INTRODUCTORY ENTOMOLOGY (ENTO 253)

ARTHROPODA: GENERAL CHARACTERISTICS AND CLASSIFICATION, CLASS: ARACHNIDA AND INSECTA

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Attention: This note is just only for guideline

Arthropods are members of the Phylum Arthropoda. The word Arthropoda comes from two Greek words *arthron* and *podos*, where *arthron* means "joint", and *podos* means "foot", which together mean "jointed feet". Arthropods include the insects, arachnids, crustaceans, and others.

**General Characteristics of Phylum Arthropoda**

1. Body bilaterally symmetrical and matamerically segmented i.e. the segments usually group in two or three rather distinct regions.
2. Externally the body is covered with a thick, chitinous, tough and nonliving cuticle.
3. The body segments bear paired segmented, lateral & jointed appendages from which the phylum gets its name Arthropoda i.e. jointed legs, which variously modified as jaws, legs.
4. Heart is dorsal to the alimentary canal with lateral openings in the abdominal region and nerve cord ventral to the alimentary canal consisting of an anterior ganglion or brain.
5. Circulatory system is open, where the only blood vessel usually being a tubular structure.
6. The body being haemocoel filled with haemolymph or blood.
7. Respiration through either body surface or gills in aquatic forms and trachea & spiracles in terrestrial forms.
8. Excretion takes place by means of Malpighian tubules that empty into the alimentary canal, the excreted materials passing to the outside by way of the anus.
9. The sexes nearly always separate.
10. A tubular alimentary canal with anterior mouth and posterior anus always present.

**Classification of Phylum Arthropoda**

Phylum: Arthropoda

Sub-Phylum: Onychophora; elongate, no head; e.g. *Peripatopsis* sp.
Sub-Phylum: Trilobita
   Class: Trilobita, e.g. Trilobites (*Triathurus becki*)
Sub-Phylum: Chelicerata
   Class: Merostomata (Xiphosurida); e.g. King crab or horseshoe crab
   Class: Arachnida/Octapoda; e.g., Spider, Mites and Ticks
   Class: Pycnogonida (Pantopoda); e.g. Sea spiders e.g. *Nymphon rubrum*
Sub-Phylum: Mandibulata (Antennata)
   Class: Crustacea; two pairs of antennae.
      e.g. Crayfish, Crabs, lobsters, shrimps, pawns, barnacles, woodlice, etc.
   Class: Myriapoda
      Sub-class: Chilopoda; e.g. Centipedes
      Sub-class: Diplopoda; e.g. Millipedes
      Sub-class: Pauropoda
      Sub-class: Symphyla
Class: Insecta/Hexapoda  
Sub-class: Apterygota (4 Orders)  
Sub-class: Pterygota (27 Orders)  
Division: Exopterygota (18 Orders)  
Division: Endopterygota (9 Orders)

GENERAL CHARACTERISTICS OF CLASS ARACHNIDA

1. A typical adult arachnid has two distinct body regions: cephalothorax and abdomen.
2. The anterior body region is cephalothorax, where cephalon (head) and thorax fused together, bears 4 pairs of legs - so the Arachnids called Octapoda (eight legs); a pair of chelicerae that are normally chelate; a pair of pedipalps that may be chelate.
3. All eyes are simple.
4. They have no antennae.
5. They have no wings.
6. The posterior body region is abdomen, which is large but has no external gills or locomotor organs.
7. Excretion by Malpighian tubules.
9. The sexes are separate and the reproductive organs are near the anterior portion of the abdomen and open through a single orifice.  
e.g. spiders, mites, ticks etc.

Fig.: Examples of arachnids belonging to the Class Arachnida
GENERAL CHARACTERISTICS OF CLASS INSECTA

1. A typical adult insect has three distinct body regions: head, thorax and abdomen.
2. The anterior region of body is the head, which bears one pair of compound eyes, usually 3 simple eyes- each of which called ocelli, one pair of unbranched antennae and paired mouthparts.
3. The mid region of the body is the thorax, which is composed of three segments viz. prothorax, mesothorax and metathorax.
4. Each thoracic segment usually bears a pair of legs, in many groups the second and third segments each bear a pair of wings.
5. Posterior region of the body is the abdomen, which consists of as many as 10-11 segments and has no legs or any locomotory organs but having mating organ.
6. The 8th, 9th and 10th abdominal segments usually have appendages modified for mating activities or egg laying.
7. Excretion by Malpighian tubules; respiration by pipe-like tracheae, exoskeleton or by gill; digestion by tubular digestive tract; blood circulation by open circulatory system; reproduction by paired reproductive organs. Muscular system, nervous systems also present.
8. Terrestrial and aquatic (rarely marine) forms are available.
   e.g. Cockroaches, houseflies, mosquitoes, butterflies, bees, bugs, ants, beetles etc.

