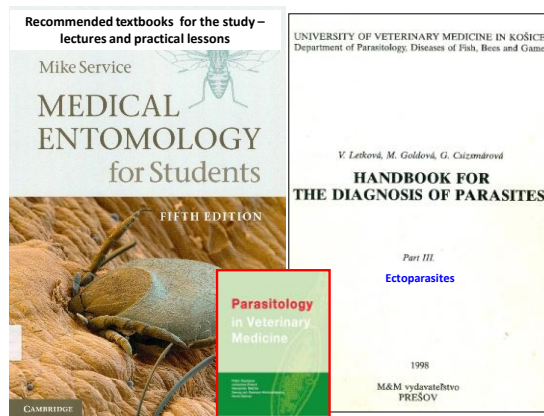


## INTRODUCTION TO ARACHNOENTOMOLOGY

Essential morphological features of arthropods,  
General introduction to **subclass ACARI** and outline  
of the **important species of ticks** in relation to their  
life cycles, epidemiology, pathogenic significance and  
importance as **vectors** of pathogens  
(**IXODIDAE** – hard ticks, **ARGASIDAE** – soft ticks).



### What are ARTHROPODS?

– the name arthropod is derived from two Greek words  
„arthros“ meaning joints, and „podes“ meaning feet.

- **Phylum Arthropoda** – vary in size, shape, and habits;
- More than a 3 million arthropod species have been described;



- **ecto- or endoparasites** of animals and humans;
- **vectors** of pathogens;
- **poisonous** animals;
- **household and storage pests**

### PHYLUM ARTHROPODA INCLUDES

**3 classes of medical importance:**

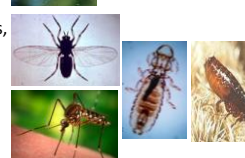
1. **CRUSTACEA**: cyclops, crabs.



2. **ARACHNIDA** (Octapoda):  
scorpions, spiders, **ticks** and **mites**.



3. **INSECTA** (Hexapoda): mosquitoes,  
flies, bugs, lice, fleas.



### Phylum: **ARTHROPODA** (Arthropods)

Subphylum: **TRILOBITOMORPHA**

Subphylum: **CHELICERATA**

Class: **ARACHNIDA**

Subclass: **ACARI** (mites in the large sense = ticks and mites)

Order: **IXODIDA** (METASTIGMATA)

Order: **GAMASIDA** (MESOSTIGMATA)

Order: **TROMBIDIFORMES** (PROSTIGMATA)

Order: **SARCOPTIFORMES** (ASTIGMATA)

Order: **ORIBATIDA**

Subphylum: **CRUSTACEA**

Subphylum: **TRACHEATA**

Class: **INSECTA**

Order: **HETEROPTERA** (true bugs)

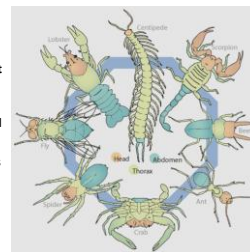
Order: **PHTHIRAPTERA** (lice)

Order: **DIPTERA** (flies)

Order: **SIPHONAPTERA** (fleas)

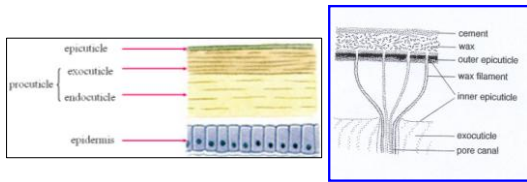
### General Features of Arthropods

1. **Segmented bodies** (**tagmata/tagmatization**) - divided to three parts: the head, thorax and abdomen.
2. **Exoskeleton** (rigid material – **chitin**) – must moult to grow
3. **Jointed limbs**
4. **Open vascular system** - dorsal blood vessel
5. **Haemocoel** (haemolymph)
6. **Ventral nerve cord**; various sensory organs
7. **Mouthparts** with different functions
8. **Respiratory system** **present** (gills, trachea) or **absent** (respiration directly through cuticle)
9. **Separate sexes** (sexual or parthenogenetic reproduction)

