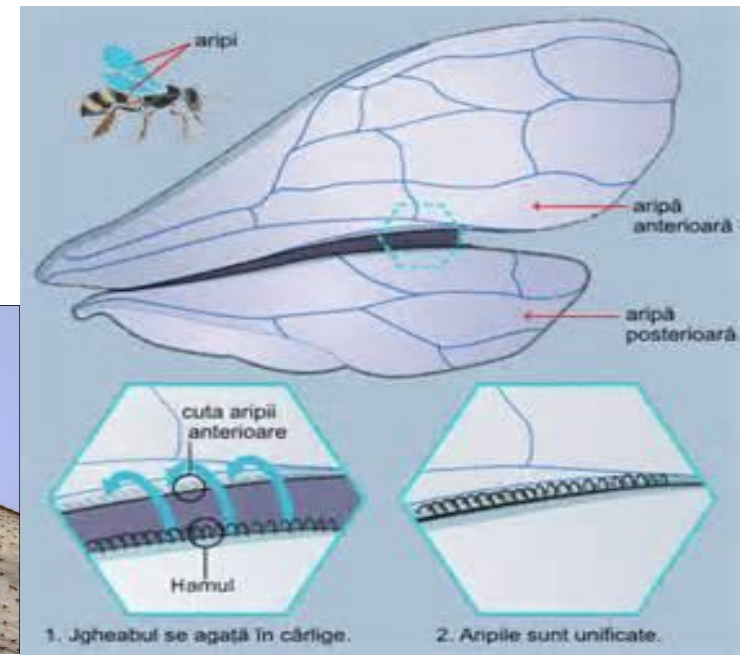
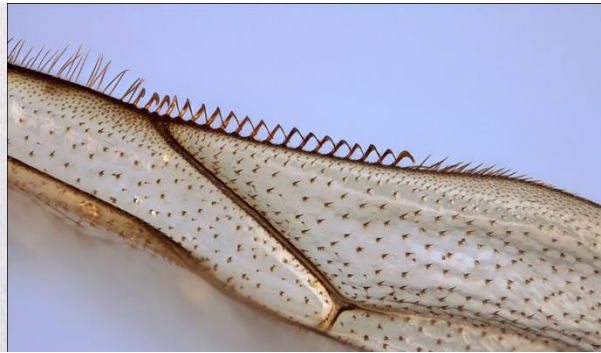
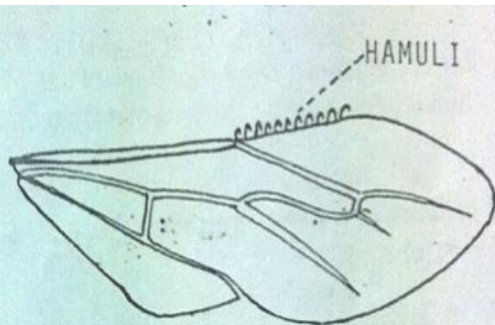
Retinaculum:

a strong process (in male) or a group of strong hairs (in female) on the lower side of fore wing. The frenulum is held by the retinaculum, e.g. geometrid moths.



Hamuli:

These consist of a row of minute hooks on the anterior border of the hind wing that catch into the uprolled hind border of the fore wing. e.g., honeybees.



