

16. Onychophora.
17. Parental care often well-marked.

## CLASSIFICATION

Arthropoda is a much heterogeneous group including a variety of animals with divergent views concerning their phylogeny. Because of this reason, no definitive system of classifying this phylum exists. The classification adopted here is a synthesis of several views so that such a large and diverse phylum may be conveniently grouped. In fact, arthropod classification is still in a state of flux, and may always remain so.

Seven subphyla are recognized in the following classification. Of these, only Trilobitomorpha, Chelicerata and Mandibulata are definitely arthropods. Trilobitomorpha includes a number of extinct classes only. Onychophora, Tardigrada and Pentastomida show only doubtful or superficial relationships with other arthropods, so that some books treat them as independent minor phyla. We have also described the type *Peripatus* under a separate phylum Onychophora, to accommodate this view. Pycnogonida is sometimes included as a class within the subphylum chelicerata. The old class Myriapoda is retained here within the subphylum Mandibulata, otherwise, every order of Myriapoda is equivalent in status to other classes of Mandibulata.

### Subphylum II. Chelicerata

(Gr., *chele*, claw + *keros*, horn + *ata*, group)

1. Body divided into an anterior cephalothorax (prosoma) and a posterior abdomen (opisthosoma).
2. Prosomatic appendages 6 pairs. First pair preoral chelicerae with claws, followed by postoral pedipalps and 4 pairs of walking legs.
3. Antennae and true jaws absent.

#### CLASS 1. Merostomata

(Gr., *meros*, thigh + *stoma*, mouth)

1. Marine with median simple and lateral compound eyes.
2. 5 to 6 pairs of abdominal appendages with book-gills.
3. Abdomen ending in a sharp telson or spine.
4. Excretion by coxal glands. No Malpighian tubules.

#### Subclass 1. Xiphosura

(Gr., *xiphos*, sword + *aura*, tail)

1. Cephalothorax with large extended, convex horseshoe-shaped carapace.
2. Abdomen unsegmented with a long terminal telson.

Example : *Limulus* (horseshoe or king crab)

#### Subclass 2. Eurypterida

(Gr., *eury*, broad + *pteryx*, wing)

1. Extinct marine, giant water scorpions.
2. Cephalothorax small. Carapace plain, not extended.
3. Abdomen 12-segmented and narrowed behind.

Examples : *Eurypterus*, *Pterygotus*.



n typically annelidan, with a  
 onnected with a nerve ring  
 entral nerve cord.  
 s comprises of eyes (simple  
 id), chemo- and tactile  
 ncing and auditory organs.  
 y separate (dioecious).  
 rgans and ducts paired.  
 ually internal. Oviparous or  
 irect or indirect with one to  
 stages. Parthenogenesis in  
 agella absent except in  
 often well-marked.

**CLASSIFICATION**

uch heterogeneous group  
 animals with divergent views  
 geny. Because of this reason,  
 of classifying this phylum  
 ation adopted here is a  
 views so that such a large  
 ay be conveniently grouped.  
 sification is still in a state  
 ays remain so.

are recognized in the  
 ion. Of these, only  
 cerata and Mandibulata are  
 Trilobitomorpha includes a  
 classes only. Onychophora,  
 tomida show only doubtful  
 ships with other arthropods,  
 treat them as independent  
 re also described the type  
 arate phylum Onychophora,  
 is view. Pycnogonida is  
 as a class within the  
 . The old class Myriapoda  
 the subphylum Mandibulata,  
 of Myriapoda is equivalent  
 ces of Mandibulata.

**Subphylum I. Trilobitomorpha**

(Gr., tri, three + lobos, lobe + morphe, form)

1. Fossil trilobites. Mostly marine and bottom-dwellers. Cambrian to Permian.
2. Body 3-lobed, due to 2 longitudinal furrows.
3. Head distinct. Probably one pair of antennae.
4. Biramous appendages on all segments except the last one.

Examples : *Triarthrus*, *Dalmanites*.

**Subphylum II. Chelicerata**

(Gr., chele, claw + keros, horn + ata, group)

1. Body divided into an anterior cephalothorax (prosoma) and a posterior abdomen (opisthosoma).
2. Prosomatic appendages 6 pairs. First pair of preoral chelicerae with claws, followed by postoral pedipalps and 4 pairs of walking legs.
3. Antennae and true jaws absent.

**CLASS 1. Merostomata**

(Gr., meros, thigh + stoma, mouth)

1. Marine with median simple and lateral compound eyes.
2. 5 to 6 pairs of abdominal appendages with book-gills.
3. Abdomen ending in a sharp telson or spine.
4. Excretion by coxal glands. No Malpighian tubules.

**Subclass 1. Xiphosura**

(Gr., xiphos, sword + aura, tail)

1. Cephalothorax with large extended, convex, horseshoe-shaped carapace.
2. Abdomen unsegmented with a long terminal telson.

Example : *Limulus* (horseshoe or king crab).