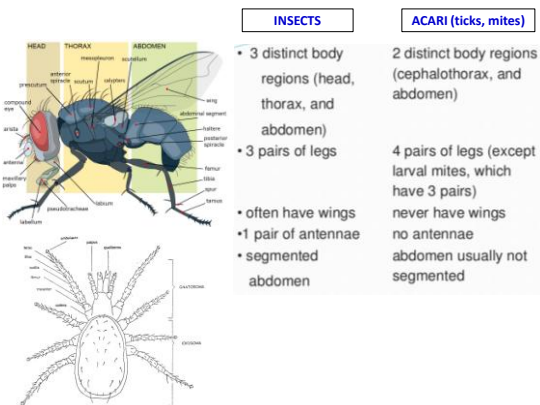
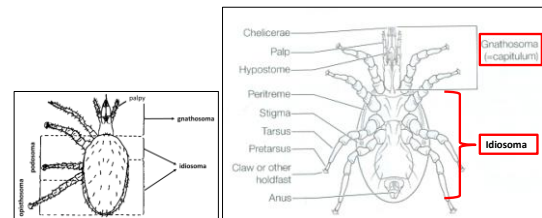
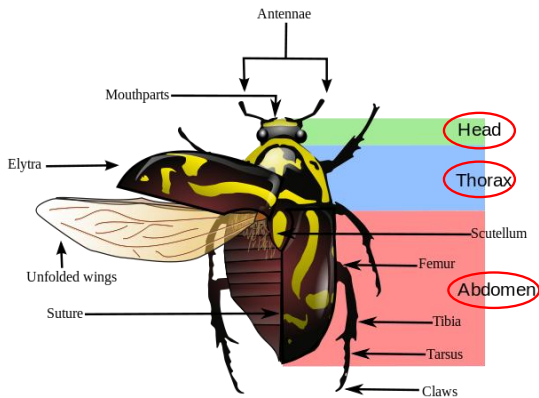
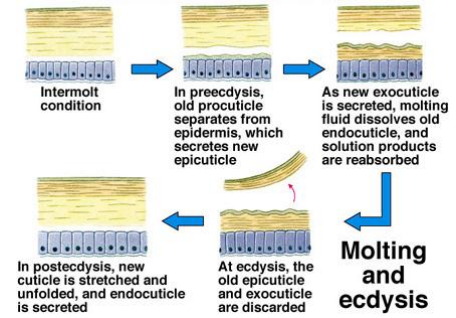


Their body parts and appendage segments are **joined by flexible membranes** which allow the various parts to move.

## Structure of the Exoskeleton



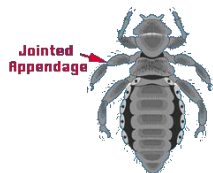
## Moulting



## Jointed Appendages

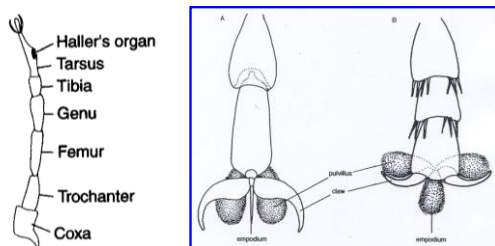
➤ Jointed Appendages - each segment may have one pair of appendages, such as:

- legs
- wings
- mouthparts

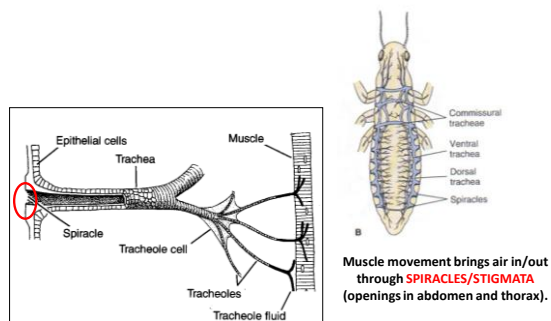


## ARTHROPODA – jointed legs

- *arthron* – joint + *podos* – leg
- the legs are usually **six-segmented**



## Arthropod Respiratory system – spiracles and gas exchange



Class: ARACHNIDA

Subclass: **ACARI**

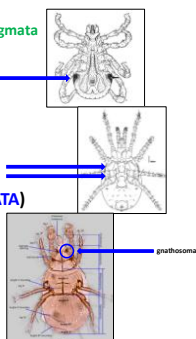
Distribution according localisation of stigmata