Thorax Appendages

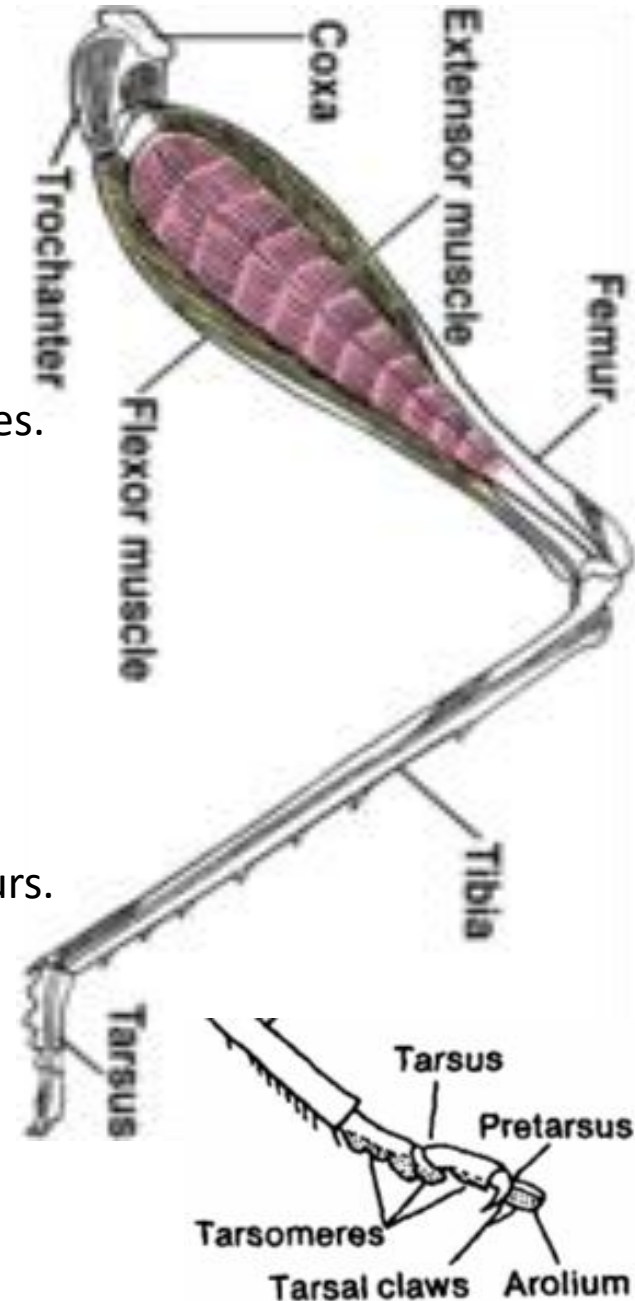
- Coxa:**
- Basal large, elongated and more or less triangular segment.
 - Coxal corium membrane for attachment with body

- Trochanter:**
- Small, triangular segment rigidly fixed to the femur.

- Femur:**
- long and thick segment provided with fishbone-shaped muscles.
 - Ventral groove femasulcus to accommodate tibia.
 - Femasulcus contains small tubercle, the Brunner's organ.
 - The femur narrows toward its apex.
 - Genicular lobes at apex to support tibia

- Tibia:**
- long and slender segment armed with two rows spines.
 - Apex contains an outer and an inner pair of strong, curved spurs.

- Tarsus:**
- Three segments (Tarsomeres)
 - First segment bears three pairs of plantulae.
 - Second segment contains a single pair.
 - Third segment has a single elongated pair.
 - Tarsus ends in a pair of hair-like, strong, curved claws.
 - Claw contains a bladder-like lobe, the arolium.