**Subclass 2. Eurypterida**

(Gr., eurys, broad + pteryx, wing)

1. Extinct marine, giant water scorpions.
2. Cephalothorax small. Carapace plain, not extended.
3. Abdomen 12-segmented and narrowed behind.

Examples : *Eurypterus*, *Pterygotus*.



## CLASS 2. Arachnida

(Gr. *arachne*, spider)

1. Terrestrial or aquatic. Eyes simple. No compound eyes.
2. Cephalothorax (prosoma) with 2 chelicerae, 2 pedipalps and 4 pairs of walking legs.
3. Abdomen generally without appendages.
4. Respiration by tracheae, book-lungs or both.
5. Excretion by coxal glands and Malpighian tubules.
6. Dioecious. Mostly oviparous courtship before mating.

### Order 1. Scorpionida (= Scorpiones)

1. Elongated, fair-sized true scorpions.
2. Small prosoma broadly joined to large opisthosoma, which is made of a broad anterior 7-segmented mesosoma, and a narrow posterior 5-segmented metasoma.
3. Metasoma ending in a telson and poison sting.

4. Two ventral comb-like sensory pectines on 2nd abdominal segment.
5. Respiration by 4 pairs of book lungs.

Examples : *Buthus*, *Palamnaeus*, *Androctonus*, *Centruroides* (= *Centruus*).

### Order 2. Pseudoscorpionida (= Chelonethida)

1. Tiny false scorpions.
2. Abdomen 11-segmented, without sting and telson.
3. Chelicerae 2-jointed, with comb-like serrations.

Examples : *Chelifer*, *Microcreagris*.

### Order 3. Araneae

1. True spiders, prosoma and opisthosoma without visible segments and joined by a narrow pedicel.
2. Chelicerae 2-jointed, with a poison duct in terminal claw.
3. Pedipalps leg-like, used for transfer of sperms in male.
4. Opisthosoma with 3 pairs of spinnerets. No telson.

Examples : *Lycosa* (wolf spider), *Agelena* (funnel-web spider), *Latrodectus* (black widow), *Achaearanea* (house spider), *Argiope* (writing spider).

### Order 4. Solifugida (= Solifugae)

1. False spiders, sun spiders or wheel spiders.
2. Prosoma divided into a large anterior and a small posterior part.
3. Opisthosoma of 10 or 11 segments with 3 pairs of spinnerets.
4. Chelicerae very large forming heavy pincers. No poison glands.
5. A flagellum on each chelicera of male for sperm transfer.

Example : *Galeodes*.

### Order 5. Palpigradi

1. Small-sized microwhip scorpions. With 4 pairs of eyes.
2. Prosomal carapace made of large anterior and small posterior portions.
3. Opisthosoma 11-segmented, ending in a 15-jointed telson or flagellum.

Example : *Koenenia*.

### Order 6. Pedipelpi (= Uropygi)

1. Elongate whip scorpions with 1 pair of eyes.
2. Prosomal carapace entire.
3. Opisthosoma 12-segmented. Last segment with a long flagellum or telson.
4. Pedipalps large, heavy, with terminal pincers.

Examples : *Mastigoproctus*, *Thelyphonus*.

### Order 7. Amblypygi (= Phrynichida)

1. Flattened scorpion-spiders or tailless scorpions.
2. Carapace undivided. Pedipalps leg-like and raptorial.
3. Abdomen 12-segmented, without flagellum.
4. First pair of legs, long, whip-like.

Example : *Charinus*.

### Order 8. Ricinulei (= Podignae)

1. Rare, small, tick-like, heavy-bodied arachnids.
2. Carapace with an anterior hood-like structure and a plate.
3. Opisthosoma 6-segmented. Narrow metasoma with a posterior tubercle bearing spermathecae.
4. Third pair of legs in male form copulatory organs.

Examples : *Ricinoides*, *Cryptocella*.

### Order 9. Opiliones (= Phalangia)

1. Spider-like Harvest-men, Harvest spiders, daddy longlegs.

c. Eyes simple. No  
na) with 2 chelicerae,  
irs of walking legs.  
ithout appendages.  
e, book-lungs or both.  
lands and Malpighian  
various courtship before

(= Scorpiones)  
ue scorpions.  
lly joined to large  
s made of a broad  
esosoma, and a narrow  
metasoma.  
a telson and poison

sensory pectines on  
L.  
of book lungs.  
hus, *Palamnaeus*,  
des (= *Centruus*),

#### ionida

without sting and  
with comb-like

*Microcreagris*.

a and opisthosoma  
ts and joined by a  
ith a poison duct in  
for transfer of sperms  
rs of spinnerets. No

olf spider), *Agelena*  
*Latrodectus* (black  
ouse spider), *Argiope*

#### Order 4. Solifugida (=Solifuge)

1. False spiders, sun spiders or wind spiders.
  2. Prosoma divided into a large anterior and a small posterior part.
  3. Opisthosoma of 10 or 11 segments. No spinnerets.
  4. Chelicerae very large forming heavy pincers. No poison glands.
  5. A flagellum on each chelicera of male, for sperm transfer.
- Example : *Galeodes*.