ORDER: IXODIDA (**METASTIGMATA**)

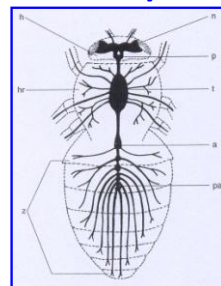
ORDER: GAMASIDA (**MESOSTIGMATA**)

ORDER: TROMBIDIFORMES (**PROSTIGMATA**)

ORDER: SARCOPTIFORMES (**ASTIGMATA**)

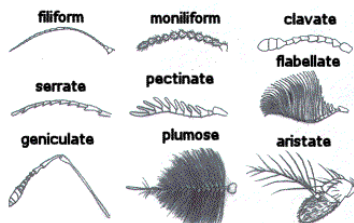


## Nervous System



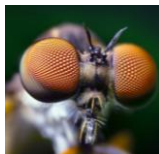
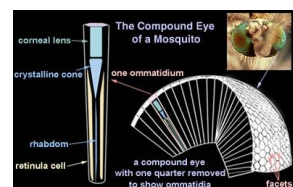
## Antennae

- The **sensory receptors** of arthropods are usually associated with modifications of the chitinous exoskeleton (seta);



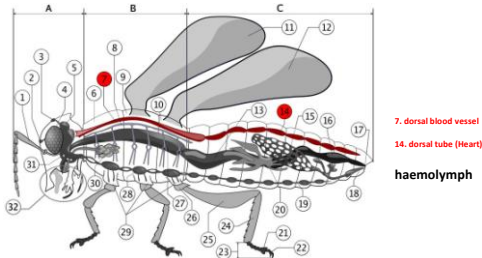
## Eyes

- **Compound Eyes**
  - visual structure with many lenses
- **Simple Eyes**
  - visual structure with one lens for detecting light
  - one pair of compound eyes and 3-8 simple eyes



## Circulatory System

### ➤ Open circulatory system



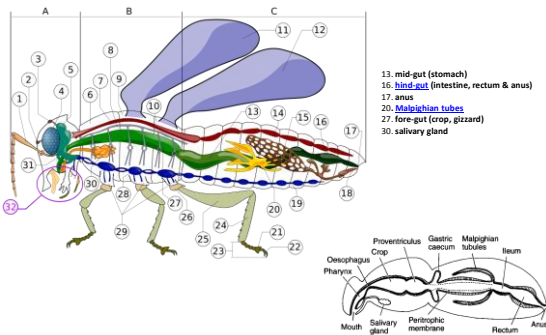
## Digestive System

### ➤ Complete digestive system with mouth, intestine, and anus



### ➤ Mouthparts are highly modified;

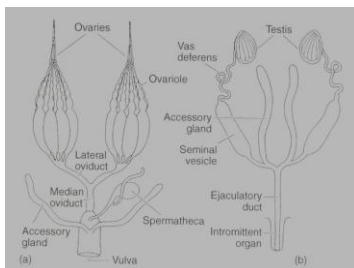
## Digestive System



## ARTHROPODA – reproduction

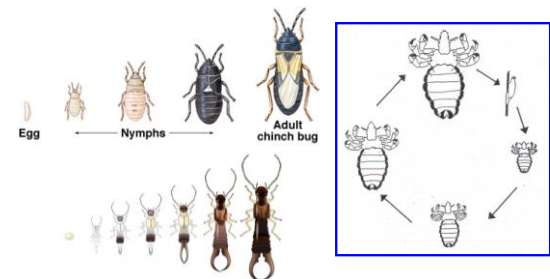
- sexes are separate
- **MATING** is usually required for the production of fertile eggs
- **PARTHENOGENESIS** – production of identical copies of themselves
- most arthropods lay **EGGS**
- some species are ovoviviparous or viviparous - **MAGGOTS**