Thorax Appendages

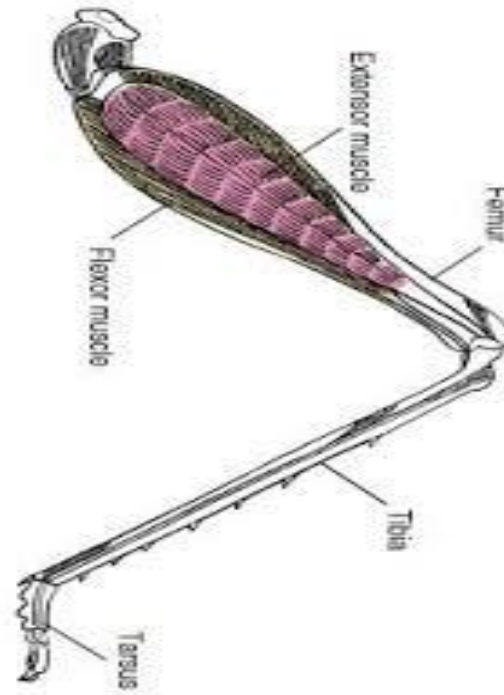
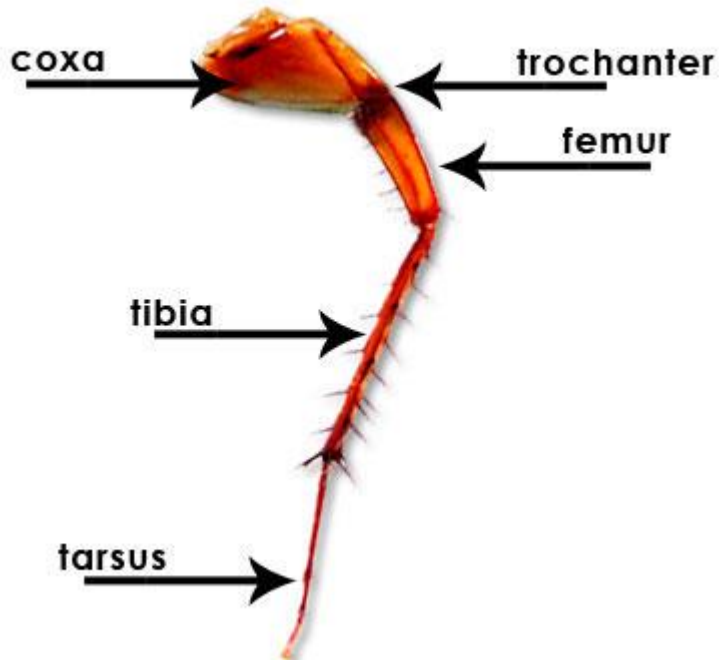
Types of Leg

Cursorial (ambulatory or walking)

The femur is normal and not thickened, e.g. metaleg of cockroach.

Saltatorial (Leaping or jumping)

Thickened femur with powerful e.g., metaleg of grasshopper



Thorax Appendages

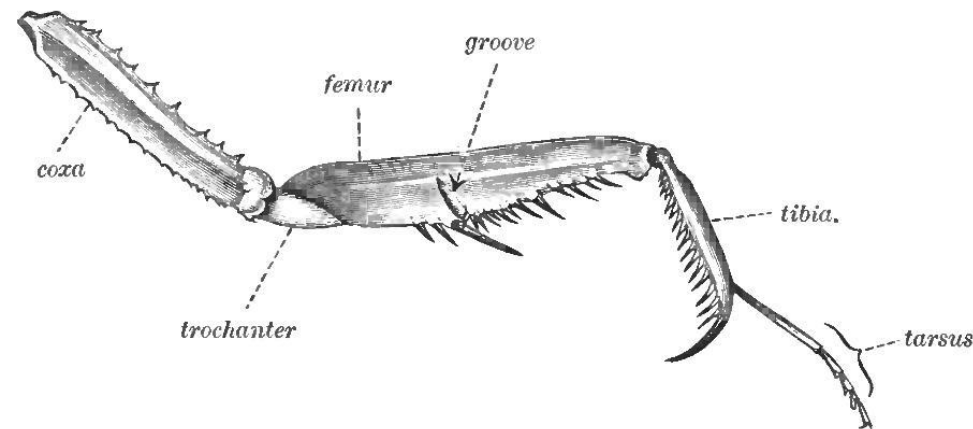
Types of Leg

Raptorial (catching or grasping)

Coxa is very long. The femur is long, thick, with double row of spines and a groove on the lower side. The tibia is shorter, spiny and fits into the groove of the femur. e.g., proleg of a mantid

Fossorial (Digging)

reduced and flattened & strong for digging. The tibia has finger-like projections on its apex. Tarsus is produced into three finger-like processes. e.g., proleg of mole cricket.