#### Order 5. Palpigradi

1. Small-sized microwhip scorpions. Without eyes.
  2. Prosomal carapace made of large anterior and small posterior portions.
  3. Opisthosoma 11-segmented, ending in a large 15-jointed telson or flagellum.
- Example : *Koenenia*.

#### Order 6. Pedipelpi (= Uropygi)

1. Elongate whip scorpions with 1 pair of eyes.
  2. Prosomal carapace entire.
  3. Opisthosoma 12-segmented. Last segment with a long flagellum or telson.
  4. Pedipalps large, heavy, with terminal pincer.
- Examples : *Mastigoproctus*, *Thelyphonus*.

#### Order 7. Amblypygi (= Phrynichida)

1. Flattened scorpion-spiders or tailers whip scorpions.
  2. Carapace undivided. Pedipalps large and raptorial.
  3. Abdomen 12-segmented, without flagellum.
  4. First pair of legs, long, whip-like, sensory.
- Example : *Charinus*.

#### Order 8. Ricinulei (= Podogna)

1. Rare, small, tick-like, heavy-bodied arachnids.
  2. Carapace with an anterior hood-like movable plate.
  3. Opisthosoma 6-segmented. Narrow anteriorly with a posterior tubercle bearing anus.
  4. Third pair of legs in male form copulatory organs.
- Examples : *Ricinoides*, *Cryptocellus*.

#### Order 9. Opiliones (= Phalangida)

1. Spider-like Harvest-men, Harvest-spiders or daddy longlegs.

- 2. Body small, oval. Legs extremely long, slender.
  - 3. Prosoma broadly joined to Opisthosoma.
  - 4. Scent glands under carapace. Two eyes.
- Examples : *Phalangium*, *Leiobunum*.

**Order 10. Acarina**

- 1. Ticks and mites. Free-living or parasitic.
  - 2. Body small, oval, unsegmented, with no distinction between prosoma and opisthosoma.
  - 3. Largest arachnid order with 20,000 species.
- Examples : *Sarcoptes* (Itchomite), *Ixodes* (Sheep tick), *Dermacentor* (Dog tick), *Argas* (Bird tick).

**Subphylum III. Mandibulata**

(L., *mandibula*, mandible + *ata*, group)

- 1. Body divisible into head, thorax and abdomen.
- 2. Head appendages are 1 or 2 pairs of antennae, 1 pair of jaws or mandibles and 1 or 2 pairs of maxillae.
- 3. Compound eyes common.

**CLASS 1. Crustacea**

(L. *crusta*, shell)

- 1. Head often joined with thorax to form cephalothorax.
- 2. Exoskeleton chitinous, hard, limy (calcareous).
- 3. Head 5-segmented, bearing 2 pairs of antennae, 1 pair of mandibles and 2 pairs of maxillae. Appendages typically biramous.
- 4. Respiration by gills or body surface.
- 5. Excretion by antennal glands.
- 6. Sexes usually separate. Development with nauplius stage.

**Subclass 1. Cephalocarida**

- 1. Body made of a horseshoe-shaped head and 19 trunk segments. Only anterior 9 trunk segments bear appendages that appear biramous.
  - 2. Antennae short. Eyes absent.
  - 3. Hermaphrodite. Larva a metanauplius.
- Example : *Hutchinsoniella*.

**Subclass 2. Branchiopoda**

- 1. Primitive, small-sized, mostly freshwater.

- 2. Trunk appendages leaf-like for respiration (gills), filter-feeding.
- 3. Antennules and 2nd maxillae absent.
- 4. Abdomen ends in a pair of unjointed caudal styles or rami.

**Order 1. Anostraca**

- 1. Fairy shrimps with 19 trunk segments. Only anterior 11 segments bear appendages.
  - 2. Carapace absent. Eyes unjointed.
- Examples : *Artemia*, *Eubranchion*.

**Order 2. Notostraca**

- 1. Tadpole shrimps with 25-40 trunk segments. Anterior half with 35 segments.
  - 2. Carapace shield-like. Eyes unjointed.
- Examples : *Apus*, *Lepidurus*.

**Order 3. Diplostraca**

- 1. Clam shrimps and water fleas. Carapace enclosing body and head.
  - 2. Eyes fused, sessile, claw-like.
- Examples : *Daphnia*, *Cyclops*.

**Subclass 3. Ostracoda**

- 1. Minute mussel or seed shrimps. Body entirely enclosed in a bivalved carapace.
- 2. Trunk appendages 2 pairs.
- 3. Antennules and antennae used for swimming.

**Order 1. Myodocopa**

- 1. Carapace with antennal notch.
  - 2. Antennae biramous, enlarged.
- Example : *Cypridina*.