COMPARISON BETWEEN INSECT AND MITE

<table>
<thead>
<tr>
<th>Insect</th>
<th>Spider/Mite</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Insects are hexapoda (i.e. six legs)</td>
<td>• Mites are octapoda (i.e. eight legs)</td>
</tr>
<tr>
<td>• Body is divided into head, thorax and abdomen; where head and thorax are separated.</td>
<td>• Body is divided into cephalothorax and abdomen; head and thorax combined to form a cephalothorax.</td>
</tr>
<tr>
<td>• Antennae present</td>
<td>• Antennae absent</td>
</tr>
<tr>
<td>• Both simple and compound eyes present</td>
<td>• All eyes are simple</td>
</tr>
<tr>
<td>• Wings may be present or not</td>
<td>• Always wingless</td>
</tr>
<tr>
<td>• Size: small to large.</td>
<td>• Size: minute.</td>
</tr>
</tbody>
</table>

Figure. External morphology of Arthropods: adult insect (left) and adult spider (right)
GENERAL CHARACTERISTICS OF SUB-CLASS APTERYGOTA

1. Wingless
2. Metamorphosis primitive or no that is called Ametabola
3. One pair or more than one pair of appendages present in front of genital opening
4. Mandible is attached into a specific position of head capsule
5. Moulting continuous after sexual maturity.

![Fig. Wingless insect (adult silverfish)](image)

Fig. Wingless insect (adult silverfish)

![Ametabolous Development](image)

Fig. Life cycle of silverfish showing Ametabola

GENERAL CHARACTERISTICS OF SUB-CLASS PTERYGOTA

1. Winged (alate) or secondarily wingless insects
2. Metamorphosis incomplete or complete
3. No appendage present in front of genital opening
4. Mandible is attached into two specific position of head capsule
5. Sexually matured adults do not moult.

![Fig. Winged insect (Butterfly in left) and secondarily wingless insect (Bed bugs in right)](image)

Fig. Winged insect (Butterfly in left) and secondarily wingless insect (Bed bugs in right)
GENERAL CHARACTERISTICS OF DIVISION EXOPTERYGOTA

1. Metamorphosis incomplete or simple that is called Hemimetabola
   [3 developmental stages include egg, nymph and adult]
2. Wings developed from external portion of the body
3. Pupal instar absent or rare
4. Young generalized as nymph
5. Immature insects similar with adults

![Grasshopper Life Cycle](image1.png)

Figure . Example of an insect (grasshopper) life cycle showing incomplete metamorphosis

GENERAL CHARACTERISTICS OF DIVISION ENDOPTERYGOTA

1. Metamorphosis complete or complex that is called holometabola
   [4 developmental stages such as egg, larva, pupa and adult]
2. Wings developed from the internal portion of the body
3. Always accompanied by larval and pupal instar
4. Young generalized as larva
5. Immature insects externally differ with adults

![Butterfly Life Cycle](image2.png)

Fig. Example of an insect (butterfly) life cycle showing complete metamorphosis
COMPARISON BETWEEN DIVISION EXOPTERYGOTA AND ENDOPTERYGOTA

<table>
<thead>
<tr>
<th>EXOPTERYGOTA</th>
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<tbody>
<tr>
<td>Metamorphosis incomplete or simple that are called hemimetabola [3 stages like egg, nymph &amp; adult]</td>
<td>Metamorphosis complete or complex that are called holometabola [4 stages like egg, larva, pupa and adult]</td>
</tr>
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<td>Wings developed externally from the body</td>
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ORDERS OF CLASS INSECTA
(According to Imms)

Sub-Class: Apterygota
- Order 1. Thysanura – e.g. Bristle tails, silverfish
- Order 2. Diplura- e.g. Two pronged bristle tails
- Order 3. Protura- e.g. Proturans
- Order 4. Collembola- e.g. Spring tails

Sub-Class: Pterygota
**Division: Exopterygota**
- Order 5 Ephemeroptera- e.g. Mayflies
- Order 6 Odonata- e.g. Dragonflies, damselflies
- Order 7 Plecoptera- e.g. Stoneflies
- Order 8 Orthoptera- e.g. Crickets, grasshoppers, locusts
- Order 9 Phasmida- e.g. Stick insects, leaf insects
- Order 10 Dermaptera- e.g. Earwigs
- Order 11 Embioptera- e.g. Web-spinners
- Order 12 Dictyoptera- e.g. Cockroaches, mantids
- Order 13 Isoptera- e.g. Termites
- Order 14 Zoraptera- e.g. Zorapterans
- Order 15 Psocoptera- e.g. Booklice, psocids
- Order 16 Mallophaga- e.g. Biting lice, bird lice
- Order 17 Siphunculata- e.g. Sucking lice
- Order 18 Hemiptera- e.g. True bugs
- Order 19 Homoptera- e.g. Leafhoppers, aphids, scale insects, cicadas
- Order 20 Thysanoptera- e.g. Thrips

**Division: Endopterygota**
- Order 21 Neuroptera- e.g. Lacewings, antlions
- Order 22 Coleoptera- e.g. Beetles & weevils
- Order 23 Strepsiptera- e.g. Stylopids
- Order 24 Mecoptera- e.g. Scorpion flies
- Order 25 Siphonaptera- e.g. Fleas
- Order 26 Diptera- e.g. True flies
- Order 27 Lepidoptera- e.g. Butterflies, moths
- Order 28 Trichoptera- e.g. Caddis flies
- Order 29 Hymenoptera- e.g. Ants, bees, wasps, sawflies.