Thorax Appendages

Types of Leg

Natatorial (swimming)

All parts are flattened and tarsus has long hair, e.g., metaleg of giant water bug and water beetle

Clinging

Tibia has small process at apex. The tarsus is 1-segmented and bears a claw that fits for clinging, e.g., louse



Thorax Appendages

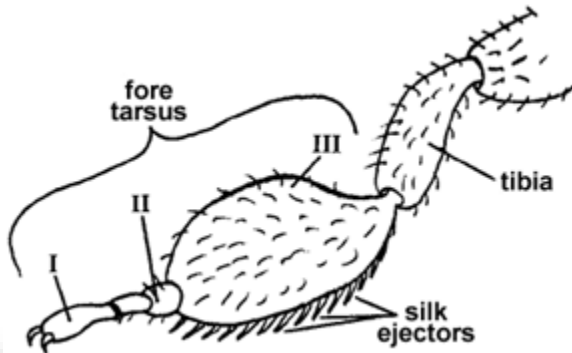
Types of Leg

Silk secreting

First segment of the fore tarsus is greatly swollen and contains silk glands, e.g., proleg of female webspinner.

Antenna cleaner

large spur on the apex of the tibia which fits into a semicircular notch on the proximal end of the tarsus. This notch also contains fine hair. e.g. proleg of worker honeybee.



Thorax Appendages

Types of Leg

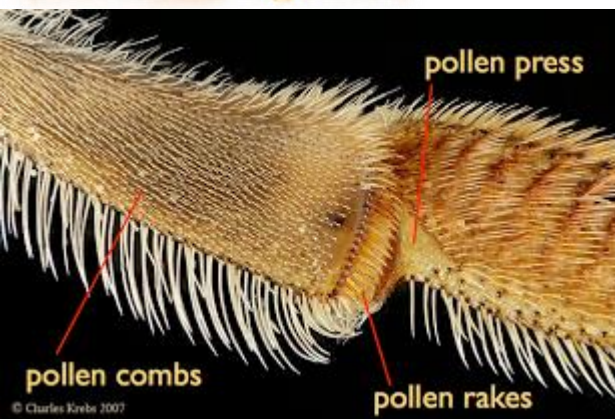
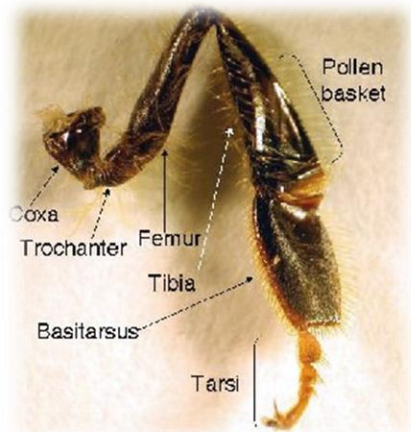
Pollen collecting

Polliniferous apparatus. The tibia is greatly dilated. Its outer surface is smooth, bordered with hairs “Corbicula” on tibia.

On the distal end of tibia, is a row of hairs called the pecten or pollen rack.

Auricle (ear like lobe with row of hairs) on the base of basitarsus to collect pollens.

Inner surface of basitarsus has several stiff hair rows “Scopa/pollen comb or brush e.g., metaleg of worker honeybee.



Thorax Appendages

Types of Leg

Basket-like

No morphological modification. But during flight, all legs come together to form a basket.
Trochanter is 2-segmented e.g., dragonfly and damselfly



Thorax Appendages

Wings

These are the membranous, paired appendage of flight located dorsolaterally on the thorax

Occurrence of Wings:

- Either no wings
- A pair of wings (on the mesothorax)
- Two pairs of wings (first on the mesothorax and second of the metathorax).

Development of wings:

- Insects without wings are called the apterous
- Insects with reduced wings are called brachypterous
- Insects with complete wings the macropterous.
- The underdeveloped wings of nymphs and naiads are called wing pads.
- The insect which are supposed primitively wingless are known as Apterygota, e.g., silverfish, doubletails, telsonatials and springtails.
- The insects which are winged or secondarily wingless are called the Pterygota.
- Pterygota has further two types.
 - The insects which develop their wings outside the body are called Exopterygota, e.g., grasshoppers, bugs etc.
 - The insect which develop their wings inside the body are known as Endopterygota, e.g. flies, wasps, moths, butterflies, beetles, etc.