**Order 2. Podocopa**

- 1. Carapace unnotched. Antennae 2 pairs.
  - 2. Antennae uniramous, claw-like.
- Examples : *Cypris*, *Darwinula*.



extremely long.

o Opisthosoma.  
ace. Two eyes.  
*Leiobunum*.

ring or parasitic.  
segmented, with no  
ma and opisthosoma.  
with 20,000 species.  
(*Itchomite*), *Ixodes*  
or (Dog tick), *Argas*

**Mandibulata**

le + ata, group)

head, thorax and  
e 1 or 2 pairs of  
vs or mandibles and 1  
2.  
non.

with thorax to form  
e, hard, limy (calcareous).  
bearing 2 pairs of  
mandibles and 2 pairs of  
es typically biramous.  
or body surface.  
sal glands.  
arate. Development with

**trida**

horseshoe-shaped head and  
s. Only anterior 9 trunk  
appendages that appear

eyes absent.  
arva a metanauplius.  
*insoniella*.

**ipoda**

sized, mostly freshwater.

2. Trunk appendages leaf-like, serving for respiration (gills), locomotion and filter-feeding.
3. Antennules and 2nd maxillae reduced or absent.
4. Abdomen ends in a pair of jointed or unjointed caudal styles or cercopods.

**Order 1. Anostraca**

1. Fairy shrimps with 19 or more trunk segments. Only anterior 11 to 19 segments bear appendages.
2. Carapace absent. Eyes stalked. Styles unjointed.  
Examples : *Artemia*, *Eubbranchipus*.

**Order 2. Notostraca**

1. Tadpole shrimps with 25-45 trunk segments. Anterior half with 35 to 71 pairs of appendages.
2. Carapace shield-like. Eyes sessile. Styles jointed.  
Examples : *Apus*, *Lepidurus*.

**Order 3. Diplostraca**

1. Clam shrimps and water fleas with a bivalved carapace enclosing body with or without head.
2. Eyes fused, sessile. Styles unjointed, claw-like.  
Examples : *Daphnia*, *Cyzicus* (= *Estheria*).

**Subclass 3. Ostracoda**

1. Minute mussel or seed shrimps with poorly segmented body entirely enclosed in a bivalved carapace.
2. Trunk appendages 2 pairs, leg-like.
3. Antennules and antennae large, used in swimming.

**Order 1. Myodocopa**

1. Carapace with antennal notches.
2. Antennae biramous, enlarged at base.  
Example : *Cypridina*.

**Order 2. Podocopa**

1. Carapace unnotched. Trunk appendages 2 pairs.
2. Antennae uniramous, clawed at tips.  
Examples : *Cypris*, *Darwinula*.

**Order 3. Platycoopa**

1. Carapace unnotched. Trunk appendages 1 pair.
2. Antennae uniramous.  
Example : *Cytherella*.

**Order 4. Cladocopa**

- Carapace unnotched. Antennae biramous.  
Example : *Polycopa*.

**Subclass 4. Mystacocarida**

1. Primitive. Body microscopic. Antennules and Antennae prominent.
2. A single median eye. No compound eyes.
3. Abdomen limbless. A pair of caudal styles.  
Example : *Derocheilocaris*.

**Subclass 5. Copepoda**

1. Body small, made of head, thorax and abdomen.
2. No carapace. No compound eyes but a median eye.
3. Antennules long. Antennae smaller.
4. Abdomen limbless. Telson with two caudal styles.  
Examples : *Cyclops*, *Ergasilus*, *Caligus*.

**Subclass 6. Branchiura**

1. Fish lice. Temporarily ectoparasites of skin and gill chambers of fishes and some amphibians.
2. Body dorso-ventrally flattened.
3. Shield-like carapace covers head and thorax.
4. A pair of sessile compound eyes. Mouth suctorial.
5. Antennules and antennae reduced.
6. First maxillae modified into suckers.
7. Abdomen unsegmented, bilobed. Caudal claws minute.  
Examples : *Argulus*, *Dolops*.

**Subclass 7. Cirripedia**

1. Barnacles. Adults sessile, attached or parasitic.
  2. Carapace forms two folds of mantle surrounding body and covered externally by calcareous plates.
  3. Thoracic limbs 6 pairs, biramous and cirriform.
  4. Antennules become cement glands for attachment.
46. (Z-1)

5. Antennae and compound eyes well developed in adult.

6. Abdomen rudimentary with caudal stylets.
7. Nauplius larva passes through a copepodid stage.

**Order 1. Thoracica**

1. Non-parasitic. With or without Hermaphrodite.
2. Mantle present with calcareous plates.
3. Thoracic appendages 6 pairs, biramous.  
Examples : *Lepax*, *Balanus*.

**Order 2. Acrothoracica**

1. Sessile. Bore into mollusc shells or other hard substrata.  
Unisexual.
2. Mantle reduced to a chitinous attachment disc.
3. Trunk appendages usually 4 pairs, biramous.  
Examples : *Alcippe*, *Cryptophialus*.