## Reproduction – Sexual



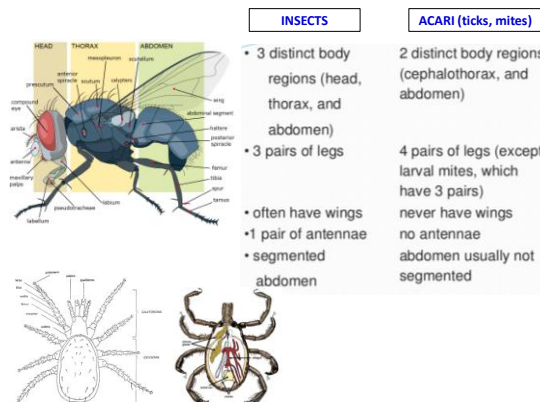
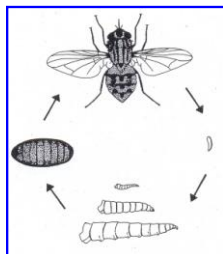
## Incomplete Metamorphosis (Hemimetabolous)

- Early developmental stages are very similar to the adults; only the wings and the **reproductive structures gradually develop**
- The **immature stages** are called **nymphs**
- Thus development is **egg** → **(larvae)** → **nymphs** → **adult**



## Complete Metamorphosis (Holometabolous)

- Each of the developmental stages is structurally and functionally very different
- The **egg** develops into an immature **larva**;
- Followed by a transitional stage – **pupa**;
- Metamorphosis occurs within the pupal exoskeleton, a sexually mature **adult**



Class: **ARACHNIDA**



## Introduction to Phylum Arthropoda

### TEMPORARY ECTOPARASITES



### PERMANENT ECTOPARASITES



## Arthropoda

### Importance

- **Intermediate hosts** for various parasites.
- **Vectors** for bacteria, viruses, parasites and other pathogens.
- **Direct causal agents of skin diseases.** Produce venoms that may be toxic.
- Nuisance pests.

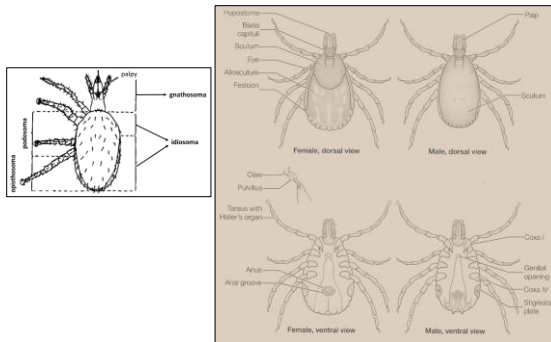
### Ectoparasite damage – direct harm

- **BLOOD LOSS**
- **MYIASIS**
- **SKIN INFLAMMATION AND PRURITUS**
- **TOXIC** and **ALLERGIC RESPONSES**

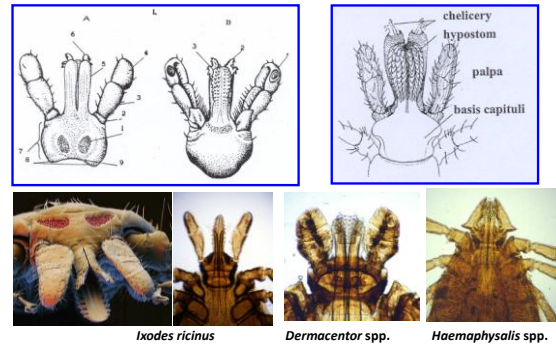




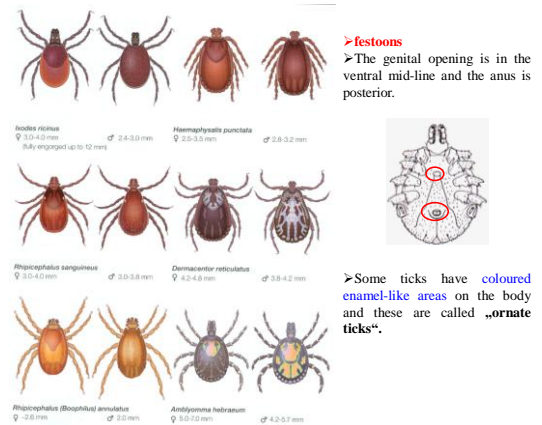
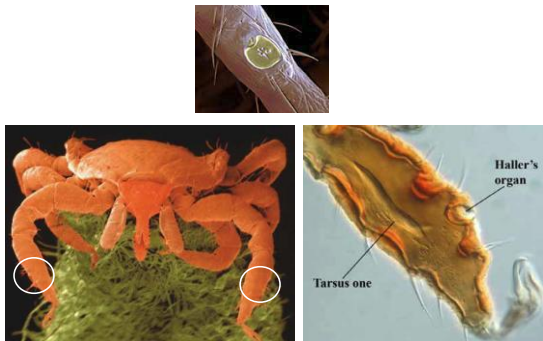
## Ixodidae (hard ticks)