**Order 3. Ascothoracica**

1. Parasitic in echinoderms and corals.
2. Mantle bivalved or saccular.
3. Often appendages are lost but antennae remain present.  
Examples : *Synagoga*, *Dendrogastra*.

**Order 4. Apoda**

- Parasitic without mantle and appendages.  
Example : *Proteolepis*.

**Order 5. Rhizocephala**

1. Adult parasitic, degenerate, sac-like.
2. Peduncle forms root-like absorptive branches ramifying throughout host's tissues.  
Example : *Sacculina*.

**Subclass 8. Malacostraca**

1. Body large-sized. Typically made of 10 segments.
2. Head and one or more thoracic segments form cephalothorax.
3. Carapace well-formed or vestigial or absent.
4. Paired compound eyes stalked or sessile.
5. Abdomen ends in a telson. No caudal stylets.  
Important orders are as follows :

**Order 1. Nebaliacea**

1. Carapace bivalved with an adhesive organ.
2. Abdominal segment 7 instead of 6.  
Example : *Nebalia*.

**3. Platycopa**

Antennae unnotched. Trunk appendages

Antennae uniramous.

Example : *Cytherella*.

**4. Cladocopa**

Antennae unnotched. Antennae biramous.

Example : *Polycopse*.

**Mytaco-carida**

Body microscopic. Antennules and

Median eye. No compound eyes.

Example : *Derocheilocaris*.

**Copepoda**

Small, made of head, thorax and

space. No compound eyes but a

Antennae long. Antennae smaller.

Example : *Cyclops*, *Ergasilus*, *Caligus*.

**Branchiura**

Temporarily ectoparasites of skin

Example : *Argulus*, *Dolops*.

orso-ventrally flattened.

like carapace covers head and thorax.

Example : *Argulus*, *Dolops*.

of sessile compound eyes. Mouth

Antennae and antennae reduced.

**Cirripedia**

Adults sessile, attached or

forms two folds of mantle

limbs 6 pairs, biramous and

become cement glands for

5. Antennae and compound eyes are lost in

6. Abdomen rudimentary with caudal styles.

7. Nauplius larva passes through a cypris stage.

**Order 1. Thoracica**

1. Non-parasitic. With or without stalk.

2. Mantle present with calcareous plates.

3. Thoracic appendages 6 pairs, cirriform.

**Order 2. Acrothoracica**

1. Sessile. Bore into mollusc shells or corals.

2. Mantle reduced to a chitinous attachment

3. Trunk appendages usually 4 pairs, cirriform.

**Order 3. Ascothoracica**

1. Parasitic in echinoderms and corals.

2. Mantle bivalved or saccular.

3. Often appendages are lost but antennules

**Order 4. Apoda**

Parasitic without mantle and appendages.

Example : *Proteolepis*.

**Order 5. Rhizocephala**

1. Adult parasitic, degenerate, sac-like.

2. Peduncle forms root-like absorptive branches

Example : *Sacculina*.

**Subclass 8. Malacostraca**

1. Body large-sized. Typically made of 19

2. Head and one or more thoracic segments

3. Carapace well-formed or vestigial or absent.

4. Paired compound eyes stalked or sessile.

5. Abdomen ends in a telson. No caudal styles.

**Order 1. Nebaliacea**

1. Carapace bivalved with an adductor muscle.

2. Abdominal segment 7 instead of 6.

Example : *Nebalia*.





**Order 2. Mysidacea**

1. Body elongated. Uropods form fan tail.
2. Carapace thin, covering mostly of thorax.
3. Example : *Mysis* (opossum shrimp).

**Order 3. Cumacea**

1. Head and thorax greatly enlarged.
2. Carapace fused to 3-4 thoracic segments.
3. Abdomen narrows. Uropods slender.
- Examples : *Diastylis*, *Cumopsis*.

**Order 4. Isopoda**

1. Wood lice. Body dorso-ventrally flattened.
2. Head and 1 or 2 thoracic segments form cephalothorax.
3. Carapace absent. Gills and heart abdominal.
- Examples : *Oniscus*, *Asellus*, *Limnoria*.

**Order 5. Amphipoda**

1. Sand hoppers. Body laterally compressed.
2. Carapace absent. Gills thoracic. Eyes sessile, lateral.
- Examples : *Gammarus*, *Caprella*, *Cyamus*.

**Order 6. Stomatopoda**

1. Mantis shrimps. Body flattened. Carapace small.
2. Abdomen large, broader than cephalothorax.
3. Second maxillipedes raptorial. Gills abdominal.
- Example : *Squilla*.

**Order 7. Decapoda**

1. Shrimps, crayfishes, Lobsters, prawns, crabs, etc.
2. Carapace well-developed. Usually enclosing gill chambers on sides of cephalothorax.
3. First 3 pairs of thoracic limbs form maxillipedes.
4. Gills usually in 3 series present on thorax.
5. Statocyst present. Larva typically a zoea.

**Suborder (a) Natantia**

1. Body laterally compressed. Rostrum prominent.
2. Pleopods well-developed. Modified for swimming.
- Examples : Prawns (*Palaemon*, *Penaeus*, *Macrobrachium*), Shrimp (*Leucifer*, *Crangon*).

**Suborder (b) Reptantia**

1. Body dorso-ventrally flattened. Rostrum short or absent.
2. Pleopods reduced. Not modified for swimming.
- Examples : Lobsters (*Palinurus*, *Scyllarus*, *Homarus*), Crayfish (*Astacus*, *Cambarus*), True crabs (*Cancer*, *Carcinus*), Hermit crab (*Eupagurus*), coconut crab (*Hippa*), Spider crab (*Inachus*).

**CLASS 2. Myriapoda**

(G., myrios, ten thousand + *podos*, foot)

1. Exclusively terrestrial, air-breathing mandibulate arthropods.
2. Body worm-like, made of head and elongated trunk with many similar leg-bearing segments.
3. Antennae 1 pair, jaws 3 pairs, legs more than 11 pairs.
4. Respiration by tracheae. Spiracles arranged segmentally.
5. Excretion by 1 or 2 pairs of Malpighian tubules.
6. Sexes separate, Gonad single. Gonoducts paired.

**Note :** The following 4 orders of group Myriapoda are not related to one another and exhibit marked differences. Therefore, each one of them is nowadays treated as a separate class of mandibulate arthropods. However, the old class Myriapoda has no systematic status and is retained here just for convenience.

**Order (or class) 1. Diplopoda**

(Gr., *diplos*, double + *pous*, foot)

1. Millipedes. Body elongate, sub-cylindrical and divisible into 5-segmented head, 4-segmented thorax and 11 to 100-segmented trunk.
2. Legs 2 pairs on each trunk segment (Diplopoda).
3. Mandibles and maxillae 1 pair each (Dignatha).

Examples : *Spirobolus*, *Julus*.

**Order (or class) 2. Chilopoda**

(Gr., *cheilos*, lip + *pous*, foot)

1. Centipedes. Body dorso-ventrally flattened and divisible into head and 15 to 173 trunk segments.



2. Legs 1 pair on each trunk segment.
  3. Mandibles 1 pair. Maxillae 2 pairs (Trignatha).
  4. First pair of legs form poison claws.
- Examples : *Scutigera*, *Lithobius*, *Scolopendra*.

### Order (or class) 3. Pauropoda

(Gr., *pauros*, small + *pous*, foot)

1. Minute grub-like body divisible into head and 11-12 trunk segments with 9-10 pairs of legs.
  2. No eyes.
- Example : *Pauropus*.

### Order (or class) 4. Symphyla

(Gr., *Syn.* together + *phylon*, tribe)

1. Body slender made of head and 15-22 trunk segments with 10-12 pairs of legs.
  2. No eyes.
- Example : *Scutigrella*.

## CLASS 3. Insecta

(L. *insectus*, cut or divided)

1. Body made of head (6 fused segments), thorax (3 segments) and abdomen (up to 11 segments).
2. Head with compound eyes (1 pair), antennae (1 pair) mandibles (1 pair) and maxillae (2 pairs).
3. Mouth parts modified for different feeding habits.
4. Thorax with 3 pairs of jointed legs and 1 or 2 pairs of wings which may be absent.
5. Respiration by tracheae. Spiracles lateral.
6. Excretion by Malpighian tubules.
7. Unisexual. Fertilization internal. Development usually with metamorphosis.

### Subclass 1. Apterygota (Ametabola)

1. Primitively wingless insects.
2. Abdomen with cerci and style-like appendages.
3. Little or no metamorphosis.

#### Order 1. Protura

1. No antennae, true eyes and metamorphosis.
  2. Abdomen of 11 segments plus a telson.
- Example : *Acerentulus*.

#### Order 2. Collembola

1. No eyes, tracheae, Malpighian tubules and metamorphosis. Mouth parts chewing or sucking.

47. (Z-1)

2. Abdomen 6-segmented, with a terminal organ.
- Examples : *Sminthurus*, *Springtails*.

### Order 3. Thysanura

1. Body covered by minute silvery hairs.
  2. Antennae long. Mouth parts chewing.
  3. Abdomen 11-segmented. Cerci long.
- Example : *Lepisma* (silver fish).

### Subclass 2. Pterygota (Metabola)

1. Wings present. Secondly lost in some groups.
  2. No abdominal appendages except in some groups.
  3. Metamorphosis complete or incomplete.
- #### Division (a). Exopterygota (Heterometabola)
1. Wings develop externally as buds.
  2. Metamorphosis gradual. Young are nymphs.

#### Order 1. Orthoptera

1. Wings 2 pairs. Forewings membranous and leathery. Hindwings membranous and veined at rest.
  2. Mouth parts chewing. Prolegs present. Hindlegs jumping.
- Examples : *Romalia* and *Pezomachus* (Grasshoppers), *Schistocerca* (Locust), *Periplaneta* (Cockroach), *Gryllus* (Cricket), *Mantis* (Praying mantis), *Phyllium* (Leaf insect), *Carausius* (Stick insect).