## Ticks – Gnathosoma

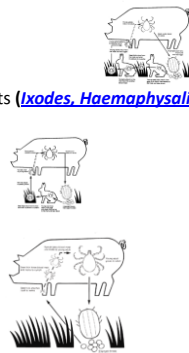


## Sensory organs

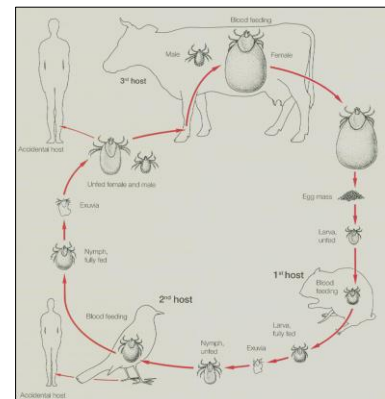


According to the number of hosts, the ticks are divided into:

- **Three-host** (all stages on different hosts (*Ixodes*, *Haemaphysalis*, *Dermacentor*))
- **Two-host** (*Rhipicephalus*, *Hyalomma*)
- **One-host** (*Amblyomma*, *Boophilus*)



## Life cycle



### Medical Importance of Ticks

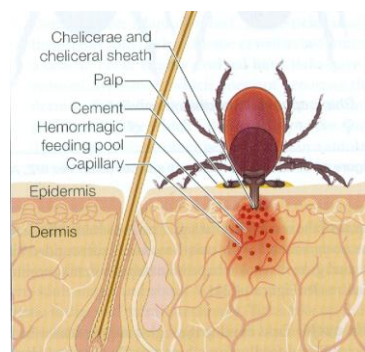
1. Dermatitis - inflammation, itching, swelling at site of bite
2. Anaemia can result from heavy infestation
3. Otitis - auditory canal infestation, poss. secondary infection
4. Predispose to myiasis and infection
5. Tick paralysis (envenomization)
6. Pathogen transmission (virus, rickettsia, bacteria, spirochaete, protozoa, filarial worms)

### Factors Accounting for High Vector Potential of Ticks

1. Persistent **haematophagous** feeders
2. Relatively **slow feeding time** allows time for pathogen transfer
3. Typically have a **wide host range**
4. Longevity increases chances of acquiring and transmitting a pathogen
5. Transovarial, transstadial transmission of some pathogens
6. **Few natural enemies**, highly sclerotized (resistant to environmental stress)
7. **High reproductive potential** - up to 18,000 eggs and parthenogenesis in some species

### *Ixodes ricinus*

(wood tick; castor bean tick; common sheep tick)



### *Ixodes hexagonus* (hedgehog tick)



### Genus *Haemaphysalis*

- cca 165 species
- Most occur in Africa, South Asia, western and central Europe
- *H. punctata*, *H. concinna*, *H. inermis*





### *Haemaphysalis punctata* (red sheep tick)



### Genus *Rhipicephalus*

- cca 80 species
- Africa, Europe

#### *Rhipicephalus sanguineus s.s.* (brown dog tick, kennel tick)



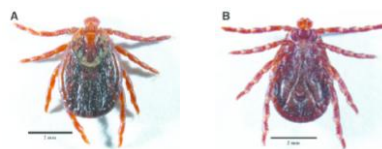
A. larva (mounted in Hoyer's medium; bar = 400 µm). B. nymph (mounted in Hoyer's medium; bar = 0.5 mm). C. female (bar = 1 mm). D. male (bar = 1 mm).