#### Order 2. Isoptera

1. Wings 2 pairs. Held flat at rest. Some are wingless.
  2. Mouth parts chewing. Social insects. Many castes.
- Examples : Termites or white ants.

#### Order 3. Dermaptera

1. Forewings small, leathery. Hindwings absent. Semicircular.
  2. Mouth parts chewing. Forcep-like appendages at tip of abdomen for offense and defense.
- Example : *Forficula* (Earwig).

#### Order 4. Ephemeroptera

1. Wings 2 pairs, membranous. Forewings longer and triangular. Hindwings rounded.

h trunk segment.  
 maxillae 2 pairs (Trignatha).  
 arm poison claws.  
 a. *Lithobius*, *Scolopendra*.

**Pauropoda**  
 + pous, foot)  
 dy divisible into head and  
 ts with 9-10 pairs of legs.

**Symphyla**  
 + phylon, tribe)  
 of head and 15-22 trunk  
 2 pairs of legs.

ad (6 fused segments),  
 and abdomen (up to 11  
 ad eyes (1 pair), antennae  
 (1 pair) and maxillae

ied for different feeding  
 s of jointed legs and 1 or  
 hich may be absent.  
 heae. Spiracles lateral.  
 ghian tubules.  
 ion internal. Development  
 orphosis.

**(Ametabola)**  
 s insects.  
 cerci and style-like

orphosis.  
 eyes and metamorphosis.  
 segments plus a telson.  
 talus.

**ola**  
 Malpighian tubules and  
 outh parts chewing or

2. Abdomen 6-segmented, with a springing organ.  
 Examples : Springtails, *Achorutes*, *Sminthurus*.

**Order 3. Thysanura**

1. Body covered by minute silvery scales.  
 2. Antennae long. Mouth parts chewing.  
 3. Abdomen 11-segmented. Cerci and telson long.  
 Example : *Lepisma* (silver fish).

**Subclass 2. Pterygota (Metabola)**

1. Wings present. Secondarily lost in some.  
 2. No abdominal appendages except cerci.  
 3. Metamorphosis complete or incomplete.

**Division (a). Exopterygota (Heterometabola)**

1. Wings develop externally as buds.  
 2. Metamorphosis gradual. Young stages are nymphs.

**Order 1. Orthoptera**

1. Wings 2 pairs. Forewings straight and leathery. Hindwings membranous and folded at rest.  
 2. Mouth parts chewing. Prothorax large. Hindlegs jumping.  
 Examples : *Romalia* and *Poecilocercus* (Grasshoppers), *Schistocerca* (Locust), *Periplaneta* (Cockroach), *Gryllus* or *Acheta* (Cricket), *Mantis* (Praying mantis), *Phyllium* (Leaf insect), *Carausius* (Stick insect).

**Order 2. Isoptera**

1. Wings 2 pairs; Held flat on back. Or wingless.  
 2. Mouth parts chewing. Social insects with many castes.  
 Examples : Termites or white ants.

**Order 3. Dermaptera**

1. Forewings small, leathery. Hindwings large, semicircular.  
 2. Mouth parts chewing. Forcep-like cerci at the tip of abdomen for offense and defense.  
 Example : *Forficula* (Earwig).

**Order 4. Ephemeroptera**

1. Wings 2 pairs, membranous. Forewings longer and triangular. Hindwings smaller and rounded.



2. Adult mouth parts vestigial. Mandibulate in nymphs.
3. Abdomen carries long cerci and caudal filament.  
Example : *Ephemera* (Mayfly).

**Order 5. Odonata**

1. Wings 2 pairs, membranous. Eyes very large.
2. Mouth parts chewing. Predaceous.  
Examples : Dragon flies, Damselflies.

**Order 6. Plecoptera**

1. Wings 2 pairs, membranous, longer than body.
2. Antennae long. Mouth parts chewing.
3. Naiads usually with tracheal gills.  
Example : *Isoperla* (Stonefly).

**Order 7. Psocoptera (= Corrodentia)**

1. Wingless or forewings larger than hindwings.
2. Antennae long. Mouthparts chewing. Cerci absent.  
Examples : Book lice (wingless), Bark lice (winged).

**Order 8. Mallophaga**

1. Wings absent. Body small. Head large. Mouth parts chewing. Eyes degenerate. Legs clasping.
2. Ectoparasitic on skin, hairs and feathers of mammals and birds.  
Examples : Bird lice, Biting lice (on mammals).

**Order 9. Anoplura (= Siphunculata)**

1. No wings. Body broad, flat. Head small. Mouth parts piercing and sucking.
2. Claws clinging to hairs. Ectoparasitic on mammals.  
Example : *Pediculus* (Human louse).

**Order 10. Thysanoptera**

1. Wings 2 pairs, similar, fringed with long hairs.
2. Mouth parts rasping and sucking.  
Example : Thrips.

**Order 11. Hemiptera**

1. Wings 2 pairs or wingless. Forewings thickened at base, membranous at tip (hemelytra).

2. Mouth parts piercing-sucking, forming jointed beak.  
Examples : Bedbug (*Cimex*), Giant water bug (*Belostomat*), Water scorpion (*Ranatra*).

**Order 12. Homoptera**

1. Wingless or 2 pairs of uniform membranous wings.
2. Mouth parts form a piercing and sucking beak.  
Examples : Cicadas, Aphids, Scale insects.

**Subclass 3. Endopterygota (Holometabola)**

1. Wings develop internally in pupal case.
2. Metamorphosis complete with larval and pupal stages.

**Order 1. Neuroptera**

1. Wings large, membranous, many-veined.
2. Antennae long. Mouth parts chewing. Cerci absent.
3. Larvae carnivorous. Abdominal gills in aquatic larvae.  
Examples : *Crysopa* (Lacewing), *Myrmoleon* (Antlion).

**Order 2. Coleoptera**

1. Forewings leathery (elytra). Hindwings membranous, folding.
2. Antennae variously modified. Mouth parts chewing.  
Example : Beetles.

**Order 3. Mecoptera**

1. Wings long, similar, narrow, membranous.
2. Mouth parts chewing, on a prolonged beak.
3. In male, tip of abdomen curved sting-like.  
Example : *Panorpa* (Scorpion fly).

**Order 4. Trichoptera**

1. Wings long, hairy, folded roof-like over abdomen.
2. Antennae long. Mouth parts rudimentary.
3. Larva pupates within a tube of foreign particles.  
Example : Caddis flies.

**Order 5. Lepidoptera**

1. Wings membranous, covered with over-lapping scales.
2. Mouth parts sucking, coiled under head.
3. Larva a caterpillar with chewing mouth parts.



Examples : Butterflies (antennae filamentous),  
Moths (antennae feathery).

#### Order 6. Diptera

1. Wings 1 pair. Hindwings as knob-like halteres.
  2. Mouth parts piercing-sucking or sponging.
  3. Larva limbless, wormlike, called maggot.
- Examples : *Musca* (House fly), *Culex* (Mosquito), *Drosophila* (Fruit fly).

#### Order 7. Hymenoptera

1. Wings 2 pairs, similar, membranous. On each side hooked together during flight.
  2. Mouth parts sucking or chewing. Ovipositor of female usually forms a piercing sting.
  3. Highly specialized. Some social in behaviour.
- Examples : *Apis*, wasp / *Vespa* and Ants etc.

#### Order 8. Siphonaptera

1. Small. Laterally flattened. Secondarily wingless.
  2. Mouth parts piercing-sucking. Legs long, leaping.
  3. Ectoparasites on birds and mammals.
- Examples : *Pulex* and *Xenopsylla* (Fleas).

### Minor Doubtful Arthropoda

#### Subphylum IV. Onychophora

(G., *onychos* = claw + *phoros*, bearing)

1. Terrestrial, primitive, worm-like, unsegmented.
  2. Single pairs of antennae, eyes and jaws.
  3. Numerous stumpy, unjointed clawed legs.
- Example : *Peripatus*

#### Subphylum V. Tardigrada

1. Minute, aquatic. Segmentation indistinct. No antennae.
  2. Mouth retractile, with a pair of horny stylets.
  3. Four pairs of stumpy, unjointed, clawed legs.
  4. No respiratory, circulatory and excretory organs.
- Example : *Macrobiolus* (Water bear).

### Subphylum VI.

#### Pentastomida (= Linguatulida)

1. Vermiform, unsegmented, parasitic worms. No antennae.
  2. Two pairs of ventral retractile hooks near mouth.
  3. No respiratory, circulatory and excretory organs.
- Example : *Linguatula* (Tongue worm).

### Subphylum VII.

#### Pycnogonida (= Pentopoda)

1. Small, marine, spider-like. Abdomen vestigial.
  2. Mouth on a long proboscis. 4 simple eyes.
  3. Appendages include chelicerae, pedipalps, ovigerous legs (1 pair) and long walking legs (4 to 12 pairs).
  4. No respiratory and excretory systems.
- Example : *Pycnogonum*, *Nymphon* (Sea spiders).

## OTHER TYPES OF ARTHROPODA

1. *Limulus*. *Limulus* or King crab belongs to the subclass Xiphosura and class Merostomata of subphylum chelicerata. It is a large-sized, marine animal, up to 60 cm long. It lives in shallow water, burrowing in sand or mud, along the coast. It is a living member of very ancient (200 million years) primitive chelicerates and hence called a 'living fossil'. Dorso-ventrally flattened body is composed of an anterior **prosoma** (6 fused segments) and a posterior **opisthosoma** (9 segments). Prosoma is covered by a large horseshoe-shaped **carapace** marked by two lateral longitudinal grooves and by two median simple eyes (ocelli) and 2 large compound eyes. Ventrally, prosoma bears 2 pairs of large **chelicerae**.