### Genus *Dermacentor*

- cca 35 species in Asia, Europe, Africa, America
- *D. marginatus*, *D. reticulatus*, *D. variabilis*, *D. andersoni*, ....
- Dermacentor marginatus* (ornate sheep tick)



#### *Dermacentor reticulatus* (ornate sheep tick)



### Genus *Hyalomma*

- 25 species; eyes
- Arid-semiarid regions of Africa, Asia, southern Europe
- *H. anatolicum* – vector of: *Theileria annulata*, *T. equi*, *T. lestoquardi*
- *H. marginatum* - 2-host tick; virus Crimean Congo fever, *Babesia occultans*, *Theileria equi*
- *H. aegyptium* – 3-host tick



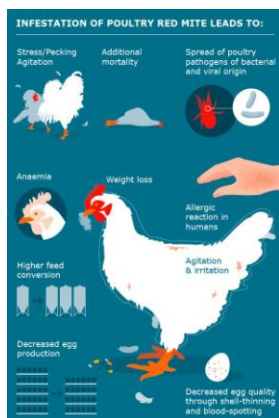
### Genus *Amblyomma*

- 140 species
- Sub Saharan Africa, America, **not in Europe**
- *A. hebraeum*, *A. variegatum*, *A. americanum*, *A. maculatum*, ..
- 3-host species – mammals, birds, reptiles, amphibians...









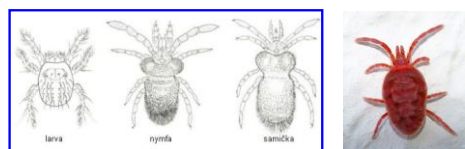
#### Treatment and control:

- palliative – cleaning with boiling water and acaricide
- individual birds may be treated with an acaricide
- **SYNERGIZED PYRETHROIDS**

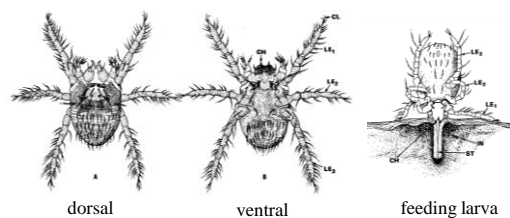
#### Order: **TROMBIDIFORMES (PROSTIGMATA)**

##### *Trombicula* (*Neotrombicula*)

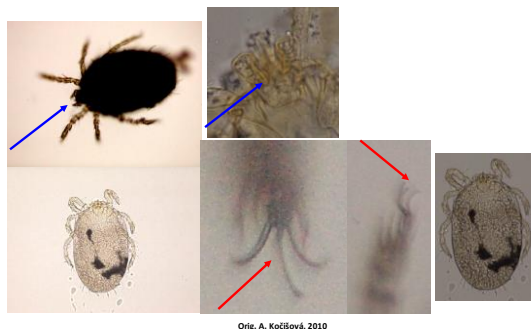
Family: **Trombiculidae** - **chiggers** - parasites of terrestrial vertebrates



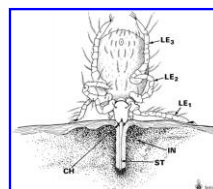
#### *Neotrombicula autumnalis* – **parasitic larva**



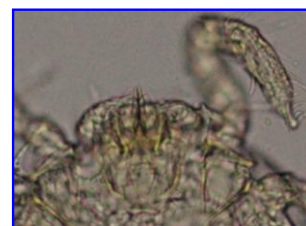
#### MORPHOLOGY



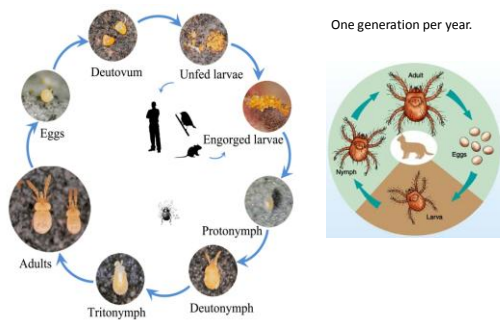
#### Feeding



**extra-intestinal digestion**



## Life cyclus



## Pathogenesis and clinical signs



## Diagnosis

- anamnesis
- clinical finding



Trombiculosis lesion in Henry's pocket of the ear of a cat.



Very pruritic, erosive lesions on the neck of a cat with trombiculiasis.

- microscopic evidence – red larvae confirm diagnosis



### Therapy:

- fipronil, selamectin – cats
- permethrin-pyriproxyfen combination – dogs

### Prophylaxis

- should avoid known *Trombicula* foci during the season;